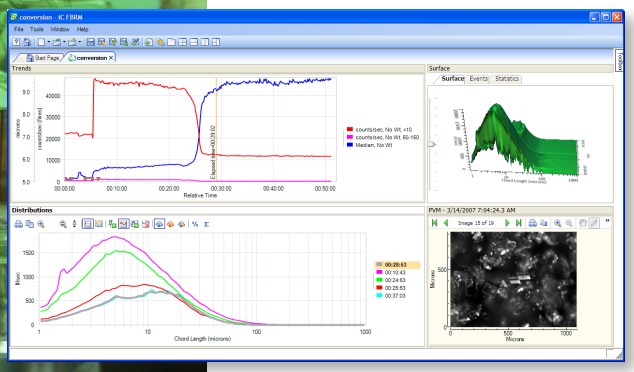
Software User Guide



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iC FBRM™ 4.4

Particle System Characterization

METTLER TOLEDO

Trademarks and Proprietary Notice

12152015

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iC FBRM™ Introduction

The iC™ FBRM® software platform interfaces with the ParticleTrack™ series of instruments and provides powerful data acquisition and interpretation tools that enable users to quickly evaluate Focused Beam Reflectance Measurement (FBRM) data.

iC Main Features

iC FBRM software is the result of over 20 years of particle characterization experience. As a result, the software helps users develop a strong understanding of particle system dynamics, optimize experimental design, speed development time, and quickly identify and solve production issues. Intuitive report generation tools produce professional reports at a click of the mouse.

The iC FBRM software enables you to:

- **Enhance your understanding of particle system dynamics through innovative tools**
  - Innovative distribution display enhances the ability to track changing particle dimensions on the fine and coarse tails of the particle distribution at the same time.
  - Mechanisms for particle size and shape change can be understood and quantified using trended statistics, distributions, and PVM® inline images, all of which may be linked at a click of the mouse.
  - Particle system kinetics can be qualified through new dynamic rate of change statistics.
- **Optimize your experimental design conditions**
  - Optimize batch conditions in the laboratory or during scale up to manufacturing.
  - Target an endpoint particle distribution using one integrated software suite which enables users to drag, drop, and overlay distributions and trends from multiple time points and multiple batches during live acquisition or post processing.
  - Relate experimental design conditions to particle system dynamics by importing process variables - such as temperature, pH, RPM, and dosing - onto FBRM trended statistics.
- **Reduce data acquisition and analysis burden**
  - Comprehensive online user assistance, video demos, and webinar based tutorials teach and answer questions within seconds.
  - Method-based setup ensures reproducibility of data acquisition. Saving data analysis sessions enables consistent data analysis even with interruptions.
  - Single-click report generation is available for professional data presentation.

DOCUMENT TYPES

iC FBRM organizes data into various types of "documents"—Experiments, Result Sets, Distribution Libraries, as follows.

Experiments

Experiments are the heart of iC FBRM data. They include experiment data plus all related pure measurements, system messages, annotations, and analysis settings associated with your experiment. The Start Experiment Wizard guides you through the process of preparing your experiment. Once started, you can monitor and control your experiment from the Experiment Display which can also be used to analyze previously recorded experiments.

Result Sets

Result Sets are great for comparing results between experiments. Each result set consists of one or more trend graphs each containing one or more profiles.

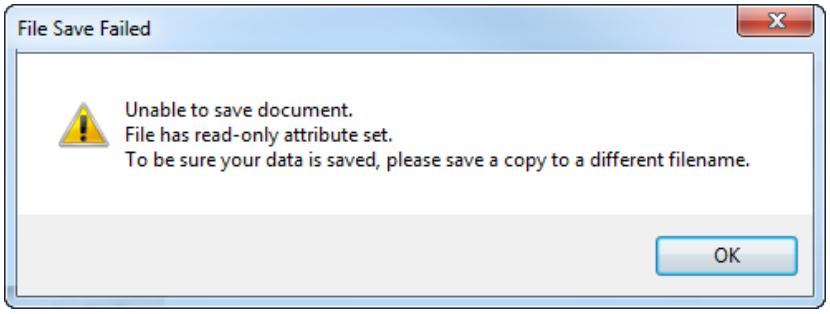
The easiest way to add a trend profile from an experiment into a result set is to open both files, then simply drag and drop profiles into result sets.

Each profile in a result set has a link back to the original experiment—simply right-click on the profile and select "Open Trend Source" to display and access the original experiment.

Distribution Libraries

Distribution Libraries provide a shared repository for references and distributions. The Working with Distribution Libraries section guides you through the process of creating a new library and how to view distributions. New Distributions can be collected from the past or live experiments or copied from another Distribution Library.

Note: Document files (experiment, result sets, distribution libraries) are normally writeable and as such can be edited. A read-only document file can be opened and edited as normal. When an attempt is made to save a read-only document, a Save As dialog box appears requiring the document be saved under a different filename. If an attempt is made to close an edited read-only document, the following error message appears.



Click the **OK** button to open the Save As dialog box.

SUPPORTED HARDWARE

All ParticleTrack™ instruments use FBRM® measurement technology to track the rate and degree of change of particles and droplets as they occur in their actual process environment. Inline measurements of particle dimension, count, and shape are recorded in real time without the need for sample extraction or dilution.

ParticleTrack is the brand name for all current instruments featuring FBRM technology. ParticleTrack instruments include onboard smart chip technology for storage of critical calibration and system configuration information—providing better security and traceability in experimental and process FBRM data.

iC FBRM software supports the following instruments:

Instrument	Description
ParticleTrack G400	• Laboratory inline particle analyzer, manufactured since January 1, 2013. • Includes ParticleTrack ACIO smart chip technology for onboard system memory. • Fixed probe or interchangeable probes. • Simultaneously measure and record data with two Chord Selection Models (CSMs). • Up to two probe systems can be operated per PC.
ParticleTrack G600/G600 Ex	• Plant/pilot scale inline particle analyzer, manufactured since January 1, 2013. • Includes ParticleTrack ACIO smart chip technology for onboard system memory. • Simultaneously measure and record data with two Chord Selection Models (CSMs). • Low maintenance design (pneumatic scanner/air bearing configuration). • Ex systems include purge overpressure and are rated for operation in IECEx/ATEX/Class I, Division 1 environments.
ParticleTrack E25	• Plant/pilot scale inline particle analyzer for non-hazardous environments • Fixed 25 mm probe. • Includes ParticleTrack smart chip technology for onboard system memory. • Simultaneously measure and record data with two Chord Selection Models (CSMs). • Electric scanner probe design, not intended for hazardous environments.

The smart chip technology in ParticleTrack instruments enables the unit to store key calibration parameters and make the instrument configuration much easier. When moving a ParticleTrack instrument from one PC to another PC, there is no need to re-configure the instrument. The control computer automatically detects ParticleTrack instruments when they connect to the iC FBRM PC. The following parameters store in the ParticleTrack instrument and transfer to the iC FBRM software:

- Unit serial number
- Probe type
- Probe diameter
- Scan circle diameter
- CP1, CP2 and CP 3
- Calibration Validation date

DATA STORAGE AND TRANSFER OPTIONS

iC FBRM supports a central data storage feature (see iC Data Center™) and OPC UA-compliant data transfer.

QUICK REFERENCE GUIDES

Quick Reference Guides are single sheets that introduce commonly used functions of the iC FBRM software.

MK-PB-0030-AC QuickRef-Experiment Setup in iCFBRM.pdf

MK-PB-0029-AC QuickRef-Data Review and Analysis in iCFBRM.pdf

These documents are included in the online iC FBRM Documentation Portfolio.

For introductory information, watch video tutorials to become familiar with the iC FBRM software. Links to the videos are on the Start Page under More Information.

FBRM DATA ANALYSIS WEBINARS

METTLER TOLEDO FBRM provides an information-rich method for tracking the number and dimension of particles or droplets as they actually exist in process. In any given particle or droplet system, there are specific and possibly unique changes that are of critical importance to the user.

This four-part webinar series explores how you can maximize data analysis.

Beginners FBRM Data Analysis—The Maximize Data Analysis with METTLER TOLEDO FBRM webinar provides an introduction to iC FBRM.

View the Maximize Data Analysis with METTLER TOLEDO FBRM webinar.

Advanced Part 1: Mechanisms of Particle Change—How does FBRM track particle agglomeration, breakage, attrition, growth, and shape? How can users extract a mechanistic understanding of these changes from FBRM data? By using the correct analysis tools, weighing, and statistics, specific particle changes can be understood and optimized with maximum precision.

View the Mechanisms of Particle Change webinar.

Advanced Part 2: Correlating to Process Efficiency and Product Quality—How can FBRM be correlated to predict downstream process efficiency or product quality? How can FBRM be correlated to an offline particle measurement such as laser diffraction, sieving, or microscopy? This webinar will provide examples of direct correlations between FBRM data and process efficiency such as filtration, flow properties, or dissolution rates as well as correlations with product quality such as bulk density, stability, color, and particle size.

View the Correlating to Process Efficiency and Product Quality webinar.

Advanced Part 3: Overcoming Pitfalls to Data Interpretation—How do changes in the particle system physics affect FBRM data? The FBRM measurement principle has inherent sensitivity which can affect results in ways unexpected by chemists and engineers. Understanding these particle system properties can significantly increase success with FBRM data interpretation.

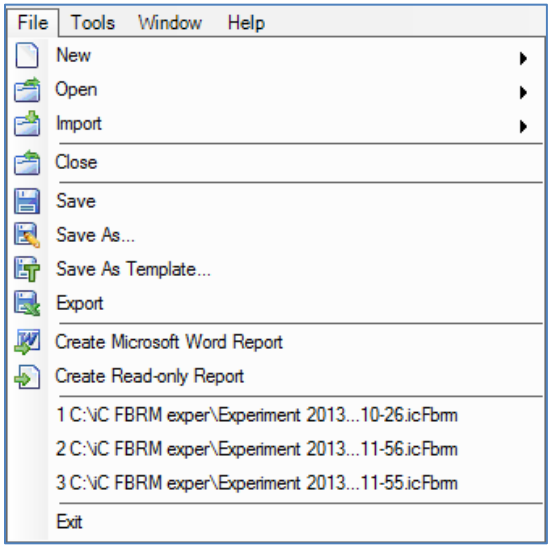
View the Overcoming Pitfalls to Data Interpretation webinar.

Using iC Menus

The iC application contains four pull-down menus located on the main menu bar.

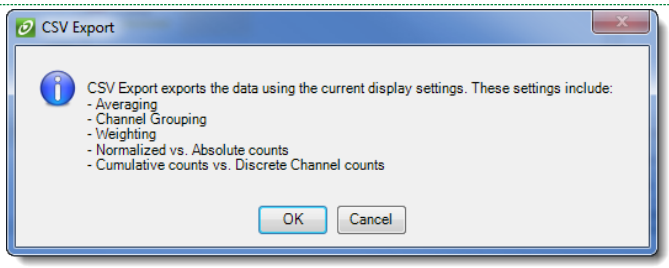
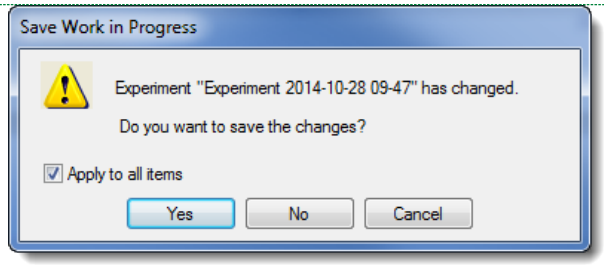
FILE MENU

The Files menu contains options for experiment file functions such as opening and saving and exporting experiment data. (Recall that iC files—experiments, Result Sets, Distribution Libraries—are referred to as documents, as described under the Document Types section.)



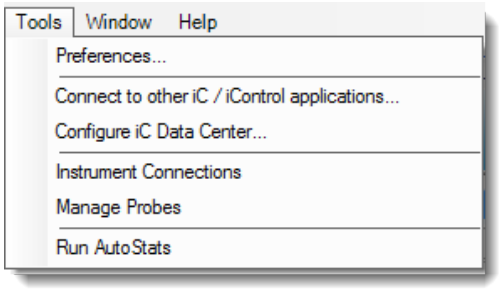
The menu contains the following options.

New	**Experiment**—Creates a new experiment document. **Distribution Library**—Creates a new Distributions Library for comparisons and analysis of selected distributions from different experiments. **Result Set**—Creates a trend comparison module for overlaying and synchronizing trended statistics from multiple experiments or from multiple iC platform software, such as iC IR.
Open	When you select 'Open,' the system remembers the most recently used folder for each type of iC document file and displays the list from that location. **Experiment**—Opens an existing experiment document (*.icFbrm). **Distribution Library**—Opens an existing Distributions Library (*.icDistribs) for comparison and analysis. **Result Set**—Opens an existing Result set (*.icResults) for analysis or insertion of additional measurement from other experiments.
Import	Imports .LST and ICFBRMRAW files from previous versions of FBRM.
Close	Closes the current document file.
Save	Saves the current opened document file.
Save As	Saves the current experiment as a new file with a name defined by the user.
Save as Template	Saves the current experiment as a template. See Saving an Experiment as a Template.

Export	Exports a CSV (Comma Separated Values) formatted report of experiment data. See Exporting Experiment Data for more information. 
Create MS Word Report	Generates a pre-formatted report of the current experiment in MS Word format.
Create Read-only Report	Generates a pre-formatted, read-only report of the current experiment in XPS format.
Exit	Closes all document files and closes the iC FBRM software. If there are any unsaved changes to open documents, a dialog prompts you to save the changes before exiting. Use the check box to save changes to all open documents. 

TOOLS MENU

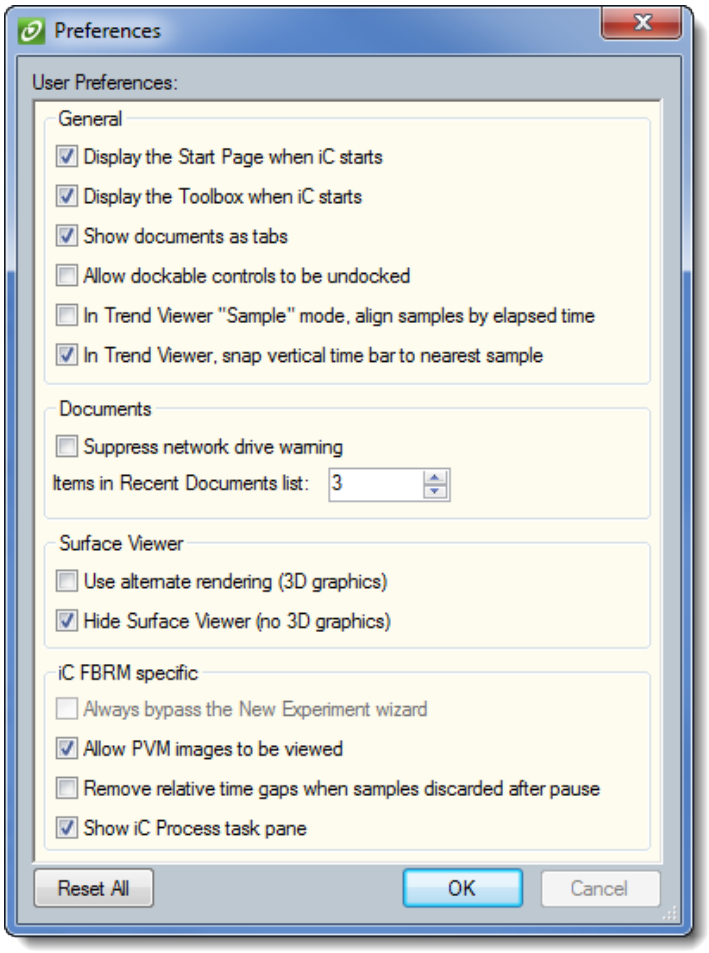
The Tools menu contains the following menu options:



- Preferences—See Preferences Dialog.
- Connect to other iC/iControl applications—See Interaction with Other iC Applications.
- Configure iC Data Center—See Configuring iC Data Center.
- Instrument Connections Dialog—Configures the connections to FBRM Service 4.4.
- Manage Probes—Manages probe tips. See Managing Probes.
- Run AutoStats—Executes an automated analysis evaluation. See AutoStats.

Preferences Dialog

Clicking the **Preferences** item in the Tools menu opens the Preferences dialog box.



Click a check box to enable a preference. Clicking **Reset All** returns the preferences to the factory default states. Clicking **Cancel** exits the window without saving changes. Clicking **OK** saves the changes and exits the window.

Below are the Preference options.

Display the Start Page when iC starts	If this option is checked, the Start Page with a list of top-level functions displays when the software starts. When unchecked, the software opens with a blank screen and the pull-down menus must be used to start a program.
Display the Toolbox when iC starts	If this option is checked, the toolbox displays when the software first starts. Otherwise, the toolbox is closed and can be opened when needed by clicking along the right edge of the application window.
Show documents as tabs	If this option is checked, multiple documents (experiments, Result Sets, Distribution Libraries) display as tabs to the right of the Start Page tab. Otherwise, multiple documents appear as separate windows similar to other Windows programs.

Allow docking controls to be undocked	If this option is checked, you can drag controls such as the Surface Viewer off the form and arrange them as independent windows. This is particularly useful if you have a multi-monitor display. When selected, this option takes effect on newly opened documents but has no effect on currently open documents.
In Trend Viewer 'Sample' mode, align samples by elapsed time	This option relates to Reference Trends and how the Trend Viewer handles the x-axis time display if you switch between "Relative Time" and "Sample Number." • If this option is unchecked, Reference Trend shifts if you toggle the X-Axis between Relative Time and Sample Number. • If this option is checked, Reference Trend does not shift—Relative Time is the elapsed time from the start of the experiment. **Note**: To switch the X-Axis Format, use the right-click context menu to change between "Relative Time" or "Sample Number."
In Trend Viewer, snap vertical time bar to nearest sample	When this option is checked, the Trends Viewer behavior is: Release the mouse button within the Trends Viewer and the vertical bar snaps to the nearest sample position. When this option is unchecked, release the mouse button and the vertical bar stays at the location where the mouse button is released.
Suppress network drive warning	If the option is checked, warning messages about saving data to a network drive do not appear.
Items in Recent Documents list:	Specify the number of recent documents to display on the Start Page and File menu.
Use alternate rendering (3D graphics)	Use this option if you are having problems with displaying 3D graphics in the Surface Viewer. Problems with 3D graphics are usually solved by switching the graphics card to 16-bit graphics. If that does not work, switch the graphics card back to 32-bit and then check this option.
Hide Surface Viewer	Hides the Surface Viewer in all viewing configurations (see Surface Viewer).
Always bypass the New Experiment wizard	When checked, the New Experiment Wizard is bypassed. An experiment is created using 'One-Click experiment' even when user clicks the 'New Experiment Wizard' button on the Start Page. Experiment duration and measurement interval are determined by previous experiment or by experiment template (see One-Click experiments).
Allow PVM images to be viewed	If this option is checked, Particle Vision and Measurement (PVM) image display is enabled (see PVM Viewer).
Remove relative time gaps when samples discarded after pause	If the option is checked, when the user comes out of pause mode and chooses to discard the samples, the time gap for the pause period is removed (in relative time mode). Refer to Starting the Experiment.
Show iC Process task pane	When checked, a Process task pane appears in the toolbox to enable viewing and analyzing batch and continuous process runs of instruments controlled by iC Process for FBRM software.

Instrument Connections Dialog

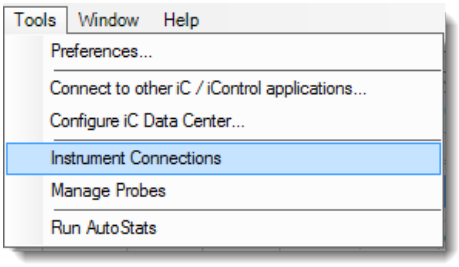
ParticleTrack instrument connections are automatically established and the instrument configuration is automatically synchronized with the system configuration stored on the instrument PC based on the instrument selected during software installation.

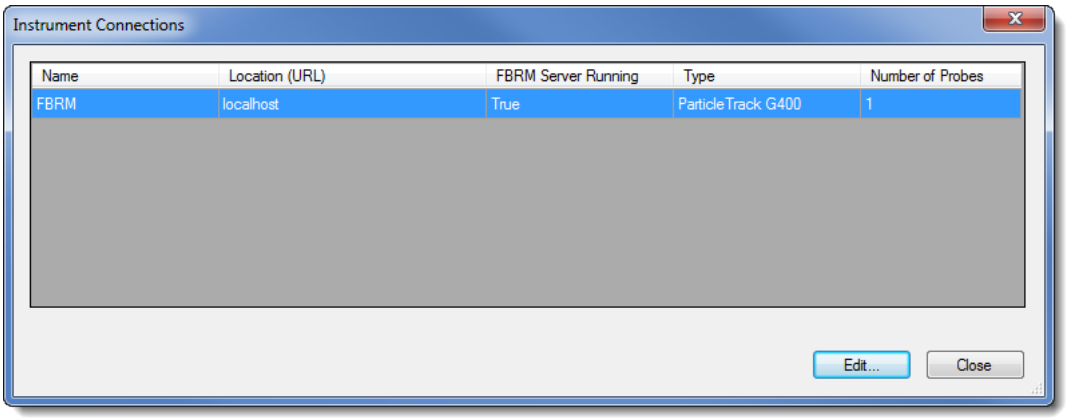
If necessary, use the Instrument Connections dialog box to verify the FBRM Server connections to the iC FBRM software by scanning for the instrument. You can also check the Instrument Connections if you encounter any connection issues.

Notes:

- Only one FBRM Server can be defined and used at a time.
- The Instrument Connections window will not open while experiments are running.

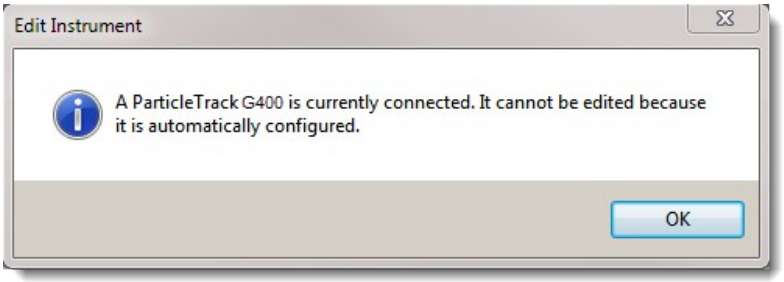
1. Access the Instrument Connections window from the Tools menu.



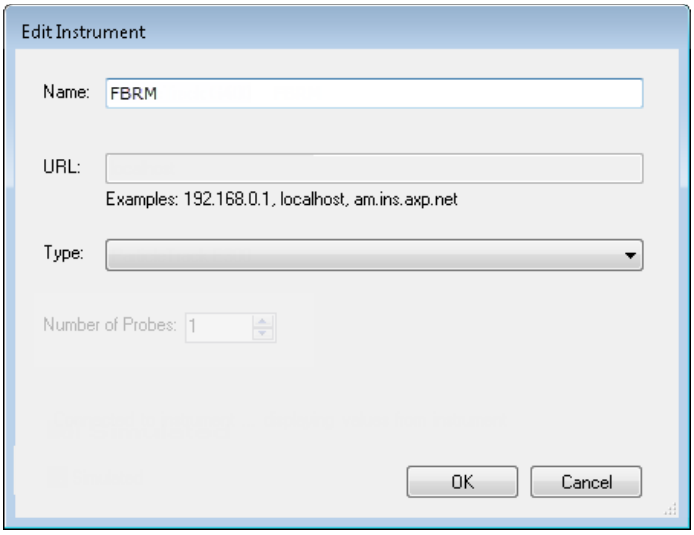


The window contains the defined server connection and its name, URL, equipment type, and number of probes. The 'FBRM Server Running' field displays the current operational status of the server. Verify the correct probe type and number of probes.

2. Click **Edit** to scan for the connected instrument. Since ParticleTrack instruments are automatically detected, they cannot be edited. The following message verifies the connection.



If the instrument is not connected to the PC, clicking the **Edit** button shows no instrument Type.



Connecting a ParticleTrack Probe with iC FBRM

Follow the steps below to connect a ParticleTrack G400, G600, or E25 probe with iC FBRM. In the case of ParticleTrack G400 systems, up to two may be configured on a single control PC. This is known as a dual-probe configuration, and the software labels them as Probe**A** or Probe**B**. When installing a dual-probe configuration, complete the configuration of a single system first. Do not connect the second system to the control PC until the first system has been configured.

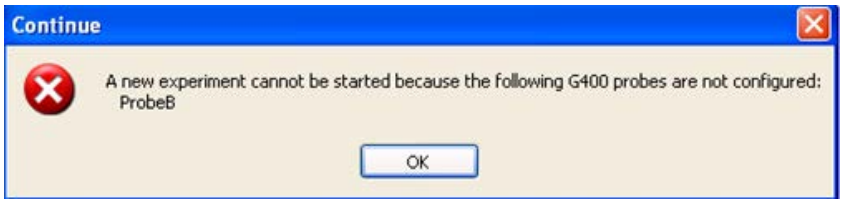
Configuring a single ParticleTrack system:

1. Start with the computer OFF.
2. Plug the ParticleTrack base unit into the computer and power the instrument ON.
3. Power ON the computer.
4. Log on to the PC and start the iC FBRM software application.
5. Follow the steps for Configuring the Instrument through the software to prepare the probe system for use in an experiment. The probe configuration must be completed in the software before an experiment can be run.

Adding a second ParticleTrack G400 for a dual-probe configuration:

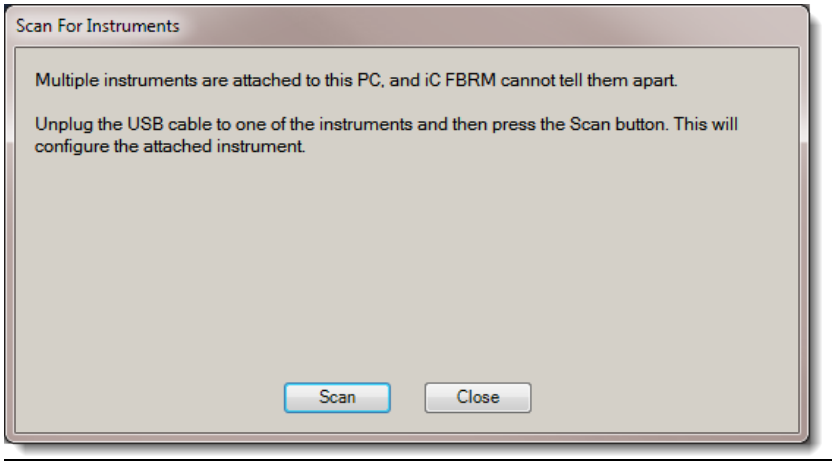
1. Plug the second G400 base unit into the computer and power the instrument ON.
2. Select Tools > Instrument Connections, and click **Edit**. The software displays a message that the instrument is connected and cannot be edited.
3. Follow the steps for Configuring the Instrument through the software to prepare the probe system for use in an experiment. The probe configuration must be completed in the software before an experiment can be run.

Note: It is important to note that if two G400 probes are connected to a system, **both** probes must be configured before an experiment can be run. If an attempt is made to start an experiment without first configuring both probes, the following error dialog is displayed..

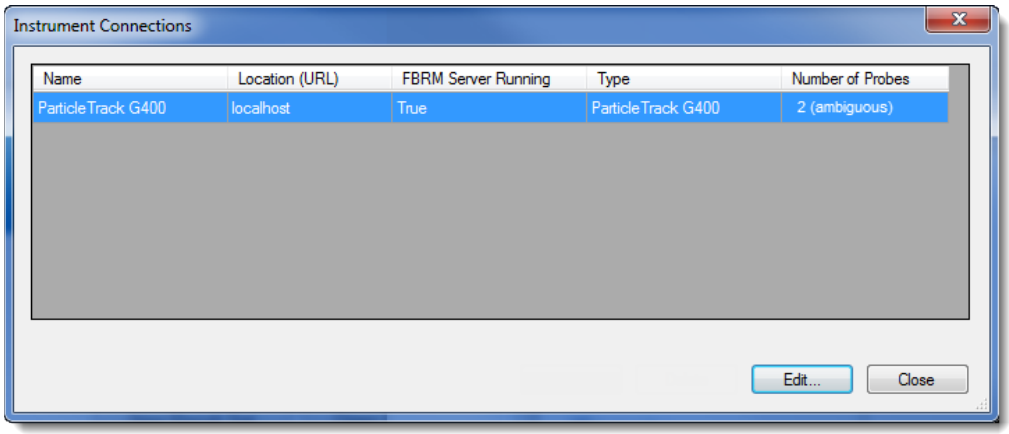


WHAT TO DO IF IC FBRM TELLS YOU IT CANNOT TELL THE PROBES APART

In a G400 dual-probe configuration, if two new un-configured G400 probes are connected to the control computer and the FBRM server cannot uniquely identify the two attached G400 instruments, the following dialog box appears:



The FBRM server labels the pairings as 'ambiguous.'

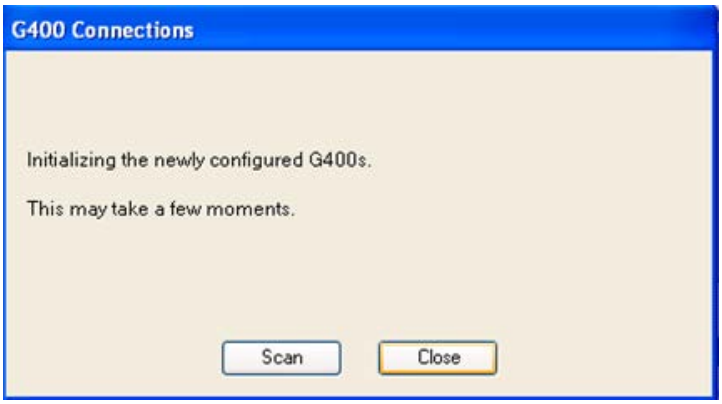


Follow these steps to resolve this issue:

1. Unplug one of the G400 USB cables from the PC and click the **Scan** button. The FBRM server will detect the instrument and after a few seconds display the following dialog box:

2. Plug in the other G400 USB cable and click the **Scan** button. After a few seconds, the second G400 will be configured and the dialog box updated with information identifying the new probe.

3. Click the **Close** button to initialize the probes.



IC FBRM DOES NOT RECOGNIZE THE G400/G600/E25 PROBES

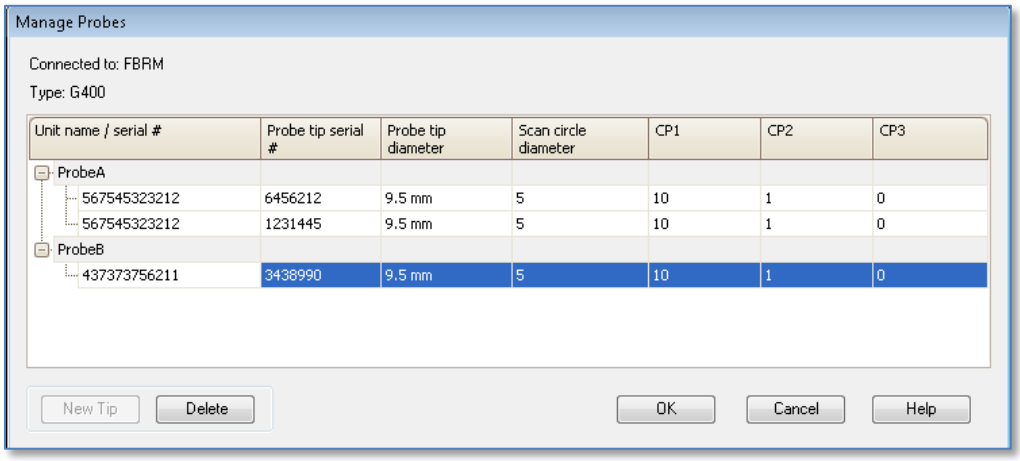
If the G400/G600/E25 probes are not recognized in the Instrument Connections dialog, perform the following procedure to correct the problem.

- Power down the PC or stop the FBRM Service (see Changing Time Zones and Regional Settings for information on stopping the FBRM server).

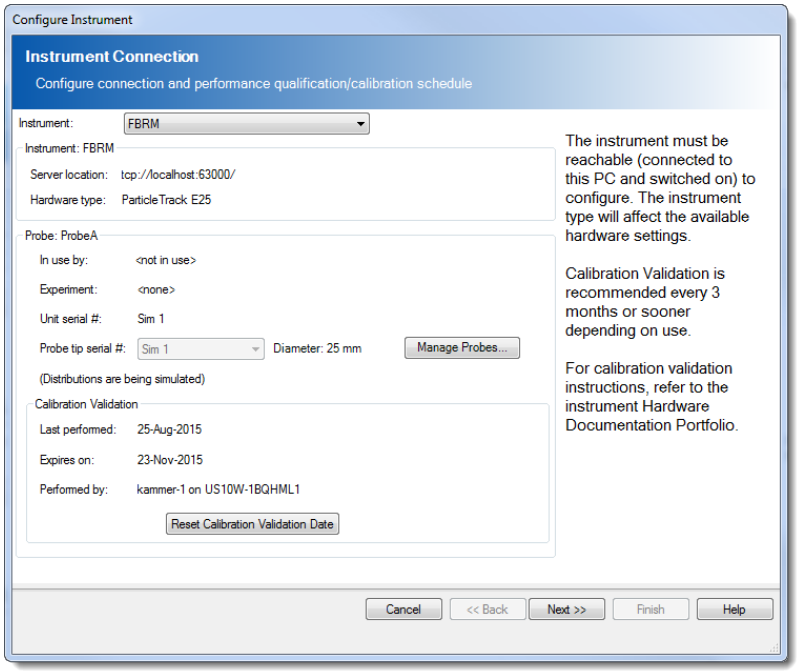
- Remove the power from the instrument.
- Disconnect the USB cable between the instrument and the PC.
- Start the PC or start the FBRM Service (see Changing Time Zones and Regional Settings for information on starting the FBRM server).
- Start the iC FBRM software application.
- Follow the procedure for. Connecting a ParticleTrack Probe with iC FBRM.
  For G400 dual-probe systems, follow the recommended procedure. If necessary, refer to What to Do If iC FBRM Tells You It Cannot Tell the Probes Apart.

Managing Probes

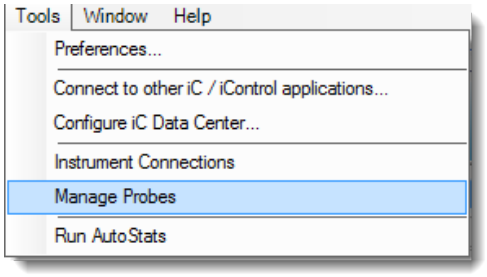
The Manage Probes dialog box stores the probe calibration parameters for your ParticleTrack probe. Editing probe calibration parameters should only be done by a METTLER TOLEDO representative.



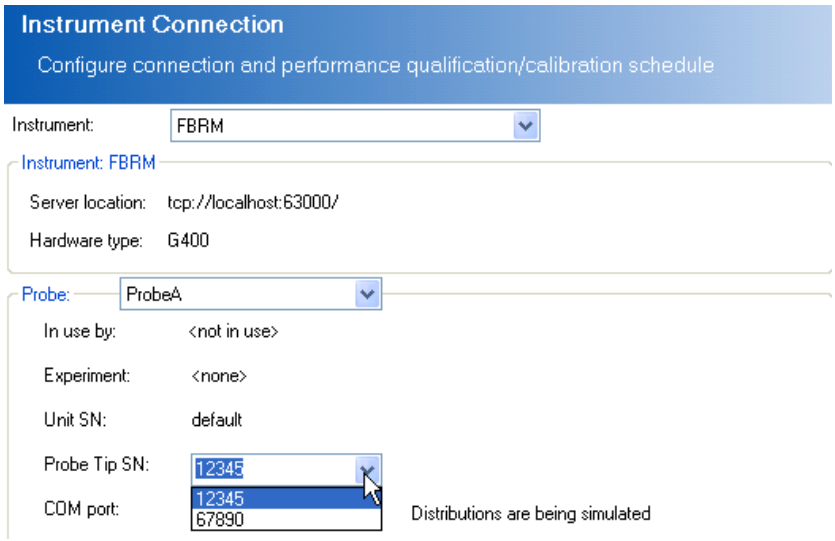
The Manage Probes button on the Instrument Connection page displays the Manage Probes dialog box.



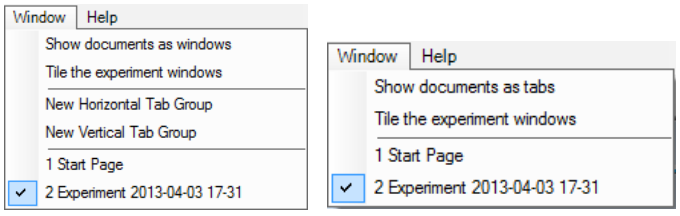
The Manage Probes dialog box can also be accessed from the Tools menu.



Select the probe tip to use for an experiment from the Configure Instrument wizard.



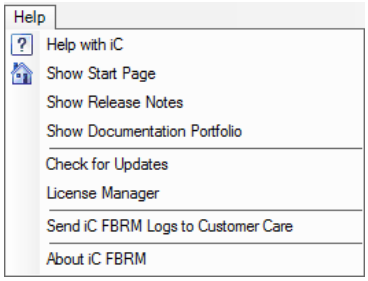
WINDOW MENU



The menu contains the following options.

Show documents as windows **Show documents as tabs**	• Clicking the 'Show documents as windows' option when tabs appear displays the files as separate windows. • Clicking the 'Show documents as tabs' option when windows appear changes the files to the default tabbed format.
New Tab Groups	Arranges the display as tabs—either horizontally or vertically. See Tab Groups allow you to view multiple documents at once.
List of open files	Lists all open files (tabs) with the file currently displayed identified by the check mark. Clicking on an open file tab displays that file.

HELP MENU

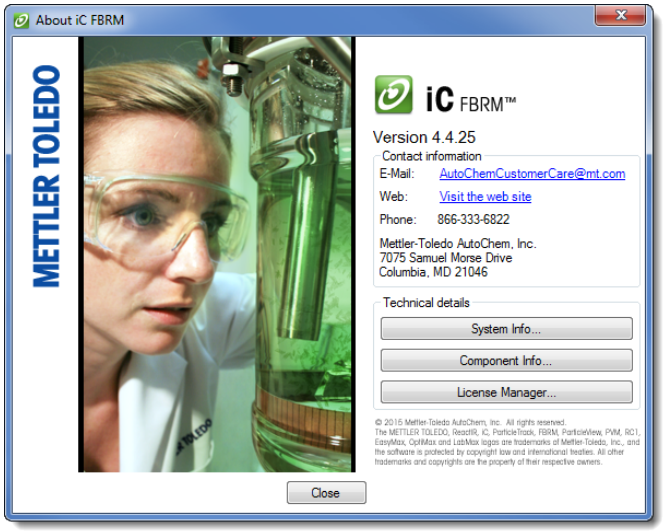


The menu contains the following options.

Help with iC	Opens the iC online Help.
Show Start Page	Opens the Start Page or displays it if it is already open.
Show Release Notes	Displays a list of changes for the installed release of the software.
Show Documentation Portfolio	Opens the PDF Portfolio of user guides and publications for iC FBRM software.
Check for Updates	Connects to the MT website and checks for recent software updates. Note that an internet connection is necessary to use this option.
Send iC FBRM Logs to Customer Care	Opens a window where you select date parameters for the system utility that generates a zipped file that you can email to Customer Care for analysis.
License Manager	Opens License Manager to enable the user to review and enter licenses.
About iC FBRM	Displays software version and contact information along with technical and copyright/trademark details.

The About iC FBRM Dialog

The About iC FBRM dialog box displays information detailing the software application version number and contains buttons to access various application/system tools.



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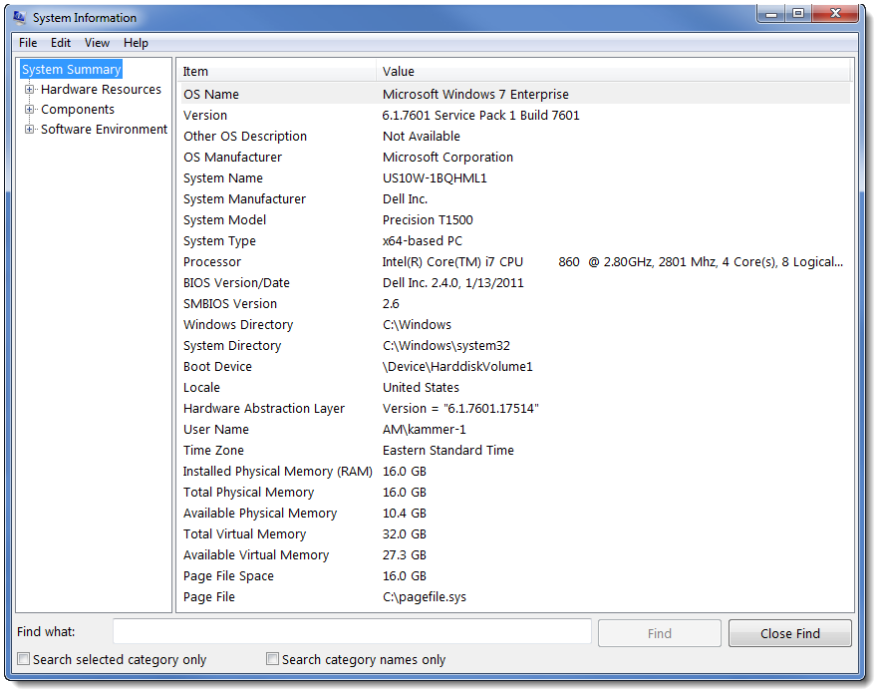
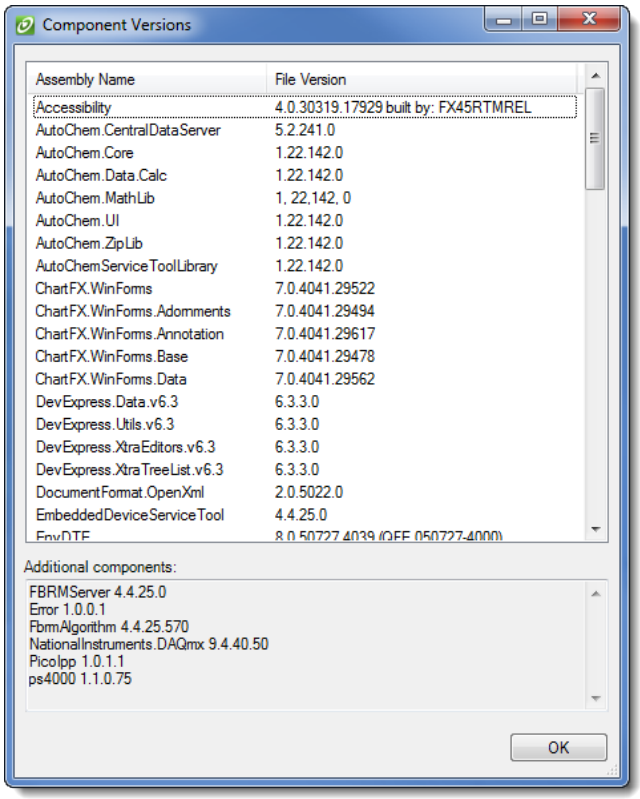
Clicking the **System Info** button opens the Windows System Information dialog box that contains information about the Windows operating environment.

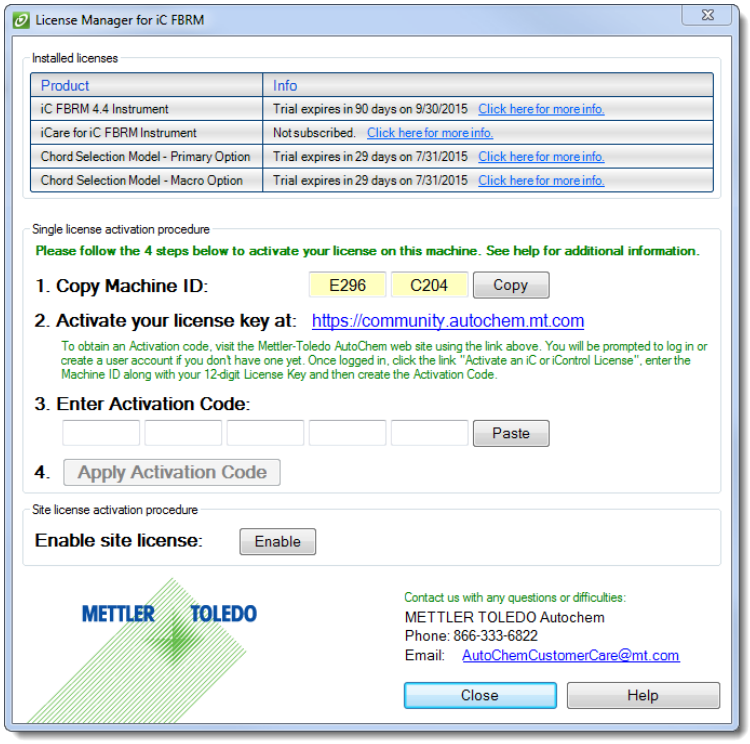


Clicking the **Components Info** button opens the Component Versions dialog box with information detailing the version numbers of all iC FBRM software components.



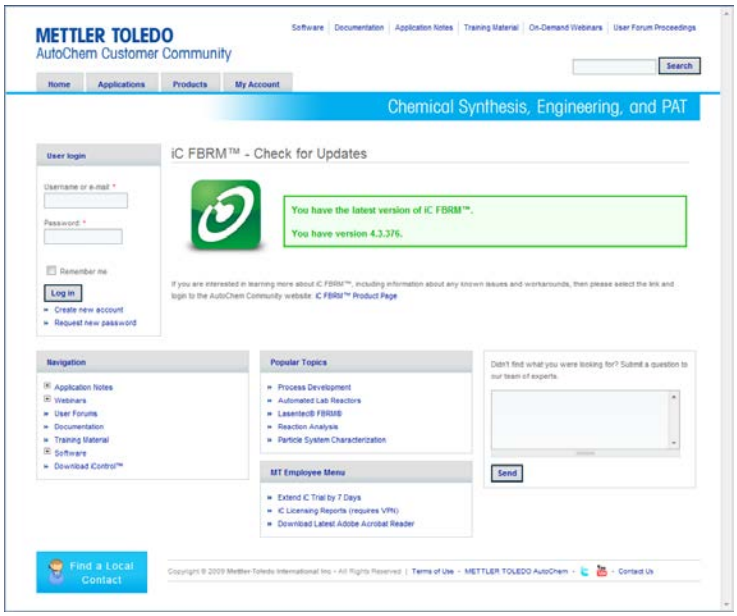
METTLER TOLEDO

The **License Manager** option provides the way to activate software and other licenses and apply activation codes. Refer to the iC FBRM Install Guide for Administrators in the Software Documentation Portfolio for complete instructions. The iC Licensing topic in this Help system provides an introduction.



Check for Updates Menu Option

The **Check for Updates** option on the Help menu opens the AutoChem Customer Community website where an automatic check occurs to determine if the system is running the latest version of the iC software.



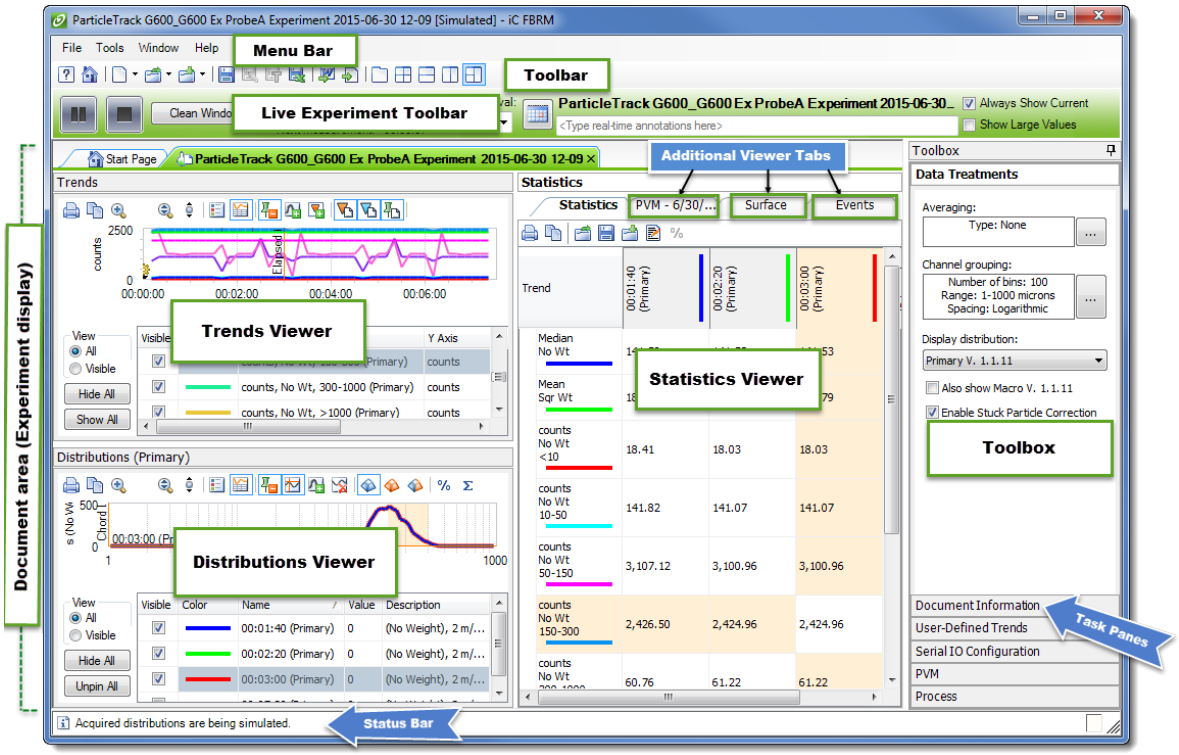
The user has the option to download and install the latest version from the website.

Working with the iC User Interface

All iC data displays are interactive. For example, when a time point is selected in the Trend Viewer, the corresponding distribution and statistics are displayed in the Distribution Viewer and Statistics Viewer. The same interaction applies if the PVM Viewer, Surface Viewer, or Events Viewer are displayed. Refer to Linked Views for more information.

IC USER INTERFACE INTRODUCTION

The iC user interface combines power and simplicity to help you collect and analyze your data. Depending on the specific iC application, a variety of interactive viewers display in the iC Main Window or dashboard.



The information below introduces the areas of the user interface.

The **Menu bar** and **Toolbar** provide standard Windows menus for accessing program functions. The toolbar contains icons for common functions and is positioned next to the menu bar to display useful functions for the current display. The user interface also includes a **Live Experiment Toolbar** with icons for common functions. While the iC FBRM system records data, this toolbar also provides a button to pause recording of the active experiment.

The **Document area** organizes multiple open documents (experiments, Result sets, Distribution libraries). By default, documents appear as tabbed windows, but you can choose to display them in separate windows. Tabbed documents can be grouped to allow side by side comparison. (Refer to the Window Menu).

Interactive Viewers—The figure above features an Experiment display that consists of several interactive viewers. Three of the viewers (Trends, Distributions, and Statistics) are featured. In the example, the Statistics Viewer, Events Viewer, Surface Viewer, and PVM Viewer share the same tile. Selecting a tab displays the viewer in the tile. The PVM Viewer and the Surface Viewer must be enabled in system Tools > Preferences Dialog, to appear as tabs in the Statistics Viewer pane.)

The “active viewer” is highlighted (name changes to bold and title bar to white) to provide feedback on which data viewer will respond to keyboard commands. Refer to Experiment Display for details on all the viewers.

- The **Trends Viewer** displays chord length statistical profiles over time. You can show or hide profiles from the Trend List. You can also manipulate the trend view (for example: zoom, change colors, show/hide legends, export data, and more) from the toolbar along the top edge of the Trends Viewer. Manipulation of trend profiles can also be performed by right-clicking the mouse to display context menus. One way to open a Details table on all trends is by double-clicking the lower left corner of the viewer.

- The **Distributions Viewer** displays a graph that represents the chord length distributions at selected times during the experiment. The X-Axis shows the channel boundaries in microns. The Y-Axis shows either the number or percent of chord counts, depending on which is selected. One way to open a Details table on all distributions is by double-clicking the lower left corner of the viewer.

- The **Statistics** panel contains up to four tabs, as follows.
    - The **Statistics Viewer** plots chosen statistics over time by collecting the time each measurement was taken and displaying the number of counts in each statistical category for that measurement.
    - The **PVM Viewer** displays images loaded from an iC PVM experiment or from a completed sequence file (*.seq). Both the Trends Viewer and Distributions Viewer can optionally link the trend crosshair to a PVM image for an associated point in time. This is supported after an experiment is complete.
    - If activated through Tools > Preferences, the **Surface Viewer** displays a 3D graph of the distribution. Surface Viewer is synchronized with the Distribution Viewer.
    - The **Events Viewer** displays system messages and user annotations. A Sample message is appended each time the system acquires a measurement. The system also reports Info, Warning and Error messages, when appropriate. The Annotation panel can be displayed to create or edit user annotations. When a sample is annotated, an option is offered to have a marker displayed on the Trends Viewer.

The **Toolbox** provides access to a set of task panes that launch programs or manipulate the active document. For example, the Data Treatments task pane provides access to analysis functions such as channel grouping and averaging. The Toolbox can be popped open as needed or “pinned” to remain open and readily available. Refer to Using the Toolbox for details including the individual task panes.

The **Live Experiment Toolbar** displays useful system information. The most recent system message displays on the left side. When an active experiment is in progress, experiment status indicators and controls are shown on the right side. A **Status Bar** on the bottom of the document area also shows system status messages.

Refer to Working with the iC User Interface for details about toolbars, tabbed displays, and linked views.

MAIN TOOLBAR

The main toolbar contains a series of buttons that function as shortcuts to commonly used menu options.

Buttons are only activated when the button function is available. Unavailable buttons appear as "grayed-out."

Button	Description
	Opens the **iC Help** system.
	Displays the **Start Page**.
	New—Create a new experiment, Result Set, Distribution Library or a One-Click Experiment.
	Open—Opens an existing experiment, Result Set, or Distribution Library.
	Import—Imports an external experiment or measurement file.
	Save—Saves changes to the active document.
	Save As—Saves changes to the active document with a new filename.
	Save As Template—Saves the current experiment as a template.
	Export—Exports the selected experiment data to a CSV file.
	Create Microsoft Word Report
	Create Read-Only Report—generates an XPS report for the currently active document.
	Dockable Viewer—Enables repositioning viewers within the window. See Dockable Viewers.
Layout Buttons—The following buttons are mutually exclusive with each other. Only one layout can be in effect at a time.	
	Tab View—displays the active documents as tabs.
	Tiled View—displays the active document viewers in a four-quadrant arrangement.
	Horizontal Layout—displays the active documents as horizontal panes.
	Vertical Layout—displays the active documents as vertical panes.
	Standard View—Trends Viewer and Distributions Viewer on the left and Statistics Viewer tabbed with Events Viewer on the right

TABBED DISPLAYS

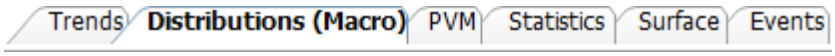
iC software presents tabbed displays at multiple levels within the user interface to provide flexibility and a maximum amount of available screen space for each analysis window.

Multiple documents can be opened at once and shown as tabs across the top of the document area. Within a document such as an experiment, multiple viewers can appear as tabs across the top of the document window.

TABBED/TILED VIEWS ORGANIZE DATA WITHIN A DOCUMENT

The default view displays the Trends Viewer and the Distributions Viewer on the left side. The Statistics and Events Viewers appear on the right side as tabbed views within a third panel.

Alternately, the data displays can be organized as tabs with only one viewer occupying the document area at a time. When a document contains multiple tabbed controls, the tabs appear on the upper portion of the display window.



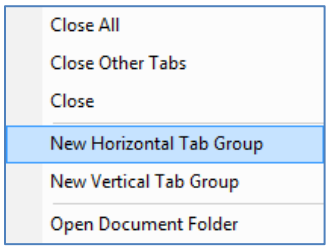
In the example above, the experiment is viewed as tabbed which means the entire window appears as a single viewer. As a result, the data detail is easier to see.

Note: PVM Viewer and Surface Viewer tabs only appear if activated through Tools > Preferences Dialog.

TAB GROUPS ALLOW YOU TO VIEW MULTIPLE DOCUMENTS AT ONCE

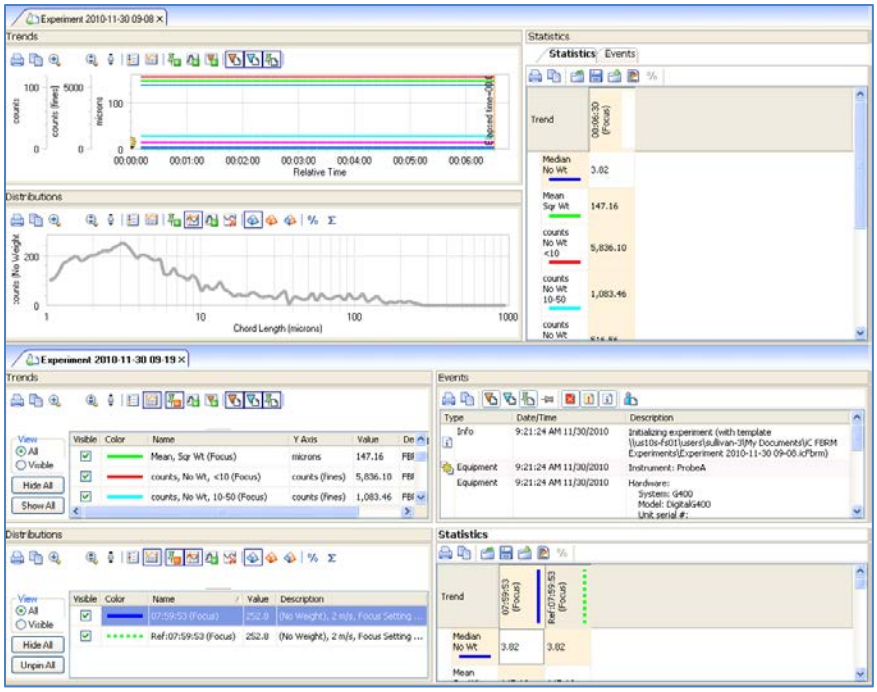
When multiple documents (for example: experiments, results sets, distribution libraries) are open, they display as tabs located at the top of the display window. Clicking a tab displays the document. The tabs are added in the order they are opened.

To view two experiments at once, right click on a tab and select one of the tab group options from the context menu.

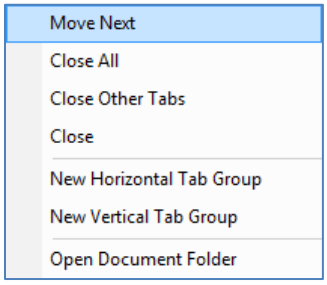


In the figure below, the New Horizontal Tab Group option was selected on an experiment.

Note: The screen is now divided into a lower tab group containing a single document and an upper tab group containing the remaining documents.



Once a new tab group has been created you can right-click on the tab again to rotate through the tab groupings by clicking the **Move Next** option. Once all tabs have been rotated, the window returns to its original configuration.



The context menu also has several options for opening and closing document tabs.

Close All—closes all open tabs except the Start Page.

Close Other Tabs—closes all open tabs except the current tab and the Start Page.

Close—closes the current tab.

Open Document Folder—opens the folder (in a file browser) where the active document resides.

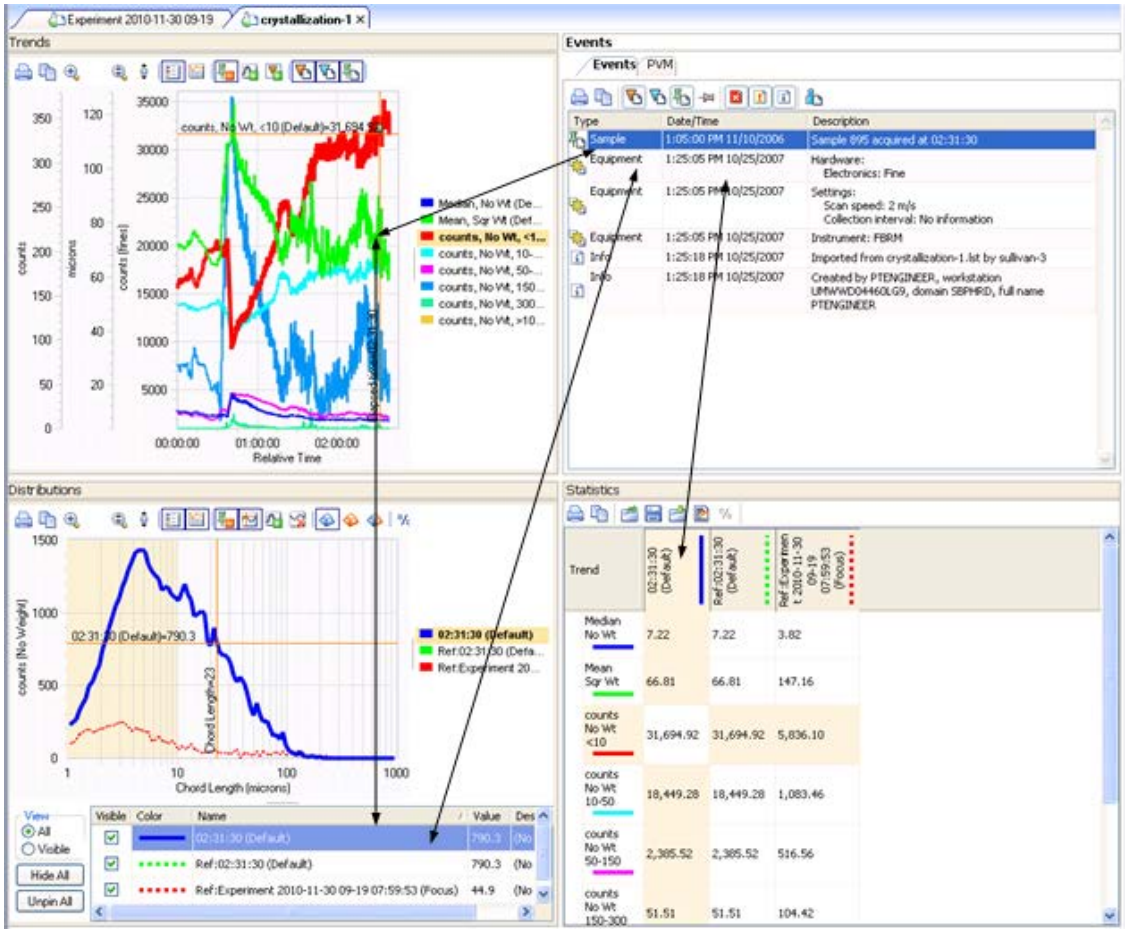
Other display configurations are available on the Main Toolbar.

LINKED VIEWS

The four main data viewers in the document display link interactively. When you select a data element in one viewer, the corresponding data elements in the other viewers are also highlighted.

Synchronized Highlighting

If you select a time point (record) from the Trends Viewer, the distribution becomes highlighted on all displays automatically.



Any of the following actions coordinate the linked views to reflect your selection:

- Click on an event in the Events Viewer.
- Select a time point in the Trends Viewer.
- Click on the measurement in the Distributions Viewer or the Details table.
- Click on the selected measurement in the Events Viewer.
- Click on a column and/or row in the Statistics Viewer.
- Select an image in the PVM Viewer (if applicable).
- Select a point on the Surface Viewer (if applicable).

Below are some examples of how all four viewers update and highlight the chosen event:

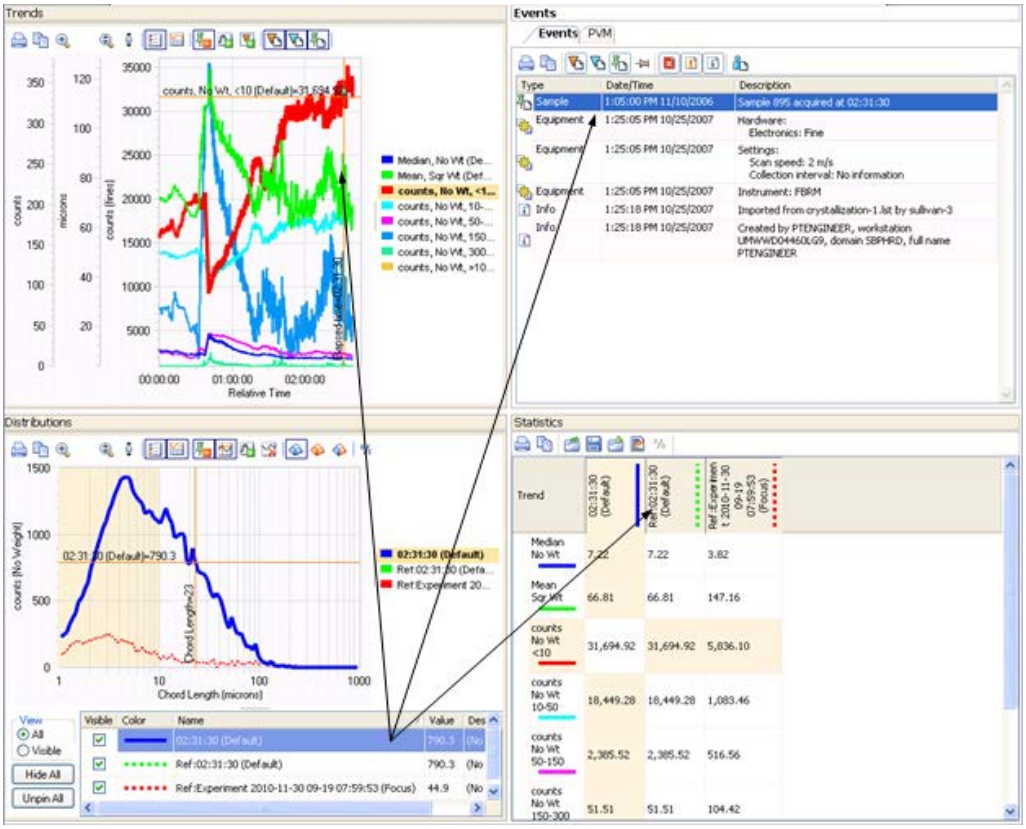
- Thickness of the selected measurement increases to enhance visualization.
- Associated y-axis title changes color to match the selected measurement.
- Time line in the Trend Viewer moves to show the point in time when the measurement was recorded.

- Event Viewer highlights the selected event.
- Selected measurement is highlighted on the Statistics Viewer.
- Corresponding PVM image is displayed (if loaded).

Selected Distribution

Select a distribution measurement using one of the following actions and observe how the linked views change to reflect your selection:

- Click on an event in the Events Viewer.
- Select a time point in the Trends Viewer.
- Click on the measurement in the Distributions Viewer.
- Click on the selected measurement in the Events Viewer or Distribution Details table.
- Click on a column and/or row in the Statistics Viewer.
- Select an image in the PVM Viewer (if applicable).



All viewers respond with corresponding data by:

- Highlighting the row in the Event Viewer.
- Positioning the Trend Viewer time line to the measurement's timestamp value.
- Displaying the measurement in the Distributions Viewer with a widened plot line.
- Adding the measurement to the Distributions Viewer's Details Panel and highlighting it.

- PVM will display the corresponding image.
- Highlighting the column in the Statistic Viewer.

DOCKABLE VIEWERS

The iC software allows the user to reposition the various viewers anywhere on the display window.

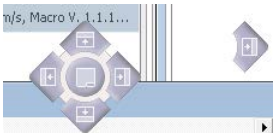
Note: The **Allow dockable controls to be undocked** option in Tools menu > Preferences must be checked for the docking button to appear.

	**Docking button**—(Inactive) To reposition viewers, click the button on the toolbar.
	**Docking button**—(Active) To exit the docking feature, click the button again to return to inactive.

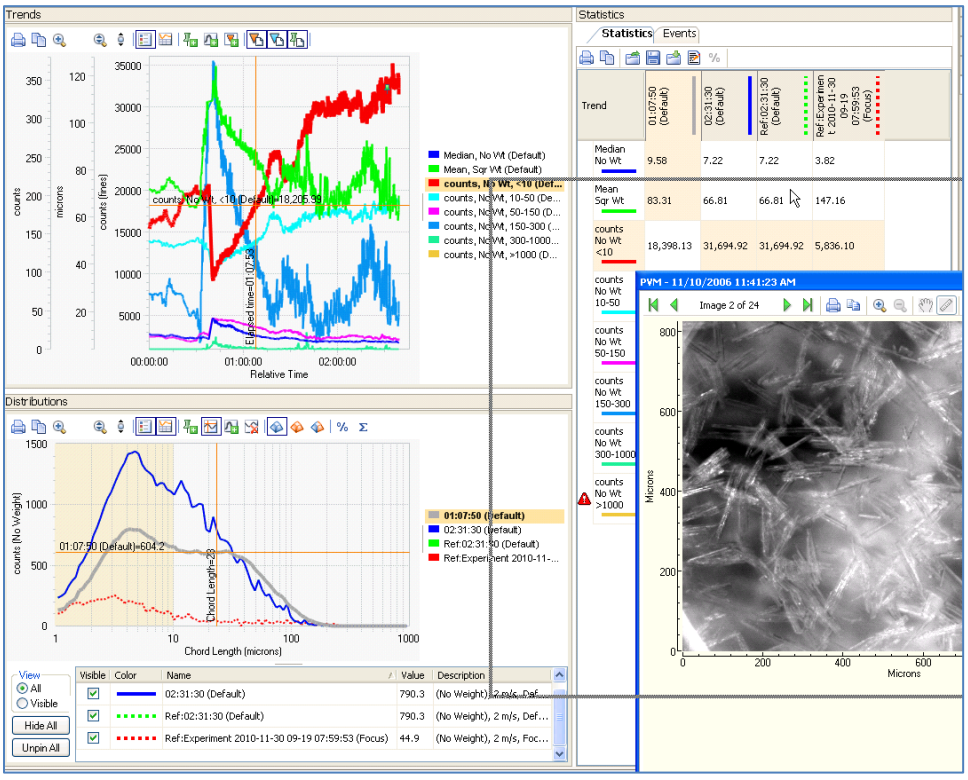
The following example illustrates how to reposition the PVM at the bottom of the Events Viewer:

1. In the main toolbar, click the docking button to activate the docking feature.

2. Click-and-drag the title bar or tab of the PVM Viewer (shown floating in example below) to the desired location.

	Docking guides appear to help you relocate the window to the top, bottom, left, or right.

3. Release the mouse button to drop the viewer in the new location.



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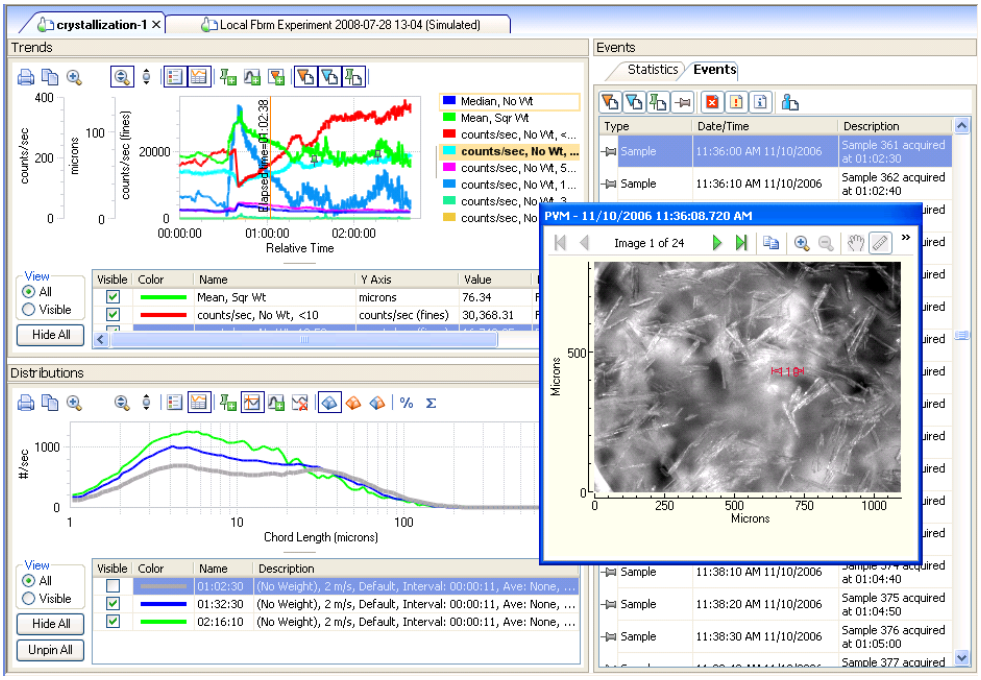
In addition to being docked, viewers can remain floating.



To undock a viewer, click the Docking button again. In the example, the PVM Viewer will return to its original docking position.

To return the window to one of the standard layouts, click one of the layout buttons on the toolbar.

PINNING

All trends and measurements in iC viewers can be pinned. When pinned, a measurement appears in the graph and in the corresponding Details table. Pinning is similar to the show/hide concept but pinning is application wide (one pin applies to all linked views). Show/hide is local to each individual viewer (or tile).

Pin/Unpin—Button on the Trends Viewer and Distribution Viewer toolbars

The following rules apply to pinning:

- Pin/Unpin is enabled/available whenever there is a selected measurement.
- With a selected measurement, the Pin button provides visual indication of whether the selected measurement is pinned or not (+ and – symbol and color on the Pin/Unpin button).
- If unpinned, the selected distribution/sample is gray in the Distributions Viewer. It will change if another distribution/sample is selected.
- Pinning from the Trends Viewer or Distributions Viewer assigns a color to the selected distribution/sample and keeps it in the Measurement/Distributions Viewer even when another distribution/sample is selected.

- Unpinning removes the permanent status of the selected sample and de-allocates its color, but the distribution is still selected and displayed in gray to reflect its temporary status. It will disappear entirely when another distribution/sample is selected.
- If a distribution is identified as a Reference Distribution, the Remove Distribution option from the right-click (context) menu deletes the Reference Distribution from the viewer.

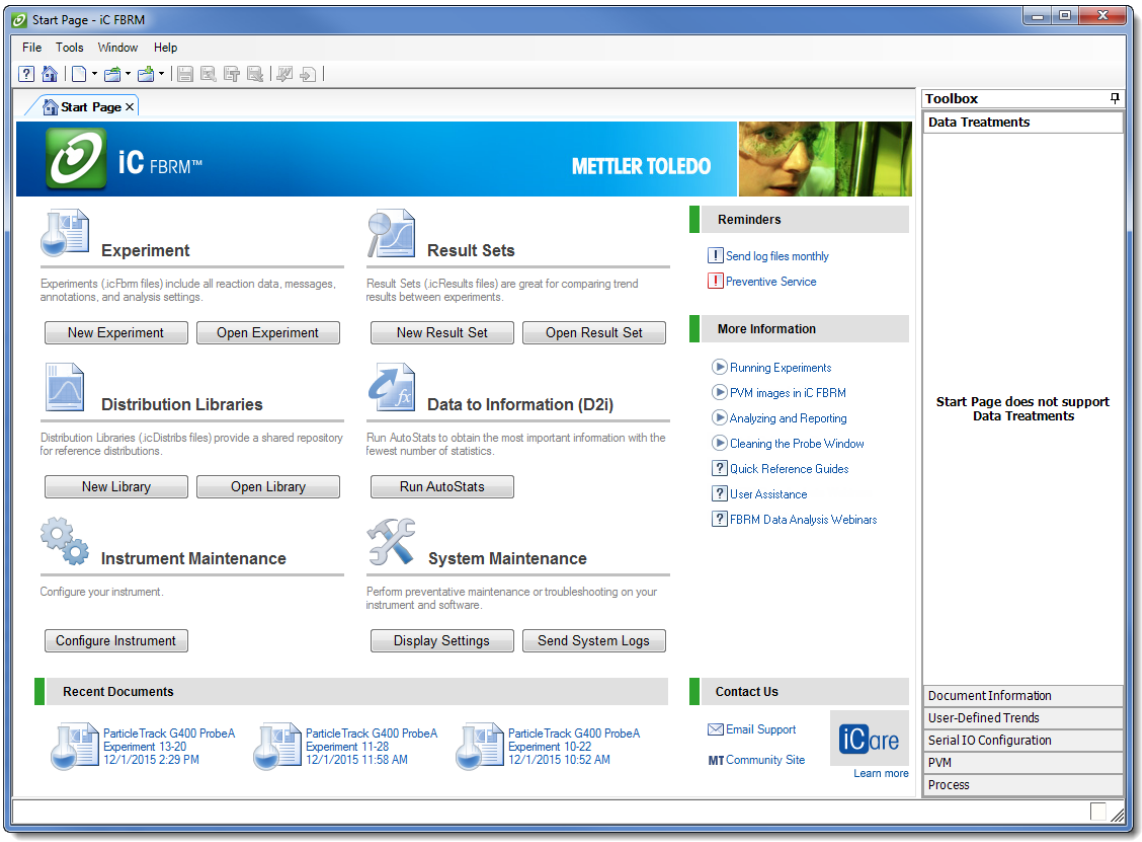
SHOW/HIDE

The Details tables for the Trends Viewer and Distributions Viewer provide show/hide capabilities.

- Show displays the measurement distribution in the Distributions Viewer.
- Show displays the trend in the Trends Viewer.
- In the Distributions Viewer, if the user clicks the check box to show an unpinned, selected measurement, the selected measurement becomes pinned.
- Hide removes the measurement distribution from the Distributions Viewer and globally deselects the measurement (this will also cause the time bar in the Trends Viewer to disappear).
- Whether or not a selected, unpinned measurement is initially checked is a user preference (default value is pinned. Refer to Preferences Dialog).

Using the Start Page

The iC FBRM Start Page is the launching point for acquiring or analyzing data. Start Page buttons lead to wizards that guide you through such functions as starting an experiment. Recent experiments appear along the bottom of the page. The Start Page also contains Reminders, More Information links to video demos, and user assistance, plus Contact links.



The Start Page offers the following command buttons:

Button	Function
New Experiment	See Working with Experiments
Open Experiment	
New Result Set	See Working with Result Sets
Open Result Set	
New Library	See Working with Distribution Libraries
Open Library	
Run AutoStats	See AutoStats
Configure Instrument	See Configuring the Instrument
Display Settings	See Viewing Display Settings
Send System Logs	See The Customer Care Log File Utility

Note: If your instrument is due for Preventive Maintenance service, a prompt appears under Reminders.

Viewing Display Settings

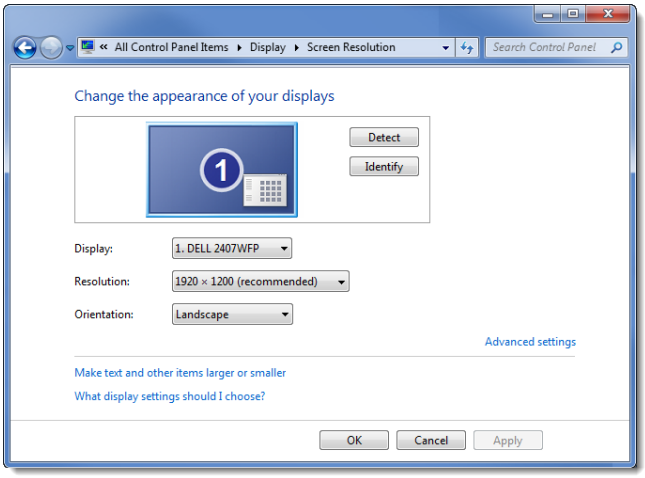
As a convenience, the **Display Settings** button on the Start Page opens the Microsoft® Windows®, Display Properties window to enable adjustments to the display setting for optimal viewing of the iC application. The display settings windows differ depending on the operating system. Examples below are from Windows 7.

The following two display settings are important for optimal viewing of iC FBRM software:

- **Graphics Requirement**

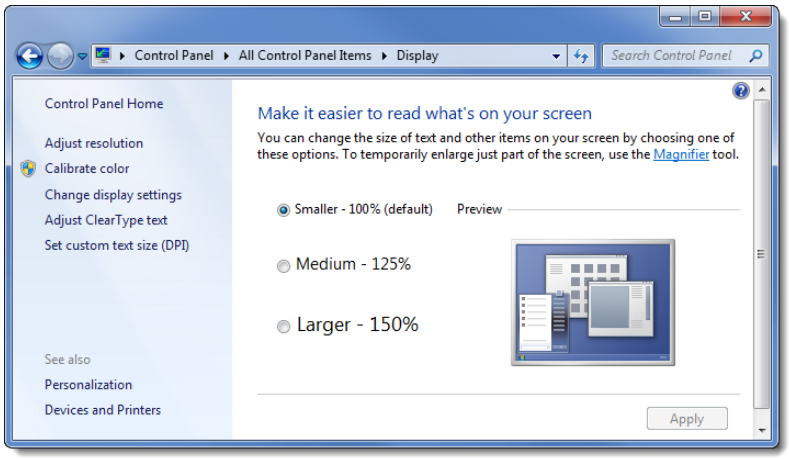
  Computer should meet minimum requirements for graphics, as stated in the installation guide: SXGA 1280 x 1024 with 3D hardware acceleration.

  If you launch iC FBRM on a PC with lower settings, a Suboptimal Display Settings prompt describes the optimal settings and provides a link to the Control Panel Display-Screen Resolution dialog box. If available, select the recommended resolution. (The example below exceeds the minimum Resolution.)



- **Set Font Size—Details**

  1. Select **Make text and other items larger or smaller** to open the Control Panel Display settings page. (Alternatively, type 'font' in the Start menu search box to access this dialog box.)
  2. Select '**Smaller – 100%**' if it is not already selected (this change may require you to log out and log back in).



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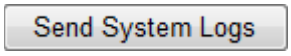
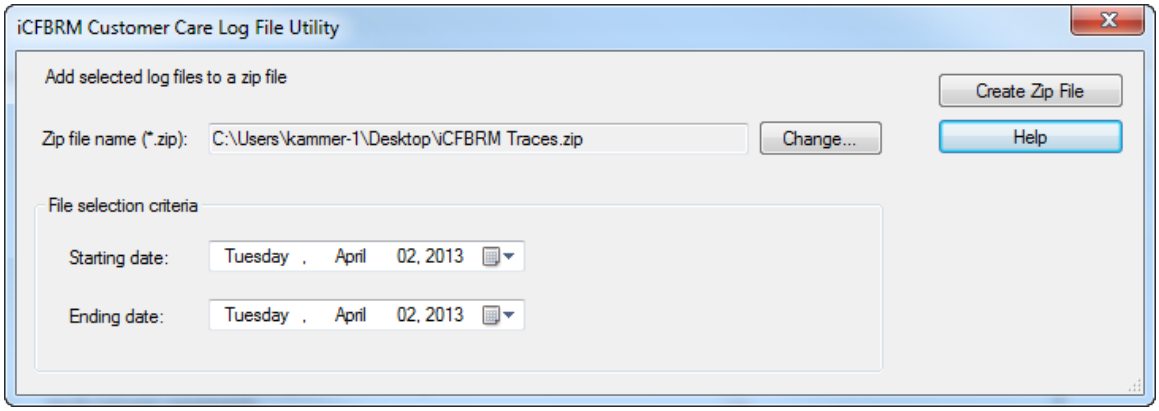
The Customer Care Log File Utility

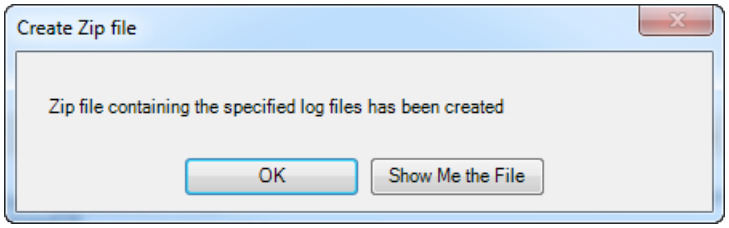
The Customer Care Log File Utility creates a compressed (ZIP) folder of all system log files. These log files are used by Mettler Toledo Customer Care as an aid in diagnosing problems with the iC software.



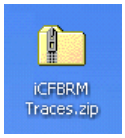
It is advisable to create a log file folder and include it with any problem reports. To create a log file, click Send System Logs on the Start Page.



Select the date period in which you encountered the issue and click on the **Create Zip File** button. A log folder is created on the Desktop and a completion message appears.



The log folder is saved to the Desktop or the location specified in the Zip File Name field. The filename for the folder is ICFBRM Traces.Zip.



The hyperlink on the Start Page can be used to email the report to METTLER TOLEDO Customer Care.

Calibration Validation Procedures

The Start Page includes a reminder to check instrument calibration regularly, and the Start Experiment Wizard includes a Calibration timer that communicates when an instrument calibration validation is due.

System Calibration and Calibration Validation procedures are included in your Hardware Documentation Portfolio. Locate and/or print the 'Calibration Validation' and 'System Calibration' procedures for use with iC FBRM.

You may wish to save these procedures to your desktop or other local directory for future reference.

Hardware Documentation Portfolios are provided on a separate CD/DVD-ROM along with your initial instrument shipment. The latest Hardware Documentation Portfolio documents are also available for download from the AutoChem Customer Community Site.

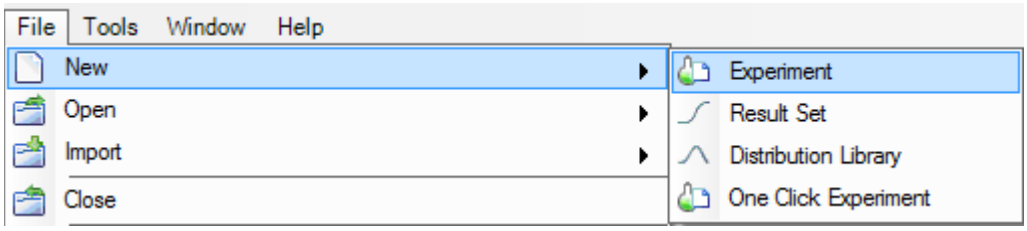
Working with Experiments

Create experiments by one of the following methods:

Click the **New Experiment** button on the **Start Page**.

or

Select the **New > Experiment** option in the **File** menu.



ONE-CLICK EXPERIMENTS

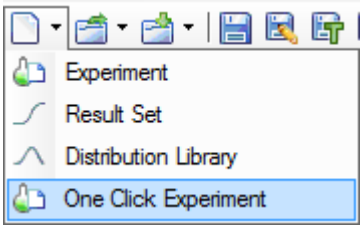
By default, experiments creation is through a New Experiment wizard. However, experiment creation can directly bypass the schedule and cleaning stages. A One-Click experiment will use the first available probe and will be named as 'Experiment [Probe name] [mm-dd-yyyy hh-ss]'. One-click experiments apply the following settings from the previous experiment to new experiment:

- Experiment path
- List of statistics
- Experiment phases
- Data averaging (with either moving or exponential window size)
- Channel grouping (with resolution, spacing, and range)

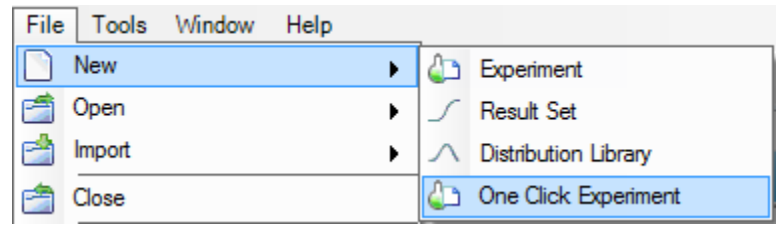
If the previous experiment was based on a template, the one-click experiment will use the settings from the template plus any modifications made in the previous experiment.

Start a One-click experiment by any of the following settings or procedures:

- If the **Always Bypass the New Experiment Wizard** option in the system Preferences Dialog is checked, all experiments will bypass the schedule and cleaning phases.
- Start a One-Click experiment from the toolbar button or menu, as follows:

New toolbar button	

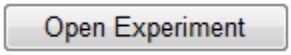
File > New menu



- Holding down the Control key while clicking the **New Experiment** button on the Start Page is another method of starting a One-Click experiment.

OPENING AN EXISTING EXPERIMENT

To open an existing experiment, select **Open > Experiment** from the File menu.



Alternately, click the **Open Experiment** button on the Start Page and choose an experiment from the Windows Explorer. Notice that the most recent experiments appear along the bottom of the Start Page.

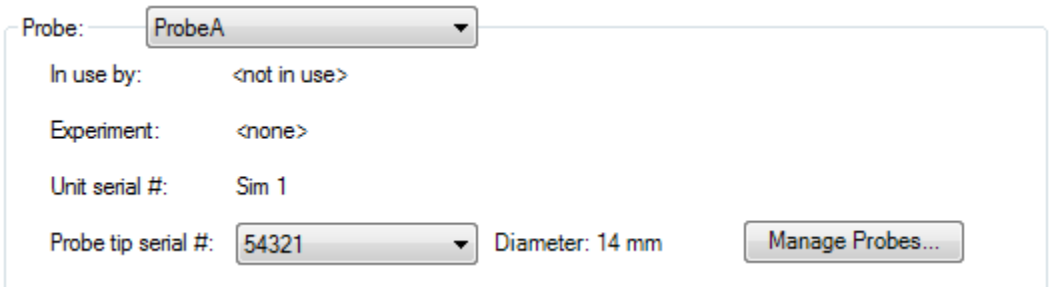
The experiment opens in the Experiment Display. Changes can be made to experiment (trends, annotations, data treatments, statistical definitions, etc.) and the experiment can then be saved as another experiment file using the **Save As ...** option in the **File** menu.

Version 4.0 of the iC FBRM software saved an experiment as the raw distributions and the experiment separated into two separate files. Starting with version 4.1 of the iC FBRM software, the system saves the raw distributions and the experiment data into one file. Version 4.3 of the software will open a version 4.0 experiment normally. When the 4.0 experiment is saved however, the system saves the file in the 4.3 format. This file cannot be re-opened by the older iC FBRM software.

The user is advised to always perform a Save As and give the file with a new name whenever a 4.0 experiment is opened in 4.3. Once a 4.0 experiment file is over-written in 4.3 format, it cannot be opened by a 4.0 version of the iC FBRM software.

MULTIPLE EXPERIMENTS

Where two ParticleTrack G400s are connected, an experiment for each G400 (Probe**A** and Probe**B**) can be run simultaneously. Each experiment runs in a separate tab and contains its own Live Experiment Toolbar. Experiments start in the normal manner. The New Experiment wizard displays the available probes for the experiment.

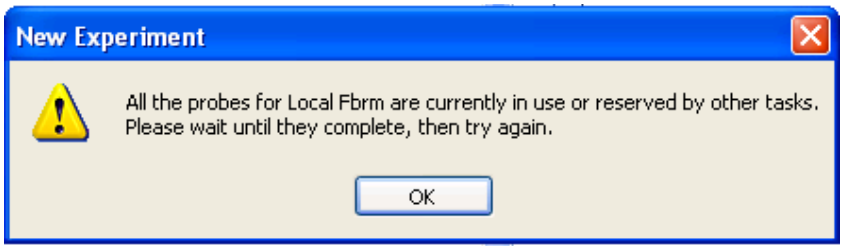


METTLER TOLEDO

If more than one G400 is available for the experiment, the Probe drop-down list displays the next available G400 probe. If only one G400 is available for the experiment (that is, the other G400 is in use) the drop-down list does not appear.

Select the serial number that identifies the probe tip being used on the G400 from the drop-down list.

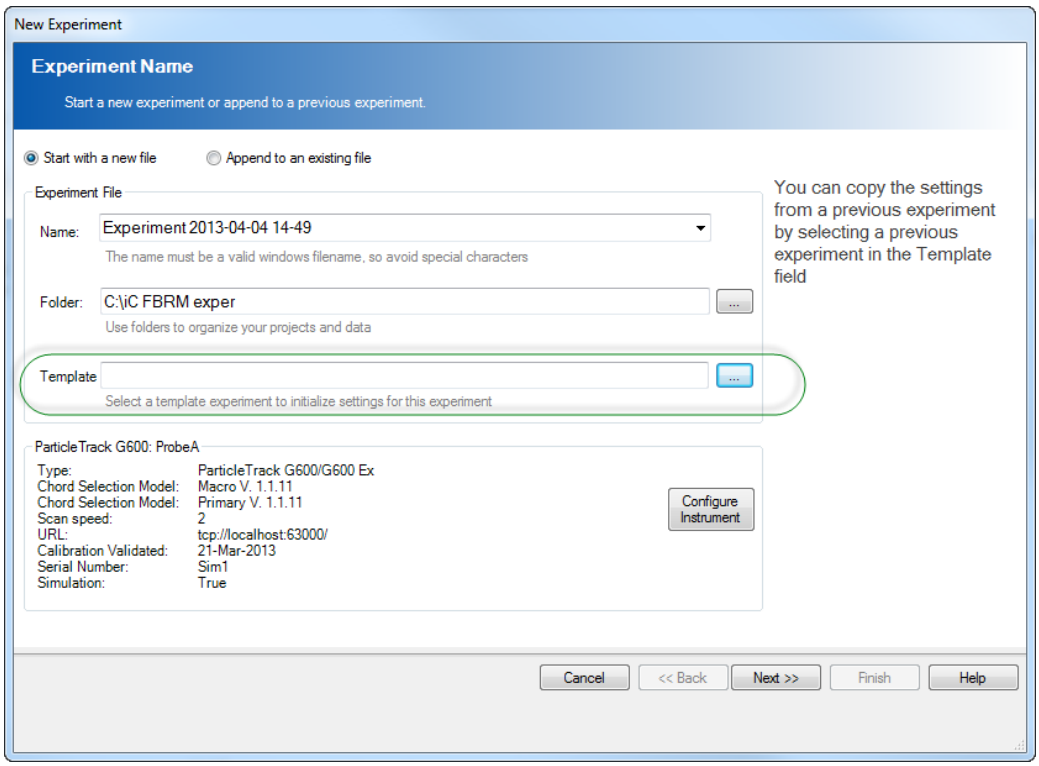
If experiments are running for all of the probes and you attempt to start a new experiment, a warning message appears.



In this case, you must wait until an experiment is complete, free up a probe, or abort a running experiment.

TEMPLATES

An experiment can be saved as a template for reuse in subsequent experiments. You can select a template to use as a "method" for a new experiment. A template is actually an existing saved experiment or experiment saved specifically as template file. The template automatically includes all hardware settings (scan speed, Chord Selection Models, serial I/O configuration) and software settings (measurement interval, experiment schedule phases, statistics definitions, references, Y-Axis settings, and display settings from a completed experiment.

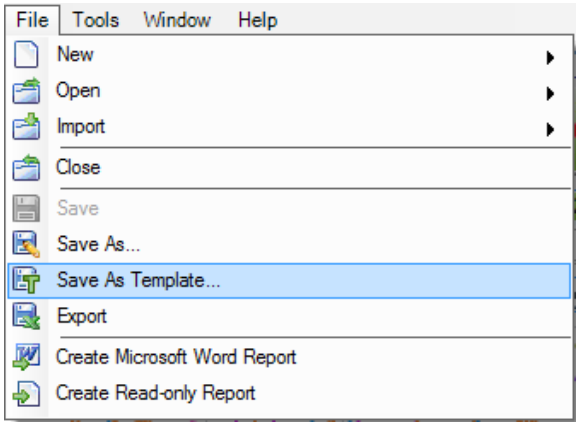


Saving an Experiment as a Template

The user can save a completed experiment as a template file. The template does not include any acquired measurement samples but includes all experiment settings/conditions. When saved as a template, an experiment name includes a 'Template' suffix to the filename: (Experiment ProbeA 06-20-2015 09-33 – Template.icFbrm).

Experiments saved as templates are significantly smaller than the original experiment since all data, messages, and so on, are deleted.

To save the current experiment as a template, select **Save As Template** from the **File** menu.



Alternately, you can click the  icon on the main toolbar to save the currently selected experiment as a template.

Start Experiment Wizard

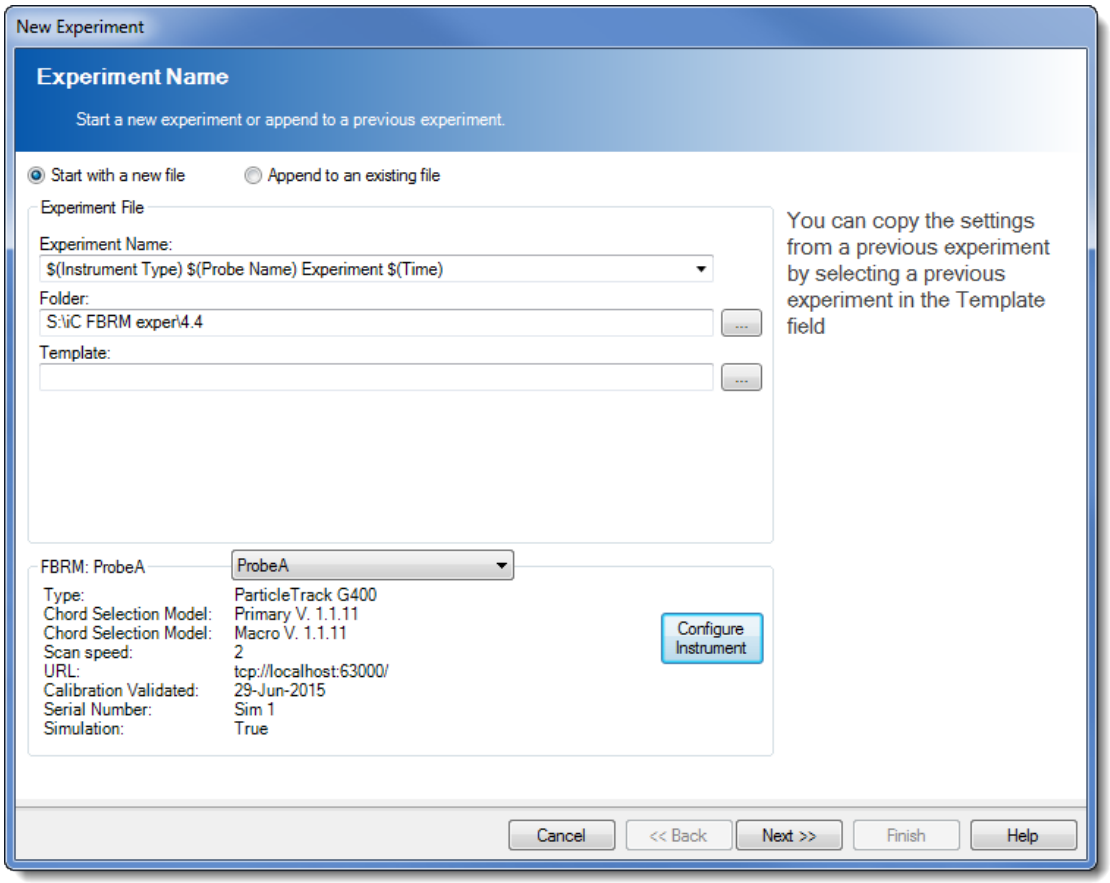
When you click **New Experiment** from the Start Page (or select New > Experiment from the File menu or Toolbar), a wizard-guided series of pages appears. Follow the wizard to complete all requirements to create a new experiment. If you have the iC Data Center™ server set up, the New Experiment page is different. Follow the instructions under Start Experiment Wizard (iC DC).

Use the first Start Experiment wizard page (Experiment Name) to define the name and location of the experiment document file. The wizard automatically assigns a name and folder location for the experiment. The location defaults to the most recently used folder. System-assigned names are as follows:

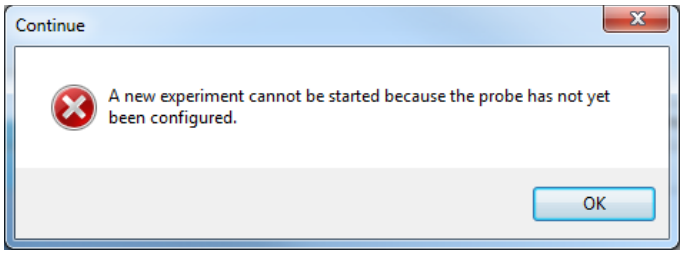
- For single probe systems—Instrument type, text string "Experiment," followed by date and time.
- For multi-probe systems—Probe name, text string "Experiment," followed by date and time.

The page also displays the current instrument configuration and includes a **Configure Instrument** button. If instrument configuration tasks are required, the system will display a message.

In most cases, you simply click **Next** to use the default settings and go to the next wizard page. For more about naming options and all the fields on the Experiment Name page, see Creating the Experiment for details about the Experiment Name Page.

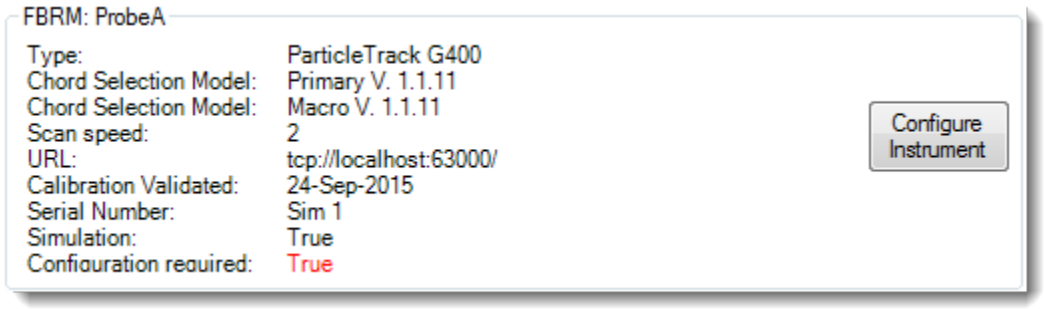


The iC FBRM software does not allow you to click the **Next** button from the first wizard page until instrument configuration is complete. The software verifies the proper probe configuration and displays the following error message if configuration is required:



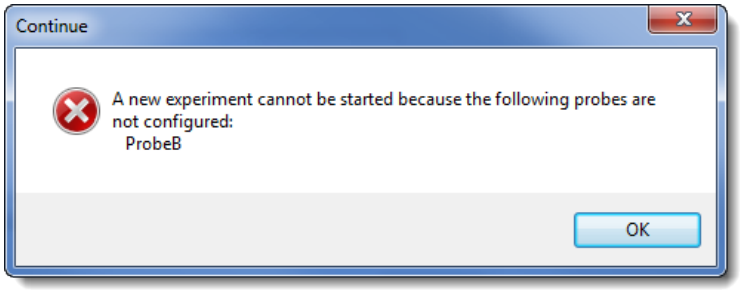
In addition, the **Configuration required** prompt on the bottom of the wizard page displays as True (in red).

Note: If the Calibration Validation is due (see Calibration Validation Timer), a red message informs you.



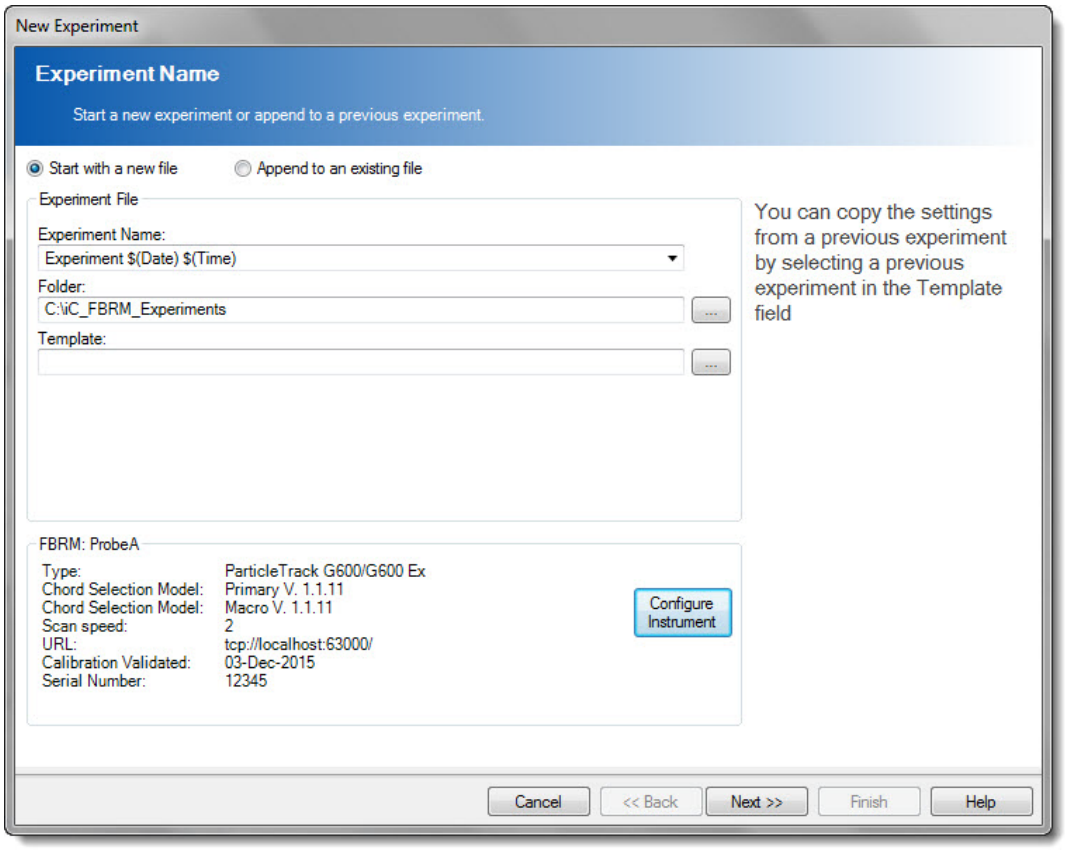
A Note about Dual-Probe Configurations

It is important to note that if two G400 probes are connected to an iC FBRM computer, both probes must be configured before an experiment can be run. If an attempt is made to start an experiment without first configuring both probes, the following error message appears:



CREATING THE EXPERIMENT

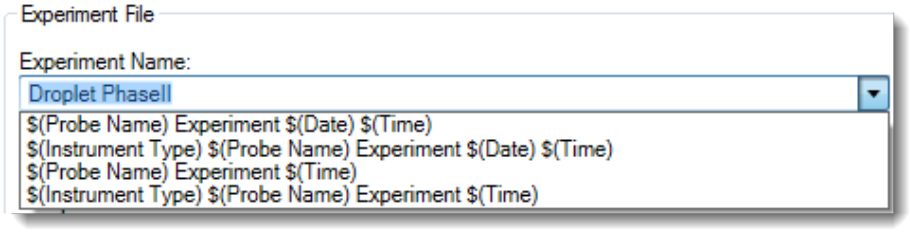
The steps below go through each section of the **Experiment Name** page for your reference.



1. Most new experiments start as a new file. However, you have the option to append a new experiment to an existing file if necessary (see Append to Existing Experiment).

   Experiment File—Name: You can configure an experiment name based on the recent experiment name, or use name format 'tokens.' The most recently used name appears by default. When basing a new experiment on a previous one, you must modify the name to make it unique.

   A drop-down list shows token name options. System-defined names are editable.



   - $(Date)—the current date
   - $(Time)—the current time
   - $(Instrument)—the instrument type by brand name
   - $(Probe Name)—the probe type (usually A or B), available for multi-probe instruments only

After you define one or more experiment name formats,

Experiment File—Folder: The default location for storing iC documents comes from the most recently used location. You can browse to a different folder location.

Note: It is recommended that experiments be saved to drives local to the PC running iC FBRM. You can move the experiment to a different drive after the experiment completes. If the experiment is being saved to a remote disk drive, a network interruption may cause an irrecoverable failure and the experiment will have to be re-run.

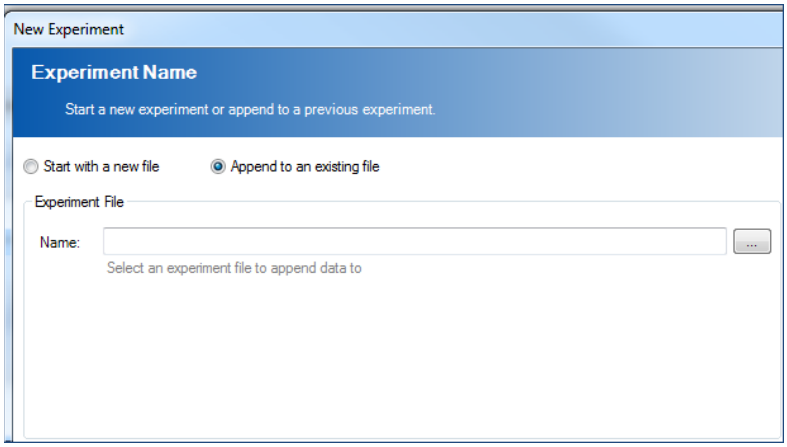
2. **Experiment File—Template:** To start the experiment based on an experiment template, browse to the location of the template file (see Templates).

Instrument Information

If instrument configuration is complete, this bottom section of the Experiment Name page is for information only. If the system indicates that configuration is required or if you want to change your instrument settings before recording an experiment, click **Configure Instrument** from this window. (See Configuring the Instrument.)

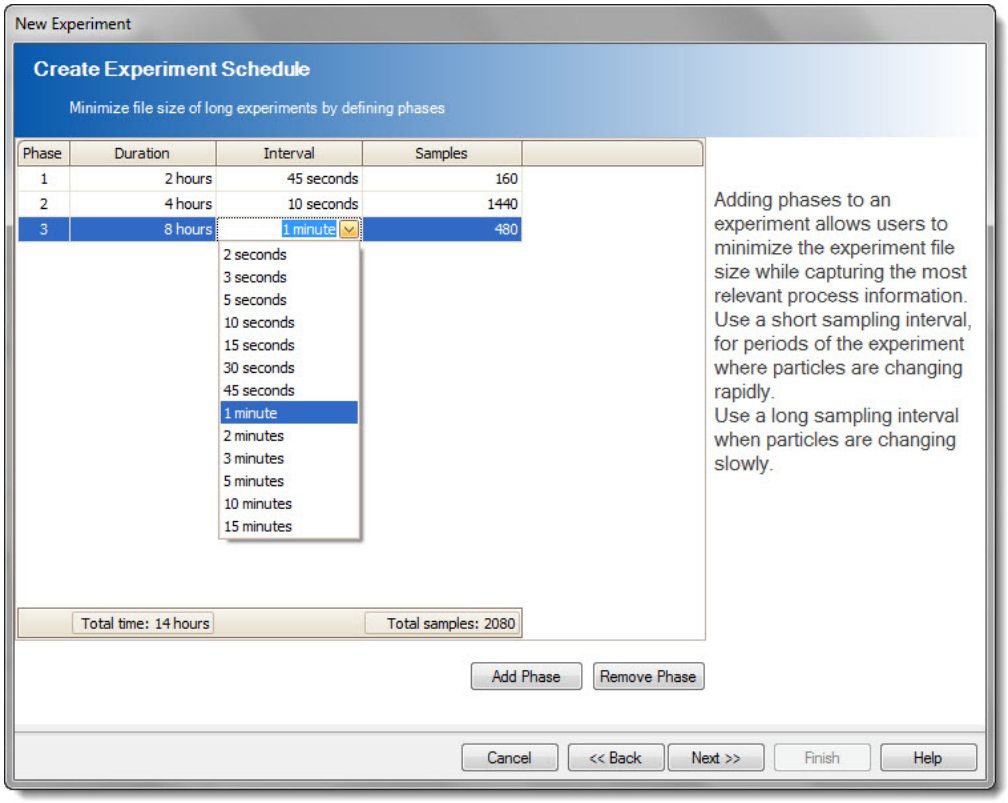
APPEND TO EXISTING EXPERIMENT

The New Experiment wizard provides the option of creating a new file for an experiment or appending the new experiment to an existing one. To append the new experiment to an existing one use the buttons at the top of the New Experiment. When you select 'Append to existing file,' the Experiment File section of the Experiment Name page changes as shown below. Click the 'browse' icon to select the existing file.



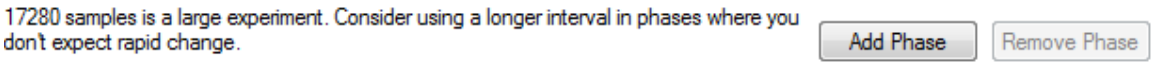
CREATING THE EXPERIMENT SCHEDULE

Use the next page of the wizard to create the experiment schedule and to partition the experiment in multiple phases. Each phase can be defined with specific duration and measurement interval. The phases execute in sequence.



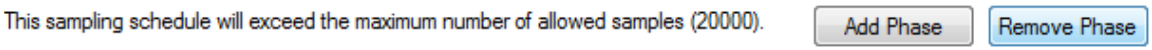
The default duration for an experiment is 1 day.

If the experiment is very large, a warning appears at the bottom of the page.

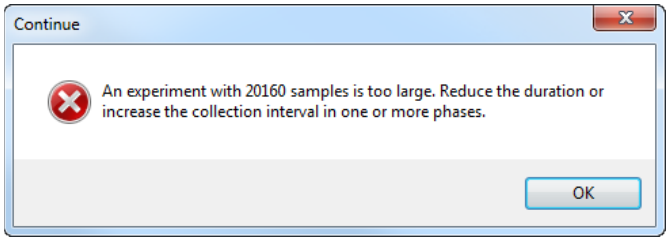


Consider reducing the number of samples to conserve disk space.

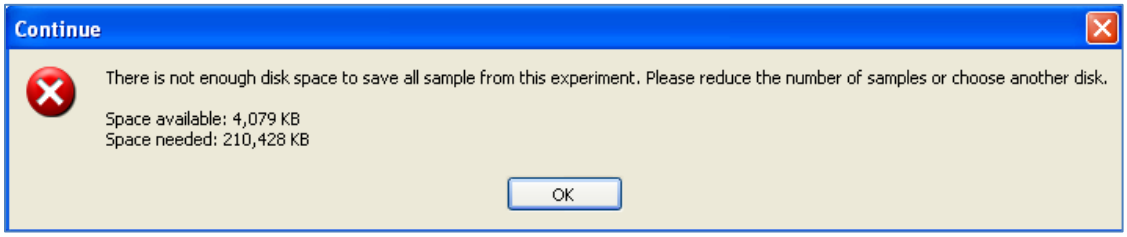
If the schedule exceeds the maximum, the following message appears:



If you click Next to go to the next Start Experiment Wizard page, the following message appears:



Click the **Next** button and iC FBRM checks for available disk on the drive designated to store the experiment. If there is not enough disk space available, an error appears.

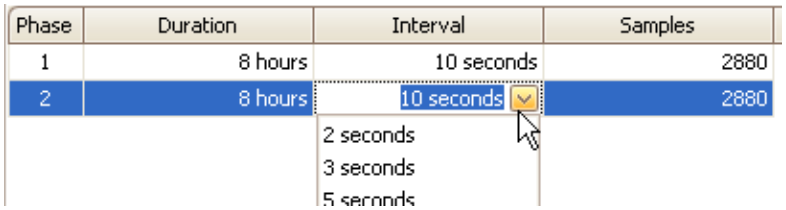


To proceed with the experiment, either free up adequate disk space or select another location for the experiment. Use the **Back** button to return to the first page of the wizard and select another drive location.

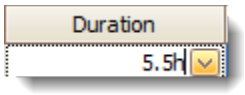
Adding/Removing Phases in The Experiment Schedule

	Click the **Add Phase** button to add a phase to the experiment. A new row appears in the Phases list. Edit the **Duration** and **Measurement Interval** fields as desired. The system automatically calculates the number of samples.
	When multiple phases have been defined: To delete a phase from the schedule, select it and click **Remove Phase**.

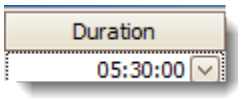
The **Duration** and **Measurement Interval** fields have a drop-down list for selecting the time values.



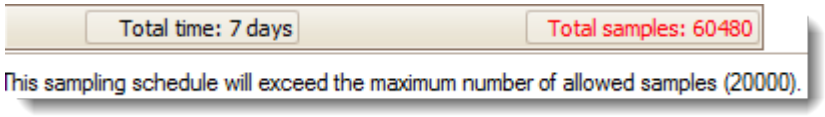
Alternatively, enter a number into the fields followed by "h" for hours, "m" for minutes or "s" for seconds.



When the cursor leaves the field, the entered time converts to the current time format.



Warning: Experiments with total samples greater that 10,000 will take up approximately 120 MB of disk space and will be very difficult to analyze. If the number of samples exceeds 20,000, a warning message is displayed that prompts the user to reduce the number of samples.

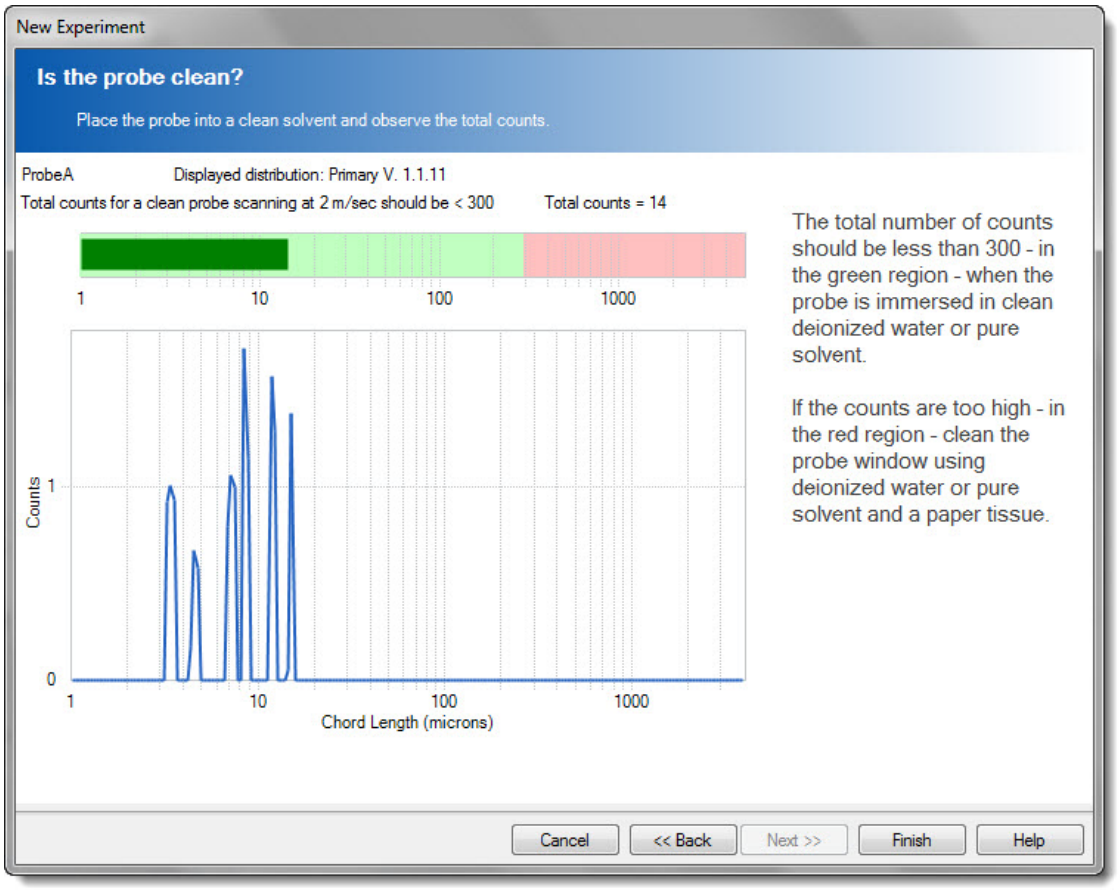


CLEANING THE PROBE

The final page of the wizard checks the cleanliness of the probe. The colored bar indicates if the probe is clean (green) or dirty (red). The total number of counts should be less than 300—in the green region—when the probe is immersed in clean deionized water or pure solvent. If the counts are too high—in the red region—clean the probe using deionized water or pure solvent and a paper tissue.

Clean the probe from the previous experiment using the most appropriate solvent(s) to dissolve the particles. A final cleaning with distilled water is recommended. Paper makes an ideal cleaning tool. **Note**: Many cotton swabs have lubricants and are not a good choice for a cleaning tool!

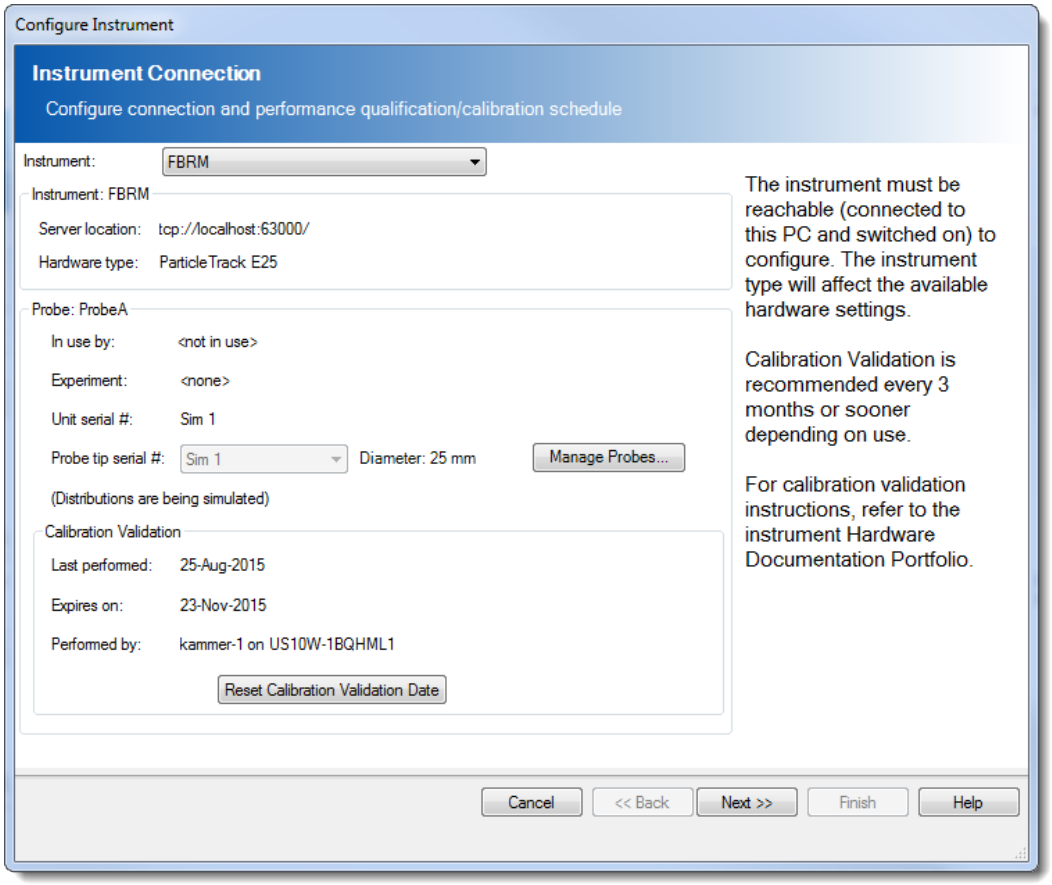
Watch the video tutorial on cleaning the probe window from the iC FBRM Start Page.



Click **Finish** to close the wizard and proceed to Starting the Experiment.

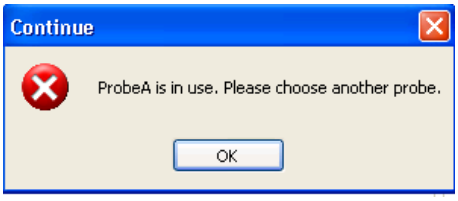
Configuring the Instrument

To access Instrument Configuration, click the **Instrument Configuration** button on the Start Page or from the Start Experiment wizard. The first page of the Configure Instrument wizard displays general information about the instrument. In most cases, you can simply click Next to move to the next wizard page after reviewing information. If you navigate to this page as part of starting an experiment, one or more configuration or calibration validation settings may be required.



The Instrument Connection page varies slightly based on instrument type.

For multi-probe G400 configurations, the Probe selection list appears. If the currently selected probe is being used for an experiment, a warning message prompts you to select a different probe. Configuration will not continue until you select an available probe. Note that each probe must be configured individually.



After editing/verifying the settings, click the **Next** button to advance to the next page of the wizard.

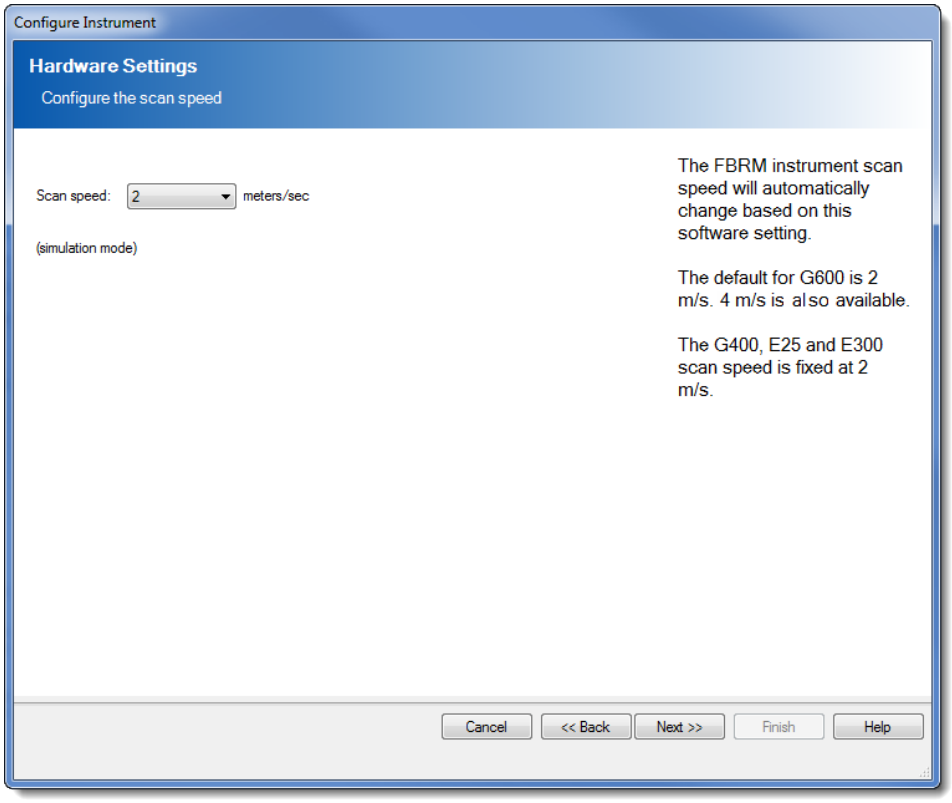
CALIBRATION VALIDATION TIMER

The first page of the Configuring the Instrument wizard also includes a calibration validation timer that displays the date of the last calibration validation and due date for the next calibration validation. After performing a new calibration validation, click **Reset Calibration Validation Date** to reset the due date.

Note: For information about Calibration Validation Procedures, refer the procedures in the hardware documentation portfolio.

SCAN SPEED PAGE

The next page of the wizard is used to select the scan speed of the instrument.



After verifying or editing the setting, click Next button to advance to the next page of the wizard.

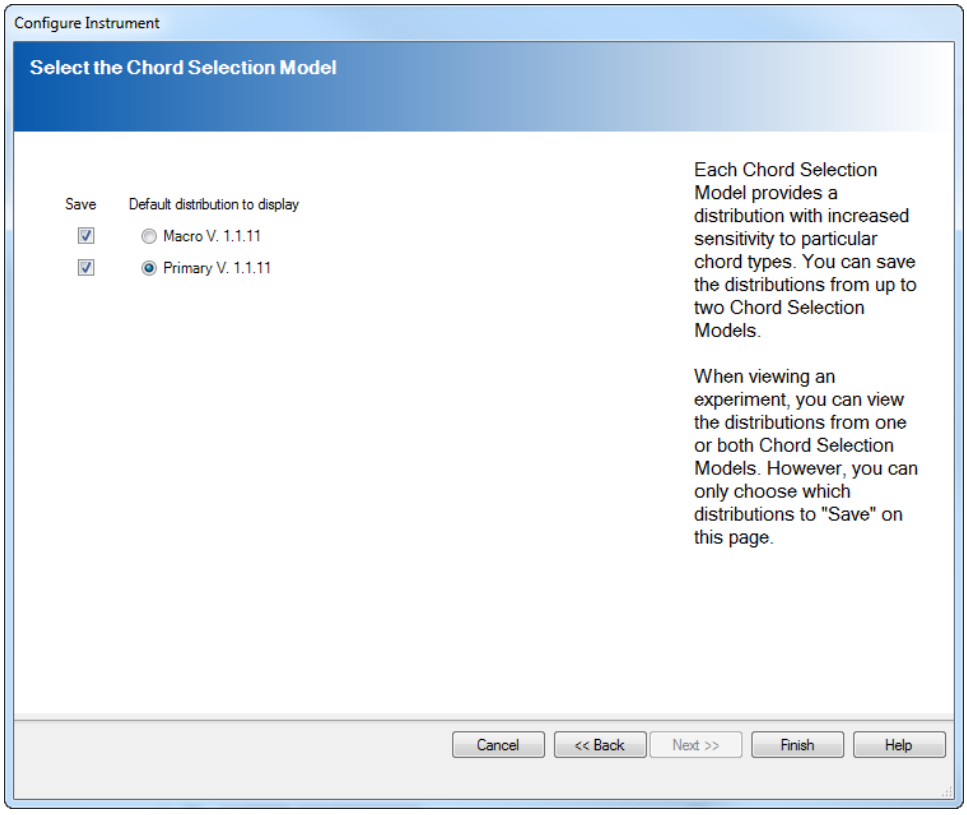
Note: E25 and G400 probes have a 2 m/s scan speed. The default scan speed for the G600 is 2 m/s with an optional scan speed of 4 m/s available.

SELECT CHORD SELECTION MODEL PAGE

The next page of the wizard enables the user to select the appropriate Chord Selection Model (CSM) that will be used to convert the raw signal collected by the probe into chord length data. Available Chord Selection Models depend on the instrument type and the purchased license options. Refer to Chord Selection Models for additional information.

Up to two Chord Selection Models can be specified per probe. Use the check boxes in the wizard window to specify whether to save one or both Chord Selection Model conversions for each measurement. Use the buttons in the 'Default distribution to display' column to specify which Chord Selection Model displays by default in the experiment. During a live experiment, if two CSMs have been saved, you have the option to display distributions from both CSMs as described later in this section and also under Multiple Chord Selection Models.

Note: If new Select Chord Selection Models are installed, you must restart the FBRM server to display the latest CSMs.

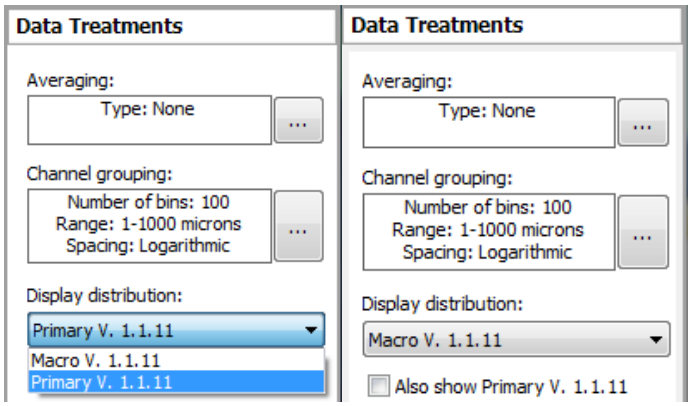


After editing or verifying the settings, click **Finish** to close the Configure Instrument wizard.

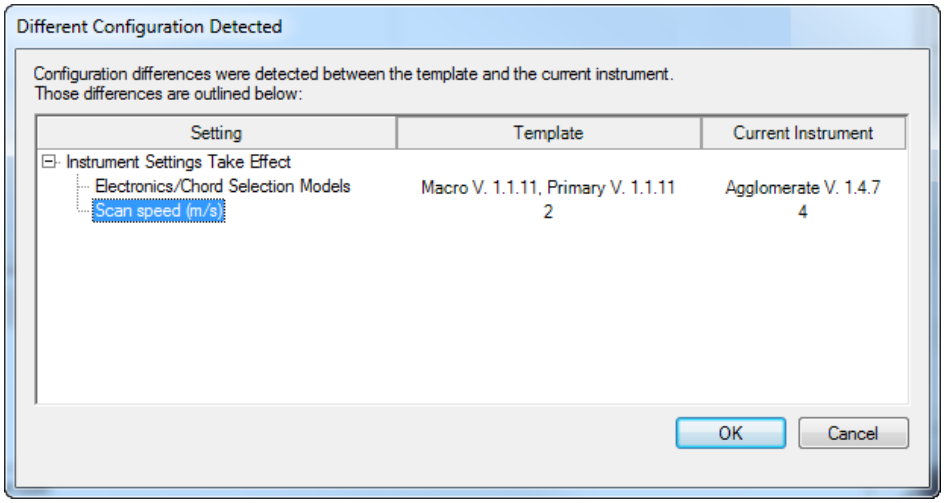
- If the wizard was initiated from the Start Page, the Start Page appears.
- If the wizard was started from within the Start Experiment wizard, continue with the experiment definition and go to the Live Experiment in paused mode.

When an experiment starts, the distribution measurements save to the Events Viewer along with the Chord Selection Model version number used to calculate the measurement.

A drop-down list on the Data Treatments task pane enables selection of which Chord Selection Model to use for the distributions display in the experiment. The user can switch between the displayed Chord Selection Models at any time; this does not affect the saved data. The system recalculates the trends and statistics and displays the resulting data. Notice that you can also display two distributions by marking the 'Also show' check box (see Multiple Chord Selection Models).



Note: If you start a new experiment based on a template experiment, the Start Experiment wizard compares the Chord Selection Model option in the template with the Chord Selection Model option of the currently selected instrument and reports any discrepancies.

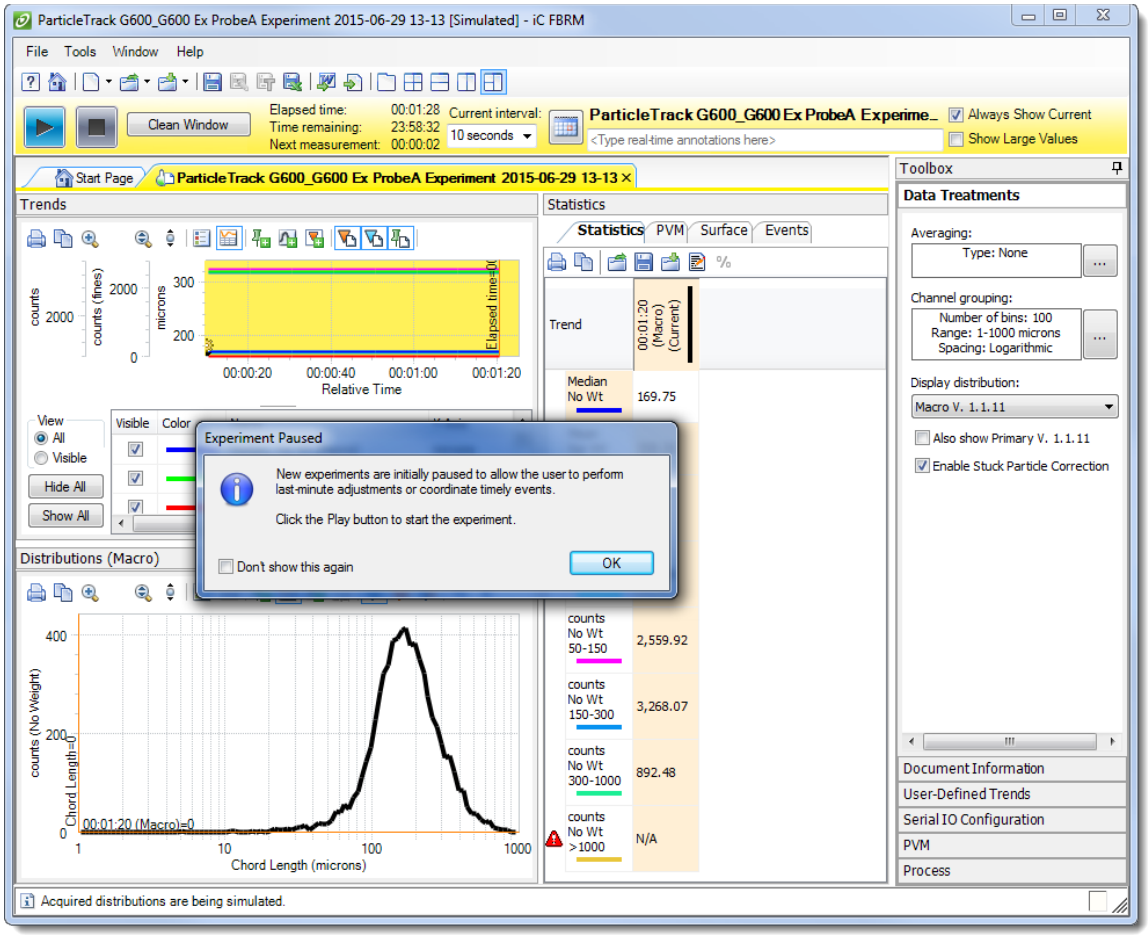


Starting the Experiment

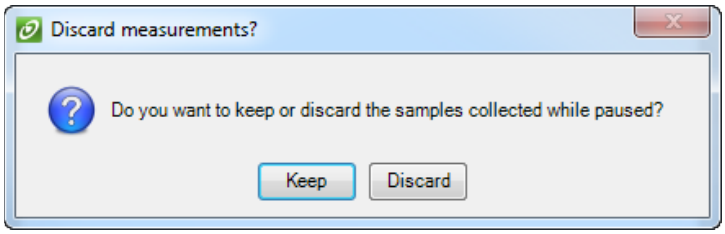
After all the preparation steps for the experiment are complete, the Live Experiment Toolbar appears.

The toolbar contains a calendar button that enables addition or removal of phases during a running experiment, or editing of existing phases.

When the experiment window appears, it is automatically in a paused state. The experiment tab is color coded (yellow) to match the Live Experiment Toolbar.



The experiment collects data while in the paused mode. When you click the **Run** button to start the experiment, a message appears that prompts for a decision to save or discard the data collected while in the paused state.

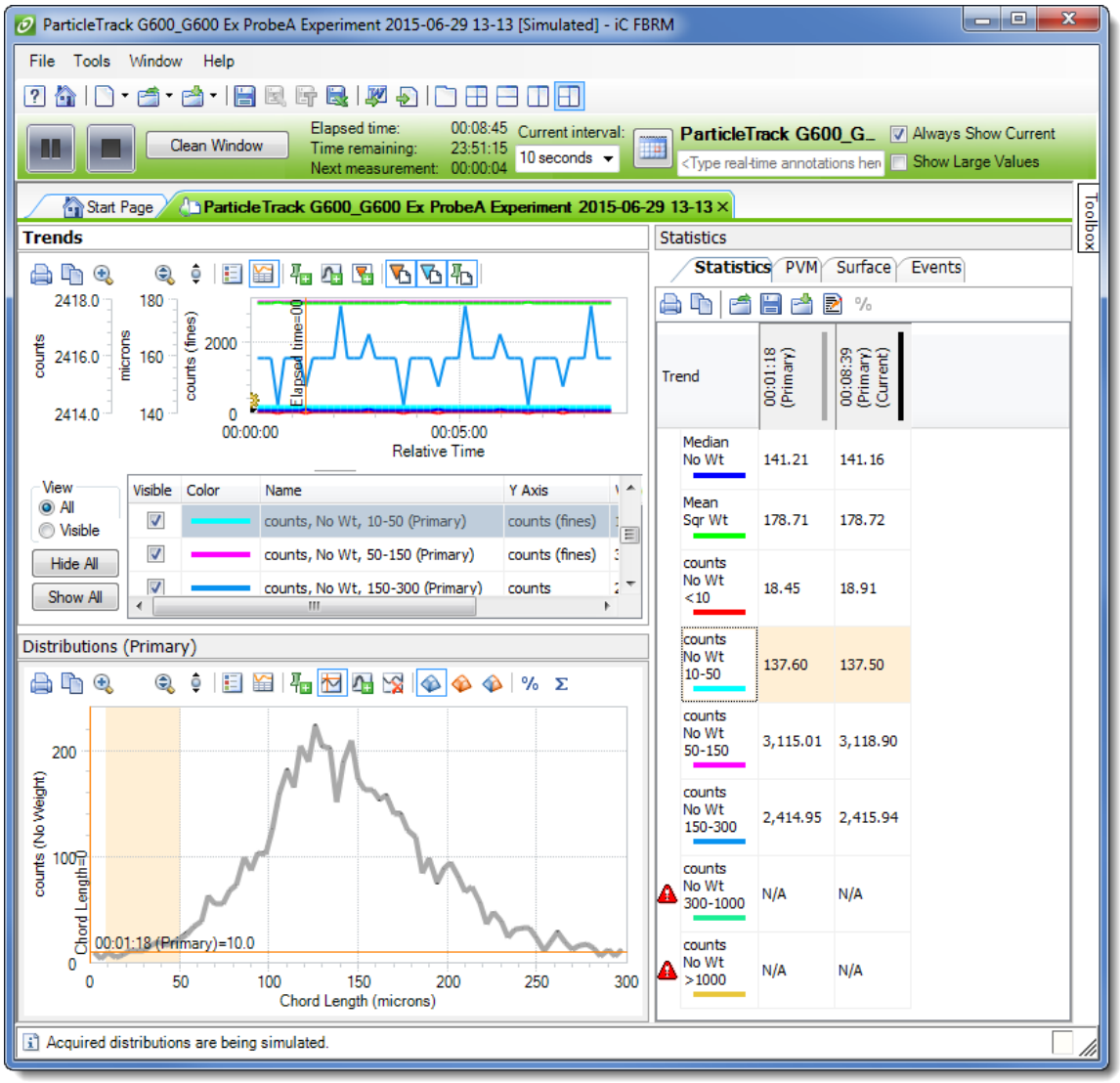


Click one of the buttons to start the experiment and save the data.

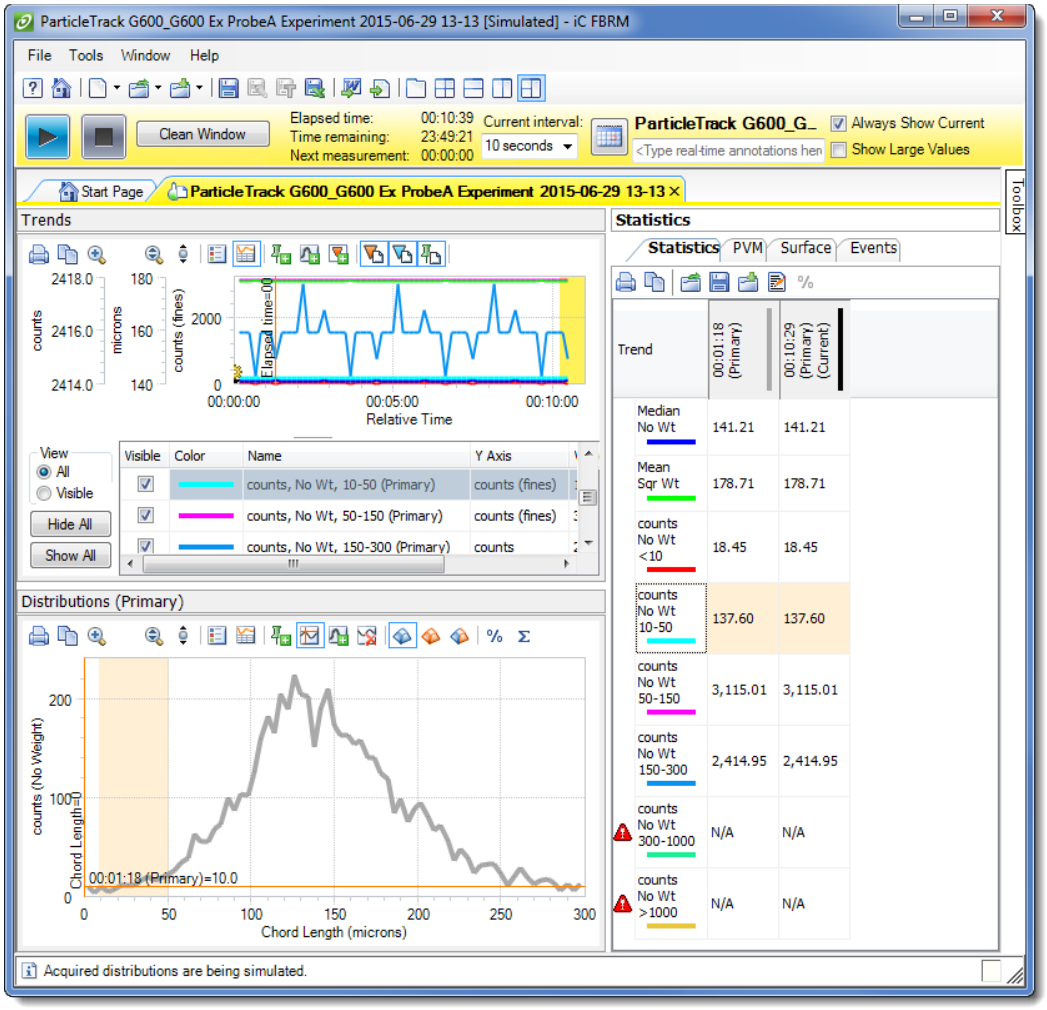
If the **Remove Relative Time Gaps when Samples Discarded After Pause** option is selected in the system Preferences Dialog, when you resume a paused experiment and select **Discard** the measurements during the pause period, the measurements are discarded and the time gap is eliminated for the Relative Time x-axis mode (The x-axis has a choice of modes—Sample Number, Absolute Time, or Relative Time. Refer to Changing the X Axis).

- The first sample after the Resume is appended after the last sample prior to the pause period.
- The eliminated time gap is not visible in the Sample Number mode either, but it is visible in the Absolute Time mode.
- A system annotation is added to the Events Viewer log to record the time the experiment resumed and an audit entry is added to record how many (if any) samples are discarded, whether or not the preference to eliminate the time gap is in effect.

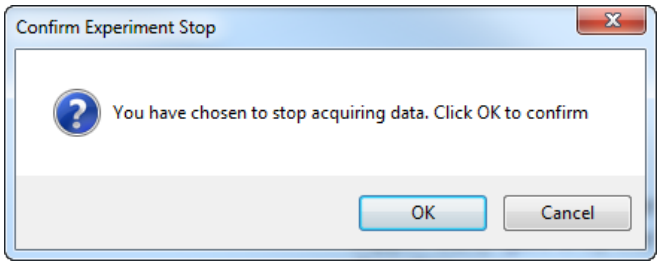
The experiment starts and data collection begins and is saved. Upon the start of data collection, the Live Experiment Toolbar and the experiment tab turn green.



A running experiment can be paused by clicking the **Pause** button in the Live Experiment Toolbar. When in pause mode, the toolbar and all data collected during while paused appear with a yellow background.



If the **Stop** button is clicked the following confirmation prompt appears:

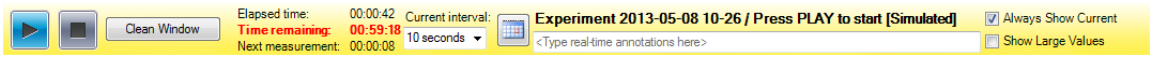


When the decision to stop an experiment is made or after the experiment schedule ends, the experiment is considered complete. When the experiment is complete, the Live Experiment toolbar changes to blue and displays a summary.

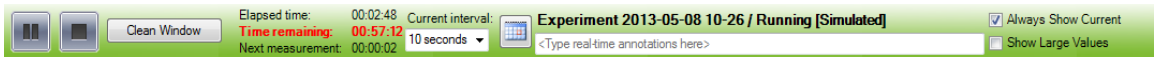
Click the **OK** button to close the completed experiment.

The Live Experiment Toolbar

The Live Experiment Toolbar displays in color to indicate experiment status.

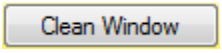
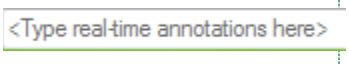
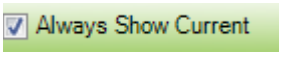


The toolbar initially appears in yellow indicating a paused experiment. When the **Run** button is clicked, the experiment starts and the toolbar changes to green.



After the experiment completes, the toolbar color changes to blue with a summary of samples taken. If any error or warning messages occurred, the toolbar reports the number.

This toolbar also includes the following experiment control tools:

 **(Run)**	Use the **Run** and **Pause** buttons to control the execution of the experiment. The buttons toggle depending on the current run state of the experiment.
 **(Pause)**	
 **(Stop)**	Permanently stops the experiment.
	Click **Clean Window** to initiate a manual window cleaning operation during an experiment. See the Clean Window Dialog.
Elapsed Time	Total time of the experiment from when it was first started.
Time Remaining:	Calculated time remaining until the completion of the experiment.
Next Measurement:	Time remaining until the next measurement scan.
Current Interval:	Enables changing the scan interval during the experiment.
	Use the calendar button to add, remove, or edit phase(s) of a live experiment. Access this button at any time during a live experiment (run mode or pause mode). Refer to The Experiment Schedule for instructions on editing the schedule during a live experiment.
	Insert an **Annotation** about the experiment. The annotation receives a timestamp equal to the time indicated by the orange time line. By default the time line is positioned at the current time.
	By default the Distributions Viewer always shows the current or latest acquired distribution, along with any pinned distributions.
	Mark the check box to open an additional display tab that shows the statistical values in a large, matrix format. Refer to Large Values Viewer.

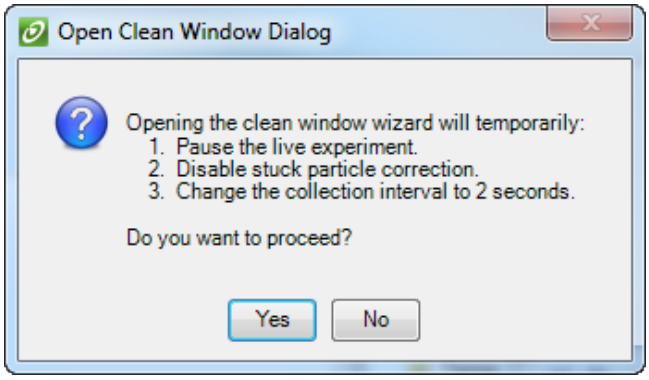
If an error or warning occurs, a red or yellow icon appears on the left side of the toolbar.

CLEAN WINDOW DIALOG

Note: A Window Cleanliness Warning (Fouling Index High) appears when the percentage of stuck particles exceeds a factory set limit.

Use the Clean Window dialog to manually initiate a cleaning operation during a live experiment.

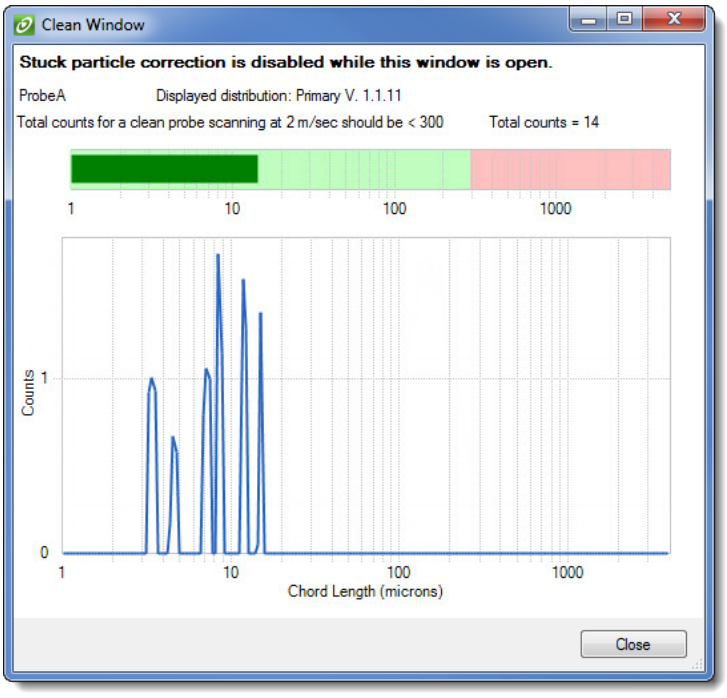
Clean Window	Clicking the **Clean Window** button on the Live Experiment Toolbar displays an informational prompt that describes how the action will affect the experiment.



If you proceed with the Clean Window function, the following actions will occur:

- Experiment will be paused during the cleaning process.
- Stuck particle detection will be temporarily disabled.
- Collection interval will be set to two seconds during the clean operation. The interval will return to its previous setting after the cleaning process is complete.

1. Click **Yes** to proceed with the clean operation.



METTLER TOLEDO

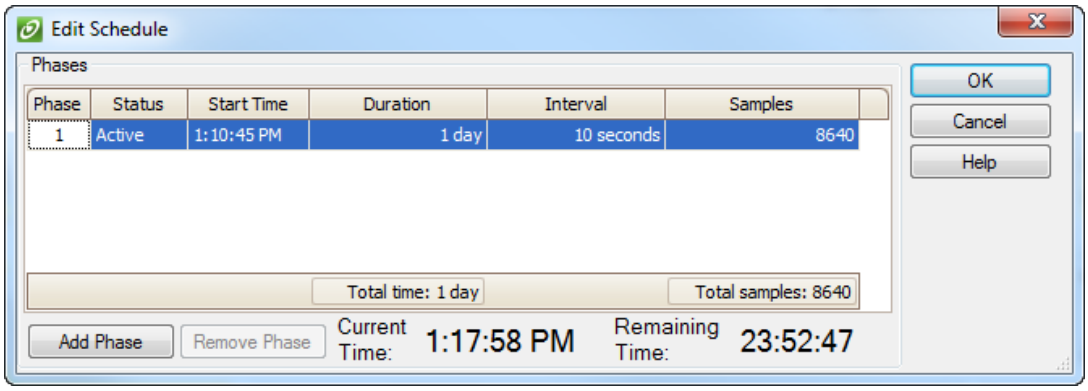
2. The total number of counts should be less than 300—in the green region—when the probe is immersed in clean deionized water or pure solvent. If the counts are too high—in the red region—clean the probe using deionized water or pure solvent and a paper tissue.

3. Click the **Close** button to complete the clean operation and restart the experiment.

THE EXPERIMENT SCHEDULE

The Edit Schedule window enables addition or removal of phases during a "LIVE" running experiment, or editing of existing phases.

To edit the schedule, click the calendar button on the Live Experiment Toolbar. The Edit Schedule window appears.



Functionality of the window is identical to the Experiment Schedule discussed in Adding/Removing Phases in The Experiment Schedule.

Unlike the experiment schedule during experiment setup, the Edit Schedule dialog box includes the current and remaining time in the live experiment.

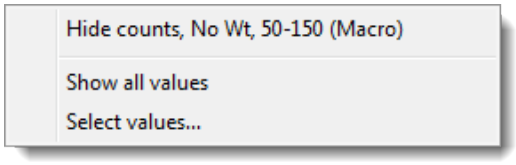
LARGE VALUES VIEWER

Show Large Values	The Large Values option displays the current values of the statistics in an enlarged table format. The display is available during live experiments and opens by clicking the check box in the Live Experiment toolbar. Statistical values update as measurements are taken.

By default the values for all defined statistics appear.

Note: The Chord Selection Model used to calculate the statistic appears in parentheses after the statistic.

To customize the display, right-click in inside it and choose from the following options:

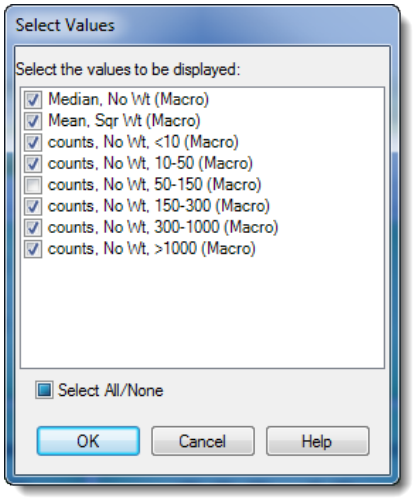


The following options are available:

Hide . . .	Hides the currently selected statistic.
Show all values	Displays all defined statistics.
Select values	Opens a Select Values dialog box that enables you to select which statistics display.

Select Values Dialog

Use the Select Values window to choose which statistics appear on the Large Values display. The window lists all defined statistics. Check the statistics to be displayed.

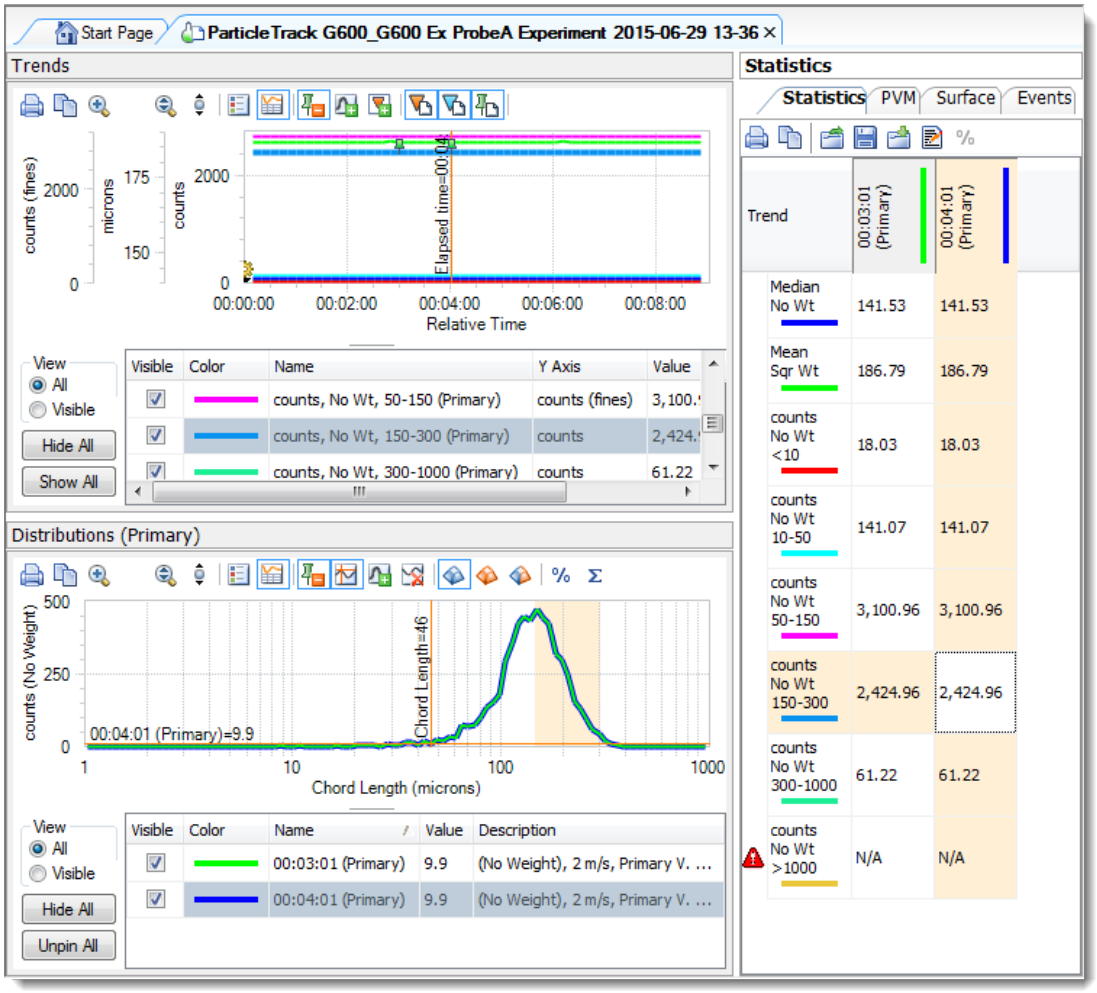


Experiment Display

The experiment display is the primary tool for viewing experiment data. When an experiment is running or when it is open for review, the document area of the iC FBRM user interface displays experiment data in several viewers.

- Trends Viewer
- Distributions Viewer
- Statistics Viewer
- Events Viewer
- PVM Viewer (optional and accessible during a live experiment when iC PVM is running on the same control computer)
- Surface Viewer (optional)

These viewers interact with each other to facilitate data interpretation and analysis. The viewers can also appear in a tiled configuration or singly as tabbed views. Notice the panel to the right in the example below includes the Statistics Viewer, PVM Viewer, Surface Viewer, and Events Viewer tabs with the Statistics Viewer selected.



METTLER TOLEDO

Trend Viewer

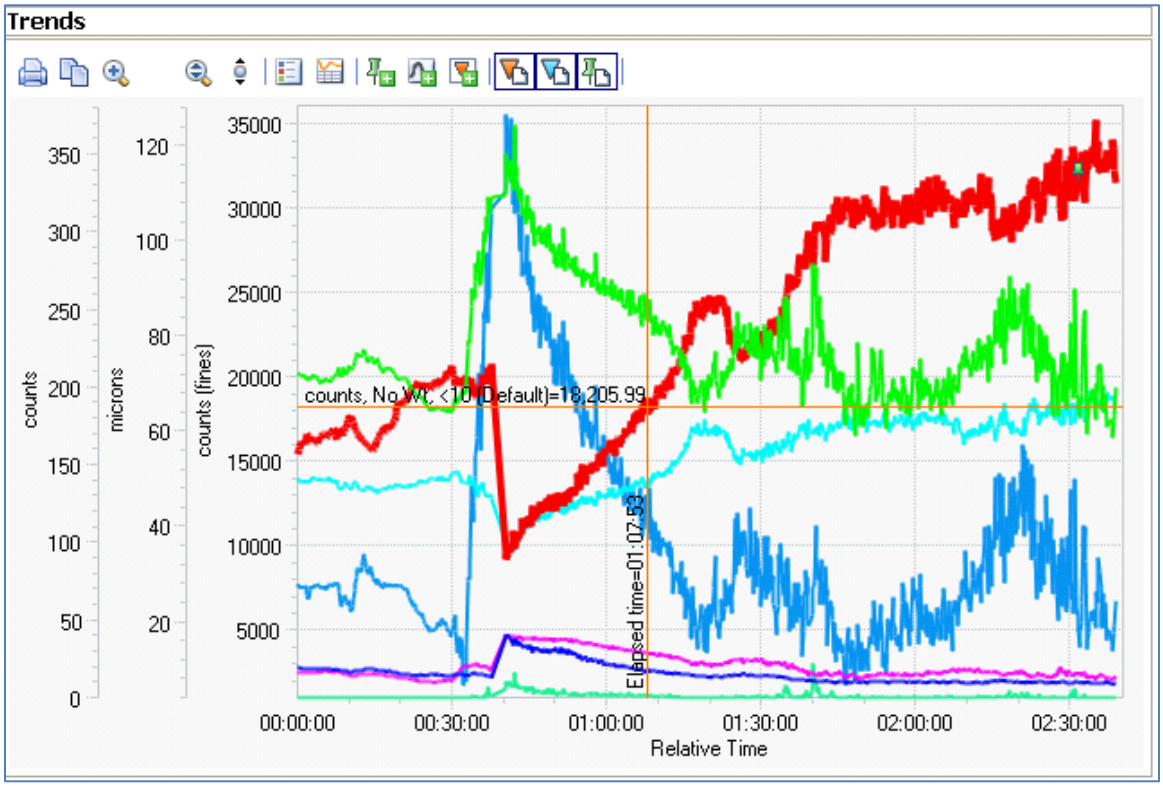
Trend profiles of several selected chord lengths statistical components for the experiment generate in real time and display in the Trends Viewer. User-defined trends also display in the viewer.

This enables you to compare the behavior of particles of different size classes over time (for example: growth, breakage, agglomeration, fines generation). The display rescales automatically with the addition of different trend profiles. This enables you to track real-time changes in the observed process.

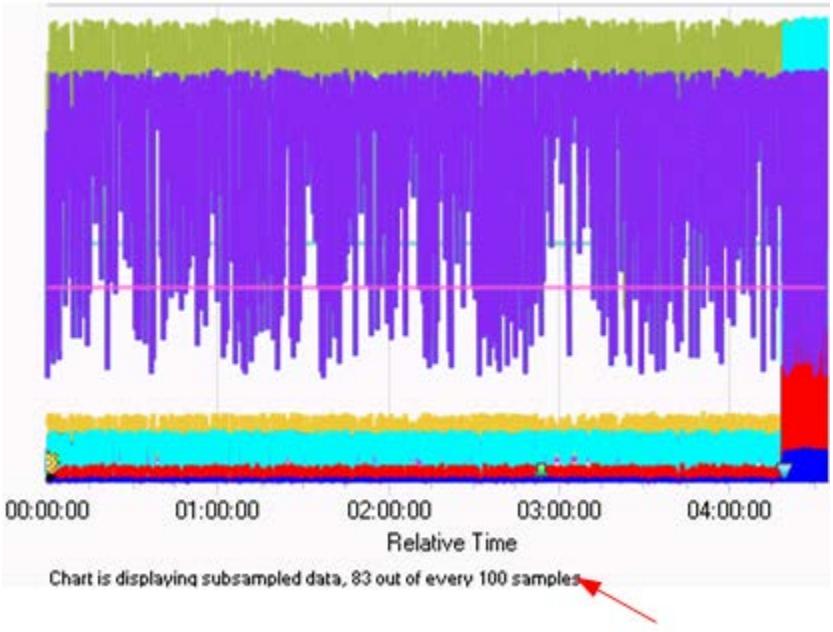
When you select a trend, the Y axis label for that trend moves to the right-most position on the graph.

	You can move the selected trend time point one step to the left or right using the Events Viewer by: (1) showing all unpinned sample messages (horizontal pin) and (2) selecting one sample, then (3) moving the curser up and down.

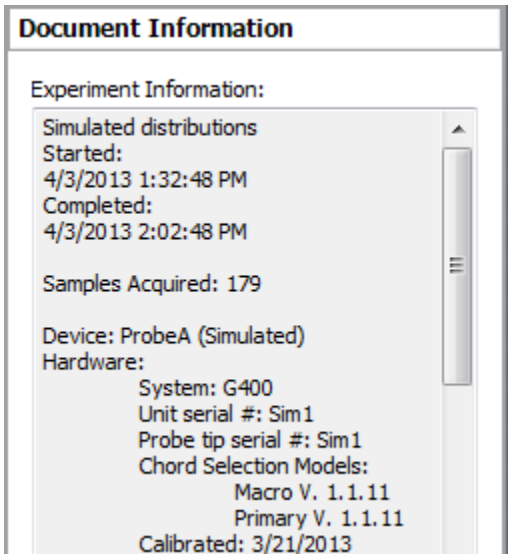
- Use the Right and Left arrow keys to step through the X axis one point at a time.
- Use the Up and Down arrow keys step through the Y axis.
- You have the option to send selected trends to a 'Result Set' library (see Working with Result Sets).



Note: By default, the Trend Viewer chart displays a maximum of 20,000 data points for all trends. When the number of data points being trended exceeds this amount, trended values are subsampled. When subsampling occurs, a message appears at the bottom of the trend chart.



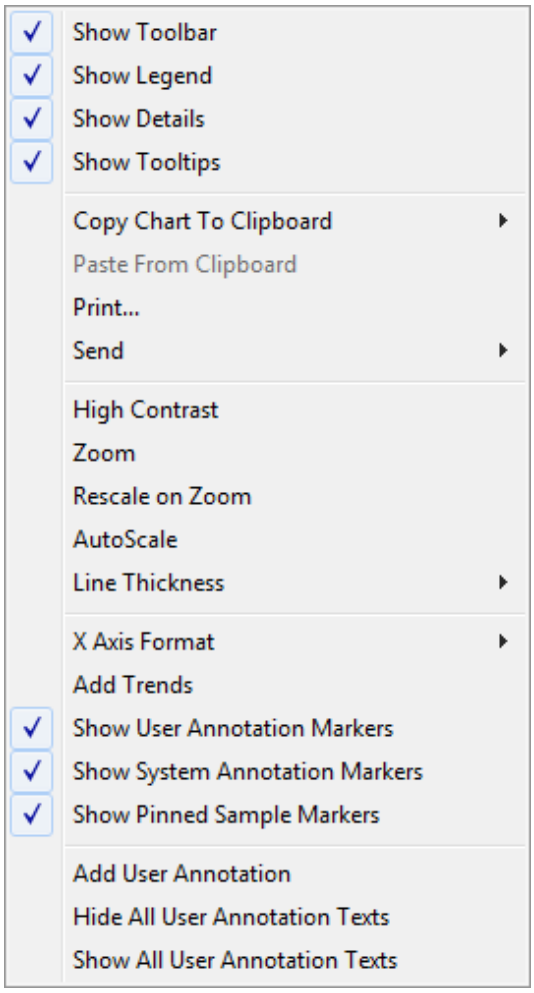
The message provides the ratio of subsampling that is being performed. If it becomes necessary to view the full 100 percent of data, the user has the option of reducing the number of trends being displayed to bring the maximum number of data points below 20,000. The number of data points is calculated by multiplying the number of trends being displayed by the total number of samples acquired. The number of samples acquired is displayed in Document Information task pane.



It is important to note that subsampling only effects the data being displayed in the trend viewer, all data for every interval is always collected and stored.

THE TREND CONTEXT MENUS

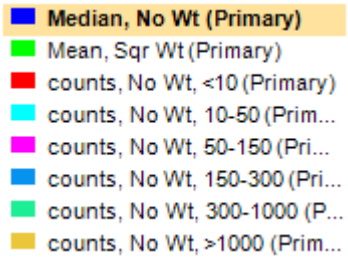
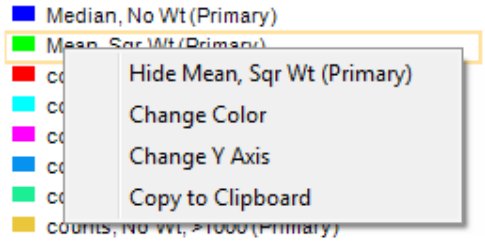
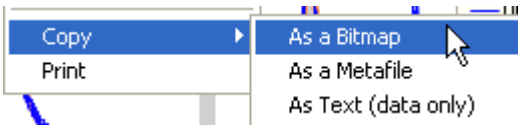
The Trends Viewer incorporates several right-click or context menus that contain tools for customizing the displayed data. Menu options appear when the user right-clicks on the data area of the display.



Main Trends Viewer Context Menu

Right-click in the Trends Viewer to display the following options:

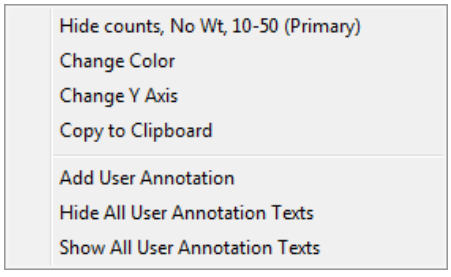
Show Toolbar	Displays the toolbar at the top of the display.  The toolbar contains the following tools:	
		Prints the display.
		Copies the display to the clipboard.
		Zooms the display. See Trend Profiles Zoom Operation.
		This button is only visible when the Zoom function is enabled. The button resets the zoom to the original scale.

		Rescales only the X-axis on zoom.
		Auto scales the Y-axis to 0-100% for all but the selected trend to enable comparisons. Refer to Trend Autoscale Operation.
		Displays the Legend to the right of the graph
		Displays the Details table below the graph.
		Pins the trends selected in the Trends Viewer to the Distributions Viewer. Clicking the button when Distributions Viewer is already pinned unpins those distributions. This tool can be used to add distributions from the Events Viewer to the distributions list.
		Adds a Reference Trend to the graph. Clicking the button opens the Add Trends window where you can select or import trends.
		Adds annotation at the specific active point in the trend.
		Displays user-generated annotation markers on the graph.
		Shows system generated annotation markers on the graph.
		Displays all pinned sample markers.
Show Legend	Displays a legend that lists each trend by name with the CSM in parentheses.  The Legend also offers a context menu that enables you to perform some of the functions discussed in this section. To access the menu, right-click on the legend. 	
Show Details	Displays information about the trends and allows access to hide and show options.	
Copy to Clipboard	Copies the display to the clipboard. The display can be copied as a bitmap, Windows metafile or as text-only. 	
Paste from Clipboard	Pastes the contents of the clipboard into the trend graph.	
Print	Opens the Print dialog to print the display.	

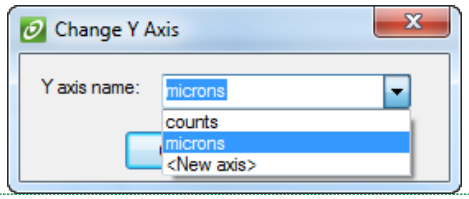
Send	Sends (exports) the trends to a Result Set. If there are any existing Result Sets currently open, a list appears so you can select the destination Result Set. There is also an option to create a new result set. See Sending Trends to a Result Set. 
High Contrast	Displays the graph with a black background.
Zoom	Zooms the display. Refer to Trend Profiles Zoom Operation.
Reset Zoom	Resets the zoom to its original scale.
Rescale on Zoom	Rescales only the X-axis on zoom.
Auto-scale	Automatically scales the Y axis. Refer to Trend Autoscale Operation.
Line Thickness	Selects the line thickness for the plots.
X Axis Format	Allows the user to change the format of the X axis as follows: • Record or Sample Number • Actual time of the measurement • Relative time (elapsed time during the experiment) See Changing the X Axis.
Add Trends	Allows the user to add trends from open Experiments and Result Sets.
Show User Annotation Markers	Displays user-generated annotations on the graph.
Show System Annotation Markers	Displays system generated annotations on the graph.
Show Pinned Sample Markers	Displays all pinned sample markers.
Add Annotation	Adds a new annotation to the event log.
Hide All User Annotation Texts	Hides the text on user annotations. The marker is still displayed.
Show All User Annotation Texts	Displays the text in user annotations next to the marker. The text can be moved by dragging it to a new location.

Trend Line Context Menu

Use the mouse to right-click on a line in the trend graph and display another context menu.

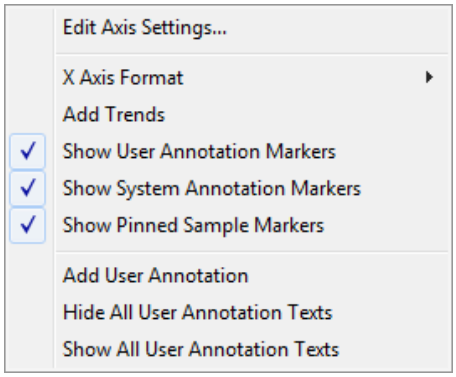


The context (right-mouse click) menu contains the following items.

Hide . . .	Hides the selected trend.
Change Color	Opens a color browser to change the color of the trend line.
Change Y Axis	Opens a window so you can select one of the defined Y axes or name a new one. 
Copy to Clipboard	Copies the trend data to the clipboard as tab-delimited text.
Add Annotation	Adds an annotation to the to the trend point.

Y-Axis Area Context Menu

Use the mouse to right-click in the Y-axis area of the graph to see a third context menu.

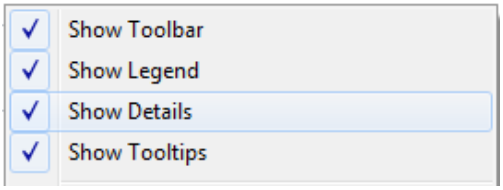


Edit Axis Settings	Changes the range and name of the Y axis. When AutoScale is not in effect, multiple Y-axes can be defined. See Changing the Y Axis.
X Axis Format	Changes the units of the X axis as follows: • Record or Sample Number • Actual time of the measurement • Relative time (elapsed time during the experiment) See Changing the X Axis.
Add Trends	Enables addition of trends from open Experiments and Result Sets.
Show User Annotation Markers	Displays a visual marker on graph for user-generated annotations.
Show System Annotation Markers	Displays system generated annotations on the graph.
Show Pinned Sample Markers	Displays all pinned sample markers.
Add User Annotation	Add an annotation to the trend point.
Hide All User Annotation Texts	Hides all user annotation texts on the graph.
Show All User Annotation Texts	Shows all user annotation texts.

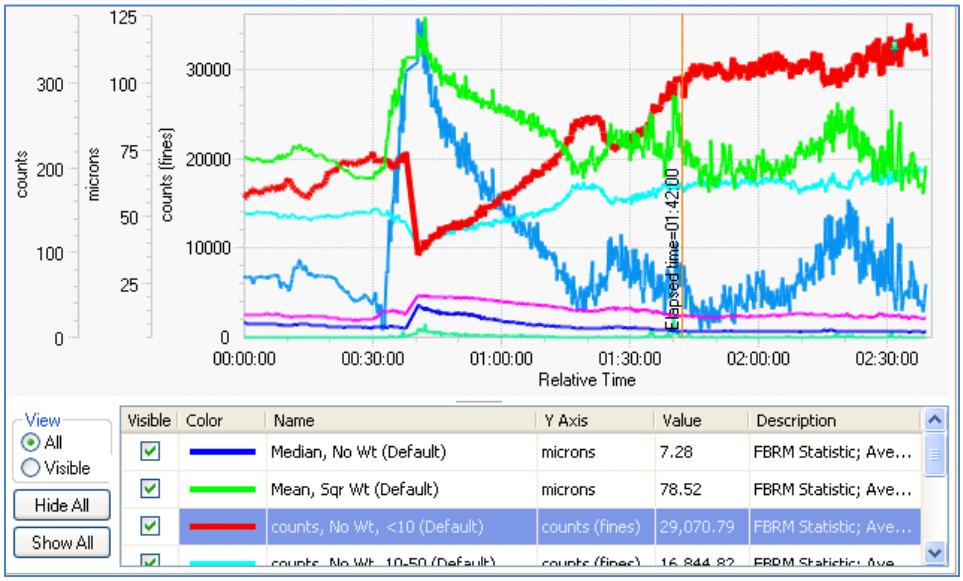
THE TREND DETAILS PANEL

The Details table offers a list of current trends along with the value and source. To display the Trend Details:

- Click the **Details** button  in the toolbar of the Trends Viewer, or
- Placing the cursor anywhere on the Trends Viewer plot area and double-clicking on it, or
- Double-click in the lower left corner of the viewer, or
- Right-click on the trend graph and select the **Show Details** option.



Checking the **Visible** check box displays the corresponding component as shown in the display below.



The Trend Details table enables you to customize the trends in the viewer.

The **View** section to the left of the details table determines which trends appear on the graph. The All button displays all the trends in the trend list. When the **All** button is selected, use the **Visible** check boxes to select which trends display. The **Hide All** button hides all visible data in the graph. The **Visible** check boxes must be rechecked to view the trend again.

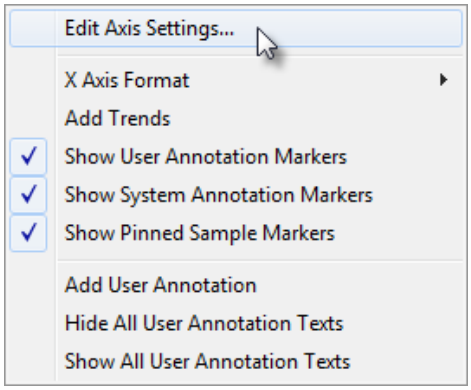
Right-clicking on the **Y Axis** of a trend enables you to change it. Axis selection is from a drop-down list of available axes.

Up to four Y axes can be defined. When you select a trend, its Y-axis legend moves to the right-most position on the graph.

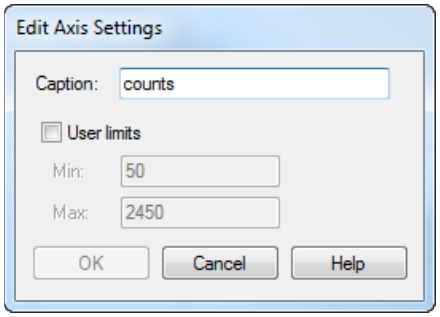
CHANGING THE Y AXIS

Note: The option to change the Y Axis does not appear on the context menu if AutoScale is in effect.

When AutoScale is not in effect, you can change the **Y-axis** to display different measurement units and scale through a context menu. To access the menu, right-click in the Y axis area of the Trends Viewer and select **Edit Axis Settings**.



The **Axis Settings** window opens.



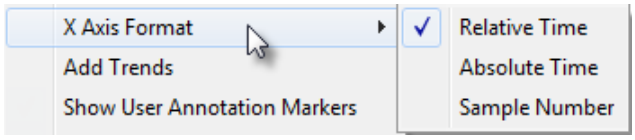
Enter a caption to label the axis and/or customization of the min/max limits of the scale.

CHANGING THE X AXIS

The **X-axis** displays the trends by one of the following units:

- Record or Sample Number
- Actual time of the measurement
- Relative time (elapsed time during the experiment)

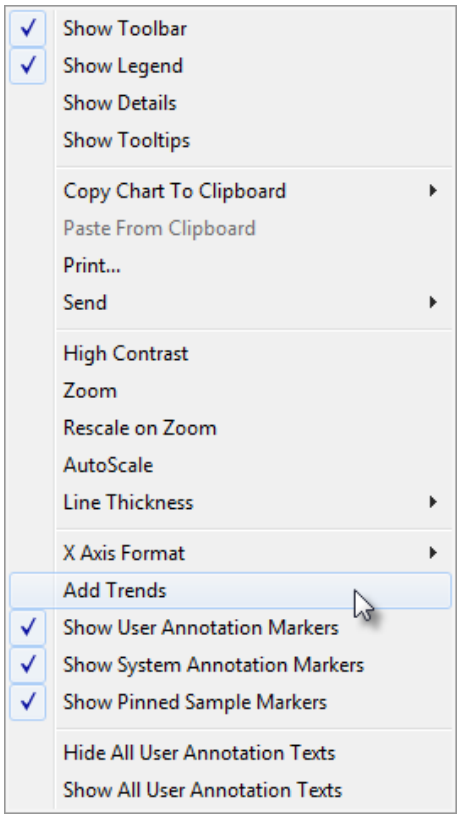
To change the **X-axis**, use a context menu.



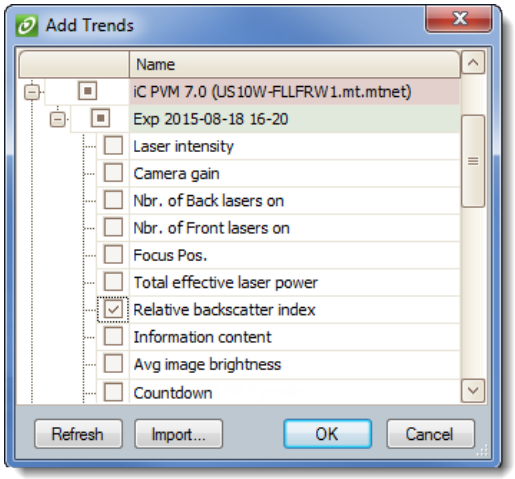
ADDING A REFERENCE TREND

Reference trends from an iC FBRM experiment, another iC application or iControl can be added to a trend. Refer to Sharing Trend Data with Other iC/iControl Applications for guidelines pertaining to interactions with iControl and other iC applications.

When adding a reference trend from a different experiment, the experiment containing the trend to be used as a reference must be opened first. Then, use The Trend Context Menus to add the reference trend to the current experiment.



Click the Add Trends option to open the following dialog box:

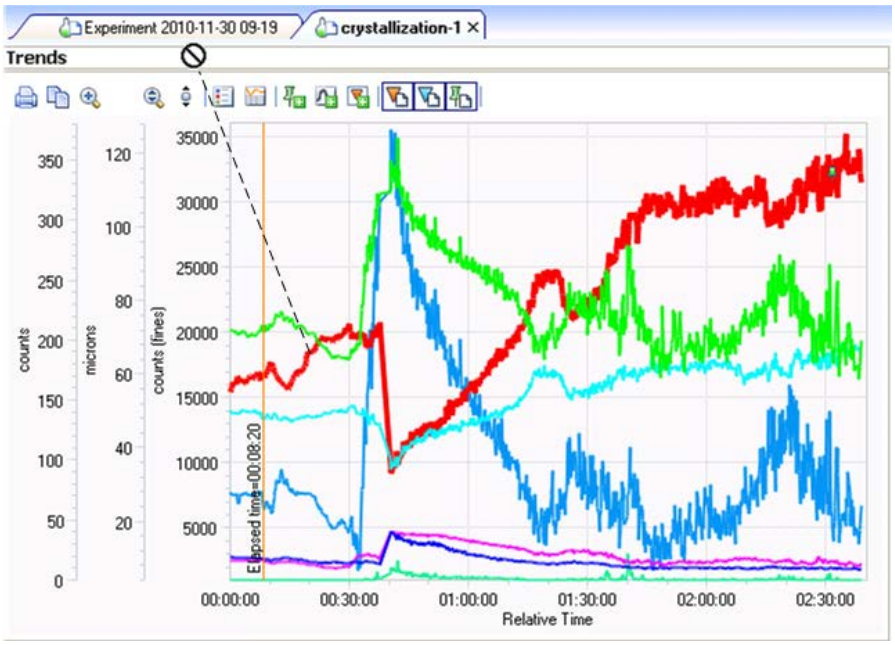


The dialog box contains a list of all active trends in all opened and live experiments. You select which trends to use as a reference and click the **OK** button to insert the reference trends.

You can also drag-and-drop reference trends from another opened Experiment or opened Result Set to the current trend display.

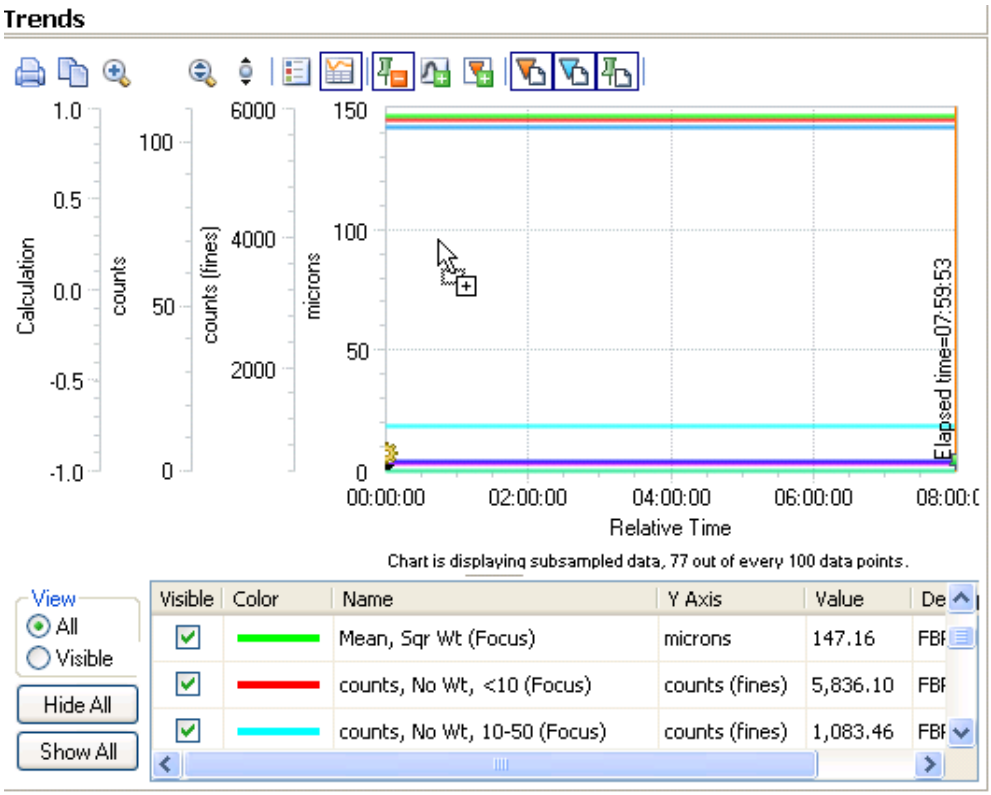
To add a reference trend using the drag-and-drop method:

	1. On a Trend display or Result Set, click on trend to be included in current Trend display. The cursor changes to the symbol shown if the plot was correctly selected.
	2. Drag the cursor to the tab of the destination Trend Display.

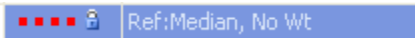


Note: On experiments containing a large number of trends, it is easier to drag the trend from the trend name in the legend.

	3. When the cursor hovers on the destination tab, focus shifts to the tab and the destination Trend Display appears.
	4. Drag the cursor down to the graph area.
	5. The cursor changes to a shortcut icon,
	6. Release the mouse button. The dragged trend is copied to the destination Trend Display.



Reference Trends display on the graph with a dotted line.



IMPORTING AN EXTERNAL TREND INTO THE TREND VIEWER

Data from MS Excel or other spreadsheet program can be pasted into iC FBRM as a plot. The desired data is first selected in the spreadsheet and copied to the clipboard.

Note: Date/Time is always in the first column. The date/time cells must contain the date and time in the format corresponding to the International settings of the computer running the iC application.

In Microsoft® Excel®, select all the time cells and go to Format/Cells and select Number: in the list.

Select Custom and format the cells as shown.

If the data does not already have a Time column, one can be generated as follows:

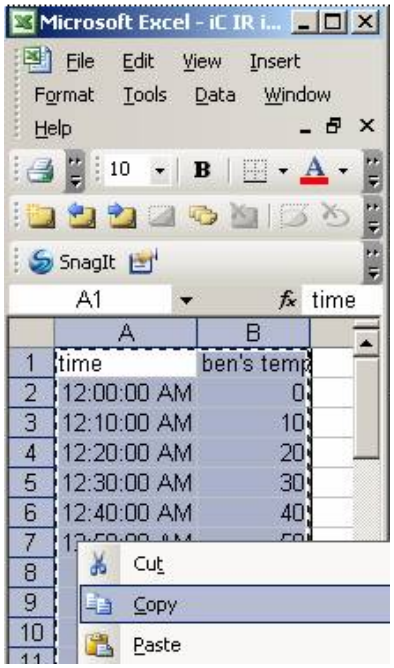
1. Modify the start time of the experiment with the appropriate date.

2. Then, modify the subsequent cells by adding the time interval. You can do this by using the Time function in Excel. For example if your experiment intervals are five seconds, then your formula would look something like this:

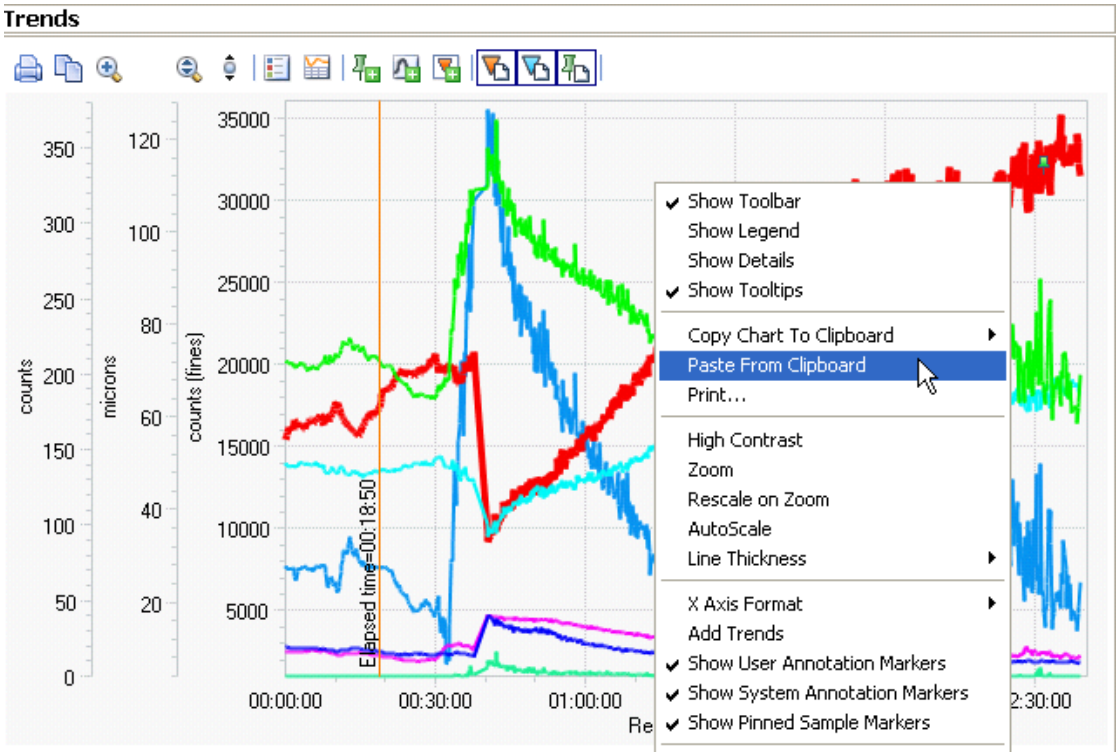
   =B4+TIME(0,0,5)

   If you had multiple stages with different time intervals, be careful when modifying your time cells.

Pasting the newly formatted data enables you to correctly overlay your FBRM data and your imported data in the iC FBRM software (Changing the configuration of the X axis should not be an issue).



In the Trend Viewer, select the **Paste from Clipboard** option from the right-click menu.



The data from the clipboard pastes into the trend graph as a new trend. You can then modify the y axis of the newly imported set of data to show a correct label. To rename the axis, right-click on the set of data just imported and selects the **Change Y Axis** option. You can then enter an appropriate name for the Y axis.

Here are some general hints for pasting data from the clipboard into the iC application.

1. What you see in Excel is exactly how it is formatted on the clipboard, and is how FBRM will see the data.

2. If the data contains a "Units" row, that row (row 2) needs to be removed. The iC import logic assumes that the first row is the column header row and subsequent rows are data rows.

3. The first row is always assumed to be the “Time row”. If using the “Local Time” column, the user must first select the column and change the cell format to show both date and time (“m/d/yy h:mm:ss”). Otherwise, if the date is not shown then iC will assume the time is relative.

4. For the time column, the other option is to use the “Experiment Time” column. In this case, iC assumes that the values are relative time in seconds from the start of the experiment.

Note: The "Time" column does not necessarily need to contain absolute Date/Time values. The column may also contain elapsed time in seconds. For example:

Time	Temperature
0	20.23
5	22.54
10	4.88
15	29.12
20	31.48

In this case, the start time is assumed to be the same start time as the iC experiment.

If you are reading in Excel data from a 3rd party source (DCS system, etc.) that is set to a different time zone than the iC computer, here is an easy way to format the data (assuming it is date and time data).

- Set the original time data column (column A) in the correct cell format as noted previously.
- Create a new blank adjacent column (column B).
- Create a formula in cell B1 “=A1-(1/24)” to subtract 1 hour from column A time (or the number of hours difference for your time zone).
- Delete column A.

If data is time only (no date) then the formula is more complicated. Below is an example.

For a time difference of minus 3 hours and a time span between midnight and 3 am, use:

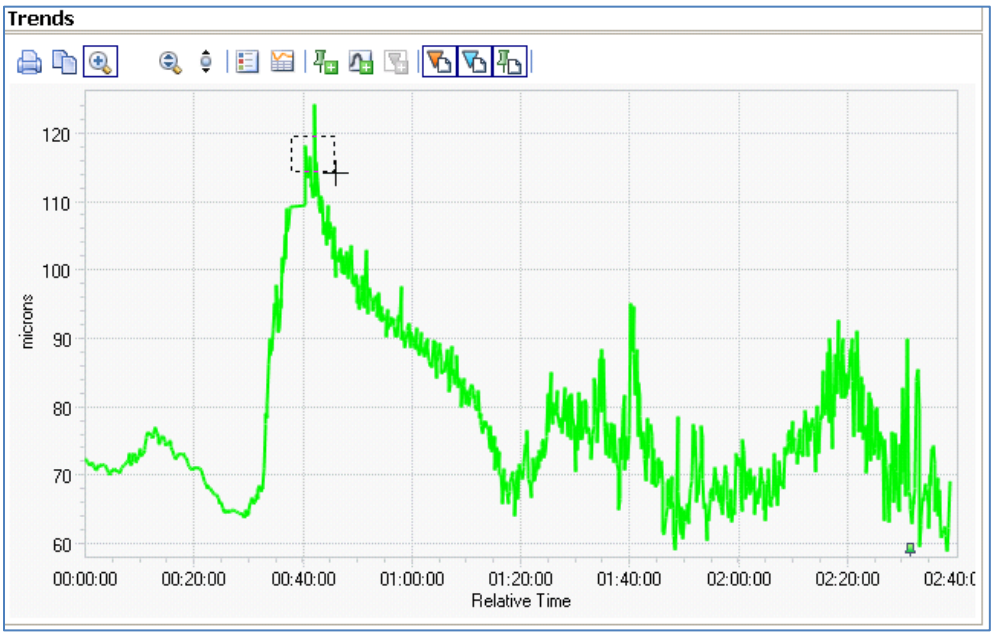
=IF(A1<0.125,A1+0.875,A1-0.125)

What this formula does if the value in A1 is strictly a time value between midnight and 3:00 am is to add 21 hours (21/24 or 0.875) to the value, providing the expected result of an adjusted time between 9:00 pm and midnight.

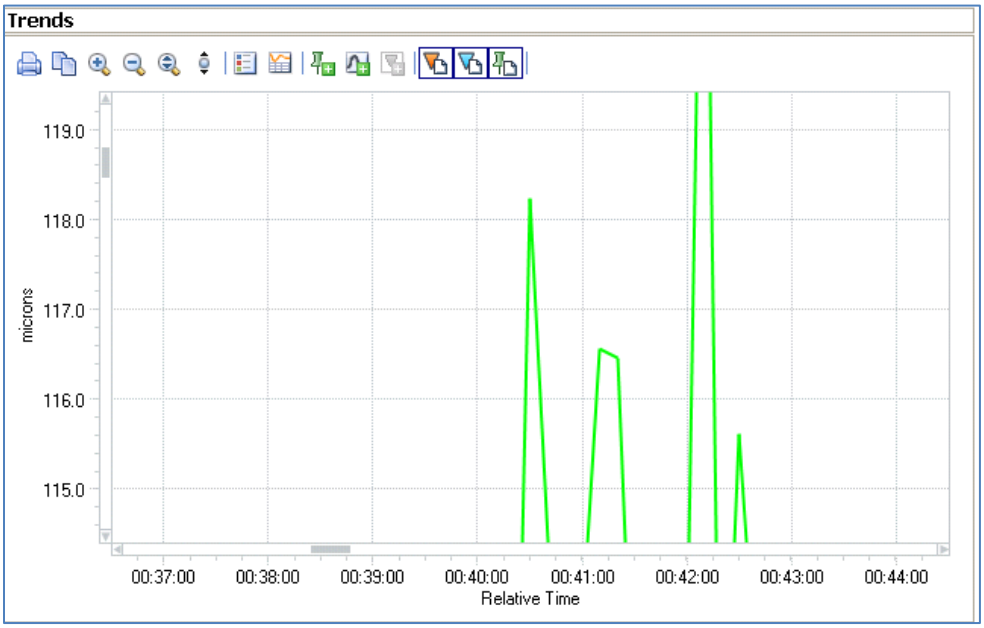
TREND PROFILES ZOOM OPERATION

There are two methods available for zooming in on the trend display.

- Right-clicking in the trend graph area and selecting the Zoom option from the right-click menu.
- Dragging the mouse over the area you wish to enlarge, as shown below.

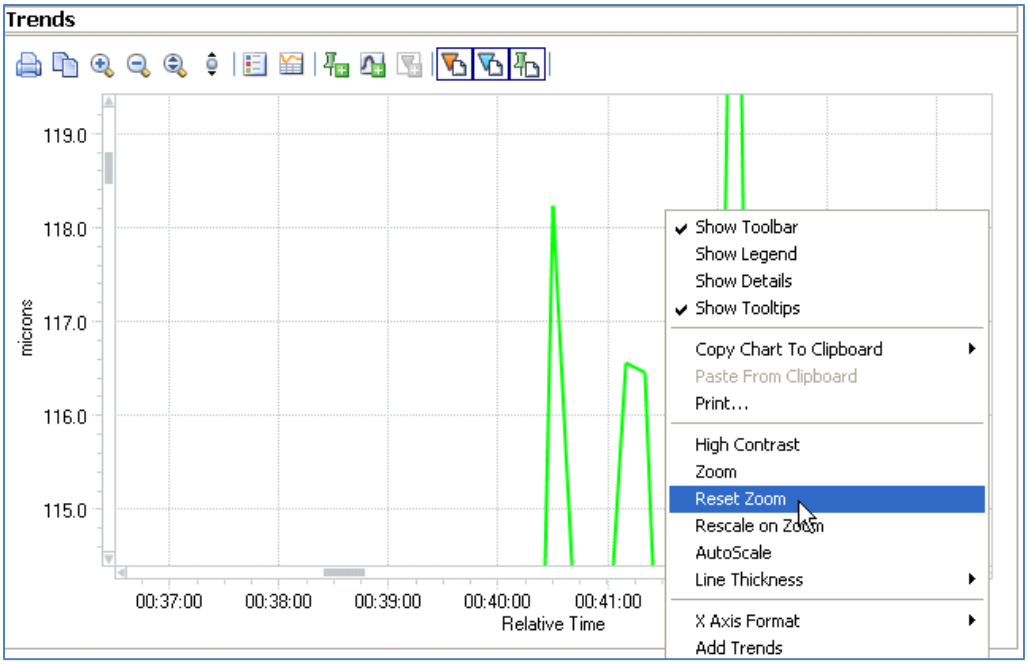


The zoomed or enlarged image can be moved by moving the corresponding slider bars with the mouse.



	Reset Zoom—To return to the normal size display, right-click on the zoomed display and select the **Reset Zoom** option from the menu or click the button in the toolbar.

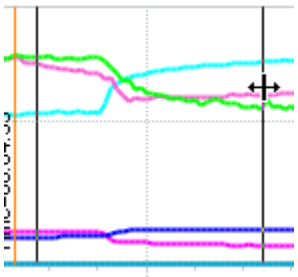
METTLER TOLEDO



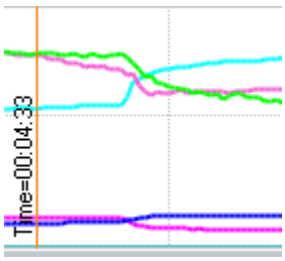
TREND ZOOM OPERATION WITH RESCALE ENABLED

When Rescale is enabled, zooming has a slightly different effect. The x-axis is the only portion of the graph that is selectable by the user. The y-axis is automatically autoscaled.

	**Zoom** button—When you click the Zoom button, the cursor changes to the symbol show at the right. Move the cursor to the beginning point of the area to be zoomed. A vertical bar appears. Click and drag the mouse cursor to the desired end point of the zoom area.



Release the mouse to zoom to display the zoomed graph with the Y axis autoscaled.



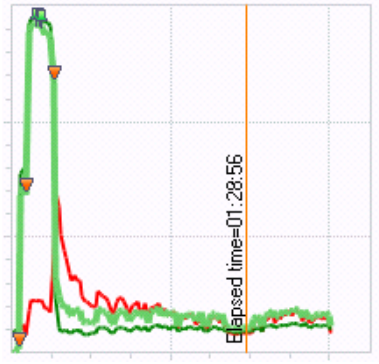
Refer to Trend Autoscale Operation.

TREND AUTOSCALE OPERATION

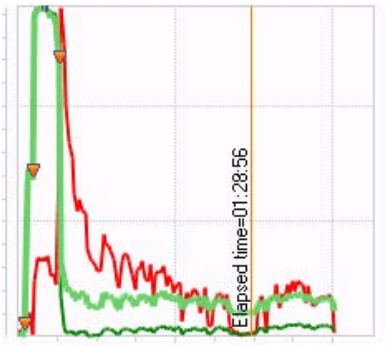
When AutoScale is enabled in the Trends Viewer or the Distributions Viewer, the y-axis automatically scales (0 to 100%) for all but the selected plot. The units used for the Y axis reflect those of the selected plot. As a result, the AutoScale feature enables a visual comparison of the shape of a trend in two different samples where the height in one is much smaller than in the other.

	**AutoScale** button—Click this button to scale the Y axis based on the selected plot in the graph. Remaining plots scale to their Y-axis extents (0 to 100%). In addition to the toolbar button, AutoScale is also an option when you right-click in the Y-axis area.

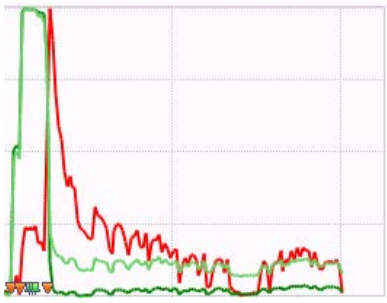
For example, when AutoScale is enabled for the following graph,



The Y axis is automatically scaled based on the selected plot.



If no plots are selected, autoscaling uses the first plot in the graph as the basis and uses a Y axis scale of 0-100%.



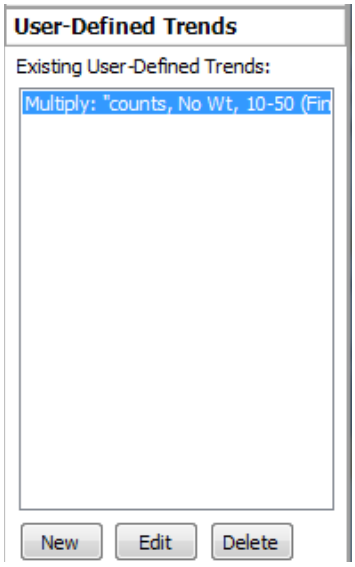
Note: When AutoScale is in effect, the x-axis is the only portion of the graph that is selectable by the user.

USER-DEFINED TRENDS

Users can define custom trends that perform math functions on one or more trends to show information or relationships that might not otherwise be apparent. Once a trend is created, it appears in the Trends Viewer where it can be tracked and analyzed. User-defined trends are treated the same as other trends in the Trend Viewer and also appear in the Statistics Viewer.

Any number of user-defined trends can be created. User-defined trends can be chained so the result of one user-defined trend can be used in another user-defined trend. The iC software has internal checks to ensure that circular dependencies are not introduced when referencing other user-defined trends in a trend equation.

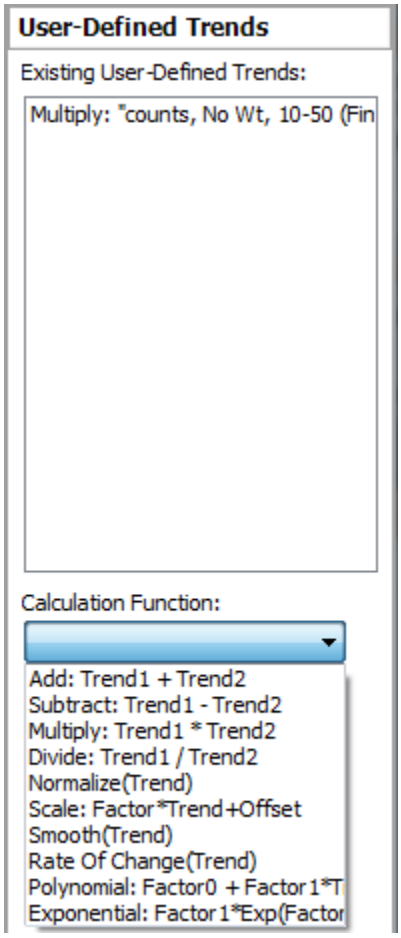
The User-defined Trends task pane in the toolbox enables you to create a user-defined trend based a selected Calculation Function. The list of available functions appears when you click **New**.



- To create a user defined trend, click **New**, select a mathematical function from the list that appears after you click **New**. Then, supply the related field information for the selected function (see Creating a User-Defined Trend).
- To edit an existing trend, select it in the list and click **Edit**.
- To delete an existing trend, select it in the list and click **Delete**. Alternatively, select the trend in the list and press the Delete key on the keyboard.

Creating a User-Defined Trend

Click **New** to create a new user-define trend. The task pane expands to display the definition fields available for the selected calculation.



Use the Calculation Function selection list to choose the type of calculation that will define the trend. The following options are available:

Add—Create a third trend based on the sum of the two specified trends.

Subtract—Create a third trend based on the difference between the two specified trends.

Multiply—Create a third trend based on the product of the two specified trends.

Divide—Create a third trend based on the ratio of the two specified trends.

Normalize—Create a normalized trend from the selected trend.

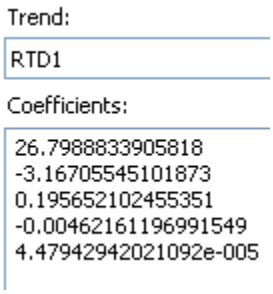
Scale—Scale a trend based on a user-specified factor and/or an offset.

Smooth—Uses the Savitsky-Golay filter (polynomial regression) to smooth a trend over a user-specified range and smoothing window.

Rate of Change—Create a new trend that is the 1st derivative of the selected tracking trend based on a user-specified sample window. In other words, for each point T[i], rate is calculated based on the different with point T[i – w], where w represents the window size.

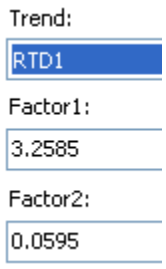
Polynomial—Create a trend that is commonly used to support solubility in a crystallization workflow. Solubility C* is often a polynomial function of the temperature of the solution. C* = a + bT + cT2+

Example:



Exponential—is commonly used to support solubility in a crystallization workflow. Solubility C* can also be expressed as exponential function of the temperature of the solution. C* = a*ebT.

Example:



The remaining fields in the task box will vary depending on the calculation selected.

The following action buttons control the adding/editing of user-defined trend after a trend is selected:

Apply	Shows the effect of the added/updated user-defined trend and keeps the editor open. The trend appears in the Existing User-defined Trends list, displays in the Trends Viewer, and the task pane remains expanded so you can create additional user-defined trends or adjust trend parameters
OK	Shows the effect of the added/updated user-defined trend and closes the editing portion of the task pane. The trend appears in the Existing User-defined Trends list, displays in the Trends Viewer, and the task pane collapses to its original view.
Refresh	To edit an existing user-defined trend, select the trend in the Existing User-defined Trends list, make changes, and **Refresh**. Alternatively, double-click on the trend in the list.
Cancel	Cancels any currently entered user-defined trend settings and closes the editor portion of the task pane.

For a specific example, see Creating a User-defined Trend Solvent Dilution Adjustment.

Creating a User-Defined Trend Solvent Dilution Adjustment

Users can build their own trends/statistics using simple mathematical operations. During a Live Experiment, define a user-defined trend to eliminate/offset the effect of dilution in the count per second trend. With the user defined trend, you can apply a correction factor to any of the trends displayed in the Trends Viewer. All the mathematical operations needed are in the User-Defined Trends toolbox. It is possible to use math operators on newly created user-defined trends.

To do so, during a Live Experiment, click the User-Defined Trends task pane in the toolbox.

Let's take the example of an experiment where the process is undergoing dissolution of a substrate/particles system by addition of a solvent:

To eliminate the effect of the dilution, offset the count per second by multiplying the counts per the reverse of the dilution factor.

> Counts at time t = counts at time t without dilution effect / (Volume initial of solution +Liquid feed rate in mL) X Volume initial of solution

To acquire the counts at time t without the dilution, use the following method:

> counts at time T without the dilution effect = Counts at time T x (Volume initial of solution + Liquid feed rate in mL) / Volume initial of solution

To create this new trend counts at time T without the dilution effect:

1. Import the feed rate curve in the FBRM Trends Viewer (this should come from external data—for example from the LabMax instrument.)

2. Phase 1: Build the dilution factor as follows:

   - **Calculation Function:** Choose the **Scale: Factor*Trend+Offset**
   - **Trend:** feed rate in mL (imported trend)
   - **Offset: 1**
   - **Factor:** result of 1/volume initial

   - The Trend name can be modified. For our purposes, the newly created user trend can be called, Dilution Factor.
   - Click **OK** to save the newly created trend.

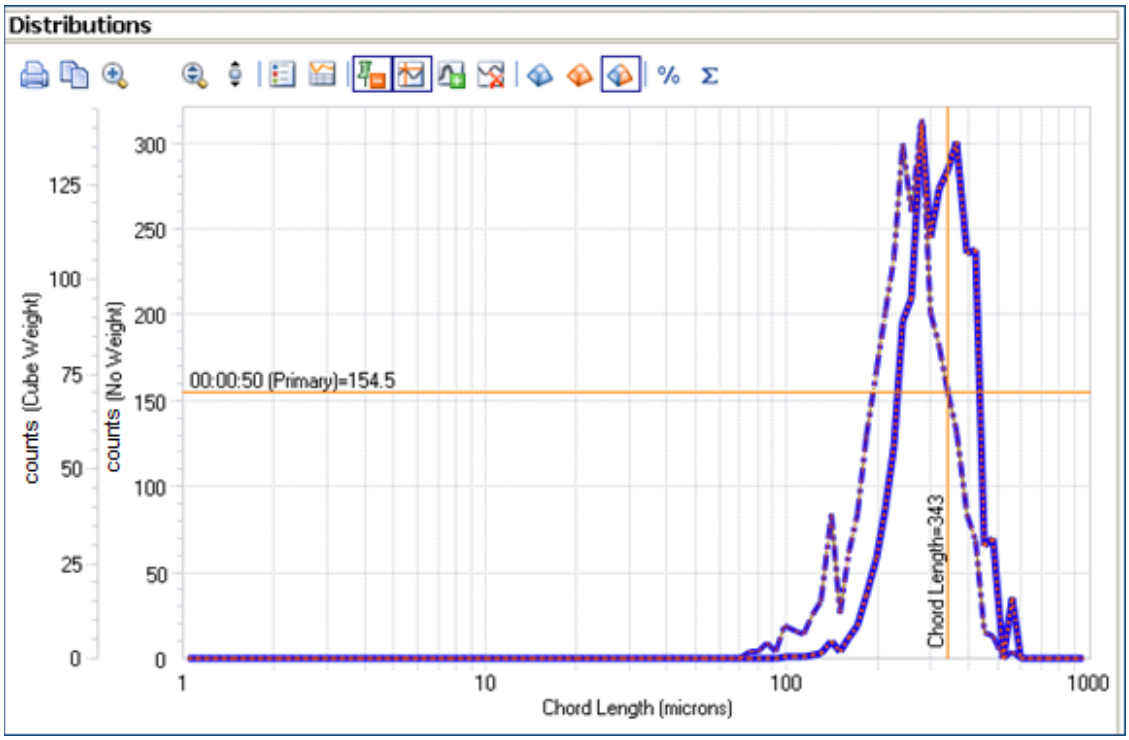
3. Phase 2: Apply the dilution factor to the counts trend of interest (the one from which we want to remove the effect of dilution). To do so:

   - **Calculation Function:** Choose the **Multiply Trend 1*Trend2**
   - **For Trend 1:** Select the Counts statistic that is of interest.
   - **For Trend 2:** Dilution factor. The trend created in Phase 1 appears at the bottom of the menu.

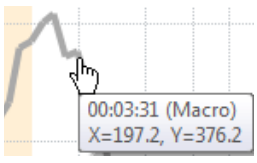
Distributions Viewer

The Distributions Viewer contains a graph that displays the completed Chord Lengths Distribution (CLD) profiles at user-selected times during an experiment. Current measurements can be supplemented by pinned distributions or distributions from previous experiments, as references. This enables you to know with accuracy the chord lengths composition of the studied particle or droplet system over time and over different conditions.

- Filters like weighted and unweighted offer the option to focus attention on coarse or fine particles or both at the same time.
- The X-Axis shows the channel boundaries in microns.
- The Y-Axis shows either the number or percent of chord counts, depending on which is selected.
- On the keyboard, use the right and left arrow keys to step through the X axis one point at a time. Use the up and down arrow keys to step through the Y axis.
- The viewer includes right-click context menus and a toolbar to facilitate performing various functions. The right-click menu includes the option to send a selected distribution to a library (see Working with Distribution Libraries).
- For instruments that support more than one CSM, you have the option to display Multiple Chord Selection Models on separate tabs.

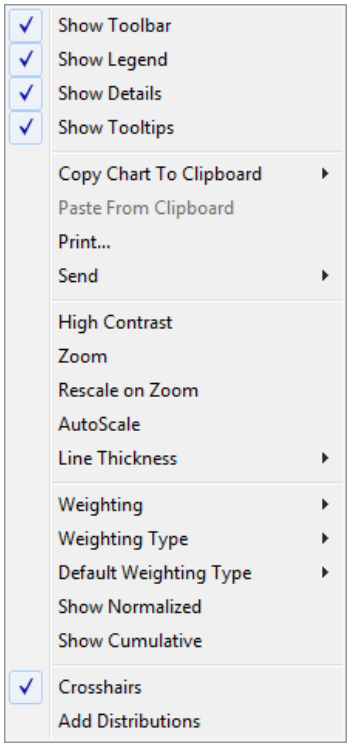


When the mouse hovers over any point in a distribution, a tooltip shows the parameters for the point under the cursor.

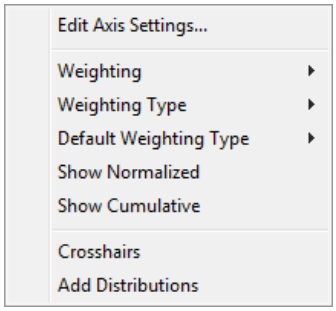


DISTRIBUTIONS VIEWER CONTEXT MENUS

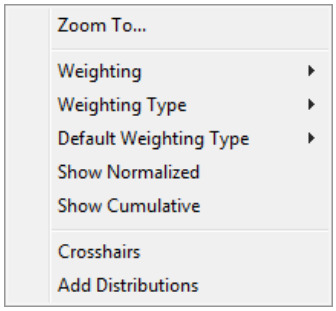
The Distributions Viewer incorporates three right-click or context menus—one when you click in the general data area and one when you click on a specific distribution measurement. Notice that the y-axis and x-axis context menus are the same as the main graph context menu, with the addition of an 'Exit Axis Settings' and 'Zoom To' options.



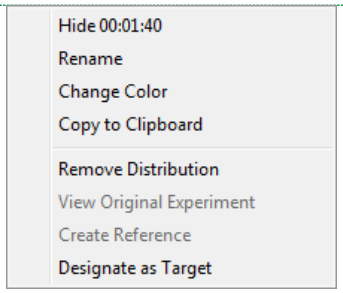
Y-Axis: Edit Axis Settings...



X-Axis: Zoom To...



Graph Context Menu (including Y-Axis and X-Axis options)

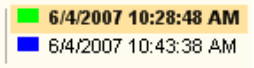
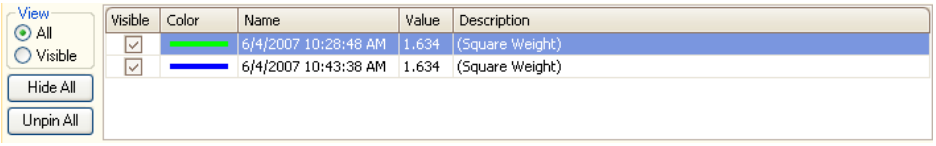


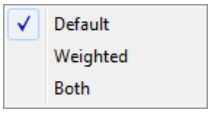
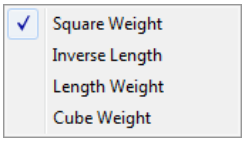
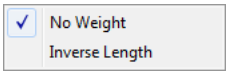
Distributions Measurement Context Menu

Distributions Viewer—Graph Context Menu

The main context menu appears when you right-click on the data area of the distribution graph and it contains tools for customizing the displayed data.

Show Toolbar	Displays the toolbar at the top of the display.  The toolbar contains the following tools:	
		Prints the current distribution graph to a designated printer.
		Copies the current distribution graph and legend as a bitmap, metafile, or as text (data only)
		Zooms the display. Refer to Distributions Viewer Zoom Operation.
		This button is only visible when the Zoom function is enabled. The button resets the zoom to its original scale.

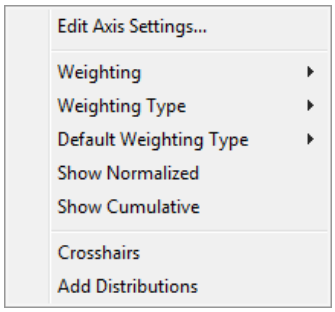
		Rescales only the Y-axis on zoom.
		AutoScales the Y-axis
		Displays the Legend
		Displays the Detail table.
		Pins the item selected in the viewer. See Pinning.
		Displays crosshairs on the viewer. Crosshairs immediately jump to the selected data point and a tool tip displays information about that point.
		Opens the Add Distributions window.
		Removes selected distribution from the graph.
		Displays selected distribution as unweighted (No Weight).
		Displays selected distribution as weighted (Square Weight).
		Displays selected distribution as both unweighted (No Weight) and weighted (Square Weight).
		Displays the selected distribution as Normalized.
		Displays the selected distribution as Cumulative, meaning a calculated statistical probability based on a running total.
Show Legend	Displays the Legend Box. 	
Show Details	Displays the Details Grid. 	
Copy to Clipboard	Copies the display to the clipboard. The display can be copied as a bitmap, Windows metafile or as text-only. 	
Paste from Clipboard	Pastes the contents of the clipboard into the graph.	
Print	Opens the Print dialog to print the display.	
Send	See Sending Distributions to a Distribution Library.	
High Contrast	Displays the graph with a black background.	
Zoom	Zooms the display. The cursor changes to a ✢ so you can specify the area to zoom. See Distributions Viewer Zoom Operation.	
Reset Zoom	Resets the zoom to its original scale. This button is only displayed when the display is in a zoomed condition.	

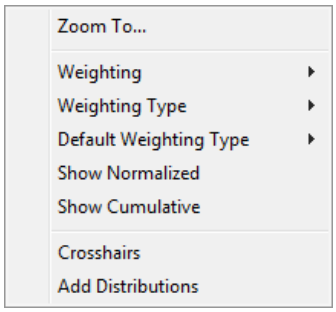
Rescale on zoom	Rescales only the X-axis on zoom.
Autoscale	Autoscales the Y-axis to 0-100% for all but the selected distribution to enable comparisons. Refer to Trend Autoscale Operation.
Line Thickness	Selects the line thickness for the plots.
Weighting	The weighting to apply to the distribution. Options include: 
Weighting Type	Selects type of weighing to assign to the middle weighting button  from a drop-down list.  **Square Weight**—Chord length squared. A weighted distribution obtained by applying a chord-length squared weighting function to the unweighted chord distribution. The square weight function enhances sensitivity to change in the coarse aspect of the distribution. **Inverse Length**—A one-over-length weight distribution obtained by applying a one-over-chord-length weighting function. **Length Weight**—Chord length weight. A weighted distribution obtained by applying a chord-length weighting function to the unweighted chord distribution. **Cube Weight**—Chord length cubed. A weighted distribution obtained by applying a chord length-cubed weighting function to the unweighted chord distribution. The cube weight function enhances sensitivity to change in the coarse aspect of the distribution. Refer to Channel Weights and 'Weighting Type' in the Editing Statistics Definitions topic.
Default Weighting Type	Controls the default behavior for the left-most weighting  button. Button behavior can be set to No Weight (unweighted) or Inverse Length type of weighting.  No Weight is the most common setting.
Show Normalized	Displays distribution by a normalized (percent) of counts.
Show Cumulative	Displays distribution by an absolute number of (cumulative) counts.
Crosshairs	Displays crosshairs on the Distributions Viewer. Crosshairs immediately jump to the selected point and a tooltip displays information about that point. The Trends Viewer and Events Viewer highlight the corresponding time. When you turn on the crosshairs option in the Distributions Viewer, they will jump to the highlighted point. Additionally, moving the crosshairs in the Distributions Viewer changes the column in the Statistics Viewer and the image in the PVM Viewer.

Axis Context Menu

When you right-click in the Y-Axis or X-Axis area of the graph, each context menu includes lower sections of the main graph context menus, plus a special option specific to the axis.

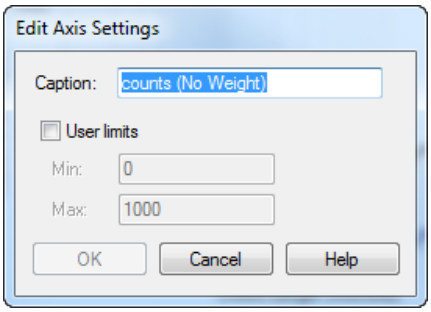
Y-Axis context menu / X-Axis context menu





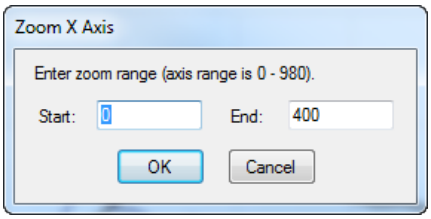
Y-Axis: Edit Axis Settings…

Enables you to change the Y-axis label and set the minim and maximum limits for a distribution.

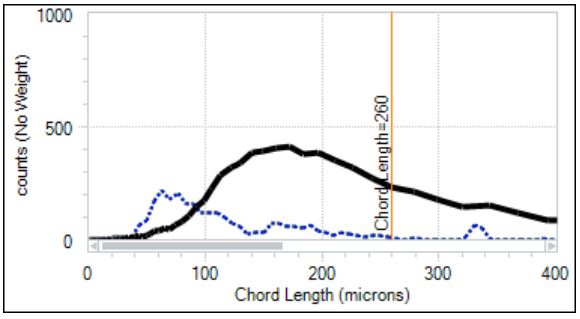


X-Axis: Zoom To…

Enables you to enter a zoom range for the x-axis to focus on a specific chord length area.



When the zoom is in effect, a the graph includes a grey slider bar to navigate within the full x-axis range.

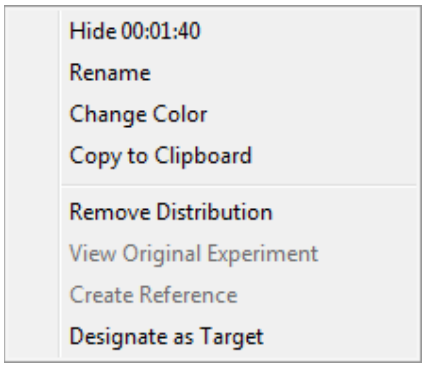


To reset the graph, use the toolbar icon or select Reset Zoom from the context menu.

METTLER TOLEDO

Distributions Viewer—Measurement Context Menu

An additional context menu data for customizing the distributions measurement data appears when you select a distribution. Access this menu by right-clicking on a measurement in the distribution graph or by right-clicking on a selected measurement in the legend or Details table. The last two methods may be preferable because it might be difficult to select a precise data point. Note that only available options are enabled and some options only appear when distributions have been imported or selected as references.



The menu contains the following items.

Hide . . .	Hides the selected distribution. The distribution is hidden in the graphic area but remains listed in the Details grid.
Rename	This option only appears when a reference distribution has been added to the Distributions Viewer. Select a reference distribution and rename it, as needed.
Change Color	
Copy to Clipboard	Copies the selected distribution data to the clipboard as text.
Remove Distribution	Permanently removes the selected reference distribution from the viewer. A confirmation dialog box appears before the distribution is removed.
View Original Experiment	If Reference Distributions have been imported to the Distributions Viewer, this option opens the source experiment, if available.
Create Reference	Designates the selected distribution as a reference.
Designate/Remove as Target	Assigns and removes the selected distribution as a verification target. The menu option toggles depending on the current state of the distribution. Target distributions can be used to calculate % difference from a target in the Statistics Viewer.

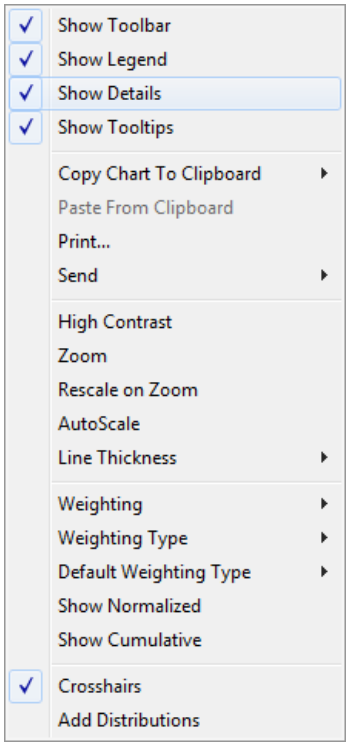
Note: If you right-click in the column heading of the Details table, additional options appear so you can customize the table or copy/print it.

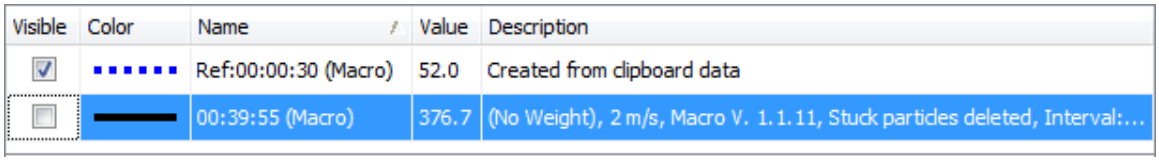
The Distributions Viewer Details Panel

A Details table enables you to customize the distributions in the viewer.

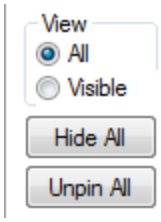
Details button—Click this button from the toolbar to open the details table. Click it again to close the table. You can also double-click in the lower left corner of the viewer to display the details.

Alternately, right-click in the distributions graph and select the **Show details** option in the context menu.





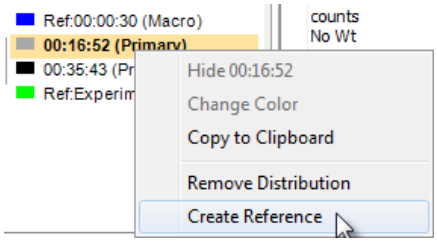
Use the **View** buttons to the left of the details table to choose which distributions display on the graph.



The All button displays all the distributions in the list. When the **All** button is selected, the **Visible** check boxes are used to select which distributions are displayed. The **Hide All** button hides all visible data in the graph. The **Visible** check boxes must be rechecked to view the distribution again. **Unpin** All button unpins (removes) all distributions on the graph.

CREATING A REFERENCE DISTRIBUTION

A Reference Distribution can be created by right-clicking the **Create Reference** option from the measurement context menu. Reference Distributions are special because they are retained when loading/importing an experiment template. Reference Distributions include all distributions imported from other Experiments and Distribution Libraries.

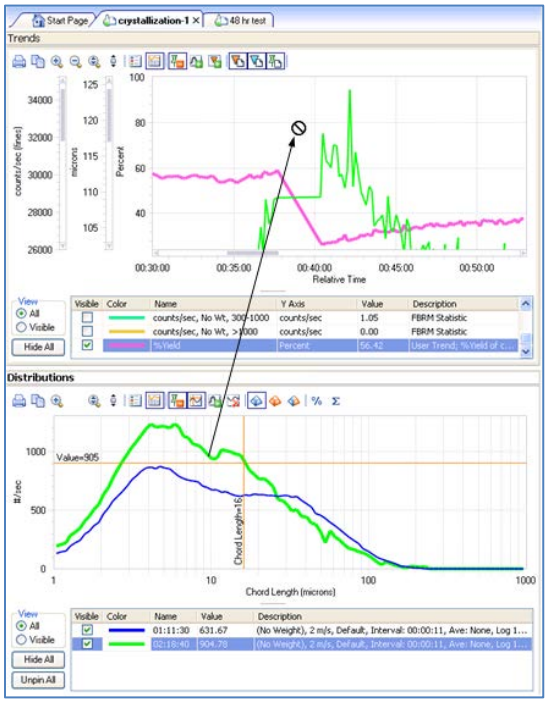


To create a reference using a distribution from a different experiment, you can drag the distribution from the Distributions Viewer in another experiment or Distribution Library to the current Distributions Viewer.

Note: On experiments containing a large number of distributions, it is easier to drag the distributions from the distribution name in the legend.

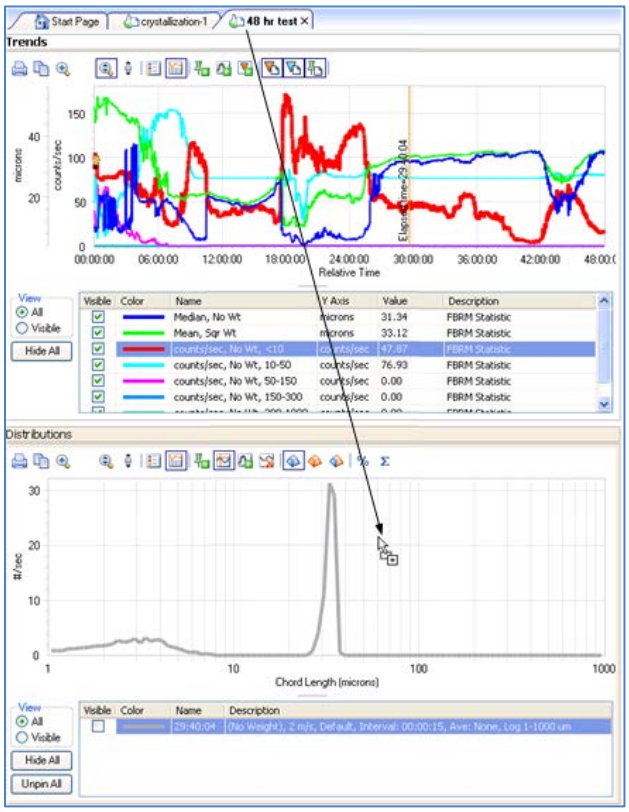
To add a reference distribution using the click-and-drag method:

1. On a Distribution display or Distribution Library, click on distribution to be included in current display. The cursor changes to the symbol shown if the plot was correctly selected.
2. Drag the cursor to the tab of the destination display.



3. When the cursor hovers on the destination tab, focus switches to the tab and the Distributions Viewer is displayed.

	4. Drag the cursor to the graph area.
	5. The cursor changes to a shortcut icon.

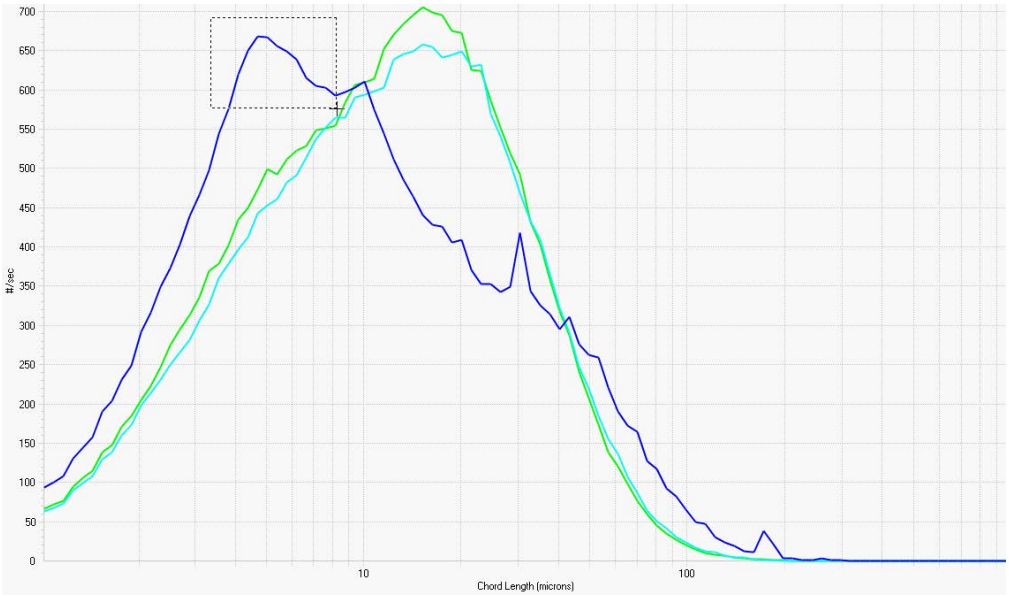


	6. Release the mouse button in the Distributions Viewer.
	The dragged trend is copied to the destination Distributions Viewer.

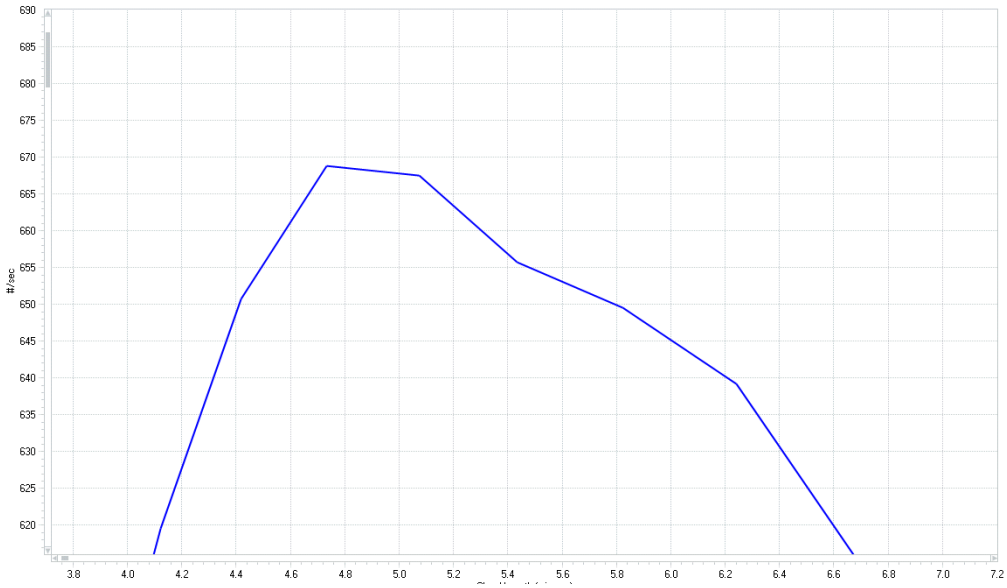
DISTRIBUTIONS VIEWER ZOOM OPERATION

Zoom in on a distribution by one of two paths: (1) Right-click on the chart and select the Zoom option, or (2) Click the Zoom icon button on the toolbar.

Using the mouse as a drawing tool, drag the mouse over the area you wish to enlarge, as shown below.



The area zooms to a close-up view of the selected area.

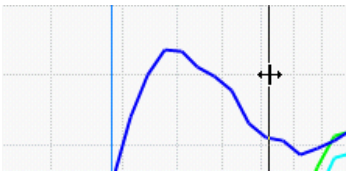


To return to the normal size, right-click on the zoomed display and select **Reset Zoom** or reset by clicking the Reset Zoom icon button on the toolbar.

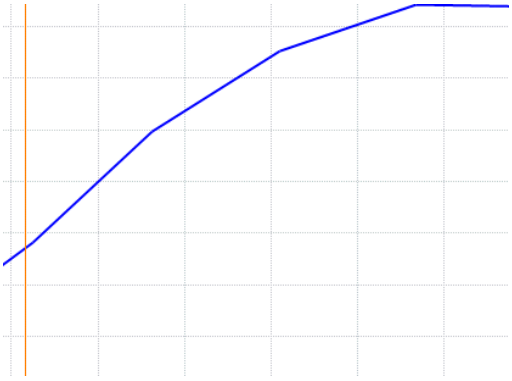
DISTRIBUTIONS VIEWER ZOOM OPERATION WITH RESCALE ENABLED

When Rescale is enabled, zooming has a slightly different effect. The x-axis is the only selectable portion of the graph.

	When the Zoom button is clicked the cursor changes to a zoom icon. Move the cursor to the beginning point of the area to be zoomed. A vertical bar appears. Hold the mouse button and drag the cursor to the end point of the zoom area.

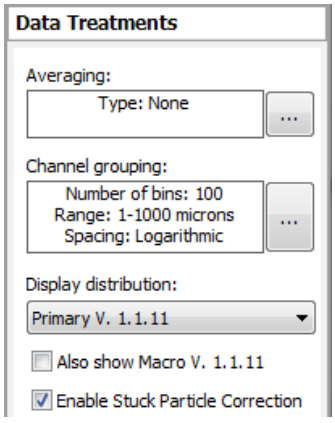


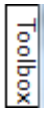
Release the mouse button to display the zoomed graph with the x-axis rescaled.



Applying Data Treatments to Experiment Data

Several data treatment tools can be applied to experiment data (Distributions and Trends) to simplify analysis and comparison. These tools are on the Data Treatments task pane located in the right corner or right side of the Experiment display page.



	To open the Toolbox, click the Toolbox icon in the upper-right corner of the main window.

	Notice the pin button that appears to the right of the open Toolbox. It toggles in the Toolbox to appear or collapse when you click it, as follows:
	Horizontal pin means the Toolbox only appears while the cursor is in a task pane. This is the auto-hide option where the Toolbox remains open until you move the cursor out of the task pane; then it closes automatically. Auto-hide is useful when you want to maximize the document viewing area.
	Vertical pin means the Toolbox is pinned to always appear. Pinning is useful if you want to monitor or interact with the Toolbox (or one of its task panes) frequently.

AVERAGING

Averaging, also referred to as a "smoothing method," is a statistical method to smooth out fluctuations from the measurement data.

Averaging methods can be applied to live experiments or post process as part of data analysis. The averaging settings can be altered at any time and are applied to the complete experiment data set.

Averaging multiple measurements over time can provide more stable chord length distributions. These distributions provide greater precision and enhanced sensitivity to change in dimension. The negative aspect of averaging is that it slows the response to change and, in some cases, can decrease the reported magnitude of change in time (see the FBRM Application Manual for examples).

There are 1324 each of input and output channels in this operation. Each output channel is an averaged version over past values of the corresponding input channel.

Each channel independently undergoes the same averaging operation. For this reason, the channel number is left out in the following discussion. The counts in a particular channel taken over time are denoted as x_t, x_{t-1}, ... , and the corresponding filtered values as y_t, y_{t-1}, ... , where t = 0, 1, 2, ... for the first, second, and third measurement, etc.

iC FBRM provides two types of averaging—Moving and Exponential.

Moving—A cumulative moving average calculation is based on a user-defined number of unweighted data points in the experiment. The moving average calculation is as follows:

$$V_t = \frac{1}{n}\sum_{i=0}^{n-1} X_{t-i}$$

where: $V_t = \ the\ calculated\ moving\ average\ at\ time\ t$

$n = \ the\ user\ defined\ number\ of\ unweighted\ data\ points$

$X_{t-i} = \ the\ measurement\ data\ point\ at\ time\ t-i$

Exponential—An exponential moving average calculation is based on all of the past data points in the experiment. This calculation applies weighting to all of the data points used in the calculation. The weight of a given data point used in the calculation decreases exponentially with time. The exponential moving average is calculated as follows:

$$V_t = \alpha X_t + (1-\alpha)V_{t-1}$$

where, $V_t = \ the\ calculated\ exponential\ average\ at\ time\ t$

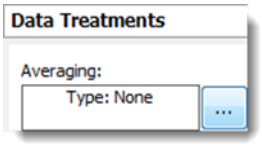
V_{t-1} = *the calculated exponential average at time* $t-1$

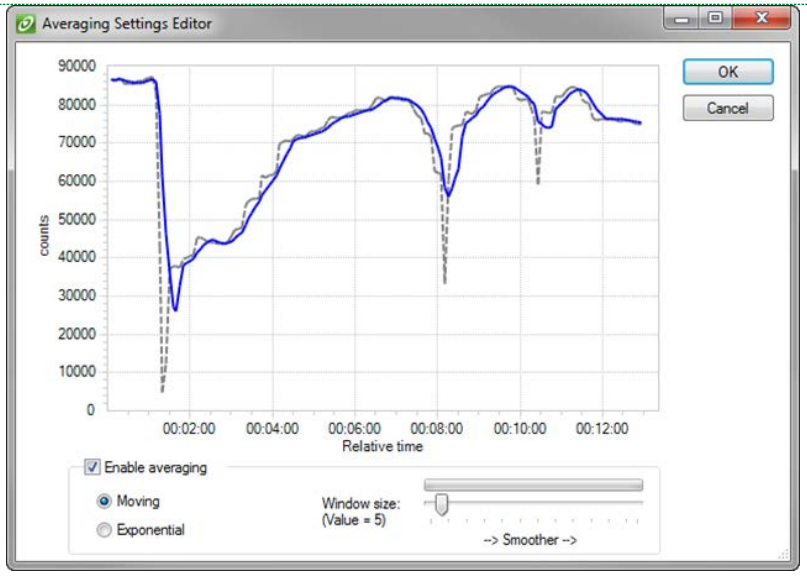
X_t = *the measurement data point at time* t

α = *the weighting coefficient.*

FBRM Averaging Settings Editor

1. Select the Data Treatments task pane from the Toolbox.
2. Click the More options button ( ) next to the Averaging data treatment to open the Averaging Settings Editor.





3. In the Averaging Settings Editor, check the box to **Enable averaging** data over time.
4. Select Averaging Method—**Moving** or Exponential. Then, use the 'Window size' or 'Alpha factor' slider to adjust the degree of averaging.

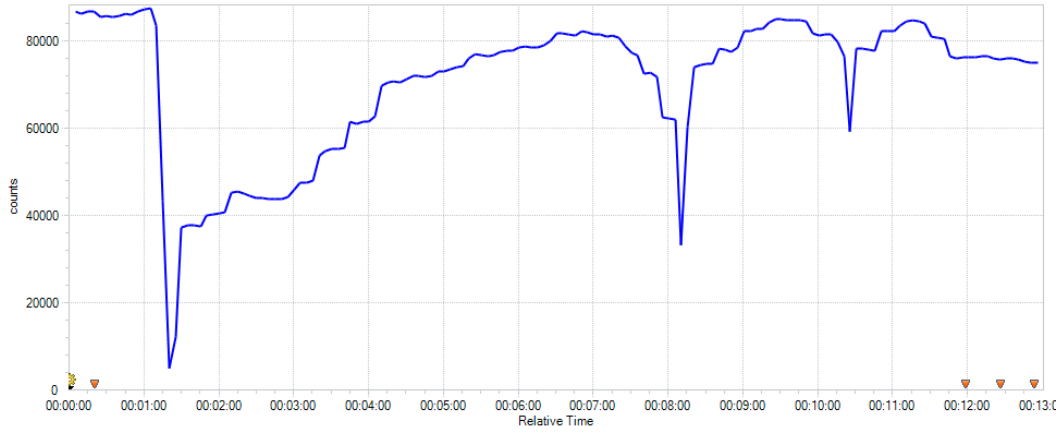
Moving Average, Window Size (2 to 60): Use the slide bar to adjust n (user defined number of unweighted data points). The larger the n, the smoother the data.

Exponential Average, Alpha factor (1.00 to 0.00): Use the slide bar to adjust alpha (α) factor to a value between one (no smoothing) and zero (maximum smoothing).

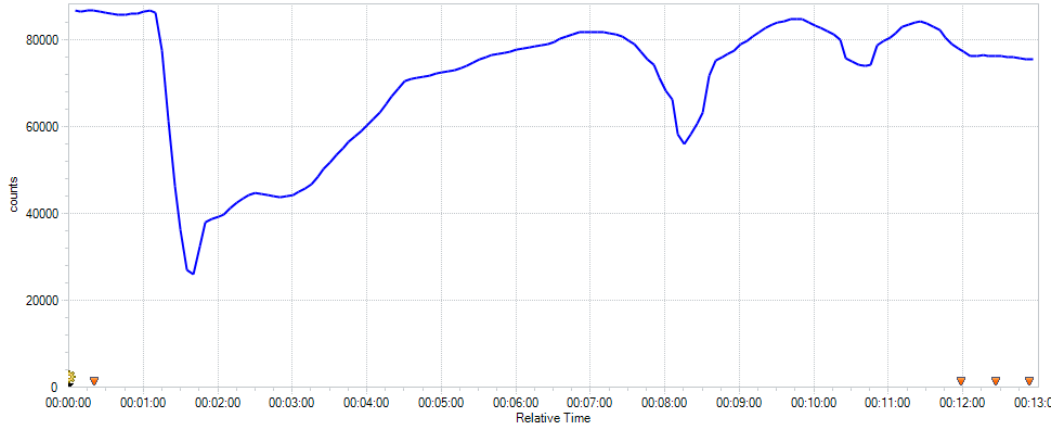
5. Click OK in the Averaging Settings Editor to apply the settings.

In the following examples, different averaging methods are applied to the same FBRM data.

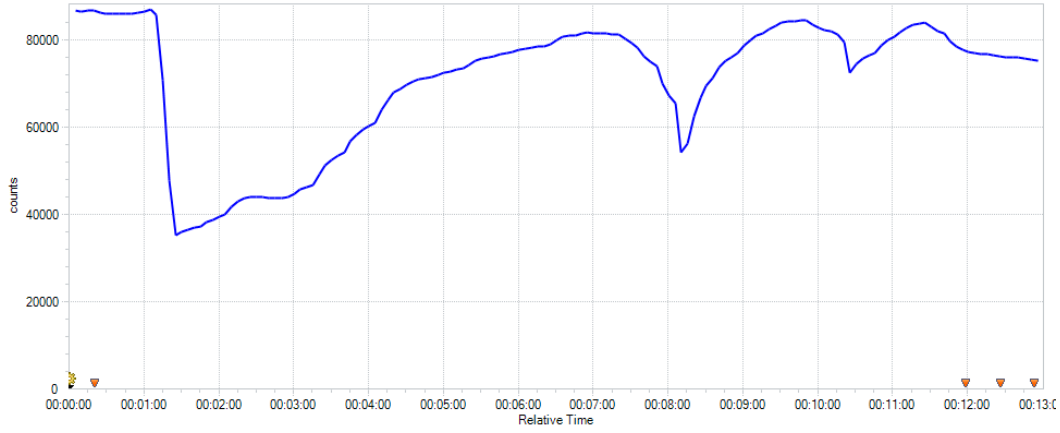
No Averaging:



Moving @ n=5



Exponential @ α = 0.35



CHANNEL GROUPING

Channel grouping provides the ability to put the primary chord length distribution of 1324 channels into a channel grouping more appropriate to the application under investigation.

Understanding the difference between channel grouping on a linear X-Axis versus a logarithmic X-Axis is important, as the choice of grouping can significantly affect both the data display and the statistic calculation.

	Logarithmic (Log) Grouping	**Linear Grouping**
Channel width	Progressively wider	All equal
Distance between midpoints	Proportionate to the logarithm	Equal
Result	High resolution on small-particle side of distribution Significantly lower resolution (channel-averaging) on large-particle side of distribution	Equal resolution throughout the distribution. Each channel has equal probability of a receiving a count

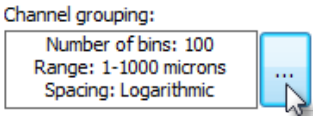
When deciding whether to use a logarithmic or linear grouping, consider the number of channels selected and the effects caused by the number of channels selected. From a display perspective, significantly different data attributes may be highlighted depending on the chosen grouping.

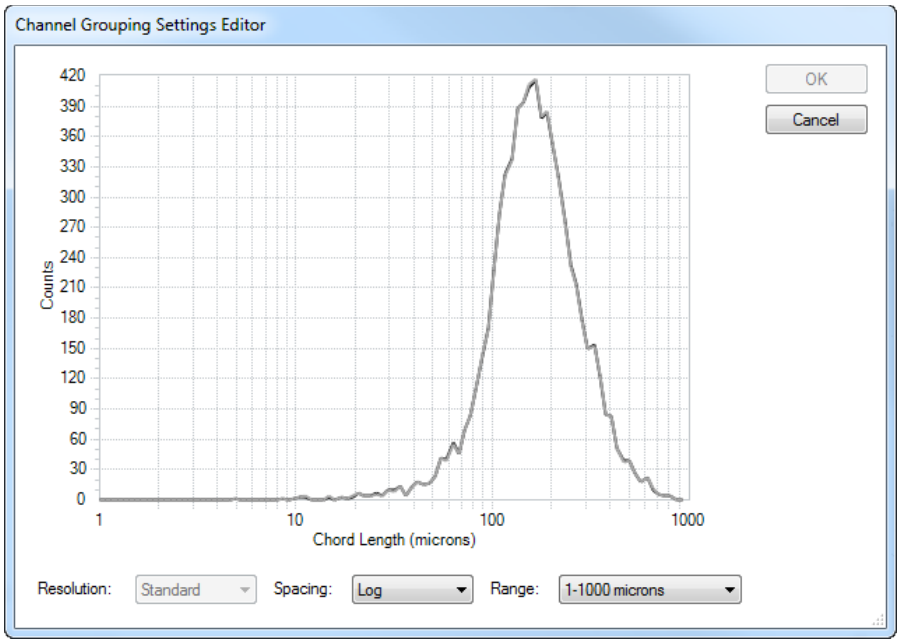
- **Counts per channel**: The more counts per channel, the better the statistical stability. The fewer channels chosen, the more counts there will be per channel.

- **Number of channels**: The more channels chosen, the higher the potential resolution of change and the more counts required for statistical stability. The fewer channels chosen, the lower the potential resolution of change and the fewer counts required for statistical stability.

FBRM Channel Grouping Settings Editor

	Use the Channel Grouping Settings Editor to specify the parameters for a channel group. Open the window by clicking the browse icon on the Channel Grouping section of the Data Treatments task pane.





The dialog box contains the following fields:

Resolution	Changes the Y-axis which effectively changes the resolution between Standard and High. See Effects of Channel Grouping on Resolution. The Log spacing scale only supports standard resolutions.
Spacing	Specifies if the spacing between chords is in a linear or log scale.
Range	0-30 microns 0-100 microns 0-300 microns 0-500 microns 0-1000 microns 0-2000 microns 0-3000 microns 0-4000 microns Specifies the overall scale of the X-axis.

Click the **OK** button after making changes to have iC reprocess the data and display a progress window.

EFFECTS OF CHANNEL GROUPING ON RESOLUTION

E25, G400, G600 Hardware

Range (microns)	**Standard Resolution (Linear/Log)** **# of bins**	**High Resolution (Linear)** **# of bins**
0-100	50	250
0-1000 / 1-1000	100	500
0-2000 / 1-2000	200	500
0-4000 / 1-4000	200	500

Note that logarithmic spacing only supports standard resolution. (Refer to Channel Grouping.)

Statistics Viewer

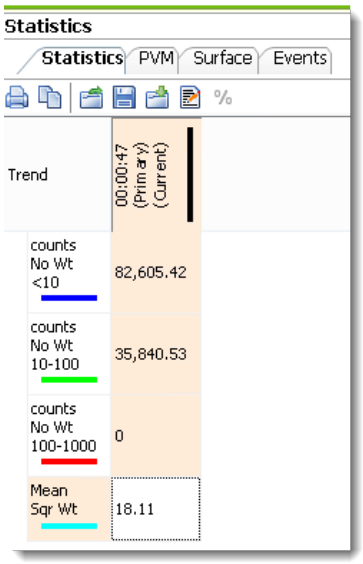
The Statistics Viewer plots chosen statistics over time so you can see how the particle or droplet system is changing. The viewer collects the time each measurement was taken and the Chord Selection Model used, along with the value for each loaded statistic. Statistics of the pinned measurements in the other viewers appear in separate columns showing counts of the different chord lengths in customizable buckets. In addition, user-defined trends and trends imported using copy/paste or drag-and-drop appear as a statistic.

You can load, merge, save, and edit statistics using the toolbar above the Statistics Viewer.

STATISTICS VIEWER DISPLAY

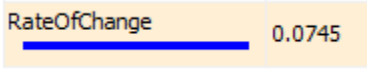
Particle or droplet counts display in distributed Statistic Sets that can be edited, loaded, and saved using the tools provided with the viewer.

A default statistics set loads when initially starting an experiment unless you select a template experiment with customized statistics in the **Start Experiment** wizard.

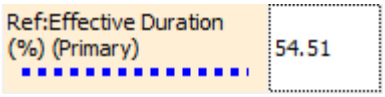


- Use the right and left arrow keys on the keyboard to step through the columns one column at a time.
- Use the up and down arrow keys to step through the rows one row at a time.

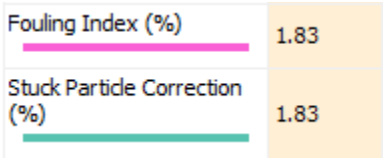
User-defined trends display on the viewer with the name of the trend listed.

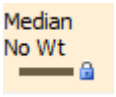


Trends imported via copy/paste or drag/drop appear at the bottom of the statistics table with dashed lines.



Statistical trends defined through the Edit Statistics window also appear in the list.



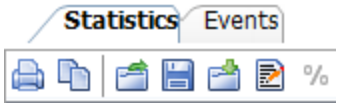


The lock symbol beside the color bar in the Statistics Viewer (and in the Trends Viewer Details table) indicates that the color has been locked (manually assigned) by the user.

LOADING, MERGING AND SAVING STATISTIC SETS

The toolbar at the top of the viewer offers functions such as editing, loading, merging, saving, printing, or comparing the statistics list, as described below.

Note: Changing statistics is a display change only and does not alter the raw data. Loading, Merging, or Saving functions have no effect on the data. These functions enable you to tailor the statistics viewer to suit individual needs.

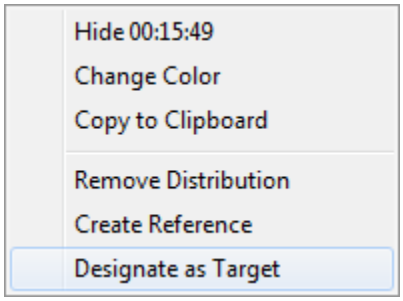


	Print the current statistics set to a designated local or network printer.
	Copy the statistics set to the clipboard. The statistics paste as a table.
	Load statistics definitions from a file (*.icStats format). This replaces the default statistics. IMPORTANT: Loading a Statistic Set overwrites the current Statistic. A set of default statistics can be uploaded to the system and return the Statistics Viewer the default. The default statistics set is located at: C:\Program Files (x86)\METTLER TOLEDO\iCFBRM #.#\default.icStats Note: The default Statistic Set cannot be modified by the user.
	Save the current statistics as a file (A set of statistics definitions save in the *.icStats file format).
	Merge statistics definitions from a file (*.icStats) with the current statistics.
	Edit Statistics—Opens a window where you can define additional statistics, delete a statistics, or edit the current definitions. See Editing Statistics Definitions.
%	Percentage of Target—After a Distribution has been 'Designated as Target,' click this button to display a "Target" column in the Statistics Viewer to compare the current values to the target. The system recalculates the statistics using the target distribution as the basis.

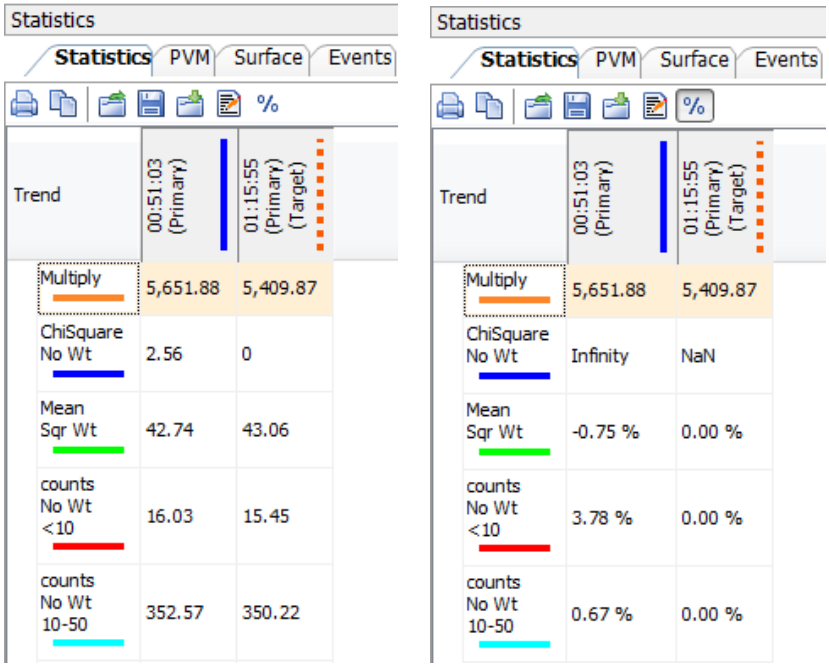
Designate a Distribution as "Target"

A distribution can be designated as a "target." A target distribution is a distribution used as a mean upon which all other distributions can be measured against when calculating the statistics. iC FBRM offers the possibility to show the statistics of the remaining distributions as a % of the target statistics.

To designate a distribution as a target, right-click on the distribution heading and select Designate as Target from the menu.



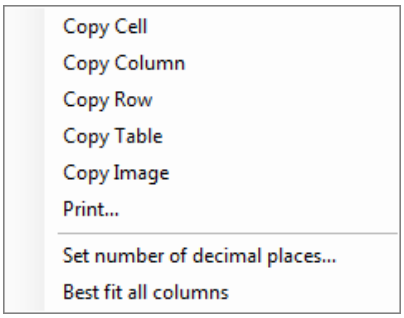
The figure on the left shows a Statistics Viewer with the left column designated as a target. The figure on the right shows the viewer after the **% of Target** button has been clicked to recalculate the values to a percentage of the target.



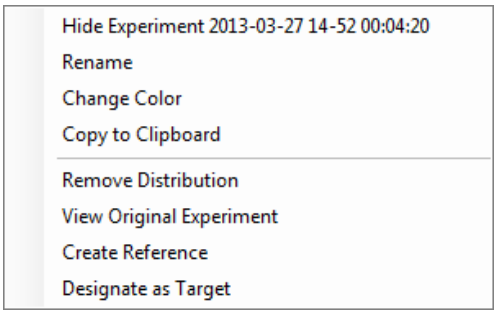
Statistics Viewer Context Menus

The Statistics Viewer incorporates several right-click 'context' menus.

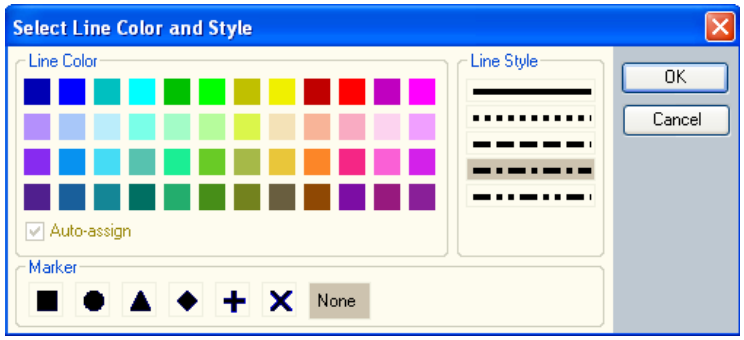
- Right-clicking in a data cell opens a menu that includes options for copying all or some of the contents of the viewer to the clipboard as text.



- Right-clicking on a distribution heading in the Statistics Viewer opens another context menu that enables the format of the distribution to be edited.

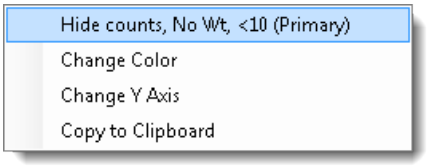


The menu contains the following options.

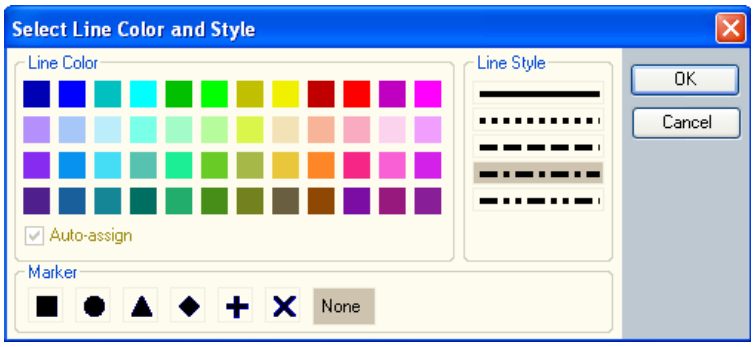
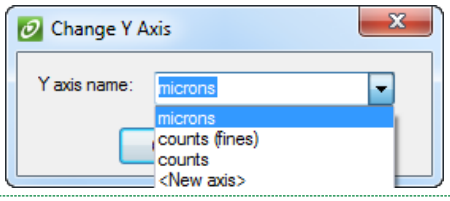
Show/Hide . . .	Shows or Hides the selected distribution. The distribution is hidden in the graphic area but remains listed in the Details grid.
Rename	Allows the user to rename a distribution.
Change Color	
Copy to Clipboard	Copies the column data from the table to the clipboard. The data copies as text.
Remove Distribution	Permanently removes the selected distribution from the viewer. If the distribution is a reference, a confirmation window displays before removal.

View Original Experiment	If a Reference Distribution is included, this option appears so you can open the experiment that contains the source of the distribution.
Create Reference	Designates the selected distribution as a reference.
Designate/Remove as Target	Assigns and removes the selected distribution as a verification target. The menu option toggles depending on the current state of the distribution. Target distributions can be used to calculate % difference from a target in the Statistics Viewer.

- Right-clicking on a statistic set row name displays a third context.

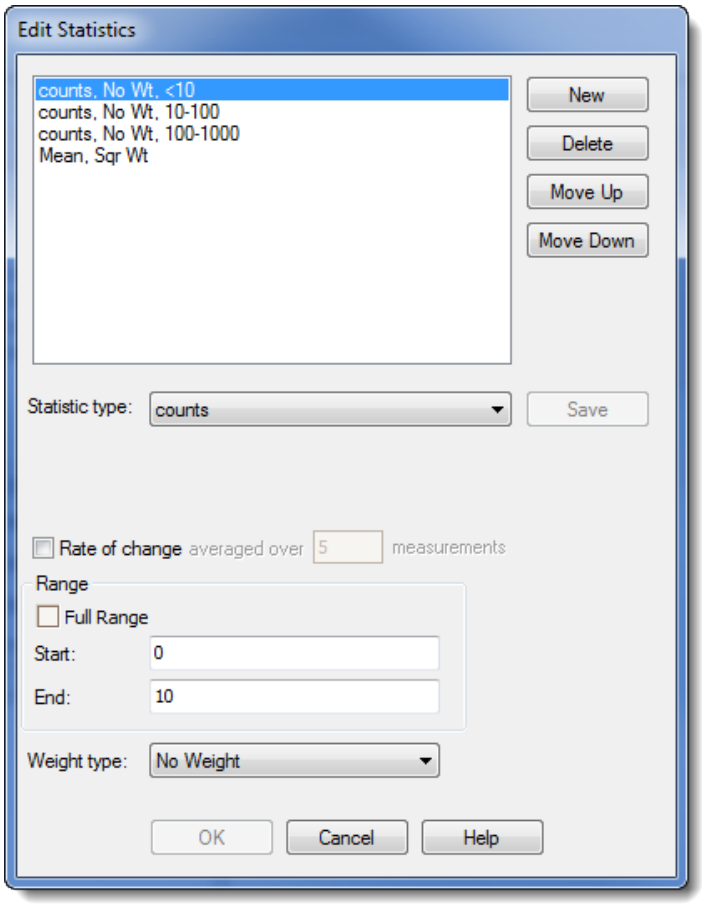


The menu contains the following options.

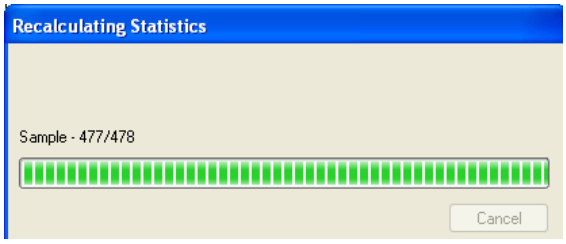
Show/Hide	Shows or Hides the selected statistic in the Trends Viewer. A hidden statistics remains listed in the Trend Viewer Details table with the Visible check box unchecked.
Change Color	 When you change a color, a locked symbol appears to the right of it in the Statistics Viewer as well as in the Trends Viewer Details table.
Change Y Axis	Enables changing the Y-axis in the Trends Viewer. 
Copy to Clipboard	Copies all the data for the selected statistic to the clipboard. The data copies as text.

EDITING STATISTICS DEFINITIONS

Edit—Click this button on the Statistics Viewer to edit the current statistics definitions. Clicking the button opens the Edit Statistics window.



Whenever a change is made to a statistic, the change must be saved using the **Save** button. This button is normally disabled until an edit to a statistic is made. Edit made for a statistic must be saved before any edits can be made to another statistic. When all changes are complete, the user clicks the **OK** button to recalculate the statistics. The **OK** button is disabled until edits are saved. This indicates that recalculation of the statistics in unnecessary since no statistic properties have changed.



Below is the normal order for editing statistics or defining a new statistic.

- Choose the Statistic Type
- Define the Range

- Specify Weighting
- Specify Rate of Change
- New Click to add a new statistic to the set.
- Save Define the new statistic or edit an existing statistic and then click Save.

To rearrange the order of the statistics in the table and the Statistics Viewer, use the **Move Up/Move Down** buttons. First, select the statistic to move. Then, click the appropriate button to place the statistic in the desired location.

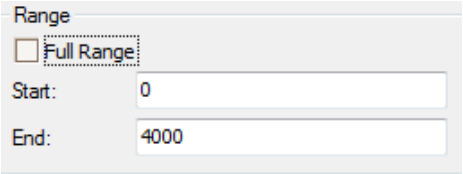
Defining New Statistics

To define a new statistic, click the **New** button and define the following properties: (When editing an existing statistic, select it and modify one or more of these properties.)

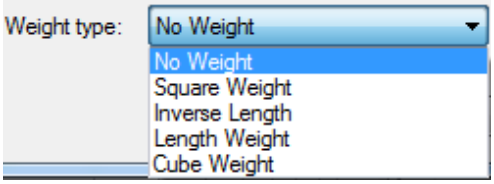
Statistic type—Select from standard types or from special sets of statistical types.

Rate of Change—A first derivative trend can be calculated based on another trend. Click the rate of Change check box and select the time window over which the first derivative will be calculated.

Range—Select the chord length range (in µm) over which the statistic is calculated using the **Full Range** check box or the **Start/End** fields.



Weight Type—Select the weighting type for the statistic.

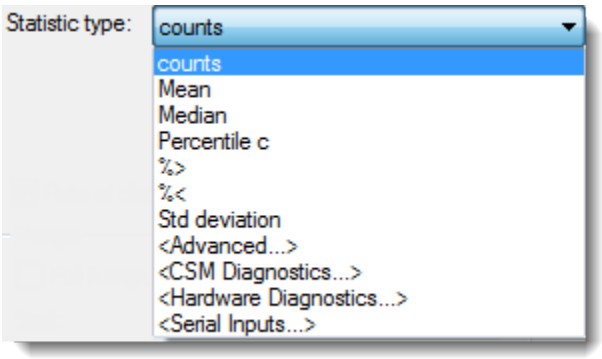


The No Weight setting applies no weighting.
The Square Weight setting applies a weight factor to each channel's counts of: **chord length ^ 2 / Avg. (chord length ^ 2)**.
The Inverse Length setting applies a weight factor to each channel's counts of: **(1 / chord length) / Avg. (1 / chord length)**.
The Length Weight setting applies a weight factor to each channel's counts of: **chord length / Avg. chord length**.
The Cube Weight setting applies a weight factor to each channel's counts of: **channel chord length ^ 3 / Avg. (chord length ^ 3)**.

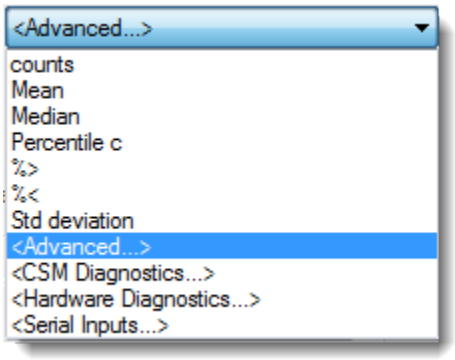
Statistic Types

In the Edit Statistics window, select a statistic type and view or edit its properties (refer to Editing Statistics Definitions for details about the editing window).

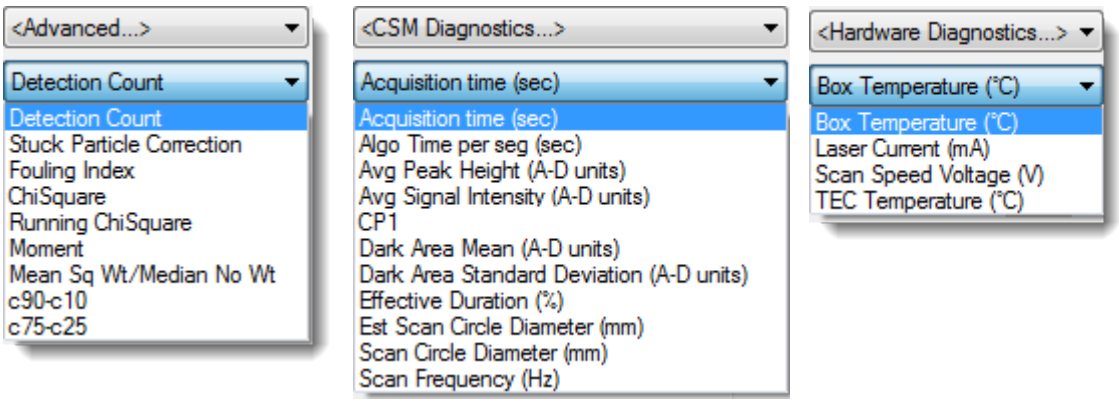
To change the type of statistic, choose from the **Statistic type** selection list. Basic statistic types appear at the beginning of the selection list.



Sets of related statistic types appear below the basic list in brackets. For example: <Advanced...>



When you choose one of the sets, an additional submenu of types appears to further define the statistic. For example, the submenus for <Advanced>, <CSM Diagnostics>, and <Hardware Diagnostics> statistics include the following options:



CSM Diagnostics and Hardware Diagnostics: Details about these are in the Diagnostic Statistics topic.

Note: Serial Inputs (up to 30), such as diagnostics and temperature values, can be trended as defined in the Serial I/O Configuration Task Pane.

The upcoming tables describe the available statistic types. More detailed information is provided in Appendix A: Data Processing in the iC FBRM Software.

BASIC STATISTICS

Counts	The Total Counts statistic calculates the sum of the number of counts over all channels in the distribution, reported in counts per meter.
Mean	The Mean statistic calculates the mean chord length of the distribution, reported in microns.
Median	The Median statistic calculates the median chord length of the distribution, reported in microns.
Percentile c	The Percentile statistic calculates the chord length, reported in microns, corresponding to a user specified percentile. In addition to the standard weighting and sub-ranging settings, this statistic requires a percentile value to two decimal places.
% >	The Percent Above statistic calculates the percentage of the measured chord lengths that are greater than a user specified chord length. In addition to the standard weighting and sub-ranging settings, this statistic requires a chord length value, in microns, to two decimal places.
% <	The Percent Below statistic calculates the percentage of the measured chord lengths that are less than a user specified chord length. In addition to the standard weighting and sub-ranging settings, this statistic requires a chord length value, in microns, to two decimal places.
Standard Deviation	Statistical calculation of the standard deviation of chord lengths of the distribution, reported in microns.

ADVANCED STATISTICS

Detection Count	Number of detected maxima in the FBRM signal. This value is normalized to maxima/2 m scanned. This diagnostic must always be larger than the number of accepted counts.
Stuck Particle Correction	(When 'Enable Stuck Particle Correction' is ON) The percent of the scan circle that has been ignored/removed due to stuck particles and corrected for by scaling the remaining counts. 10% is the maximum. NOTE: This statistic should be added (trended) if 'Enable Stuck Particle Correction' is selected in the Data Treatments Task Pane.
Fouling Index	Percentage of the scan circle that is covered with stuck particles or "fouled." If the percentage exceeds 50%, the system issues a Fouling Index High alarm. NOTE: This statistic should be added (trended) if 'Enable Stuck Particle Correction' is selected in the Data Treatments Task Pane.
Chi Square	The Chi-Square statistic calculates the value of the chi-square test for the distribution compared to the target reference distribution. This statistic is reported as a dimensionless number.
Running Chi Square	The Running Chi-Square shall calculate the chi-square test for the current distribution compared to a previous distribution that is n records back from the current distribution. In addition to the standard weighting and sub-ranging settings, this statistic requires a value for n, the number of distributions back from the current. Chi-square test is actually a ratio. Therefore, if two distributions are identical, the value is 1 (default). The user must enter an integer value when the statistic type is running chi square.

Moment	The N-th Moment statistic - full range. The user can specify the value for n, the order of the Moment. The value for n ranges from 0 to 4. The unit of the statistic is: 0th moment = the total number of particles 1st moment = the total length of the particles (micron) 2nd moment = the total area of the particles (micron^2) 3rd moment = the total volume of particles (micron^3) 4th moment = micron^4 The user must enter an integer value when the statistic type is moment.
Mean Sq Wt /Median No Wt	The Mean/Median statistic calculates the ratio of the square-weighted mean and the unweighted median over the full range of the distribution. This statistic shall ignore any user-defined weighting and sub-ranging settings.
c90-c10	The c90-c10 statistic calculates the 90th percentile statistic minus the 10th percentile statistic, reported in microns.
c75-c25	The c75-c25 statistic calculates the 75th percentile statistic minus the 25th percentile statistic, reported in microns.

DIAGNOSTIC STATISTICS

Below is a list of available diagnostic statistics for hardware and Chord Selection Modules (CSMs). Available diagnostic statistics correspond to specific instrument types. For example, with the G600 hardware, all diagnostics statistics are available. For G400 and E25 hardware, as these are electronic probe systems, air-pressure related alarms are suppressed and the air-pressure diagnostic is not available. CSM Diagnostics apply to all ParticleTrack instruments.

Hardware Diagnostics	
Air Pressure	Air supply pressure to the air motor (does not apply to electronic probe systems).
Box Temperature	Field unit enclosure temperature.
Laser Current	Electrical current being drawn by the laser (mA)
Scan Speed Voltage	The error between the desired scan speed and the actual scan speed. A value close to zero indicates the probe is running at the desired speed (air-driven probes only).
TEC Temperature	Temperature of the Thermoelectric Cooler (TEC) adjacent to the detector/laser assembly inside the field/base unit.
CSM Diagnostics	
Acquisition Time	Number of seconds' worth of data that was used in calculating the distribution. For example, only 7 seconds of data may have been used to create a distribution after 10 seconds.
Algo Time per Seg	Amount of time (seconds) required to process the CSM algorithm.
Average Peak Height (A-D units)	Average height above the dark area mean of any detected maxima.
Average Signal Intensity (A-D units)	Height of the average FBRM signal above the dark area mean.
CP1	Calibration Parameter configured during manufacturing and service. This is usually a straight line on the Trend chart.

Dark Level Mean (A-D units)	Average FBRM signal height when the laser is turned off.
Dark Level Standard Deviation (A-D units)	The FBRM signal STD deviation when the laser is turned off.
Effective Duration (%)	The processing efficiency of the Gen 3 unit. It is defined as the total time of the signal processed divided by the measurement duration.
Estimated Scan Circle Diameter (mm)	Estimated scan circle diameter in millimeters is a calculation based on the instrument scan speed. The diameter should be within ± 10% of the calculation.
Scan Circle Diameter (mm)	Actual parameter configured during manufacturing and service. This is usually a straight line on the Trend chart.
Scan Frequency (Hz)	Number of rotations the scanner makes per second.

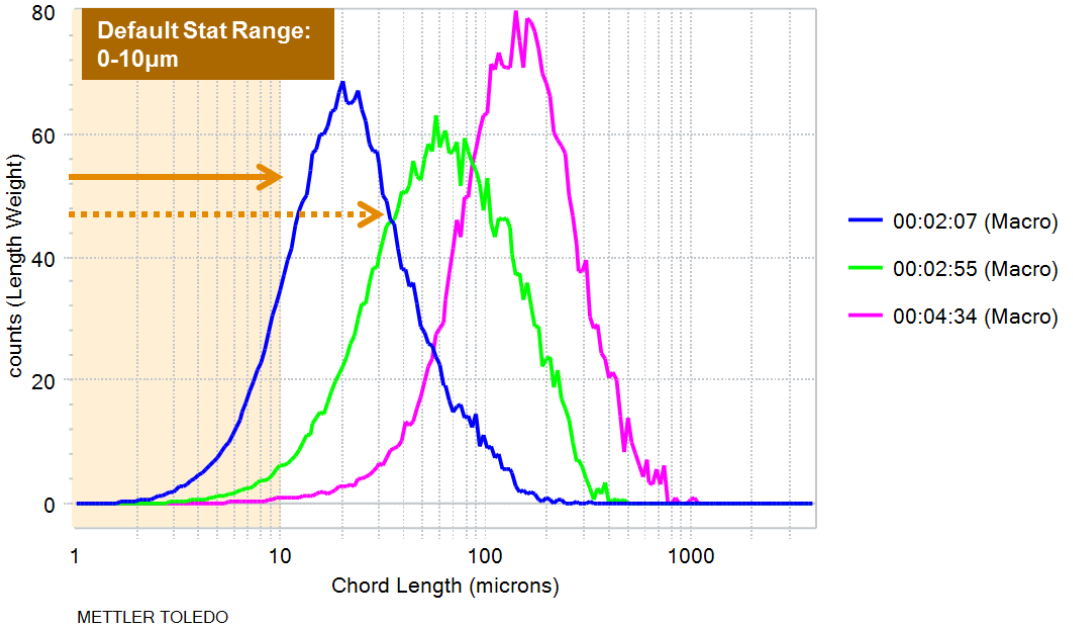
AUTOSTATS

AutoStats is an automated analysis function tool that provides the user with the most amount of information in the least number of statistics. By applying a D2i (Data to Information) algorithm called AutoStats, a minimum number of statistics are automatically calculated to maximize the sensitivity to change for the particle system under investigation.

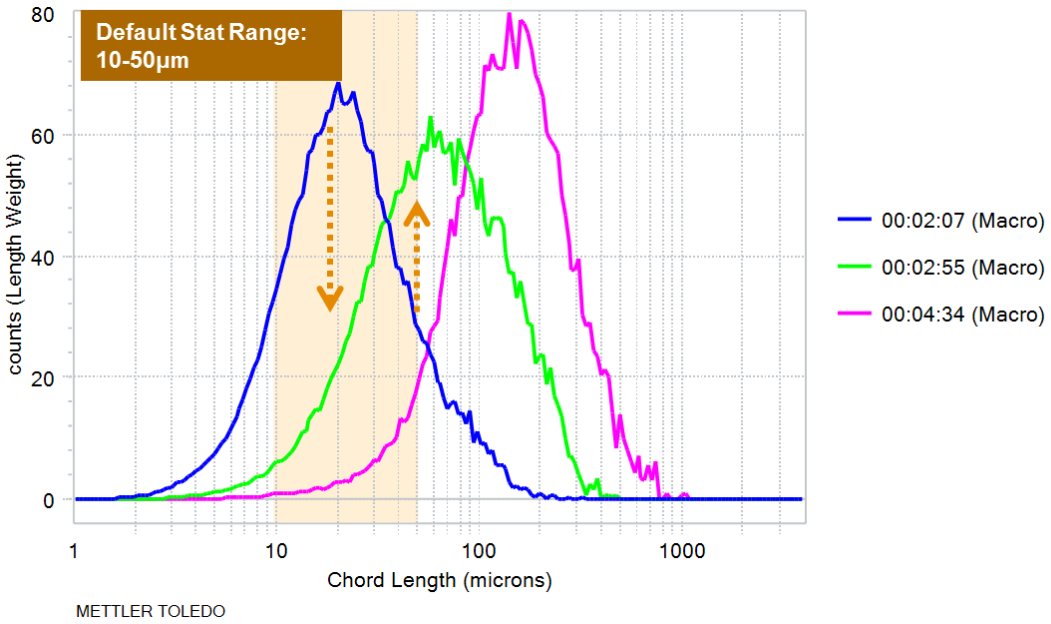
Smart AutoStats algorithms reduce analysis time by maximizing sensitivity to change while simplifying the number of trends to analyze.

Examples

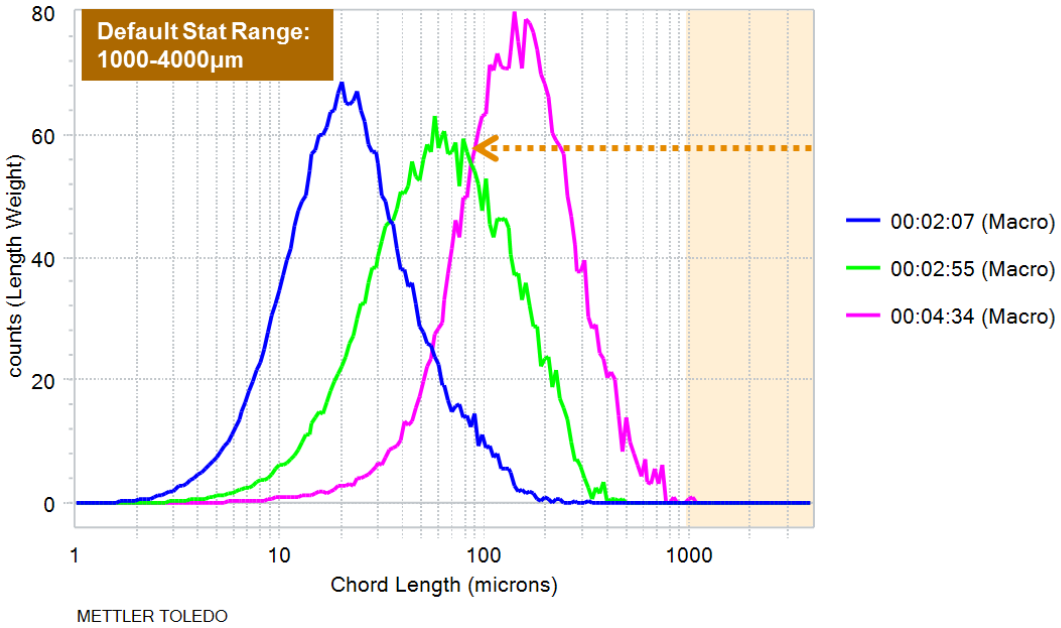
- The default fine statistic range can often be expanded to encompass all the fine particles.
  - In this example fines can extend out to 30 µm.
  - Between 2:07 and 2:55 there is a decrease in particles <30 µm and an increase in particles >30 µm.



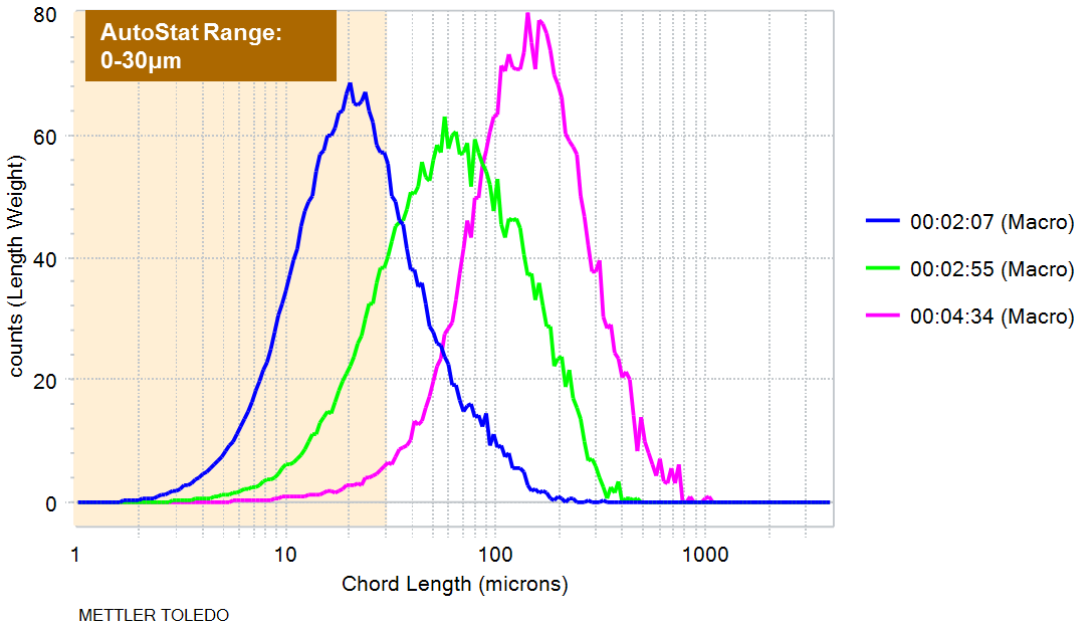
- The default statistic range may mask changes if it extends through a transition where there are changes to the fine and coarser particles.
  - The range can be split to enhance resolution to changes in the particle system.
  - Below a decrease in particles 10-30 µm is offset by an increase in particles 30-50 µm.

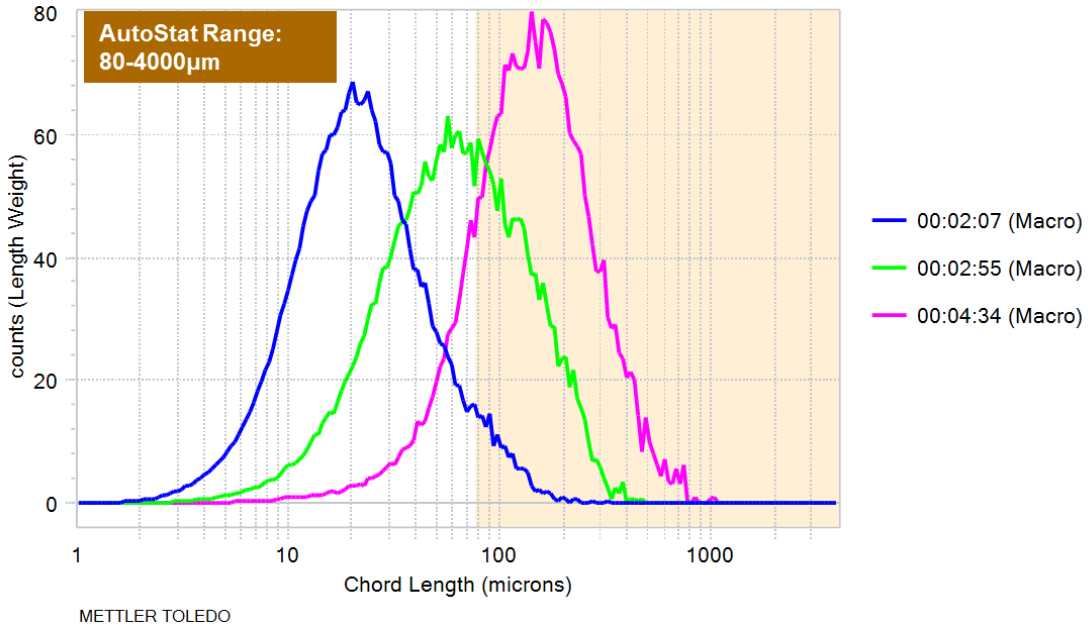


- The coarse default stat range can often be expanded to encompass all the large particles.
  - This simplifies the statistics and adds to the statistic resolution.
  - The default range 1000-4000 µm can be combined with 150-300, 300-1000 µm.



- By applying AutoStats, a mathematical algorithm analyzes changes to:
  - Simplify analysis by minimizing the number of statistics.
  - Maximize resolution to change for the specific particle system.

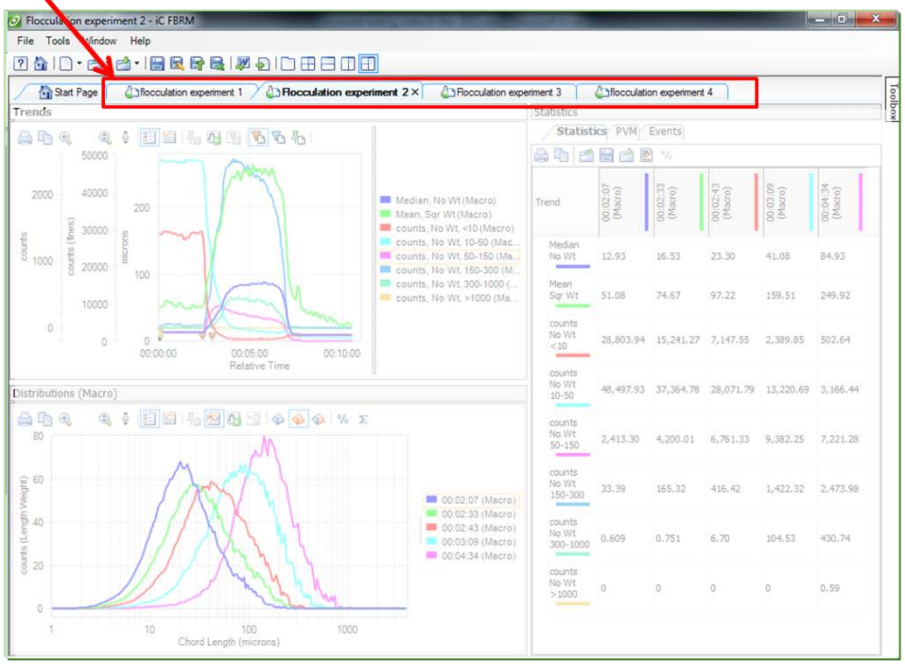




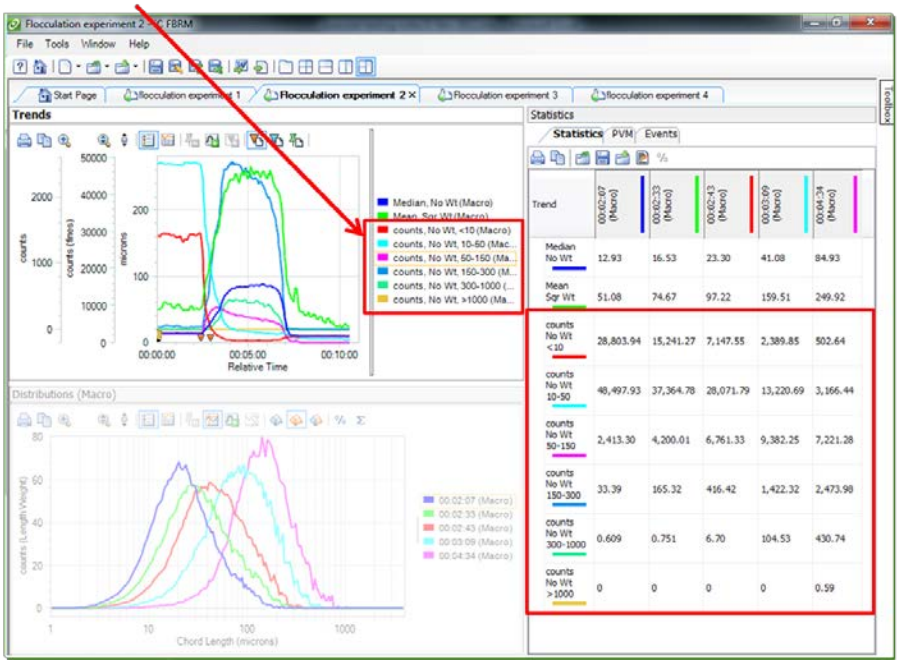
Applying AutoStats to Multiple Experiments Simultaneously

If the default statistics are compounded by multiple experiments such as in a design of experiment (DOE), complexity increases and the default statistics potentially become less sensitive to specific changes across all the particle systems.

- Four DOE Experiments for simultaneous analysis



- Default Statistics include 6 default channel ranges configured without analysis of the particle system



  - Users may run AutoStats that provides rapid analysis of all four experiments choosing the minimum number of statistics. This maximizes sensitivity to change.

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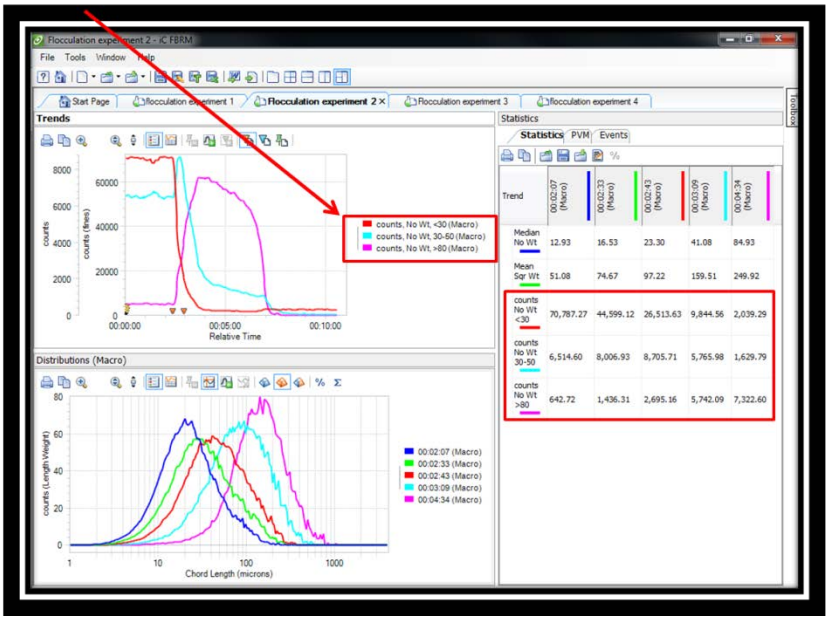
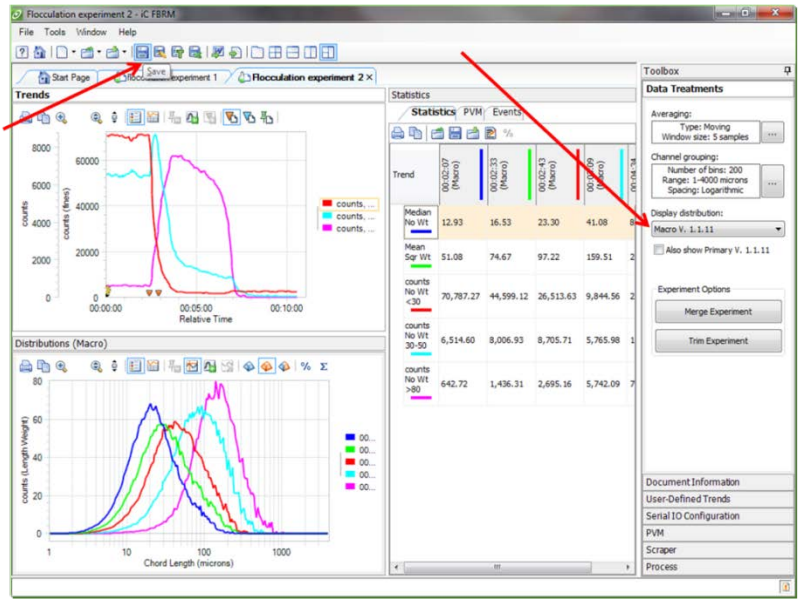
- Auto Stat results include only 3 channel ranges intelligently chosen to maximize the resolution to change for the particle system under investigation



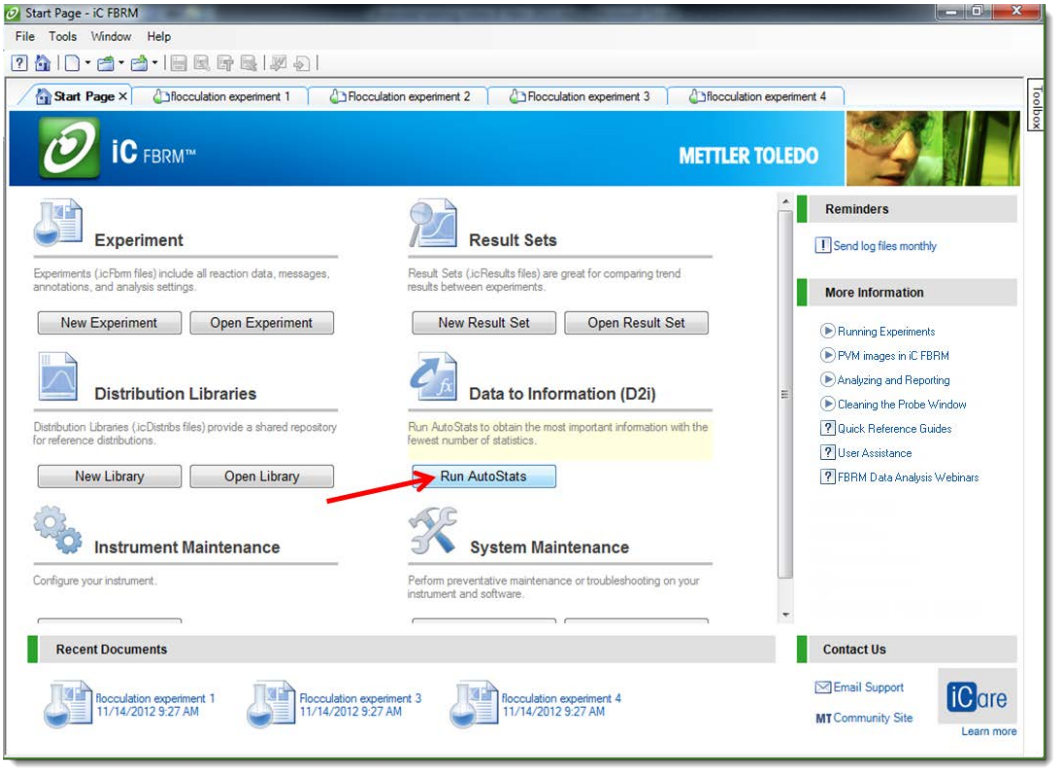
- By applying AutoStats, a minimum number of statistics are automatically calculated to maximize the resolution to change for the particle system under investigation.
- Smart AutoStats algorithms reduce analysis time by maximizing sensitivity to change while simplifying the number of trends to analyze.

How to Apply AutoStats in iC FBRM

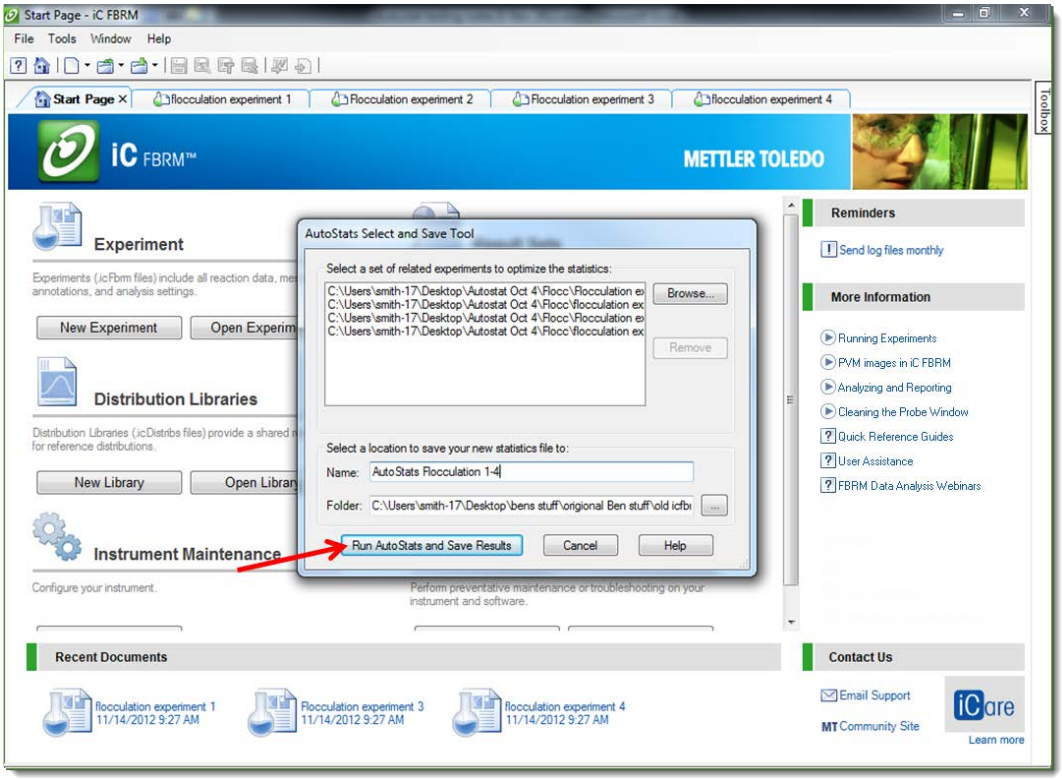
1. Before running AutoStats, save the experiment after selecting the same Chord Selection Model (Primary or Macro) as the Chord Selection Model to be effective.



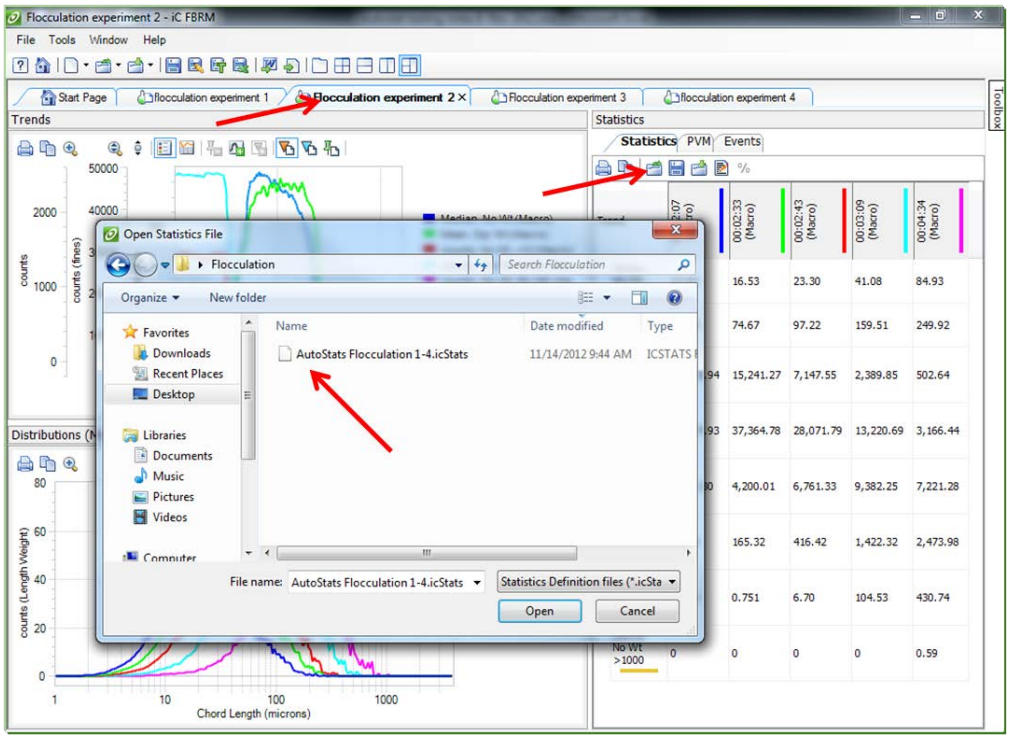
2. Select to **Run AutoStats** from the Start Page.



3. Select to Run AutoStats on all four open files.



4. Highlight an experiment and open the results.



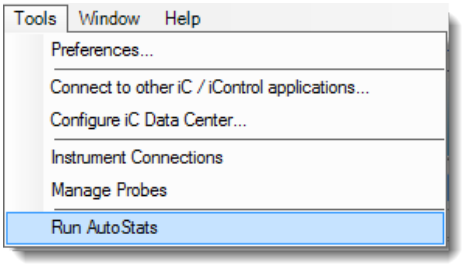
Running AutoStats

Choose one of two methods to perform an AutoStats evaluation.

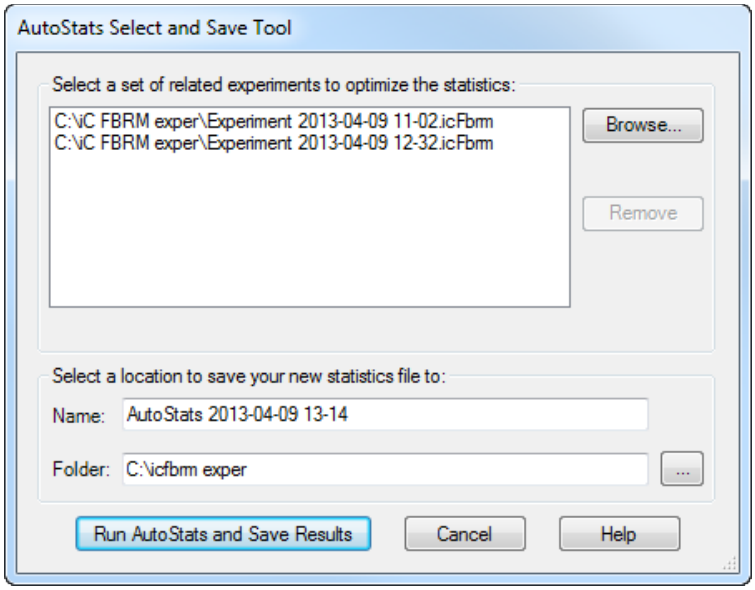
- **Run AutoStats** button on the Start Page that is used to initiate an AutoStats evaluation.

or

- **Run AutoStats** option from the Tools menu that that runs an AutoStats evaluation on currently opened experiments.

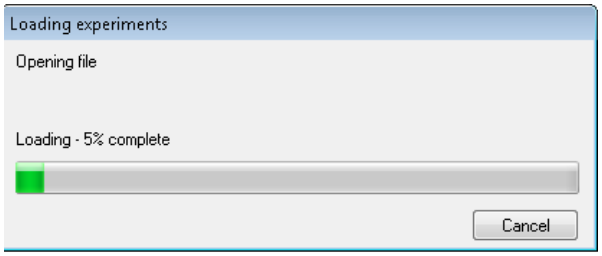


When initiated, an 'AutoStats Select and Save Tool' window displays a list of all opened experiments.

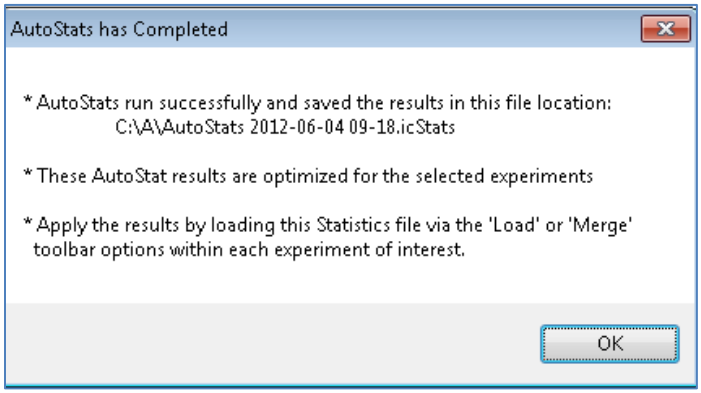


Browse...	Click the **Browse** button to open a file browser and select the experiment/s to use for the evaluation. Use the Shift and Control keys on the browser to select multiple experiments. You can use the **Browse** button multiple times to add additional experiments to the list of experiments.
Remove	Existing experiments in the list can be removed by first selecting the experiment and then clicking the **Remove** button.
Name and Folder	Enter a file name and browse to the location for the new statistics file that will be created when you run AutoStats.
Run AutoStats and Save Results	Click this button to run the AutoStats evaluation.

A progress dialog appears during experiment data analysis.



When the evaluation completes, a success dialog appears.

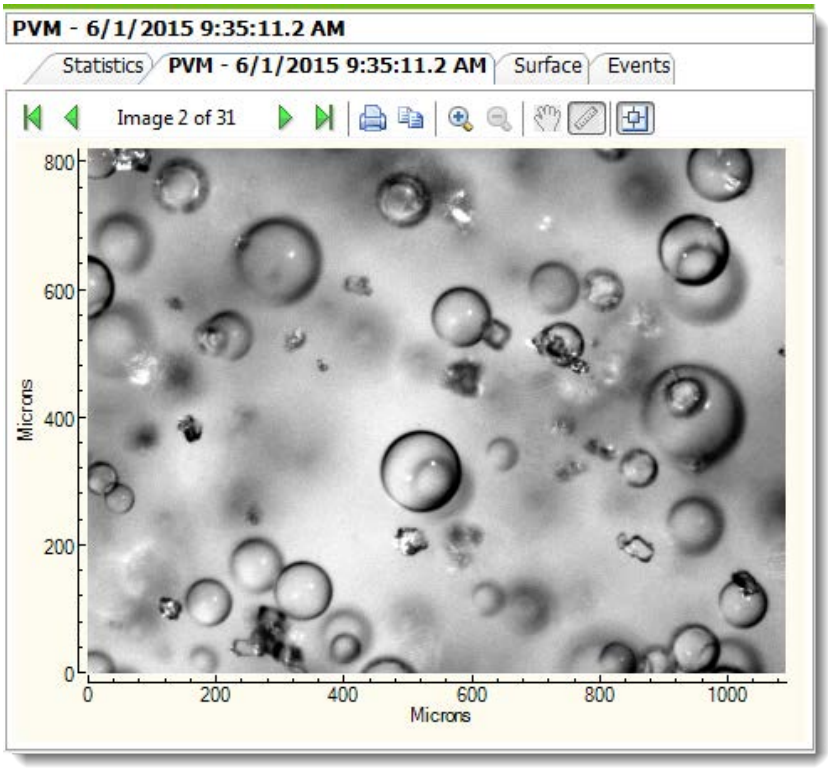


Load Statistics Definitions from a file—When saved, the new AutoStats file is a statistics definition file and can be used in any experiment by clicking on this 'Load Statistics Definitions from a file' button in the Statistics Viewer toolbar. After you select the AutoStats definition file, the optimized statistics are used for the experiment.

Note: If an AutoStats evaluation contains multiple experiments, the default Chord Selection Model (CSM) must be the same for all experiments. If the CSMs for the experiments do not match, the user should change the default CSM using the Data Treatments task pane and **Save** the experiment prior to running the AutoStats evaluation.

PVM Viewer

The PVM (Particle Vision and Measurement) Viewer in iC FBRM processes and displays images from an iC PVM experiment or a saved sequence (*.seq) file.



To load and adjust PVM images, use the PVM Task Pane in the Toolbox.

1. Choose the image source:

- iCPVM export folder

  Starting with iC PVM 7.0 SP1, choose this option to load images from the folder designated in the iC PVM export. User can import during live experiment or after the experiment is complete. Images can be in .png or .jpg format. To enable the live images feature, iC PVM must also be running on the same control computer as iC FBRM.

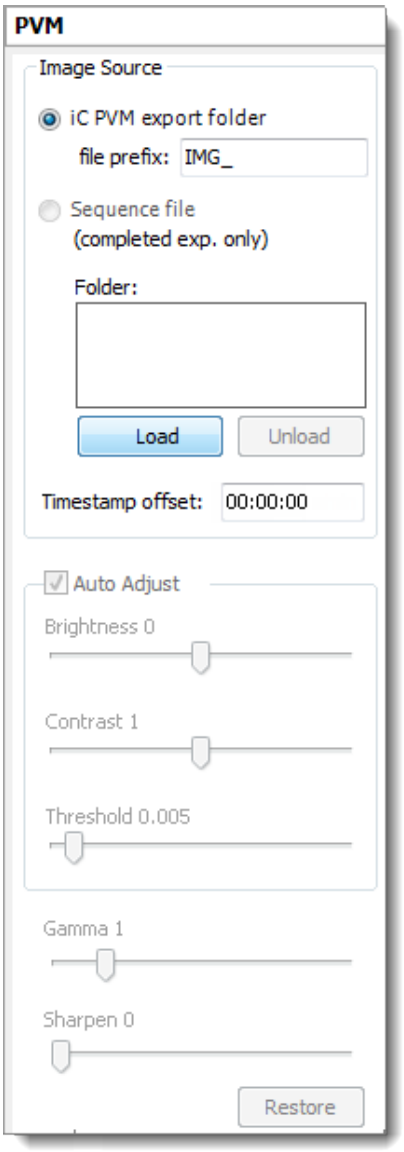
  Note: Please use the same prefix for the image files as specified in the iC PVM export. By default, the prefix is IMG_. If the prefix is changed in iC PVM, you must change the prefix in the iC FBRM PVM task pane.

- Sequence file (completed experiment)

  For sequence files exported from iC PVM 7.0 or from PVM v8.x software (.seq format), choose this option.

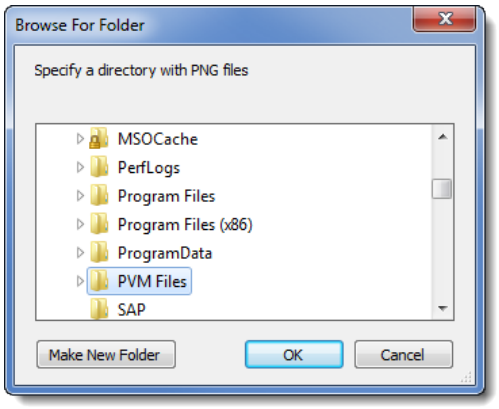
  Note: Importing sequence file is for completed experiment only.

  To import a sequence file, the sequence file (*.seq) for the experiment and its accompanying image folder must have the same name (disregarding the extension) and reside in the same upper-level folder. The date and time that the image was taken appears in the PVM title bar.

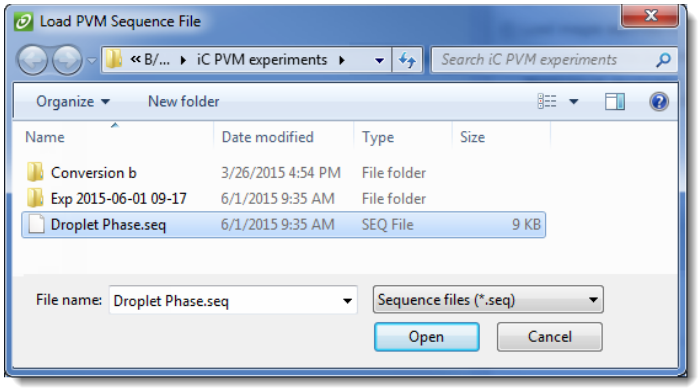


Click **Load** on the PVM task pane to navigate to one of the following, depending on the image source you selected:

a. iC PVM export folder of images:



b. Or, the Sequence file (*.seq) and its accompanying images.

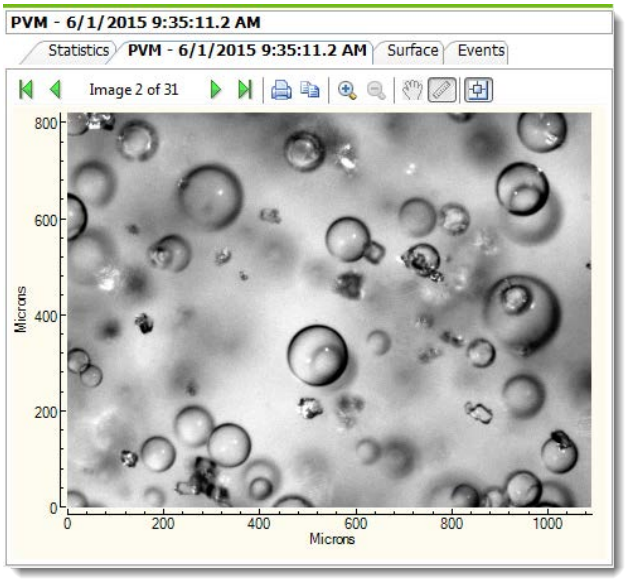


2. Select the file to import and click **Open** to load the selected images into the iC FBRM PVM Viewer.
3. **Timestamp Offset**: If the loaded sequence file was created in another time zone or on a PC with a different time setting, use the up/down arrows to adjust the image time stamp to the current PC time zone (in minutes and seconds).

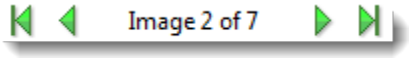
You can now observe PVM images appear in the PVM Viewer.

USING THE PVM TOOLBAR

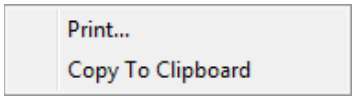
Use the PVM toolbar to manipulate the displayed image.



Arrow buttons at the top of the image enable navigation through the images in the file. Information identifying the currently displayed image appears between the arrows.



The toolbar above enables you to perform the following actions:



Copies the displayed image to the clipboard. When copied, the image is in its native resolution. To obtain a high resolution, expand the image to its maximum (Tab) view before copying. The copy function is also available through the context menu.

Zoom/Restore zoom—Use the magnifying glass buttons to zoom the image.

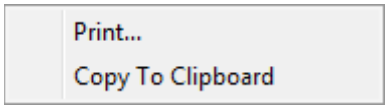
Move image—When hen in zoom mode, the Hand button enables you to pan the image.

Measure particles—Use the ruler button to measure particles. With the button is enabled, drag the cursor over the particle area to be measured to create a measurement line.

An arrow appears on the image with the particle size displayed in microns. Multiple measurements can be drawn on an image. To clear measurement arrows, move to another PVM image and then return to the image of interest. When the original image redisplays, the measurement arrows are cleared.

Individual measurement arrows can be removed by using the Ctrl-Z key combination.

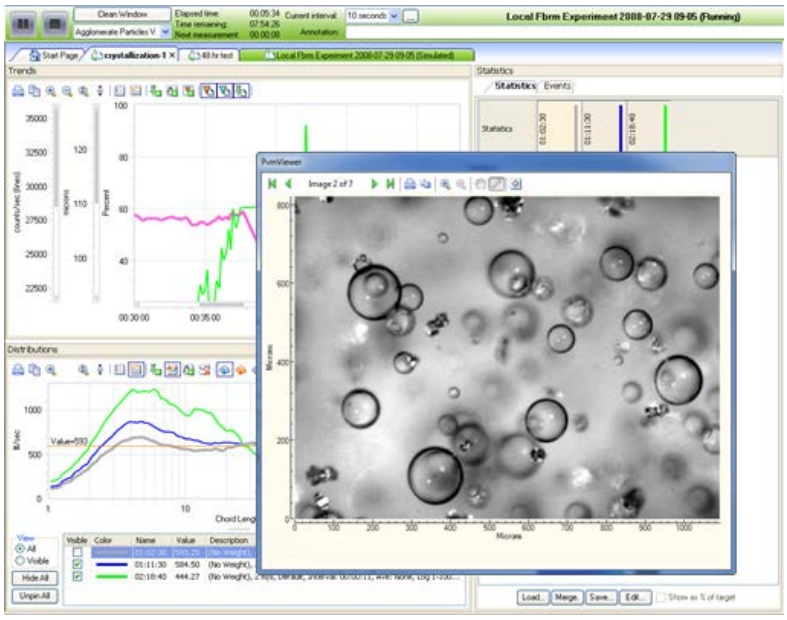
NOTE: The measure loses accuracy as the image is zoomed multiple times. This effect is the result of the pixel size of the image.



Prints the PVM image to a local or network printer. This option is also available from the context menu.

Undock viewer—The PVM viewer can also be displayed as a floating window. To open the viewer in a floating window, click the Undock button on the toolbar (see example in this section).

Dock viewer—To close the floating PVM viewer and return it to the docked position, click the button again.



As with other viewers, the PVM Viewer is linked. When a measured time in a trend or distribution is selected, the corresponding PVM image displays.

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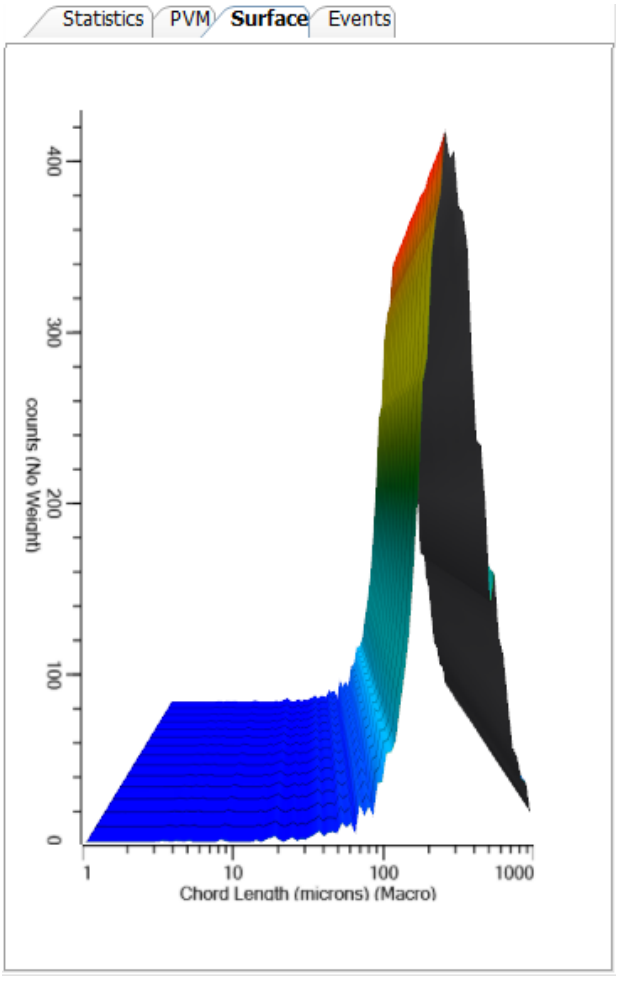
Surface Viewer

The Surface Viewer shows a three dimensional view of the entire experiment with a time line and two planes—one in the x axis and one in the z axis—for an in-depth analysis. The display can be enlarged or reduced in size, completely rotated about all three axes, and moved within the Surface Viewer. Colors can be changed to emphasize different parts of the experiment and a wire frame can be added for detailed analysis.

The data displayed in the 3D Surface Viewer matches the data treatment settings including averaging settings, channel groupings settings and selected Chord Selection Model (when more than one Chord Selection Model is selected).

The Surface Viewer supports the view currently displayed in the Distributions Viewer (weighting type, normalization, cumulative). If both weighted and unweighted distributions are displayed in the Distributions Viewer, unweighted distributions display in the 3D Surface Viewer.

During live experiment, the 3D surface is linked to the Trends Viewer, Distributions Viewer, and Statistics Viewer. During post-processing review mode, the 3D surface is linked to the Trends Viewer, Distributions Viewer, Statistics Viewer, and PVM image.



To rotate the Surface Viewer about its three axes:

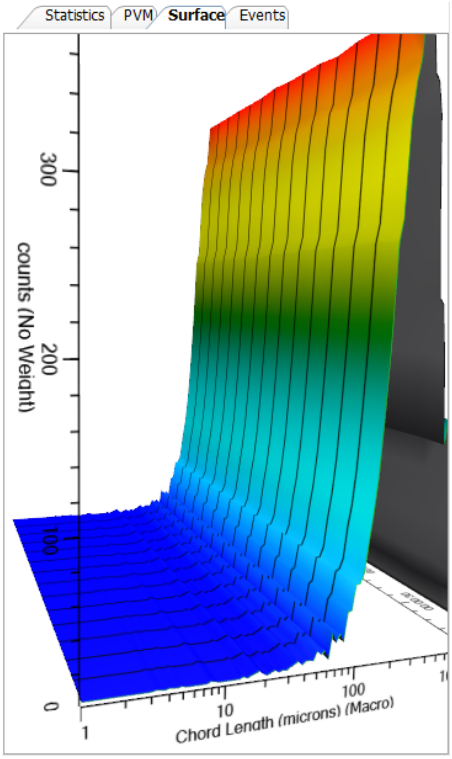
Place the cursor anywhere on the display, hold down the left mouse button and move the cursor. The display will rotate about its axis in response to vertical and horizontal movements of the mouse.

To move the display up, down, or sideways in the display area:

Put the cursor anywhere on the display, click the right mouse button, and move the mouse in the desired direction. The display moves in the same direction as the mouse.

To enlarge or reduce the size of the Surface Viewer:

Put the cursor anywhere on the display, rotate the mouse wheel counterclockwise to reduce the size of the display, or rotate the mouse wheel clockwise to enlarge the display.



Keyboard Control Keys

Place the cursor in the 3D display and use any of the following keyboard keys to adjust or navigate the image:

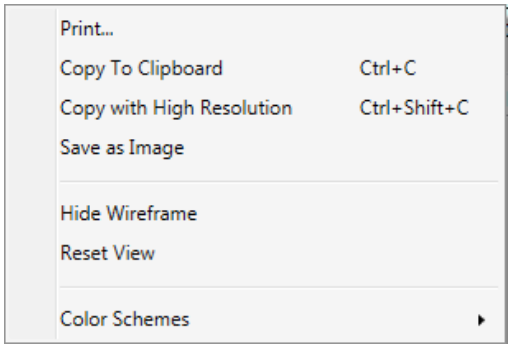
- Press the **C** key to change the color to one of the selections in the Color Schemes submenu. The color changes each time you press the **C** key until it cycles through all Color Scheme options.
- Press the **W** key to display the wire frame display. Pressing it again turns off the wire frame display.
- Press the **R** key to reset the Surface Viewer display.

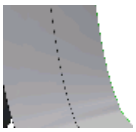
Press the keyboard up or down key ↑↓ to move the time sequence on the topographic surface.

Press the x key to display the chord length on the topographic display. Press the left or right keyboard keys ←→ move the chord length line to the right or left.

Surface Viewer Context Menu

There are several options available in the Surface Viewer context (right-click) menu.



Print	Prints the display to a local or network printer.
Copy to Clipboard	The Copy function copies a bitmap image of the surface to the clipboard. The image can be pasted into any application supporting bitmaps.
Copy with High Resolution	Copies the image to the clipboard with a higher resolution than the normal copy function.
Save as Image	Saves the view as a PNG image file.
Show/Hide Wire Frame	Show wire frame – When checked, displays a wire frame on the surface. 
Reset View	To reset the display to its default setting, select Reset View.
Color Schemes	To select a color scheme for the Surface Viewer, select the desired color scheme from the drop-down list. 

Event Viewer

The Events Viewer is a log of various events, including:

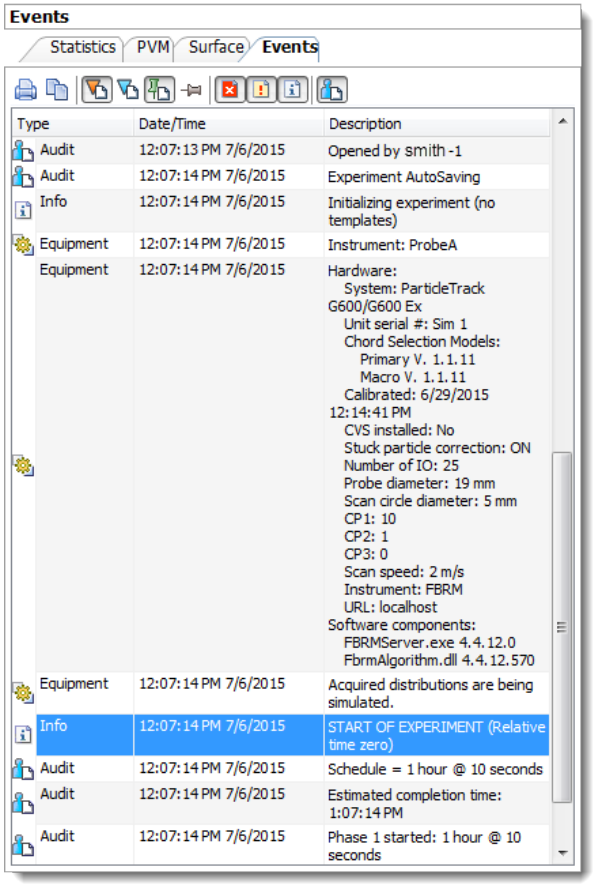
- Hardware and Software configuration
- Annotations made by the user
- System messages including Pause and Resume actions
- Error and warning messages
- Audit events
- Sample events that record the date and time a sample was taken
- A list of pinned distributions.

Event Viewer Display

The Events Viewer logs the time each sample measurement was taken during an experiment. When the user clicks a sample in the list, the sample displays in the Distributions Viewer.

IMPORTANT: Observations about an experiment can be added to the Events Viewer during an experiment by (1) right-clicking on a row in the Events Viewer and selecting Annotation from the context menu or by (2) entering an annotation in the The Live Experiment Toolbar.

To select multiple samples in the Events Viewer use the keyboard. Press the Ctrl key (for individual), or Shift+Ctrl keys (for a range). Use the context menu to pin or unpin selected multiple samples.

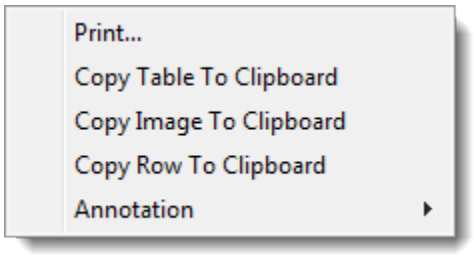


Event Viewer Context Menu

The Events Viewer incorporates a right-click or context menu that contains an option for copying the contents of the viewer to the clipboard. The data can be copied as:

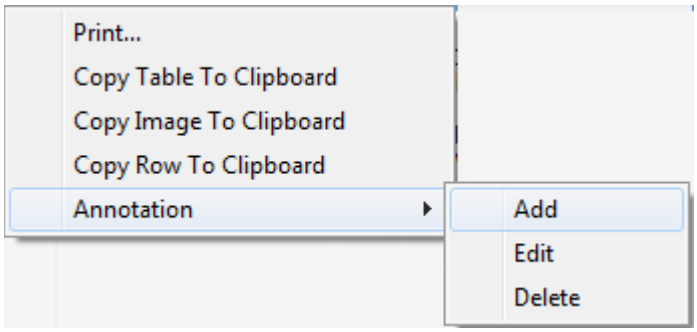
- A table of all events
- The table of events as an image
- Copy the selected row as text

A Print option can be used to print the contents of the display to a local or network printer.

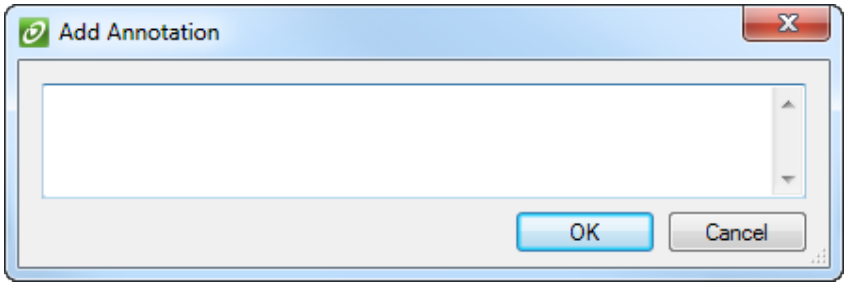


Adding an Annotation

Annotations can be added to the Events Viewer by right-clicking on a row in the Events Viewer or by using The Live Experiment Toolbar (only while an experiment is running).



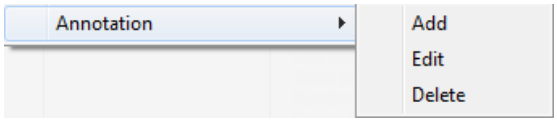
A blank annotation window opens. Enter the text for the annotation and click **OK** to save it.



	User Annotation markers display in the Events Viewer with Date/Time information
	Pinned icon displays to designate a pinned sample.
	System Message icon displays when a system message generates.

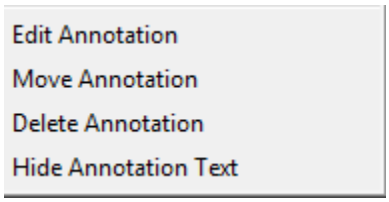
When the mouse hovers over the marker on the Measurement graph, a tool tip is displays the annotation text. Double-clicking the marker will open a popup with the annotation text.

Existing annotations can be edited by double-clicking the annotation in the Events Viewer or by using the Edit option in the right-click menu.



The menu also contains options for deleting an annotation.

Right-clicking on an Annotation in the Trends Viewer displays a context menu with two additional options.



When choosing the Move Annotation option, the marker can be dragged to the new location with the cursor. When the marker is at the desired location, click the mouse button to set the marker at that location. The annotation can be moved by right-clicking either directly on the marker or the marker text.

The annotation text can be moved by clicking on the text. The cursor changes to an arrow that can be moved to the decided location on the graph.

The Show/Hide Annotation Text will display or hide the text of the annotation next to the annotation marker.

Event Viewer Toolbar

The Events Viewer contains a toolbar that provides filters for selecting which type of messages will be displayed. The toolbar contains the following filters.

	Prints the contents of the display
	Copies the table to the clipboard
	Show/Hide all user annotations
	Show/Hide all system messages
	Show/Hide all pinned sample actions
	Show/Hide all unpinned sample actions
	Show/Hide all error messages
	Show/Hide all warning messages
	Show/Hide all informational messages
	Show/Hide all audit messages

Customize the Events Viewer filters in any combination to show or hide the log items according to you individual preferences or requirements.

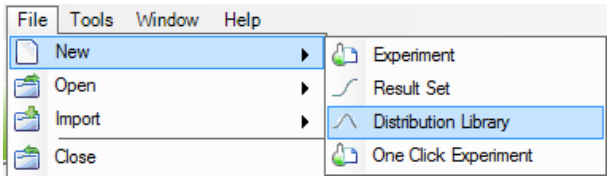
Working with Distribution Libraries

Multiple Distributions can be saved in library sets for comparison and analysis purposes.

To create a new Distribution Library:

Click **New Library** on the Start Page, or

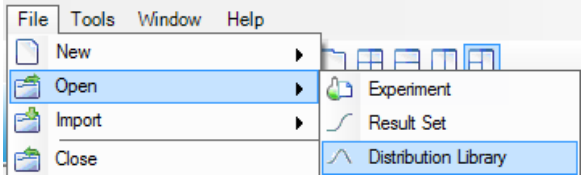
Select the New > New Distribution Library option in the File menu.



To view an existing Distribution Library:

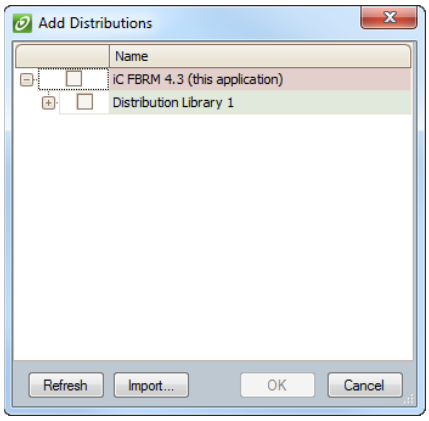
Click **Open Library** on the Start Page, or

Select the **Open >Open Distribution Library** option in the File menu.



ADD DISTRIBUTIONS DIALOG

The Add Distributions window opens when you create a Distribution Library or when you add distributions to a library.

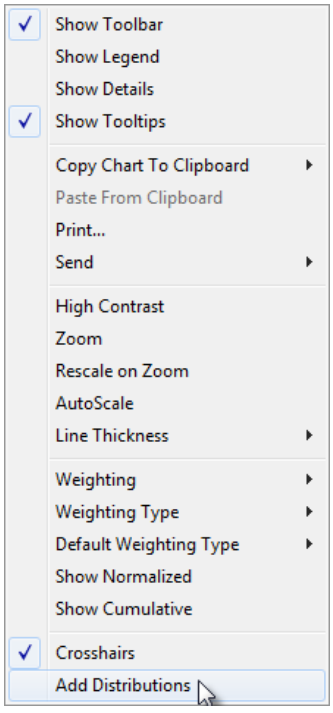


The window contains a tree-list of all pinned distributions in opened experiments. Check the desired distributions and click **OK**. The window closes and the Distribution Library view opens as a new tab in the display area.

Add Distributions by one of the following actions:

Click toolbar button  or

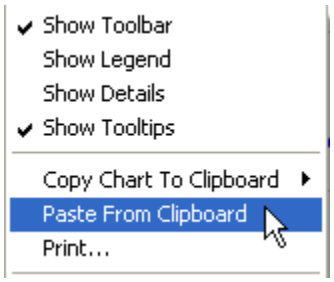
Select the **Add Distributions** option from the right-click menu.



Both these options open the Add Distributions window.

Copy-and-Paste Spreadsheet Data into Distributions Library

The user can also copy data from an Excel spreadsheet to the clipboard and paste the data into the Distribution Library viewer to create distributions. The paste function is available on the context (right-click) menu of the distributions viewer.



The first column of the data must contain the midpoints, with subsequent columns containing the values for the distributions. The first row must be a header row containing the distribution names.

- Distributions copied into iC FBRM from Excel are not be affected by Data Treatments or weighting.
- Statistics cannot be calculated for the distributions that are created from clipboard data.

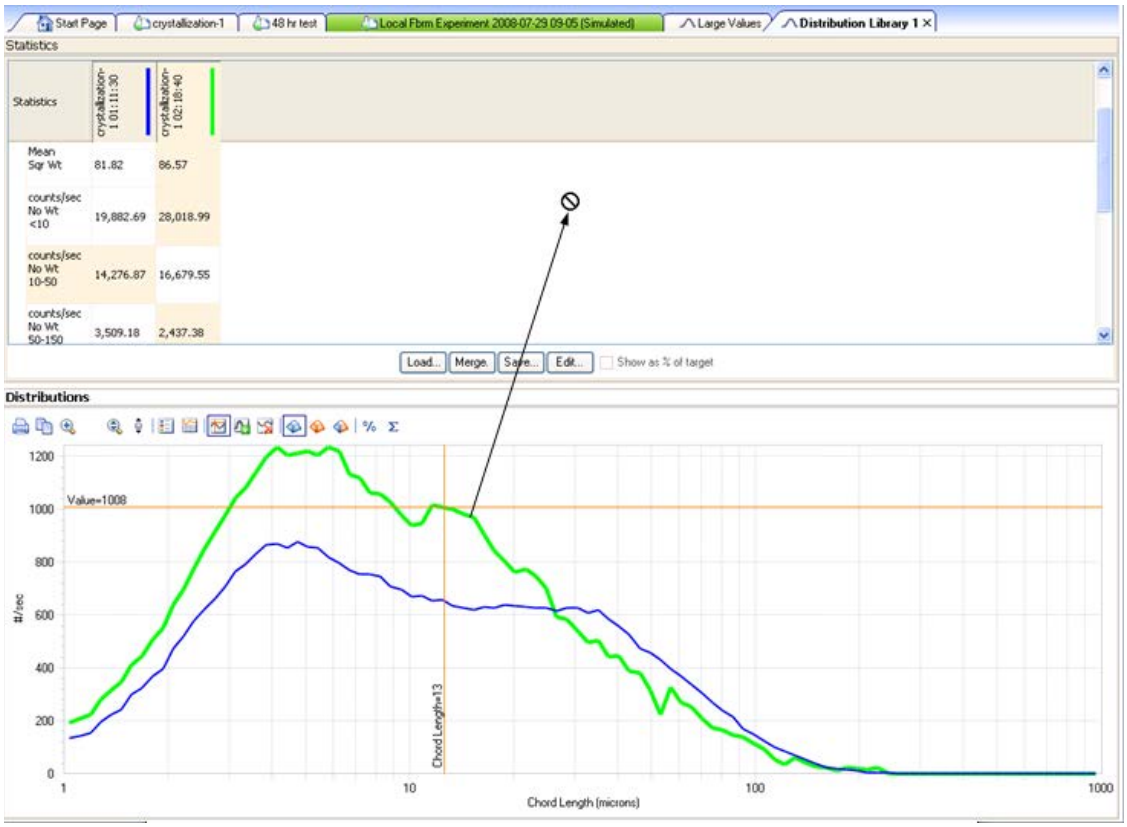
Drag Distributions from an Experiment to the Distributions Library

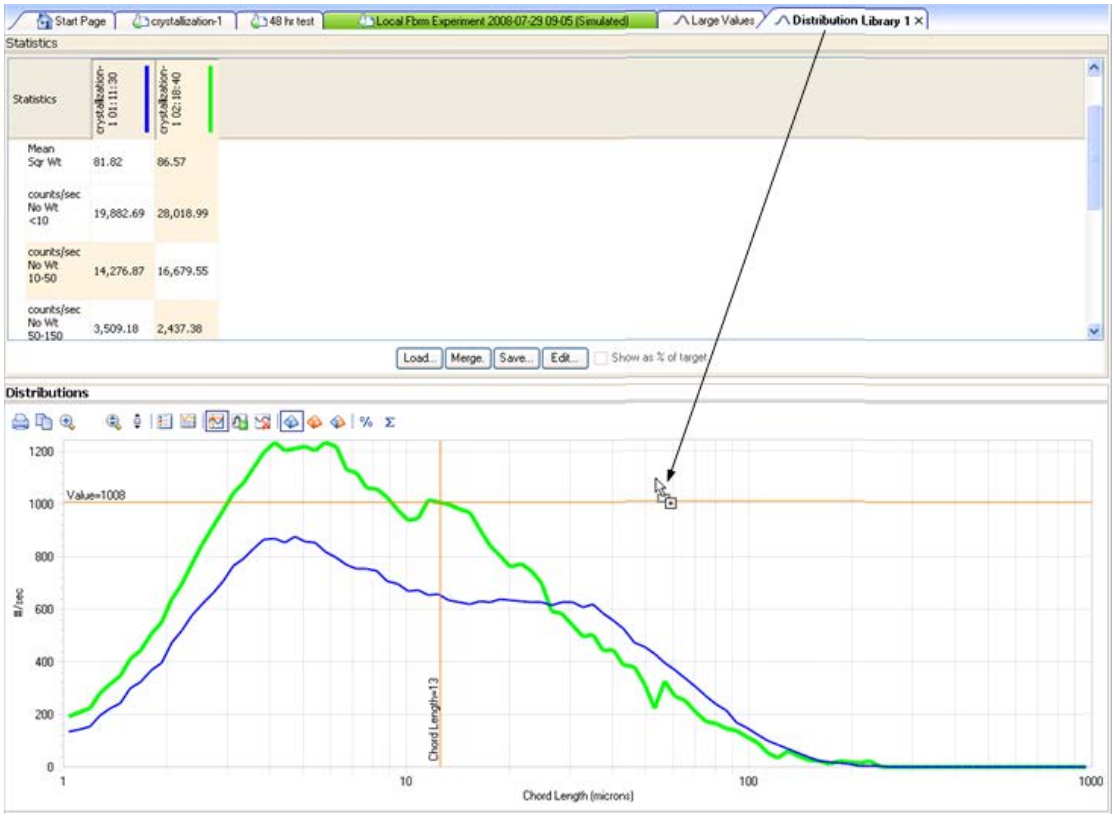
The user can also drag distributions from an experiment to the Distribution Library display.

Note: On experiments containing a large number of distributions, it is easier to drag the distribution from the name in the legend.

To add distributions by this method:

	1. On a Distributions display, click on trend to be included in new Distribution Library. The cursor changes to the symbol shown on the left if the plot was correctly selected.
	2. Drag the cursor to the Distribution Library tab.
	3. When the cursor hover on the destination tab, focus changes to the tab and the Trend Display displays.
	4. Drag the cursor down to the graph area.
	5. The cursor changes to a shortcut icon.
	6. Release the mouse button. The dragged trend is copied to the destination Distributions Library window.





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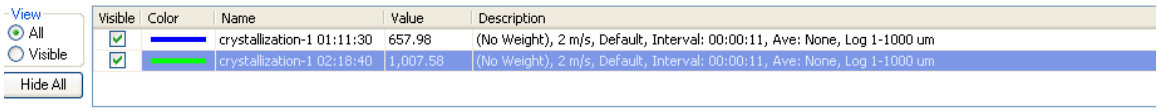
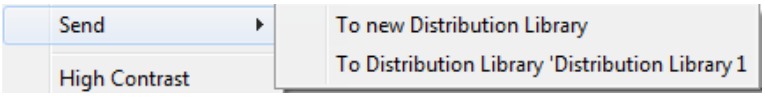
Note: Once inserted into the library, distributions can be renamed using the Details table. Select the Distribution Name field and type in a new name.



SENDING DISTRIBUTIONS TO A DISTRIBUTION LIBRARY

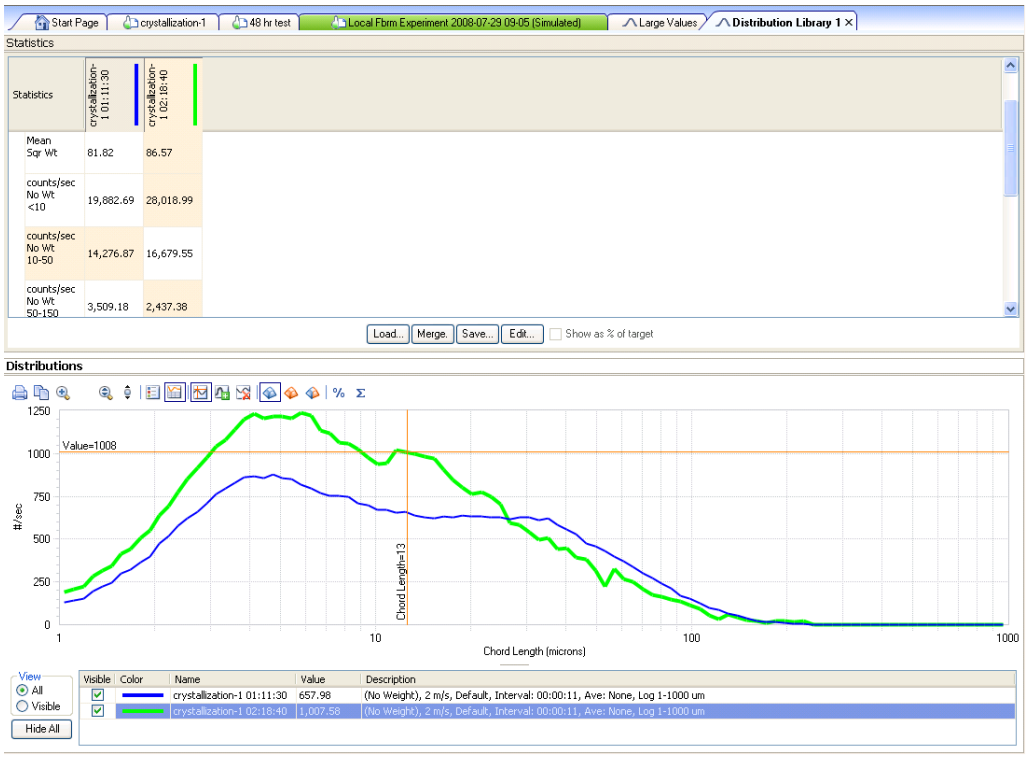
Distributions in an experiment's Distributions Viewer can be sent to a Distribution Library using the **Send** option in the Distributions Viewer context menu.



The **Send** option automatically sends all experiment distributions to a selected Distribution Library. When the option is selected, it expands to list any opened Distribution Libraries. There is also an option available to send the distributions to a new library. If no libraries are currently opened, the only option displayed is to send the distributions to a new library.

DISTRIBUTION LIBRARY DISPLAY

The Distribution Library display is a two-paned window that incorporates a Statistics Viewer and a Distributions Viewer. The operation of these viewers is identical to the ones used for viewing experiment data. Refer to Statistics Viewer and Distributions Viewer.



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Working with Result Sets

A Result Set is a separate file containing trends selected by the user. Trends from several experiments can be put into one result set for comparison. Result Sets are maintained using several methods.

- Create a new blank Result Set – see Creating a Result Set
- Send trends directly to a new or existing Result Set – see Sending Trends to a Result Set
- Adding trends to an existing Result Set – see Adding Trends to a Result Set
- Adding a New graph (tab) to an existing Result Set – see Adding a New Graph to a Result Set

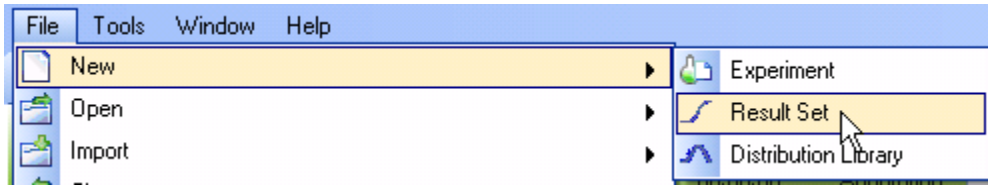
CREATING A RESULT SET

Measurements and trends from a file can be easily transferred to another file called a **Result Set**.

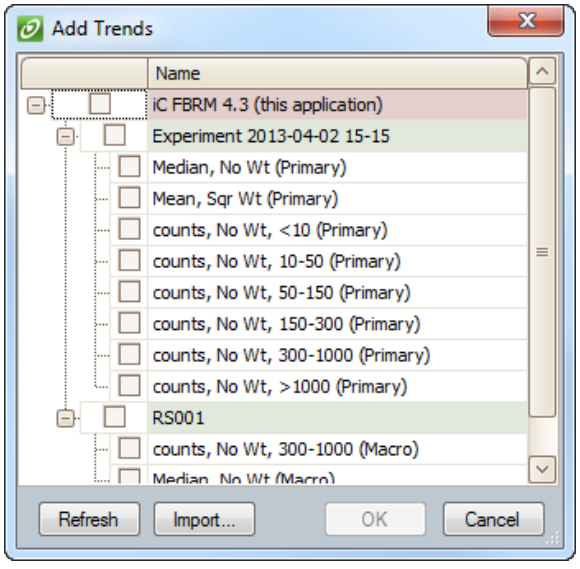
To create a new Result Set, click the **New Result Set** button on the Start Page.

or

Select the **New/Result Set** option from the **File** menu.



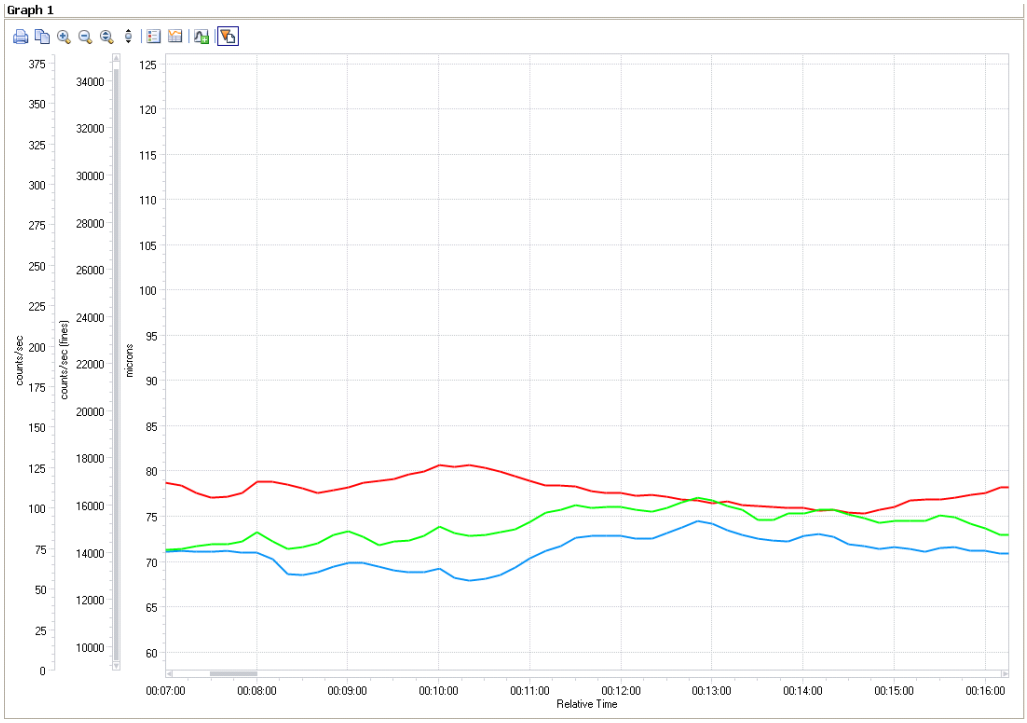
The **Add Trends** window opens.



The window contains a tree-view of all trends in open Result Sets and Experiments. Select one or more trends to include in the new Result Set and click the **OK** button.

Click **OK** to close the window and display the new **Result Set**.

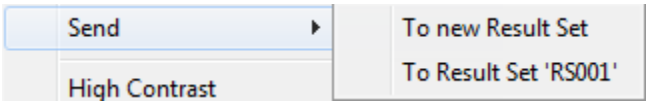
Also see Interaction with Other iC Applications.



It is good practice to save the new Result Set for future reference. To save the set, select the **File/Save As** menu option.

SENDING TRENDS TO A RESULT SET

The Trends Viewer contains a context menu option that allows the user to send trends from an experiment directly to a result set. If there any existing result sets currently opened, a list is displayed that allows the user to select the destination result set. There is also a heading that allows the user to create a new result set.



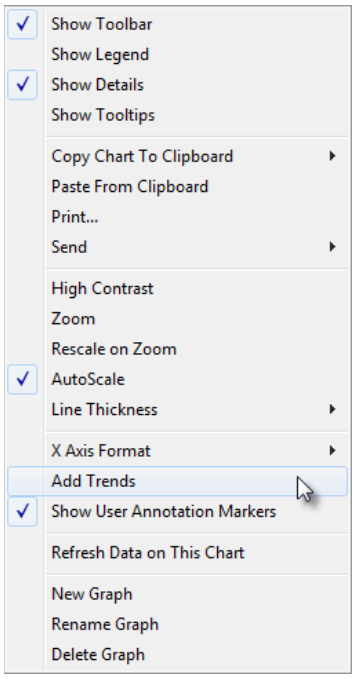
All trends from the experiment are automatically inserted into the result set.

ADDING TRENDS TO A RESULT SET

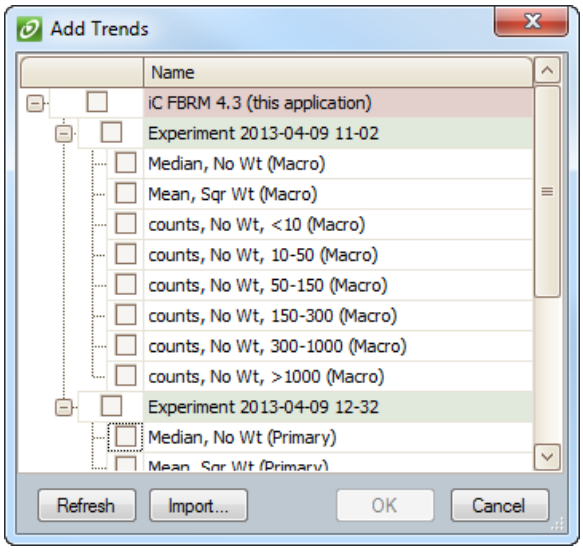
Trends from an iC FBRM experiment, another iC application or iControl can be added to a Result Set. Refer to Sharing Trend Data with Other iC/iControl Applications for guidelines pertaining to interactions with iControl and other iC applications.

Additional trends can be added to an existing Result Set using two methods.

Users can right-click in the graph area of the display and select the **Add Trends** menu option.



The **Add Trends** window opens.



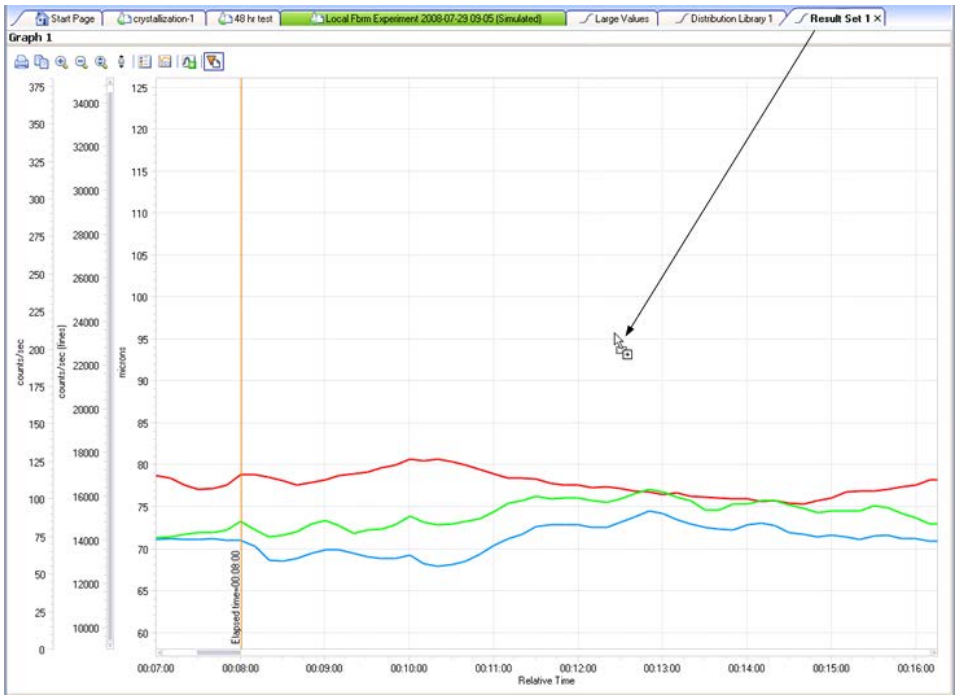
Check the trends to add and click **OK**.

You can also drag trends from an experiment's Trend Viewer to the Result Set display.

Note: On experiments containing a large number of trends, it is easier to drag the trend from the trend name in the legend.

To add trends by this method:

	1. On a Trend graph, click on the trend to be included in new Result Set. The cursor changes to the symbol shown to the left, if the plot was correctly selected.
	2. Drag the cursor to the Result Set tab.
	
	3. When the cursor hovers on the destination tab, focus is given to the tab and the Trend Display appears.
	4. Drag the cursor to the graph tab.
	5. The cursor changes to a shortcut icon.
	6. Release the mouse button. The dragged trend is copied to the destination Result Set Display.

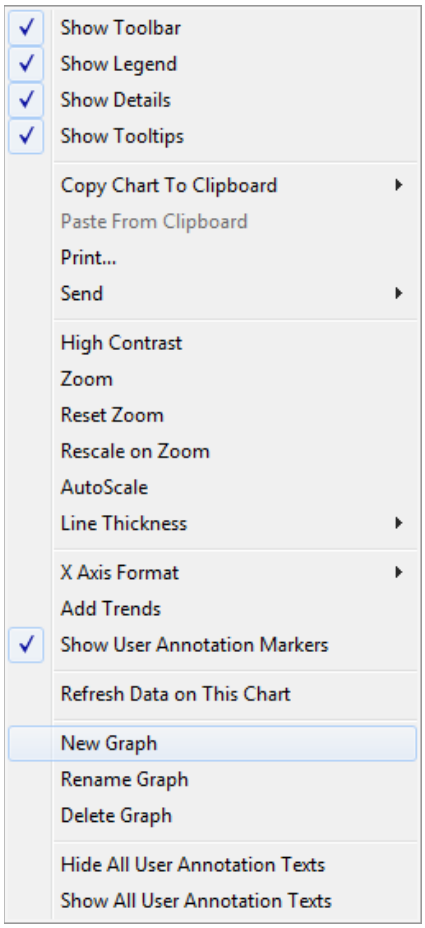


Note: If the trend was added from a live experiment, the trend will be updated in real time.

ADDING A NEW GRAPH TO A RESULT SET

A new graph can be added to create a specific result set. New graphs appear as tabs along the top of the Result Set display.

To create a new graph, select the New Graph option from the right-click menu.

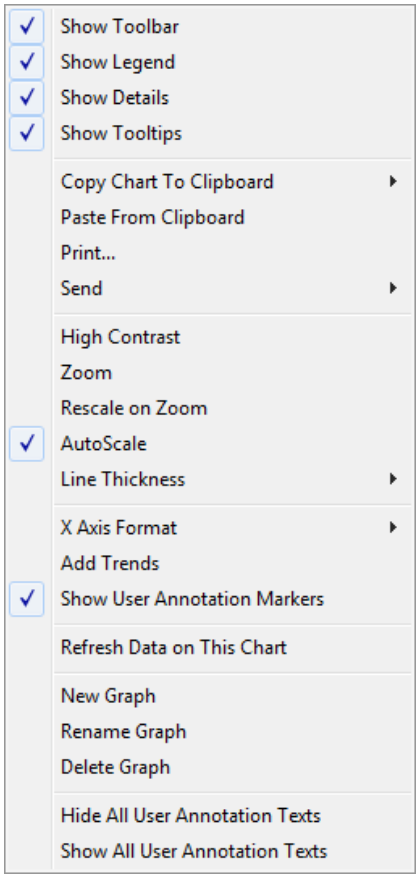


A new blank graph opens. Add trends to the graph as described previously. Refer to Adding Trends to a Result Set.

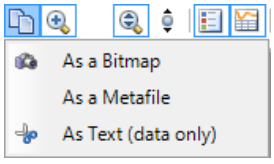
THE RESULT SET CONTEXT MENU

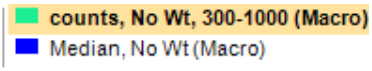
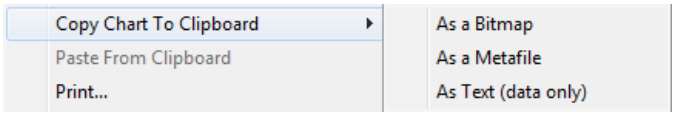
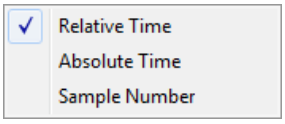
The Result Set display incorporates two right-click or context menus.

The first menu appears when you right-click within the graph (but not directly on a data point). This menu contains tools for customizing the displayed data.



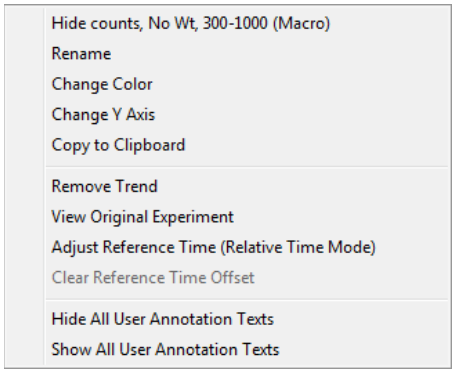
The menu contains the following items:

Show Toolbar		Displays the toolbar at the top of the display.  The toolbar contains the following tools:
		Prints the display.
		Copies the graph to the clipboard in one of the selected formats: 
		Zooms in on the display.

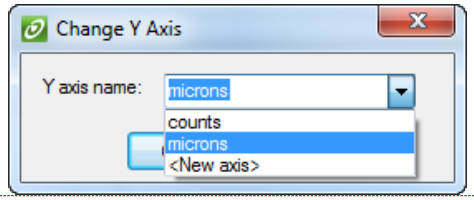
		Resets zoom to original scale (button only appears when the Zoom feature is enabled)
		Rescales only the X-axis on zoom.
		Trend Autoscale Operation the Y-axis.
		Displays the Legend box
		Displays the Details table
		Displays Add Trends window where you can select trends that adds a Reference Trend to the graph. Clicking the button opens the Add Trends window.
Show Legend	Displays a legend box that lists each trend and its name and the CSM used to calculate the statistic. 	
Show Details	Displays the Details table.	
Show Tooltips	If selected, a tooltip appears when the cursor hovers over data areas in the trend.	
Copy Chart to Clipboard	Copies the display to the clipboard. The display can be copied as a bitmap, Windows metafile or as text-only. 	
Paste from Clipboard	Pastes the contents of the clipboard into the trend. The data must be in an X-Y table format such as a time/temp table from MS Excel. The first Y row should contain the column names for the table.	
Print	Opens the Print window so you can select a printer and print the display.	
Send	Sends a copy of the entire Result Set to one of the open Result Sets or to a new set with "1" appended to the name.	
High Contrast	Displays the trend graph with a black background.	
Zoom	Zooms the display.	
Reset Zoom	Resets the zoom to its original scale. This button only appears when the display is in a zoomed state.	
Rescale on Zoom	Rescales only the X-axis on zoom.	
Autoscale	Autoscales the Y-axis.	
Line Thickness	Selects the line thickness for the plots.	
X Axis Format	Selects the format for the X axis. 	
Add Trends	See Adding a Reference Trend.	

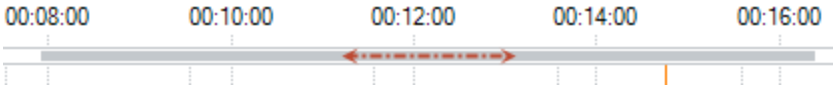
Show User Annotation Markers	If a trend includes associated annotations, the orange marker appears at data points that have comments
Refresh Data on This Chart	Refreshes all the data on all the charts from their sources. This option only appears when the Result Set contains multiple graphs.
New Graph	Creates a new graph in a new tab.
Rename Graph	Renames the currently active graph.
Delete Graph	Deletes the currently active graph.
Hide All User Annotation Texts	This option only appears when you right-click on a data point in the graph. If a trend includes associated annotations, the orange markers do not appear at applicable data points in the graph.
Show All User Annotation Texts	This option only appears when you right-click on a data point in the graph. If a trend includes associated annotations, the orange markers appear at data points that have comments.

The second menu appears when you right-click on a data point in the display, the legend, or the details table. The menu contains tools for customizing the data.



The data context menu contains the following items:

Hide . . .	Hides the selected trend in the graph. The trend remains listed in the Details table.
Rename	Use this option to change the data point name from the default statistic name.
Change Color	Opens a color browser to change the color of the trend line.
Change Y Axis	Opens a window that enables changing the Y Axis name. 
Copy to Clipboard	Copies the display data to the clipboard. The data can be pasted into such applications as MS Word or Excel. Note: To copy the graph to clipboard, use the first context menu (right-click off a data point) and select Copy Chart to Clipboard.
Remove Trend	Permanently removes the selected trend from the viewer.
View Original Experiment	Opens the source experiment for the selected trend in a new tab.

Adjust Reference Time 	When the X-axis is in Relative Time mode, you can synchronize the trend times from separate experiments using the slider bar on top of the viewer graph. Two additional buttons appear in the toolbar with the time reference bar.  When the adjustment is correct, the click the green check button. To cancel the time adjustment, click the red X.
Clear Reference Time Offset	If the **Adjust Time Reference** option adjustment has been applied, this option enables you to remove the adjustment.

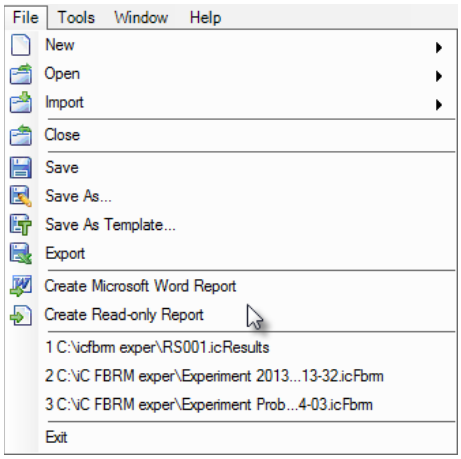
Generating Reports of iC Data

The iC FBRM software provides several methods for generating reports of experiment data:

- One-click pre-formatted report in MS Word® format. See One-click Reporting Function.
- Using the Microsoft Office® Clipboard to copy and paste data. See Copying Experiment Data and Copying Experiment Events.
- Export function to export data in CSV format. See Exporting Experiment Data.

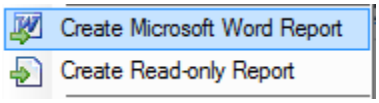
One-click Reporting Function

The One-click Reporting feature creates a pre-formatted report in MS Word or Microsoft XPS format. The XPS format is read only. Reports can be made for any current document: Experiments, Spectra Libraries, and Result Sets. The Report contains all data in the document.

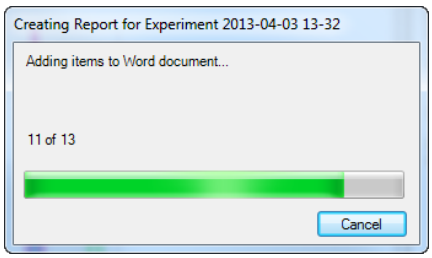


CREATING A MS WORD REPORT

Access the Microsoft Word Report feature from the **File/Create Word Report** menu or from the corresponding button on the main toolbar.



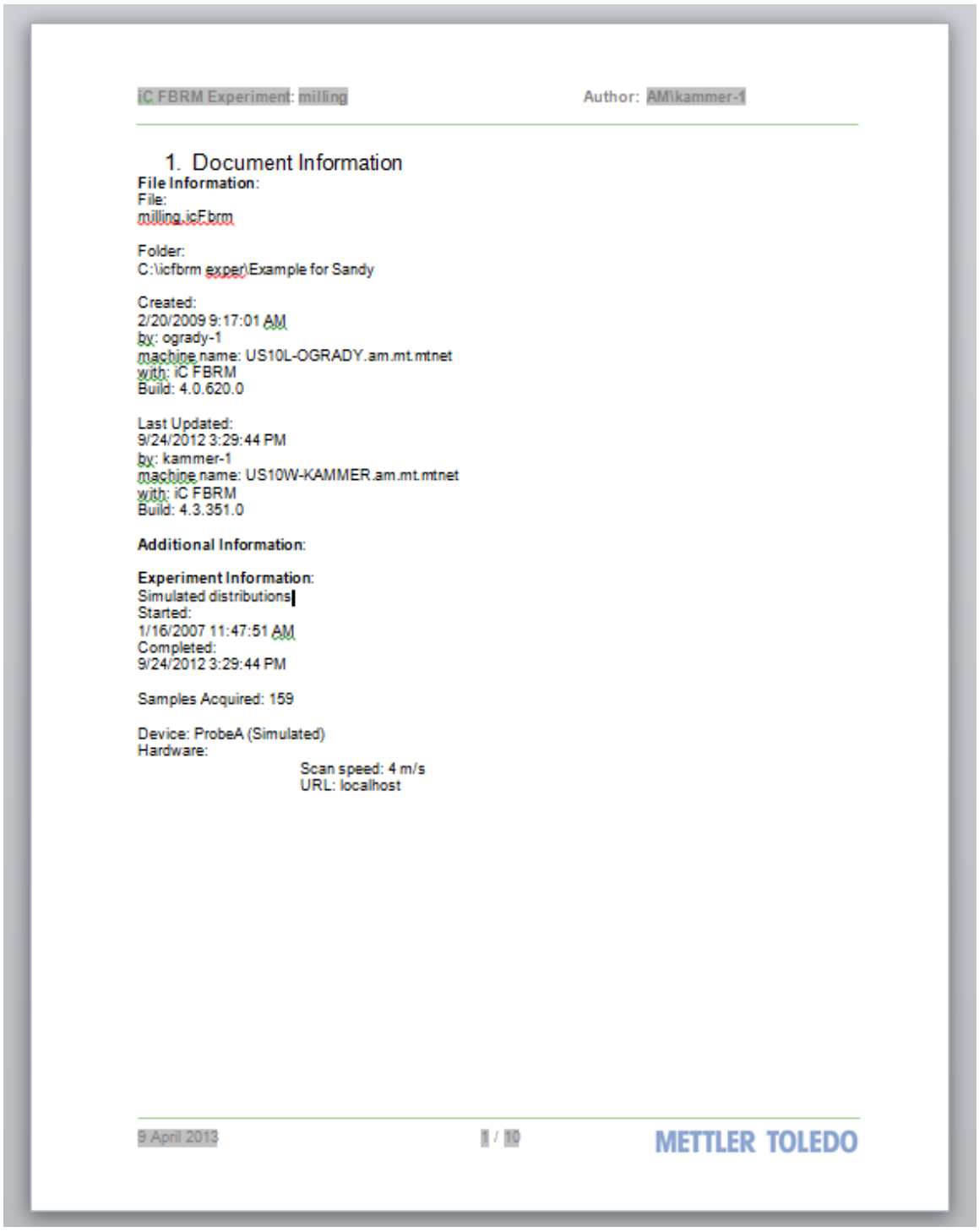
Click the report option and iC creates a report of the selected experiment. A progress indicator displays during the creation process.



When processing completes, the report opens in MS Word as a new document.

Example Report

Note that the format of the report is based on an MS Word template, iC Report Template.dot, located in the Program folder for the iC application. This template can be edited by the user to create custom report formats. It is advisable to make a backup copy of the template file before any edits are made. The name of the template file must not be changed.



iC FBRM Experiment: milling Author: AM\kammer-1

1. Document Information

File Information:
File:
milling.icFbrm

Folder:
C:\icfbrm exper\Example for Sandy

Created:
2/20/2009 9:17:01 AM
by: ogrady-1
machine name: US10L-OGRADY.am.mt.mtnet
with: iC FBRM
Build: 4.0.620.0

Last Updated:
9/24/2012 3:29:44 PM
by: kammer-1
machine name: US10W-KAMMER.am.mt.mtnet
with: iC FBRM
Build: 4.3.351.0

Additional Information:

Experiment Information:
Simulated distributions
Started:
1/16/2007 11:47:51 AM
Completed:
9/24/2012 3:29:44 PM

Samples Acquired: 159

Device: ProbeA (Simulated)
Hardware:
Scan speed: 4 m/s
URL: localhost

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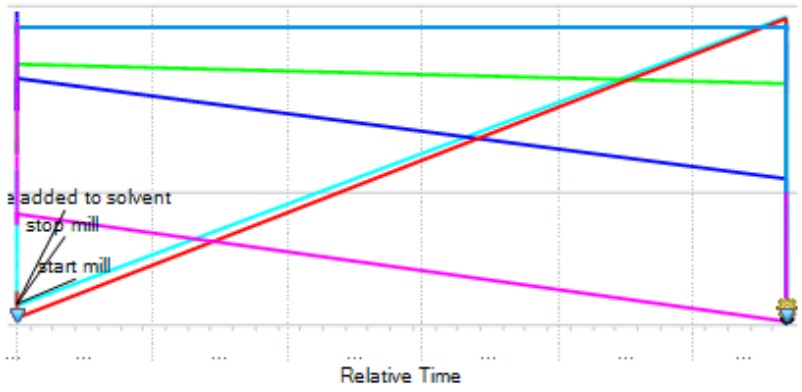
2. Legend

Visible	Color	Name	Y Axis	Description
X		Subtract	Calculation	User Trend: "counts, No \Alt, <10 (Agglomerate)" - "counts, No \Alt, 10-40 (Agglomerate)"
X		RateOfChange	Rate of change (Seconds)	User Trend: Rate of change("Mean, Sqr-\Alt (Agglomerate)", 1 points, Seconds)
X		Mean, Sqr-\Alt (Agglomerate)	microns	FBRM Statistic; Averaging: Moving(8); Channels: 100 channels from 1-1000, Log spacing; Electronics: Agglomerate V. 1.4.7
X		counts, No \Alt, <10 (Agglomerate)	counts (fines)	FBRM Statistic; Averaging: Moving(8); Channels: 100 channels from 1-1000, Log spacing; Electronics: Agglomerate V. 1.4.7
X		counts, No \Alt, 10-40 (Agglomerate)	counts (fines)	FBRM Statistic; Averaging: Moving(8); Channels: 100 channels from 1-1000, Log spacing; Electronics: Agglomerate V. 1.4.7
X		counts, No \Alt, 40-200 (Agglomerate)	counts	FBRM Statistic; Averaging: Moving(8); Channels: 100 channels from 1-1000, Log spacing; Electronics: Agglomerate V. 1.4.7

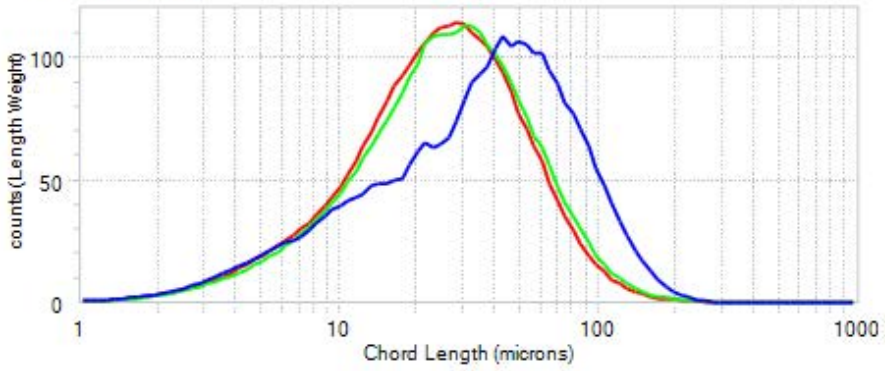
3. Trends



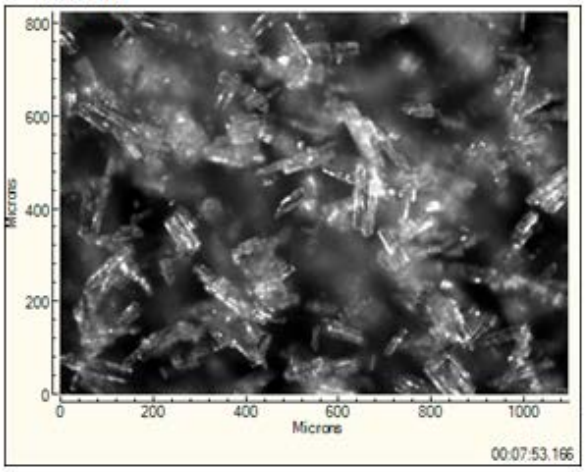
4. Legend

Visible	Color	Name	Description
X		00:07:45 (Agglomerate)	(Length Weight), 2 m/s, Agglomerate V. 1.4.7, Interval: 00:00:16, Avg: Moving 8, Log 1-1000 um
X		00:19:45 (Agglomerate)	(Length Weight), 2 m/s, Agglomerate V. 1.4.7, Interval: 00:00:16, Avg: Moving 8, Log 1-1000 um
X		00:32:30 (Agglomerate)	(Length Weight), 2 m/s, Agglomerate V. 1.4.7, Interval: 00:00:16, Avg: Moving 8, Log 1-1000 um

5. Distributions



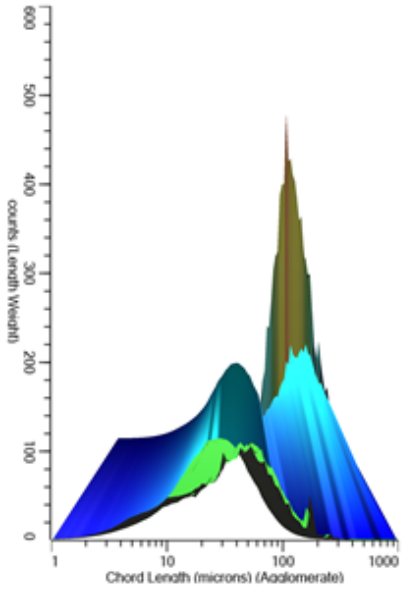
6. PVM



7. Statistics

Trend	00:07:45 (Agglomerate)	00:19:45 (Agglomerate)	00:32:30 (Agglomerate)
Subtract	3,870.85	-1,197.56	-770.51
RateOfChange	-0.000226	-0.00147	-0.00276
Mean Sqr Wt	72.76	53.62	50.00
counts No Wt <10	12,675.02	11,347.56	12,402.37
counts No Wt 10-40	8,804.17	12,545.12	13,172.88
counts No Wt 40-200	3,256.43	2,148.84	1,977.18

8. Surface

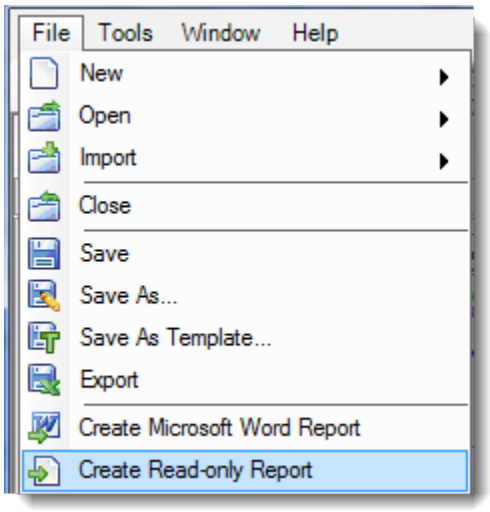


9. Events

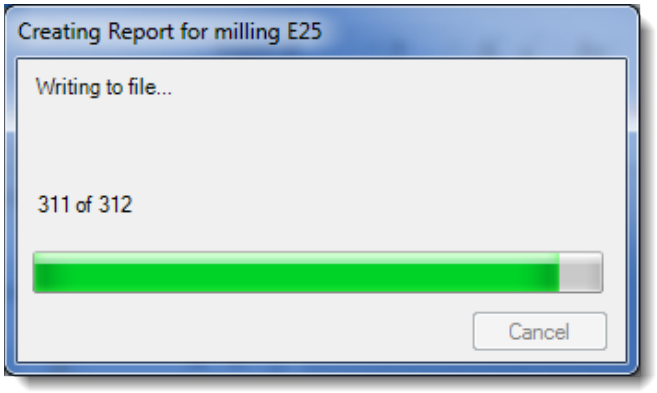
Type	Date/Time	Description
Annotation	11:48:59 AM 1/16/2007	solute added to solvent
Annotation	11:55:42 AM 1/16/2007	start mill
Annotation	12:18:05 PM 1/16/2007	stop mill
Audit	9:17:09 AM 2/20/2009	Opened by ogrady-1
Audit	9:17:10 AM 2/20/2009	Experiment saving to C:\desogrady\2 - PSD TAC FTP\B - Training Data and Abstracts\1 - iC\FBRM Crystallization Examples\milling.icRem
Audit	11:31:38 AM 3/5/2009	Opened by ogrady-1
Audit	11:31:55 AM 3/5/2009	Annotation "start mill" added at 11:55:42 AM on 1/16/2007.
Audit	11:32:08 AM 3/5/2009	Annotation "solute added to solvent" added at 11:48:59 AM on 1/16/2007.
Audit	11:32:12 AM 3/5/2009	Annotation "stop mill" added at 12:18:05 PM on 1/16/2007.
Audit	11:33:56 AM 3/5/2009	Distribution "00:07:00" shown
Audit	11:33:56 AM 3/5/2009	Distribution "00:07:00" pinned
Audit	11:34:02 AM 3/5/2009	Reference Distribution "00:07:00" created from reaction distribution "00:07:00"
Audit	11:34:15 AM 3/5/2009	Distribution "00:07:00" renamed to "start"
Audit	11:34:18 AM 3/5/2009	Distribution "00:07:00" hidden
Audit	11:34:18 AM 3/5/2009	Distribution "00:07:00" unpinned
Audit	11:34:23 AM 3/5/2009	Line Info changed for Distribution "start"
Audit	11:34:39 AM 3/5/2009	Distribution "00:19:30" shown
Audit	11:34:39 AM 3/5/2009	Distribution "00:19:30" pinned
Audit	11:34:43 AM 3/5/2009	Reference Distribution "00:19:30" created from reaction distribution "00:19:30"
Audit	11:34:50 AM 3/5/2009	Distribution "00:19:30" renamed to "Middle"
Audit	11:34:55 AM 3/5/2009	Line Info changed for Distribution "Middle"
Audit	11:35:09 AM 3/5/2009	Distribution "00:30:15" shown
Audit	11:35:09 AM 3/5/2009	Distribution "00:30:15" pinned
Audit	11:35:12 AM 3/5/2009	Reference Distribution "00:30:15" created from reaction distribution "00:30:15"
Audit	11:35:21 AM 3/5/2009	Distribution "00:30:15" renamed to "End"
Audit	11:35:25 AM 3/5/2009	Distribution "00:19:30" hidden
Audit	11:35:25 AM 3/5/2009	Distribution "00:19:30" unpinned
Audit	11:35:27 AM 3/5/2009	Distribution "00:30:15" hidden
Audit	11:35:27 AM 3/5/2009	Distribution "00:30:15" unpinned
Audit	11:35:35 AM 3/5/2009	Line Info changed for Distribution "End"
Audit	11:36:55 AM 3/5/2009	Statistic "counts/sec, No |Δt|, 10-50" reconfigured as "counts/sec, No |Δt|, 40-1000"
Audit	11:37:35 AM 3/5/2009	Statistic "counts/sec, No |Δt|, <10" reconfigured as "counts/sec, No |Δt|, 6-40"
Audit	11:37:48 AM 3/5/2009	Statistic "Mean, Sqr |Δt|" reconfigured as "counts/sec, Sqr |Δt|, <6"
Audit	11:38:23 AM 3/5/2009	Statistic "Median, No |Δt|" reconfigured as "Mean, Sqr |Δt|"
Audit	11:38:46 AM 3/5/2009	Statistic "counts/sec, No |Δt|, 50-150" removed
Audit	11:38:46 AM 3/5/2009	Statistic "counts/sec, No |Δt|, 150-300" removed
Audit	11:38:46 AM 3/5/2009	Statistic "counts/sec, No |Δt|, 300-1000" removed
Audit	11:38:46 AM 3/5/2009	Statistic "counts/sec, No |Δt|, >1000" removed
Audit	11:38:54 AM 3/5/2009	Statistics definitions saved as C:\desogrady\1 - AFTs 2009\BMB - Macias - HSWG\milling stats.icStats
Audit	11:40:20 AM 3/5/2009	Y Axis changed to "fines" for Trend "counts/sec, Sqr |Δt|, <6"
Audit	11:40:36 AM 3/5/2009	Y Axis changed to "counts/sec (fines)" for Trend "counts/sec, Sqr |Δt|, <6"
Audit	11:41:54 AM 3/5/2009	Y Axis changed to "very fine material" for Trend "counts/sec, Sqr |Δt|, <6"
Audit	11:42:19 AM 3/5/2009	Trend "counts/sec, Sqr |Δt|, <6" hidden
Audit	12:15:52 PM 3/5/2009	Distribution "Middle" hidden
Audit	12:15:54 PM 3/5/2009	Distribution "End" hidden
Audit	1:31:45 PM 3/5/2009	Distribution "Middle" shown
Audit	1:31:46 PM 3/5/2009	Distribution "End" shown
Audit	8:55:43 PM 3/5/2009	Experiment saving to C:\desogrady\2 - PSD TAC FTP\B - Training Data and Abstracts\1 - iC\FBRM Crystallization Examples\milling.icRem
Audit	3:35:52 PM 3/16/2009	Opened by ogrady-1
Audit	3:36:14 PM 3/16/2009	Statistic "counts/sec, No |Δt|, 6-40" reconfigured as "counts/sec, No |Δt|, 10-40"
Audit	3:36:26 PM 3/16/2009	Line Info changed for Trend "Mean, Sqr |Δt|"
Audit	3:36:28 PM 3/16/2009	Trend "counts/sec, No |Δt|, 10-40" hidden
Audit	3:36:35 PM 3/16/2009	Trend "counts/sec, No |Δt|, 10-40" shown
Audit	3:36:39 PM 3/16/2009	Trend "counts/sec, No |Δt|, 40-1000" hidden
Audit	3:36:50 PM 3/16/2009	Statistic "counts/sec, Sqr |Δt|, <6" reconfigured as "counts/sec, No |Δt|, <10"

CREATING AN READ-ONLY XPS REPORT

The XPS report contains the same information as a MS Word report except that it is in a read-only format. To create this type of report, select **File > Create Read-only Report** or click the associated toolbar button.

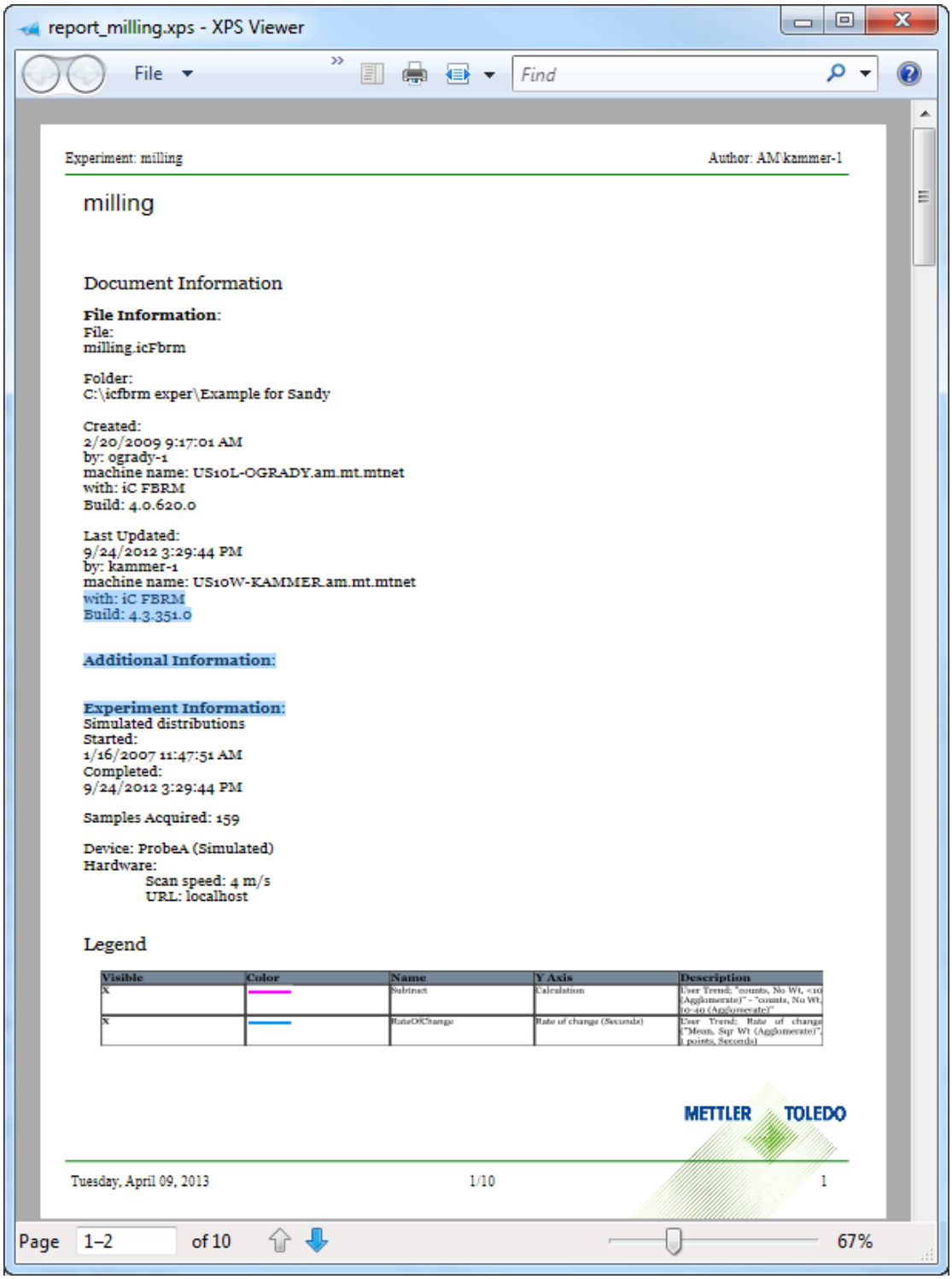


When the Create Report menu option is selected, iC creates a report of the selected experiment. A progress indicator appears during the creation process.



When report generation completes, it opens in an XPS viewer.

Example Report

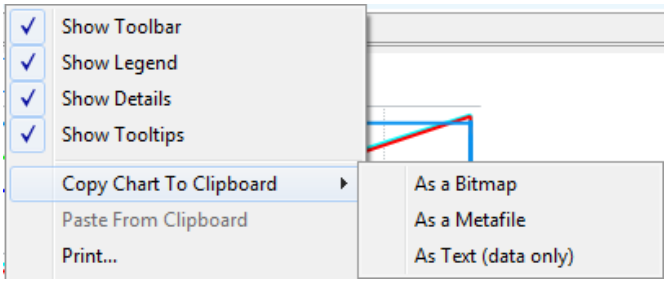


The report resides in a temporary directory and must be saved to permanently store the report. Note that the report is read-only and can be opened by any application supporting the XPS format (Internet Explorer, Microsoft XPS Viewer, etc.)

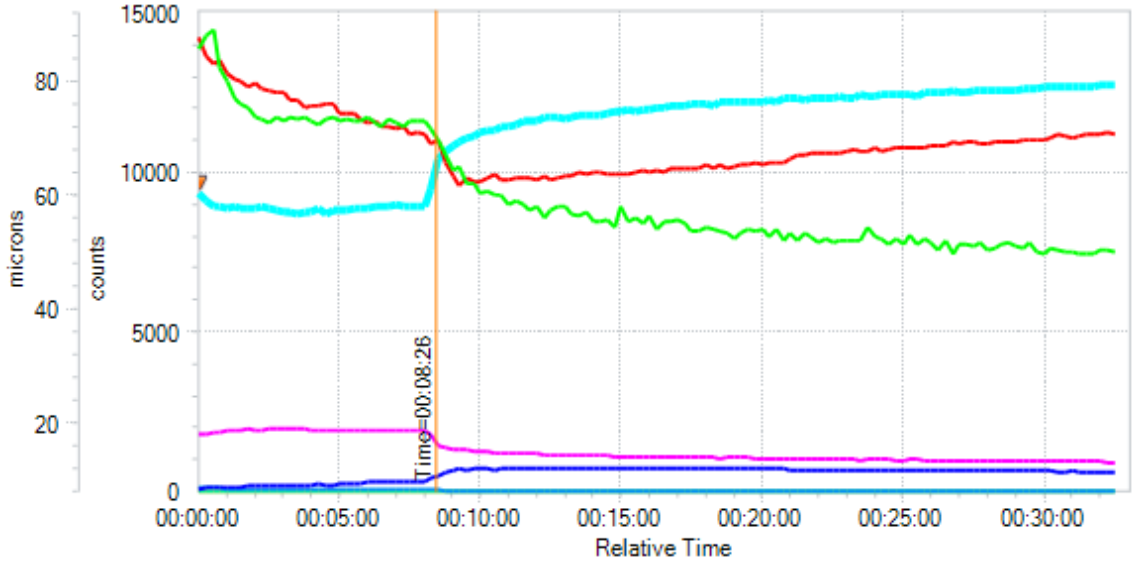
Copying Experiment Data

Data from the various viewers in the iC software can be used to create experiment reports. The Microsoft Office® Clipboard is used to copy and paste data into a suitable application such as Microsoft® EXCEL®. Data can be copied to the Clipboard using the viewer's context (right-click) menu. The menu offers three options for copying data.

- Bitmap—Copies the trend data as a bitmap (BMP) graphic file.
- Metafile—Copies the trend data as a Windows metafile (WMA) graphic file.
- Text—Copies trend data as text. See the explanation below for a description of the textual format.



Both the Bitmap (BMG) and Metafile (WMA) options copy the data as a graphic image. The Windows Metafile format provides a clearer image but is not supported by some non-Microsoft applications. A bitmap image is universally supported but the file size tends to be large.



When trend data is copied as textual data, the data is copied as tab-delimited text. This format can readily be pasted into an Excel spreadsheet as a table. The first row of the data always contains the column headings for the table, as illustrated below.

Time	Median, No Wt	Mean, Sqr Wt	counts, No Wt, <10	counts, No Wt, 10-50	counts, No Wt, 50-150	counts, No Wt, 150-300	counts, No Wt, 300-1000	counts, No Wt, 10-50	Annotations
00:00:00	8.38664	85.5195	14235	9317.94	1766.99	92.0063	0.900364	9317.94	
00:00:30	8.61091	89.1336	13415.8	8930.36	1867.02	95.1139	1.48858	8930.36	
00:00:45	8.5736	82.3313	13488	8944.32	1847.71	92.5469	0.157523	8944.32	
00:01:00	8.70881	80.077	13083.7	8893.84	1891.96	78.1062	0.0562899	8893.84	
00:01:15	8.81392	77.0005	12901.3	8954.17	1929.94	50.2944	0.140725	8954.17	
00:01:30	8.79801	76.0715	12841.1	8840.86	1930.03	45.5922	0.257169	8840.86	
00:01:45	8.92954	75.2779	12668	8864.32	1955.16	42.0234	0.0642921	8864.32	
00:02:00	8.85344	73.7476	12788.2	8880.3	1929.53	38.011	0	8880.3	
00:02:15	8.90314	73.2215	12638	8918.22	1930.48	36.1398	0.0642921	8918.22	
00:02:30	8.88081	72.8214	12583.4	8881.02	1943.34	35.1468	0.0281449	8881.02	
00:02:45	8.85836	73.8016	12527.2	8810.9	1940.48	39.5767	0.0562899	8810.9	
00:03:00	8.8685	73.0732	12505.8	8745.74	1934.7	33.9485	0.148727	8745.74	
00:03:15	8.98394	73.7486	12281.1	8749.86	1935.57	37.1146	0.109235	8749.86	
00:03:30	8.99017	73.2592	12259.1	8712.34	1949.57	36.7452	0.0924371	8712.34	
00:03:45	9.15155	73.5342	12049.7	8778.09	1945.99	35.8438	0.184874	8778.09	
00:04:00	9.12329	73.0258	12091.4	8769.91	1926.62	35.2053	0.0642921	8769.91	
00:04:15	9.17598	72.4017	12065	8843.07	1930.13	34.1722	0.0642921	8843.07	

If the viewer contains data sampled at different time intervals, the format of the exported data varies depending upon which data is selected, as explained below.

- **If data is selected in the viewer** when the user selects the Copy function, iC exports the raw values for all the visible data based on the set of timestamps associated with the selected data. Note that in a typical experiment all the data have the same timestamps, so data is copied without manipulation.

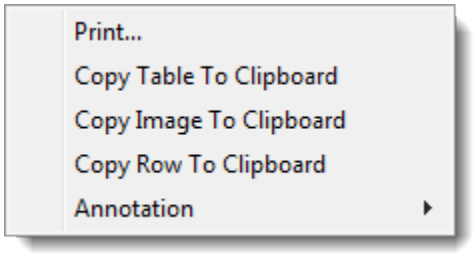
  For the more complex case in which there are multiple sets of timestamps to deal with, interpolation is used on those data with different timestamps to estimate the value at each timestamp in the selected data. In this case the selected data is copied 'as is" since its timestamp is used as the master. Data with different timestamps will have their data copied as interpolated data.

- **If there is no selected data** when the user selects the Copy function, the viewer creates a composite set of timestamps combining together ALL the timestamps for all the data and then eliminates any duplicates. Timestamps that vary by less than second are also eliminated.

  Interpolation based on the timestamps of the selected data is useful for analyzing data collected across multiple experiments. On the other hand, to export the most complete data set when multiple sets of timestamps are involved, make sure that no data is selected. That way, all the actual data points plus additional interpolated values are copied. To deselect all data, click outside of the actual graph area in the viewer.

Copying Experiment Events

Annotations and messages from the Events Viewer can be copied to the clipboard for use in experiment reports. Events copy as tab-delimited text that can be pasted as a table into MS Excel or Word. You also have the option to copy the entire Events table, an image of the currently displayed portion of the table, or the currently selected row to the clipboard.



Before copying event data, format the data displayed in the Events Viewer window. Do this by using the filter buttons on the Events Viewer toolbar to select which types of events to include. The Copy function copies all the event data currently displayed in the window. The following example features informational, audit, annotation, and pinned sample 'events.'

Type	Date/Time	Description
Info	2:39:44 PM 8/5/2015	START OF EXPERIMENT (Relative time zero)
Audit	2:39:44 PM 8/5/2015	Schedule = 1 hour @ 10 seconds
Audit	2:39:44 PM 8/5/2015	Estimated completion time: 3:39:44 PM
Audit	2:39:44 PM 8/5/2015	Phase 1 started: 1 hour @ 10 seconds
Audit	2:40:23 PM 8/5/2015	Experiment AutoSaving
Sample	2:42:54 PM 8/5/2015	Sample 19 acquired at 00:03:10 (10.0s)
Audit	2:44:09 PM 8/5/2015	Statistic "Percentile c, (0.5), No Wt, >1000" removed
Audit	2:44:46 PM 8/5/2015	Added trend: Normalize: Normalize(counts, No Wt, 10-50 (Primary))
Audit	2:45:13 PM 8/5/2015	Replaced trend: Normalize
Audit	2:45:23 PM 8/5/2015	Experiment AutoSaving
Annotation	2:45:24 PM 8/5/2015	Increased temperature by 15 degC-JU
Audit	2:46:31 PM 8/5/2015	Replaced trend: Normalize1
Sample	2:46:34 PM 8/5/2015	Sample 41 acquired at 00:06:50 (10.0s)
Audit	2:47:10 PM 8/5/2015	Experiment stopped by user request.
Audit	2:47:10 PM 8/5/2015	Phase 1 stopped: 1 hour @ 10 seconds
Info	2:47:10 PM 8/5/2015	Experiment Complete
Audit	2:47:10 PM 8/5/2015	Experiment saving to \\us10s-users\users\joeuser-1\My Documents\iC FBRM Experiments\Experiment 2015-08-05 14-36.icFbrm
Audit	2:58:00 PM 8/5/2015	Annotation "Increased temperature by 15 degC-JU" added at 2:45:24 PM on 8/5/2015.

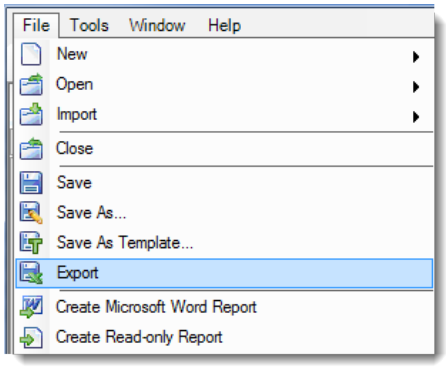
Refer to the Event Viewer topic for more information.

Exporting Experiment Data

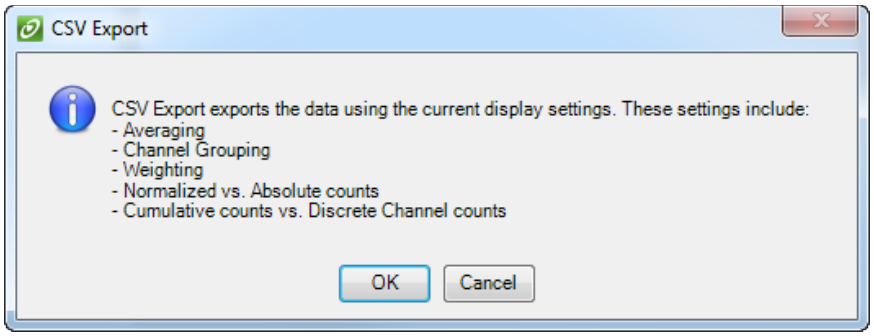
Data including all distribution values [X, Y] from an entire experiment can be exported to an external CSV file that can be directly opened by Microsoft® Excel®. Depending on the actual experiment, the resulting file can be very large.

Note: Instructions below assume the decimal separator is the period. To use comma as the decimal separator, follow the instructions under Exporting CSV Files with Comma as Decimal Separator.

To export experiment data, select the **Export** button in the **File** menu.



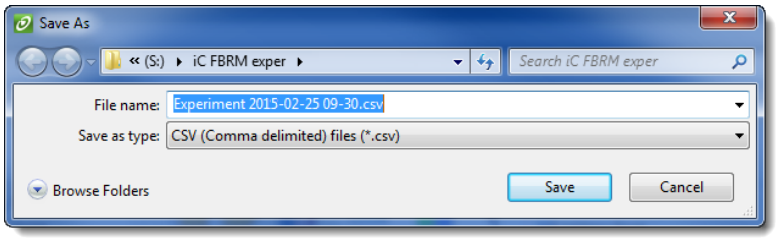
The following dialog box describes the exported data, explaining that it uses the current display settings for the Distributions Viewer (WYSIWYG):



- Averaging and Channel Grouping settings come from the Data Treatments Task Pane.
- Weighting, Normalized vs. Absolute counts, and Cumulative vs. Discrete Channel counts are settings in the Distributions Viewer toolbar (see Distributions Viewer—Graph Context Menu).

Note: If you are using Microsoft® Excel® 2003 or earlier, you should use low resolution (Standard) channel grouping. This is because with higher channel grouping settings, the exported file will contain too many columns to be read by Excel 2003 or earlier.

A standard **Save As** window opens (shown with Folders collapsed).



Enter a filename for the file and click the **Save** button.

Note: Data is exported with the current averaging, channel grouping, weighting and Y axis applied. To change the data to be exported, you must first change the display settings. See Editing Statistics Definitions. If you wish to edit the display settings, click **Cancel** to abort the export operation.

The saved CSV file can be opened directly by Microsoft® Excel®.

Note: Refer to Contents of Exported CSV File for details on the exported CSV file.

CONTENTS OF EXPORTED CSV FILE

Below is an example of the distribution values exported in CVS format from an iC FBRM experiment.

	A	B	C	D	E	F	G	H	I	J	K	L
1	No Weight											
2	Ch.#				1	2	3	4	5	6	7	8
3	Ch.Bd				1	1.0715	1.1482	1.2303	1.3183	1.4125	1.5136	1.6218
4	Ch. Midpoints				1.0351	1.1092	1.1885	1.2735	1.3646	1.4622	1.5668	1.6788
5	1	2/25/2015	9:30:52 AM		0	0	0	0	0	0	0.1003	0.53342
6	2	2/25/2015	9:30:57 AM		0	0	0	0	0	0	0.062476	0.33226
7	3	2/25/2015	9:31:02 AM		0	0	0	0	0	0	0.062476	0.33226

The first four rows contain the following information:

No Weight—Distributions can be weighted or not, based on the setting in the Distributions Viewer toolbar.

Ch.# —Channel or bin index (1 to the total number of bins defined in the channel grouping setting)

Ch.Bd—Low boundary for each channel or bin. For example, Bin #1 starts from 1.0 and ends at 10.715.

Ch.Midpoints—Midpoint for the channel boundary for each bin.
(This is the X-axis value in the Distribution Viewer.)

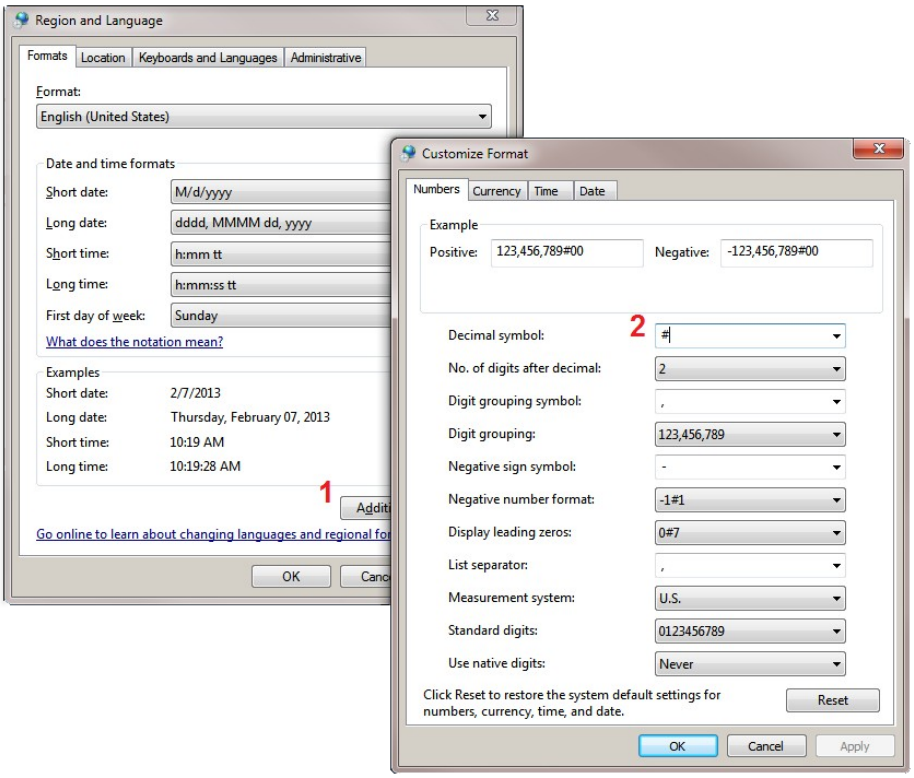
Each subsequent row represents a distribution taken and the given Date (2nd column) and Time (3rd column) and the counts of particles of sizes between the [bin low boundary and high boundary].
(This is the Y-axis value in the Distribution Viewer.)

- If you click on the Distribution Viewer chart and do not 'Copy Chart to clipboard-> As Text (data only),' the data that gets copied are the currently displayed distributions.
- If you choose the MS Excel transpose option, the data copied to the clipboard is a subset of the exported CSV file.

EXPORTING CSV FILES WITH COMMA AS DECIMAL SEPARATOR

When exporting a CSV file, iC FBRM uses a comma to separate the values that should be imported into separate columns. For countries that use a comma as the decimal separator, a conflict arises. Typically the CSV export results in two columns for a number—the whole number in one column and the decimal part in the next column.

To work around this situation, temporarily change the PC's Region and Language > Additional Settings to use a different symbol as the Decimal Symbol.



Do the export to CSV and the import to Microsoft® EXCEL® using the temporary setting. After the file is in Excel, return the decimal separator setting to a comma.

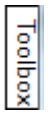
The workflow is:

1. Temporarily change PC Region and Language setting for the Decimal Separator.
2. Restart iC FBRM. Open the experiment to be exported.
3. Do the export. Make sure the extension is .txt.
4. Open Excel; then open the .txt file.
5. In the Excel import, set the column separator to comma.
6. Save as spreadsheet (.xlsx).
7. Change the PC Region and Language setting back to the comma.

Note: Refer to Contents of Exported CSV File for details on the exported CSV file.

Using the Toolbox

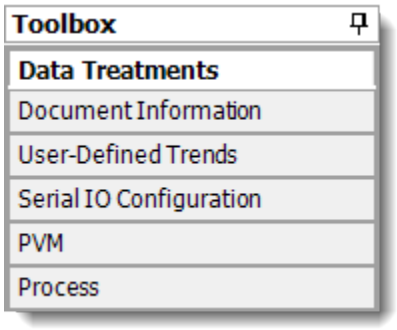
The Toolbox is a windowed pane that provides a collection of "task panes." Each task pane provides a set of controls for performing a task. For example, the Data Treatments task pane provides quick access to various data analysis functions that may be applied to the current experiment.

	To open the Toolbox, click the Toolbox icon in the upper-right corner of the main window.
	Notice the pin button that appears to the right of the open Toolbox. It toggles in the Toolbox to appear or collapse when you click it, as follows:
	Horizontal pin means the Toolbox only appears while the cursor is in a task pane. This is the auto-hide option where the Toolbox remains open until you move the cursor out of the task pane; then it closes automatically. Auto-hide is useful when you want to maximize the document viewing area.
	Vertical pin means the Toolbox is pinned to always appear. Pinning is useful if you want to monitor or interact with the Toolbox (or one of its task panes) frequently.

The Toolbox is organized as a button bar representing the set of task panes available to you based on an XML configuration file stored under your account in the Documents and Settings folder. This configuration file is typically stored under the hidden folder, based on the operating system:

C:\Documents and Settings\<your username>\Local Settings\Application Data\METTLER TOLEDO\
or
C:\ProgramData\METTLER TOLEDO

Below is the iC Toolbox with the individual task panes.

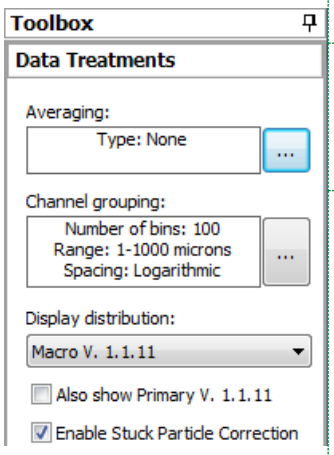


The upcoming sections describe the standard task panes configured with iC software.

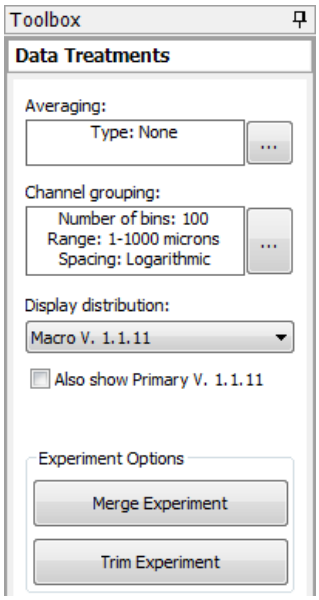
Data Treatments Task Pane

The Data Treatments task pane provides data manipulation and analysis tools for the currently displayed experiment. The following options can be selected from the task pane (Notice the differences between a live experiment and a completed experiment):

Live Experiment:



Completed Experiment:

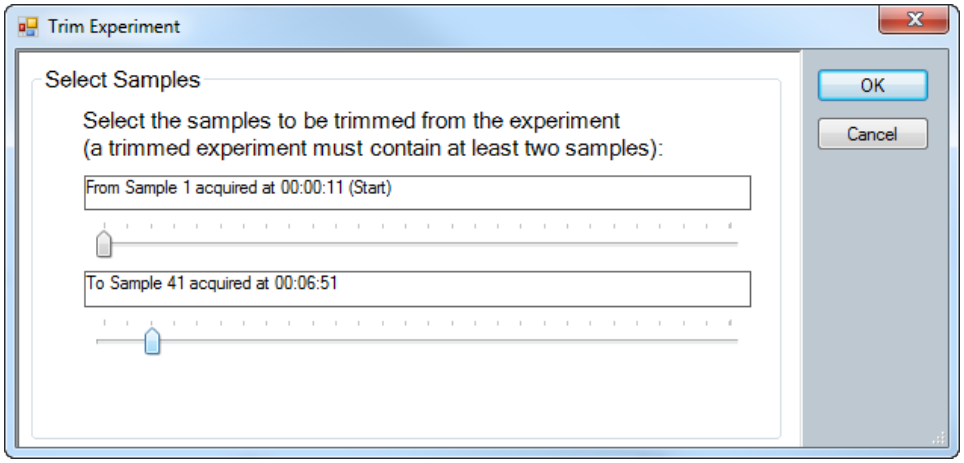


Averaging	Averaging is used to improve measurement precision of the trends. Refer to: Averaging.
Channel Grouping	Channel grouping gives the user the ability to group the primary chord length distribution of 1324 channels into a channel grouping more appropriate to the application under investigation. Refer to: Channel Grouping.
Display Distribution	Only applicable if multiple Chord Selection Models (CSM) are available. Click the Display Distribution selection arrow to choose which distribution (CSM) displays in the viewer. The selection list shows the distributions (CSMs) that are being calculated and displayed. To compare two distributions (CSMs), use any of the standard tools for moving distributions and trends between documents. Document types include results sets for trends, distribution libraries, and experiments. **Note**: For the E25, only a single CSM is available. Refer to Select Chord Selection Model Page.
Also show <CSM name>	Only displays if multiple Chord Selection Models (CSMs) are available. When checked, this Chord Selection Model is also calculated and displayed in the Trend, Distribution and Statistic viewers. See Chord Selection Models.
Enable Stuck Particle Correction	Only displays during a live experiment. If checked, this check box causes the system to attempt to remove/subtract stuck from the distributions through mathematical calculation. Note that the two diagnostic statistics, Fouling Index and Stuck Particle Correction, should be trended when using Stuck Particle Detection. Refer to Advanced under Statistic Types.
Merge Experiment	Enables you to merge two completed experiments into a composite experiment file. Clicking the button opens a file browser to select the experiment that will be merged into the currently selected one. **Note:** It is advisable to use the **Save As** function to save the merged experiment to a new file name.
Trim Experiment	Enables trimming (deleting) unnecessary samples from an experiment. Clicking the button opens a The Trim Experiment Dialog. **Note:** It is advisable to use the **Save As** function to save the trimmed experiment to a new file name.

THE TRIM EXPERIMENT DIALOG

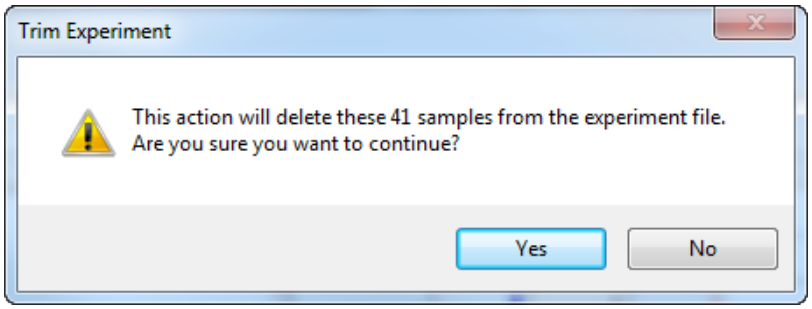
Use the Trim Experiment dialog box to trim samples from a completed experiment. This feature is useful to remove insignificant samples from an experiment. It is advisable to save a trimmed experiment to a different filename leaving the original experiment intact.

Move the slider bars to select the range of samples to delete from the experiment. To advance the slider bar in one-sample increments, use the arrow keys.

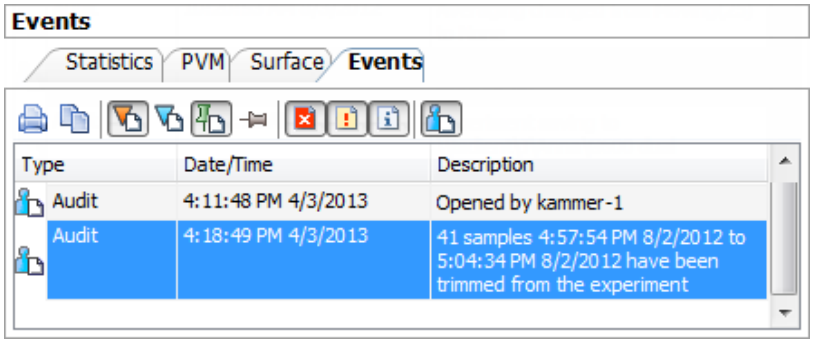


In the above example, samples 1 through 41 are selected to be deleted from the experiment.

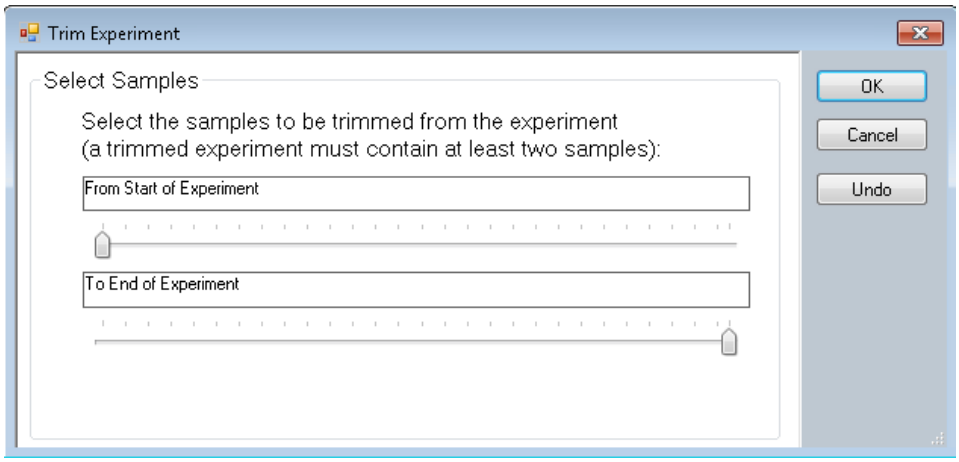
A confirmation window summarizes the deletion so you can see the impact before the software executes the trim operation.



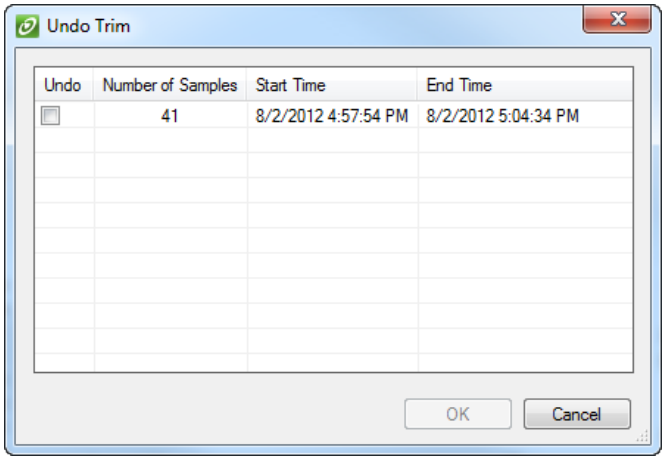
An audit message records in the Events Viewer.



Once an experiment has been trimmed, if you open the Trim Experiment window again, the **Undo** button appears. This button enables you to reverse a trim operation.



When the button is clicked, the **Undo Trim** window appears.



The window contains a list of all Trim operations that have been performed on the experiment. The user checks the appropriate operation and clicks the **OK** button. Then, the trimmed samples are reinserted into the experiment and an audit message logs in the Events Viewer.

CHORD SELECTION MODELS

iC FBRM is a powerful technique that tracks the rate and degree of change to particles and particle structures as they naturally exist in process. iC FBRM requires no calibration or other information about the particle system to track the process with a high degree of precision and sensitivity. However, particulate systems are complex—especially when measured in situ at full concentration—and the accuracy of the chord length distribution (CLD) measured by iC FBRM will be influenced by particle size, solids concentration, number of modes, particle structure, and surface characteristics.

With this in mind, iC FBRM technology developed two operating models that enable measurement of diverse particle systems. These Chord Selection Models (CSMs) are called Primary CSM and Macro CSM. Each offers specific advantages depending on the particle system under investigation.

Regardless of which CSM is selected, a precise and sensitive measurement is assured—however the accuracy of the Chord Length Distribution (CLD) can be improved dramatically by choosing the appropriate CSM. Care should be taken not to directly compare Primary and Macro data from the same experiment or set of experiments because any differences will be due to a difference in the measurement, not the process itself. PVM Viewer is the optimal tool for understanding which mode is the better choice for a given system since it provides a validating image and is also measuring in process. The result of using PVM negates the potential impact of poor sampling and preparation procedures. If there is any doubt about the appropriate CSM for a particle system, the user should contact their local TAC for more detailed support.

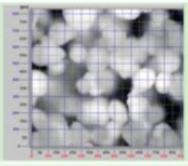
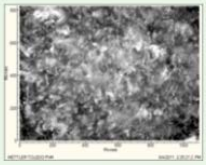
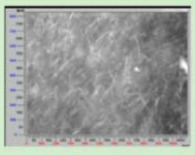
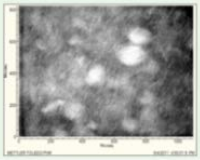
Note: iC FBRM supports showing distributions from two CSMs, where applicable. See Multiple Chord Selection Models.

Primary CSM

The Primary Chord Selection Model (CSM) has a narrow fixed measurement zone that offers enhanced sensitivity to primary and discrete particles. This CSM is best suited for systems with limited surface structure and facets.

Primary CSM has enhanced sensitivity to:

- Particle Edges
- Primary particles at high concentration
- Nucleation
- Opaque Particles
- Fine crystals and small needles

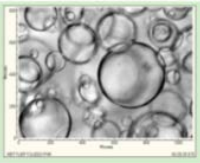
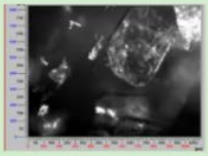
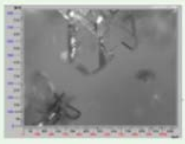
Image	Description	Primary vs Macro
	Opaque Particles	Primary
	High Concentration crystals	Primary
	Small Needles	Primary
	Bimodal Distributions with opaque particles	Primary

Macro CSM

The Macro Chord Selection Model has a wider fixed measurement zone that offers enhanced sensitivity to agglomerated and flocculated groupings of particles as well as discrete particles with significant facets and surface structure.

Macro CSM has enhanced sensitivity to:

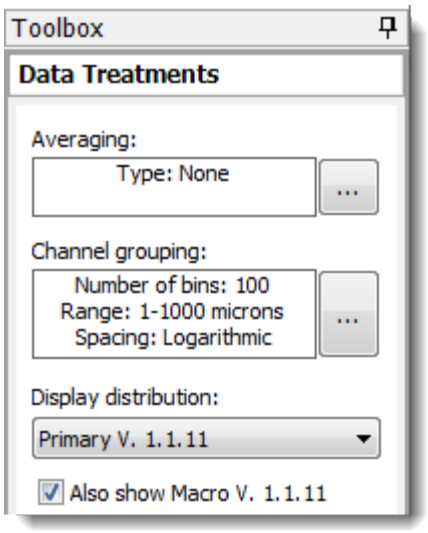
- Droplets
- Low concentration, dissolution
- Faceted Crystals
- Agglomerated crystals
- Transparent crystals

Image	Description	Primary vs Macro
	Droplets/Bubbles	Macro
	Dissolution	Macro
	Facetted Crystals Agglomerates at moderate conc.	Macro
	Transparent crystals	Macro

MULTIPLE CHORD SELECTION MODELS

iC FBRM supports statistical trends and distributions from two Chord Selection Models (CSMs) simultaneously.

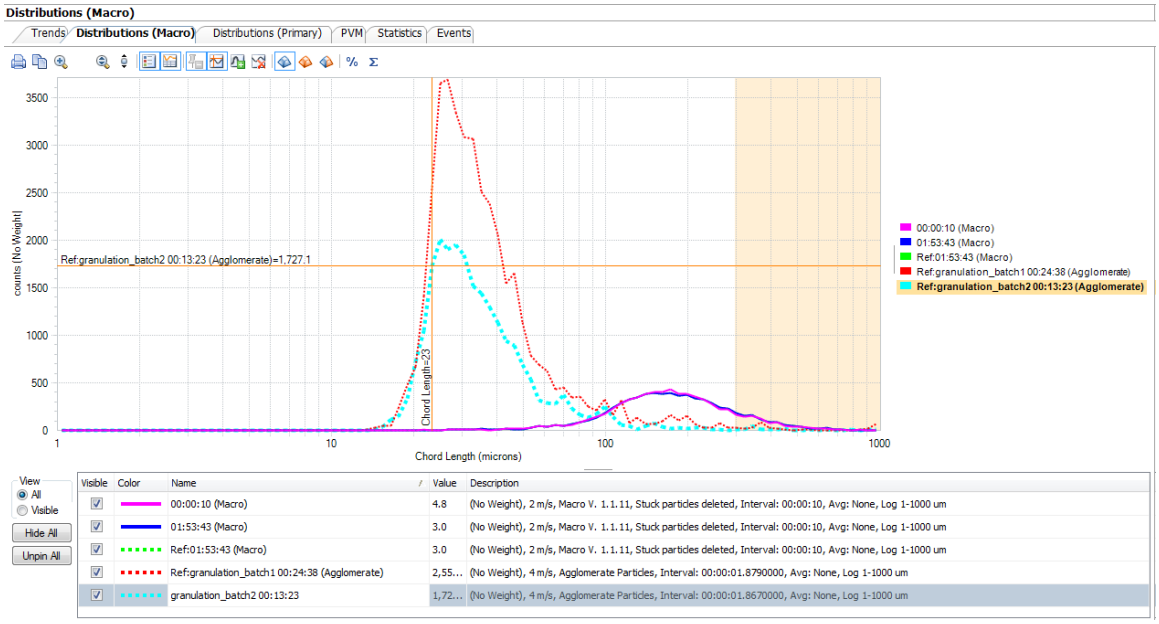
The Data Treatments task pane includes a “Display distribution” check box that enables selection of both of the chord selection models for converting the raw signal collected by the probe into chord length data.



The following sections describe how multiple CSMs appear in the iC FBRM viewers.

DISTRIBUTIONS VIEWER—MULTIPLE CSMS

When distributions from two CSMs are available, the current measurement displays two distributions—one from each CSM. The Distributions Viewer shows two tabs and the Statistics Viewer shows two sets of values. The CSM type displays in the tab heading. The CSM selected in the Display Distribution drop-down list in the Data Treatments task pane display in the first tab as the default CSM.



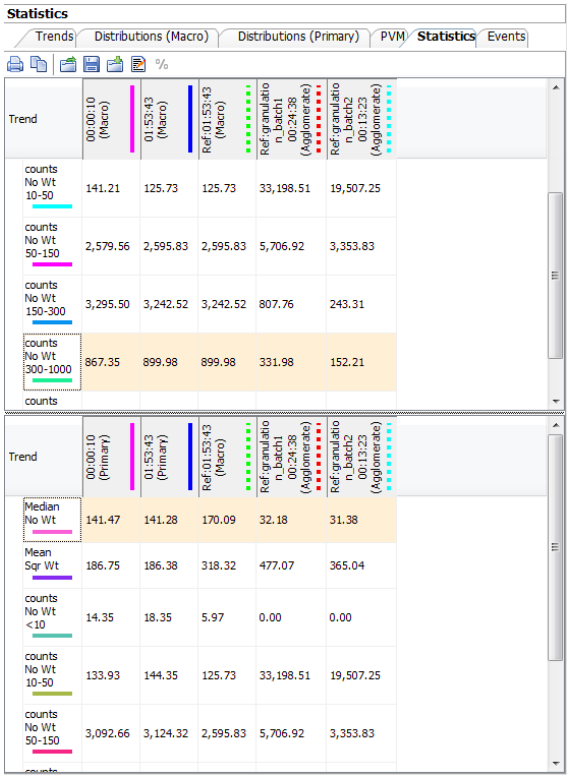
TRENDS VIEWER—MULTIPLE CSMS

If the user selected the option to display both CSMs, for each statistic defined, two trends display in the Trends Viewer—each with a different CSM.

As a result, the number of trends displayed doubles in the Trends Viewer graph area, details panel, and legend panel.

For each defined statistic, trends for the default CSM display first in the list, followed by the trends for the other available CSM.

STATISTICS VIEWER—MULTIPLE CSMS



If an experiment has the option to show distributions from two Chord Selection Models selected, each CSM displays as a separate table in the Statistics Viewer. The trend heading identifies the CSM.

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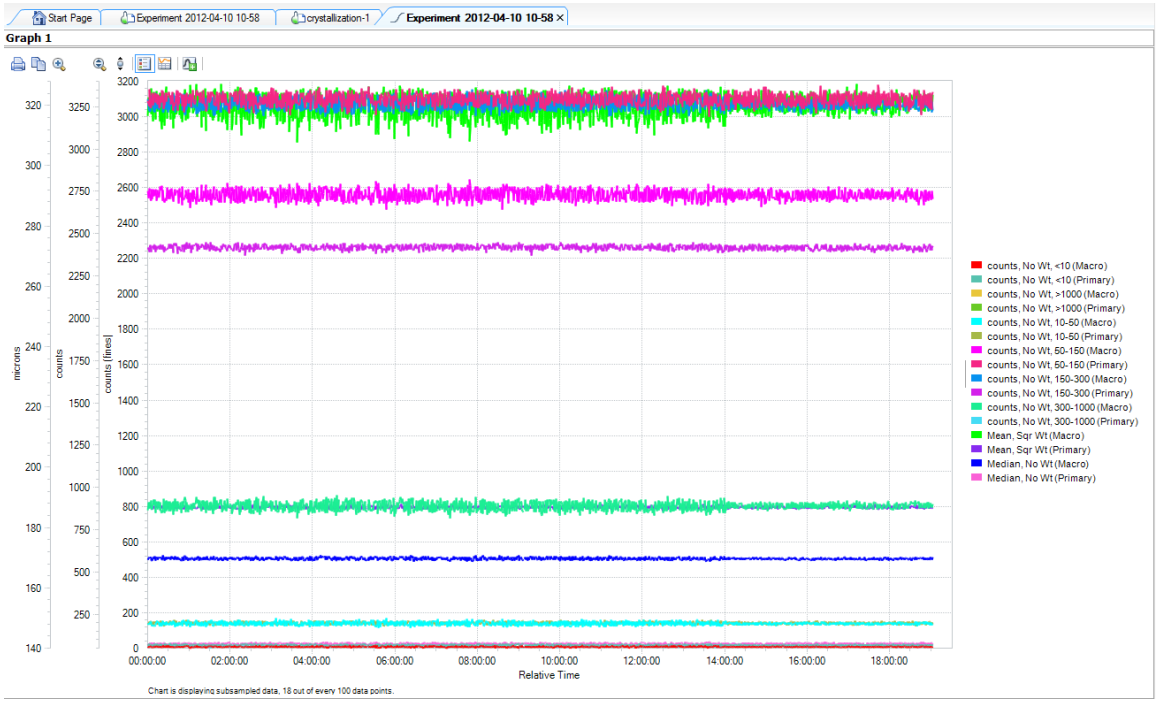
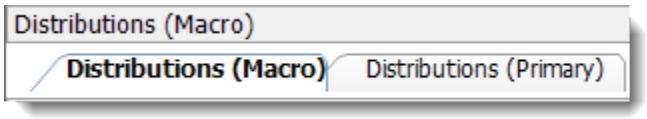
RESULT SETS—MULTIPLE CSMS

When trends from an experiment that contains multiple CSMs are sent from the Trends Viewer to a Result Set, the trends from both CSMs are imported (see Sending Trends to a Result Set). Both CSMs display in the Result Set graph area, details panel, and legend panel.



DISTRIBUTION LIBRARIES—MULTIPLE CSMS

Since distributions from multiple CSMs display in separate tabs, only distributions from the selected tab export to a Distribution Library. If the distributions from both CSMs are required in a Distribution Library, each of the CSMs distributions must be copied individually.

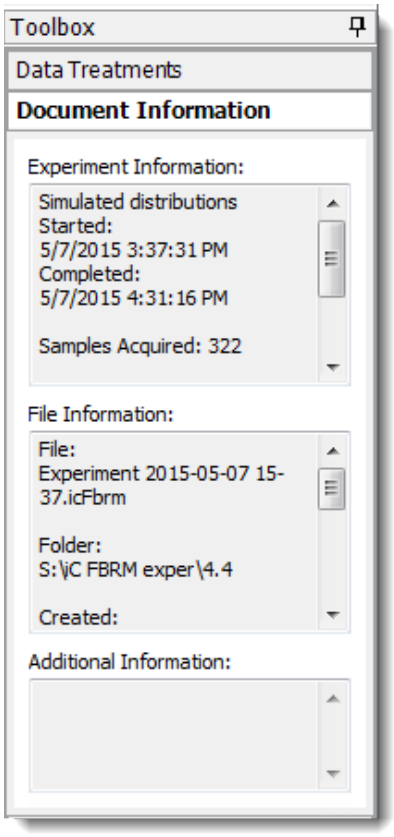


Document Information Task Pane

The Document Information task pane is an informational display that provides chronological and summary information about the currently displayed data document.

The document information pane displays different information depending on the type of document (Experiment, Result List, or Measurement Library).

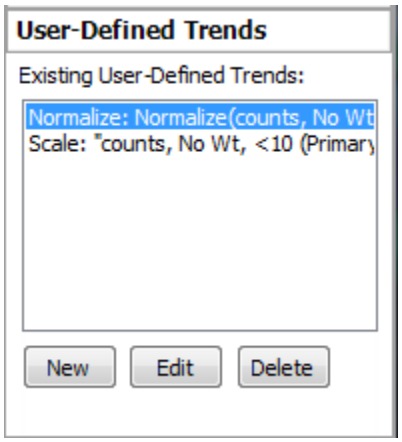
The document information pane for an experiment includes the following information.



Experiment Information	Provides statistical information about the experiment. Date and time of start of the experiment Date and time of finish of the experiment Samples Acquired
Instrument Information	Describes the hardware configuration of the instrument.
File Information	The Filename for the experiment document. (test1.icFbrm) (example)
Folder:	The folder where the file resides. (U:\\Experiments) (example)
Created:	Date, time, author, file name and build number.
Last Updated:	Date, time, author, file name and build number for last update.
Additional Information	Miscellaneous information about the experiment.

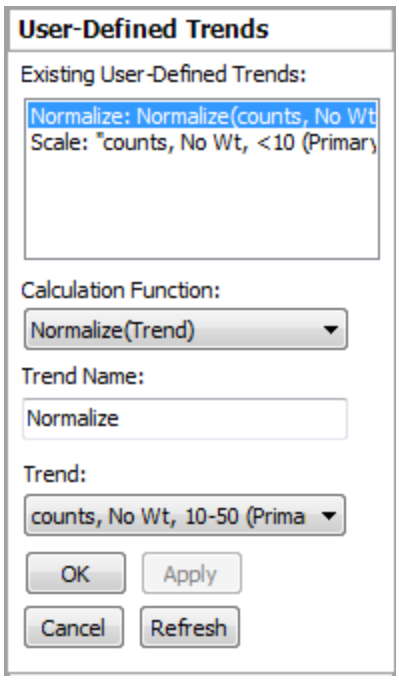
User-Defined Trends Task Pane

The User-defined Trends task pane is where you can create new trends by performing math functions on selected trends to show information that might not otherwise be apparent. User-defined trends appear in the Trend and Statistic viewers. The User-defined Trends task pane for an Experiment includes a list of any user-defined trends that have been defined for the experiment and includes buttons to create and edit trends.



Existing User-defined Trends

A list of trends created by the user.



When you click the **New** or **Edit** button, the task pane expands to include additional fields available for defining the trend. Refer to User-Defined Trends and Creating a User-Defined Trend for more information.

Serial I/O Configuration Task Pane

The Serial I/O task pane is only available during a live experiment. Use the task pane to assign input and output specifications for the serial I/O. The serial I/O communicates with external devices that support the Serial Data Exchange (SDE) protocol.

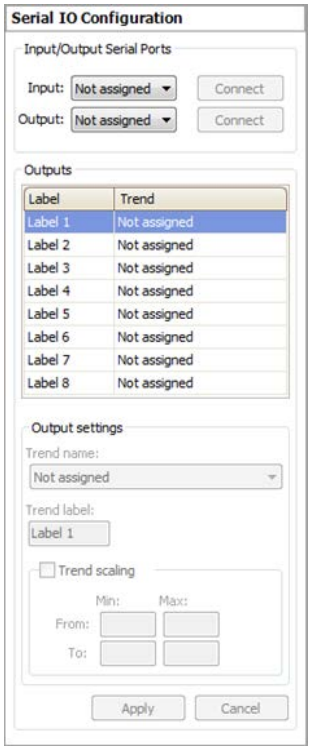
Use the Serial I/O task pane to:

- Read and write specified trends to and from other external programs using the serial data exchange protocol.
- Read specified trends using the serial data exchange protocol.
- Choose the COM port or source for inputs.
- Select from the available inputs in the trend list including label names.
- Define up to eight (8) outputs.

Define the following parameters to configure the I/O:

- COM port or destination selection for outputs
- Statistical trends from the list of active trends you want to output
- Label that identifies the outputs
- Trend value range and mapped range must be available

The Serial I/O task pane contains the following fields:



Input	If inputs are configured, select the communications (COM) port for the FBRM input from the drop-down list. Click the **Connect** button to establish communications with the device.
Output	Select the communications (COM) port for the FBRM output from the selection list. Click the **Connect** button to establish communications with the device.
Output (Label column)	The Label column provides a list of labels (aliases) for the outputs. To assign the labels, use the Output Settings fields.
Output Settings	Select the trend and a corresponding label field to assign a serial output label to the trend.
Trend Scaling	If the trend values for this output are to be scaled, check this box.
Min/Max	Default values reflect the scaling that will be applied to each label (Channel Grouping for the selected statistic). Default values reflect the settings as they were originally set up. You can change to a different min/max range of values for a particular statistic.

PVM Task Pane

Use the PVM task pane to load and adjust the viewing properties of the displayed PVM image. Auto Adjust options only apply to sequence files loaded from PVM V819 instruments.

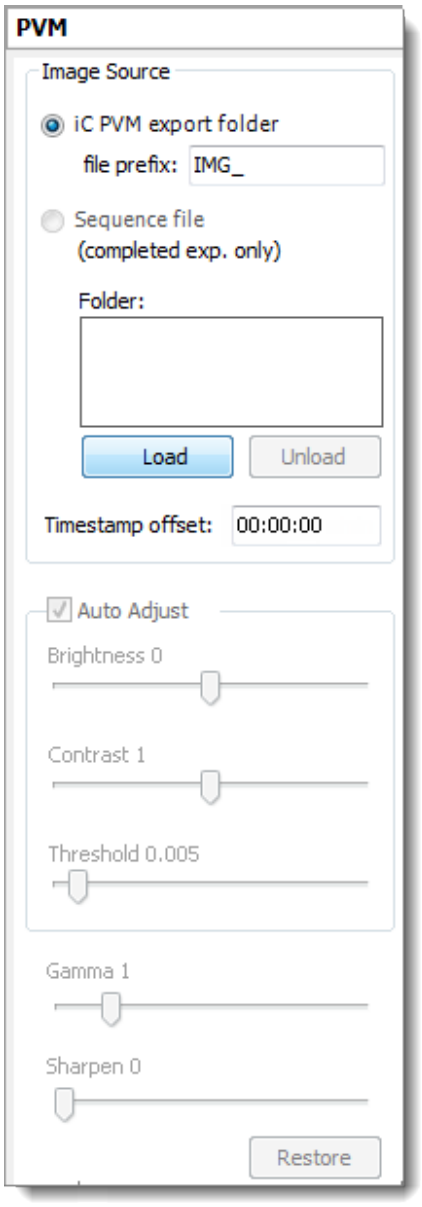


Image source	This section defines the PVM image source and settings.	
	iC PVM export folder—Select this option to load images from the folder designated in iC PVM export. When set up in iC PVM 7.0 (SP1 or later) images will be automatically exported in .png or .jpg format to the specified folder. **file prefix**—Default prefix from iC PVM is IMG_. If the prefix is changed in iC PVM, you must change it here. **Sequence file (completed experiment only)**—Select this option to load images in .seq format.	
	Load	Click button to locate and load images to the iC FBRM PVM Viewer from the Image Source. Enter a prefix for the .png images, if desired.
	Unload	Click to remove the currently loaded images.
	Timestamp offset	If the PC time or time zone of the Image Source file differs from the iC FBRM PC time, enter an offset amount of time in hours: minutes: seconds.
Auto Adjust	(applies to PVM V819 only) Auto Adjust is checked, by default. Uncheck to manually fine-tune the following settings using the slider bars:	
	Brightness—Manually adjust the brightness of the PVM image.	
	Contrast—Manually adjust the contrast of the PVM image.	
	Threshold—Manually adjust the threshold for the PVM image. Threshold helps you filter out images that are blank or have very little content.	
	Gamma—Manually adjust the gamma of the PVM image. Gamma deals with lighting adjustment to account for the differences between the camera and the human eye.	
	Sharpen—Manually adjust the sharpness of the image.	
	Restore—When clicked, restores image to its original view. This button 'undoes' any adjustments made.	

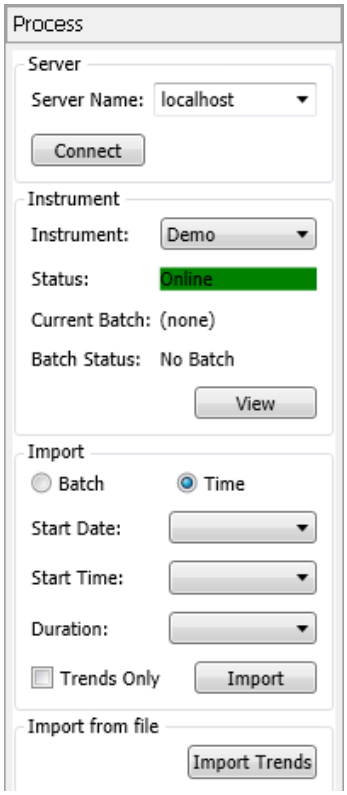
See information on the PVM Viewer.

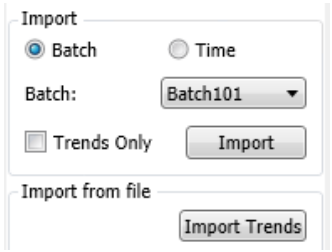
Process Task Pane

If iC Process for FBRM™ software controls a process instruments (ParticleTrack G600, E25) you can connect to the instrument through the server and view real-time or post-processing data for advanced analysis. The Process task pane in the iC FBRM toolbox enables the following:

- Instrument Connection for Live Monitoring
- Reporting Functions
- Batch Importing of Data

Use the Process task pane to manage connections with the iC Process for FBRM server and associated instruments. The task pane is also used to check instrument status, view real-time or batch processing data, import specific data, or import one or more trend files into a Result Set.





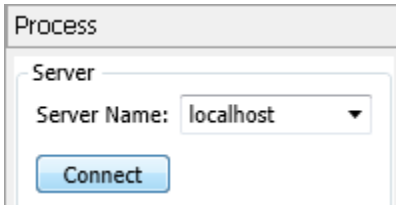
Server Name	Network name (URL/Machine ID or IP Address) of the computer where the iC Process for FBRM server is running. If iC Process for FBRM and iC Process are on the same computer, the server name is the PC name or 'localhost.'
Connect	Click **Connect** to connect to the specified iC Process for FBRM server. The server must be running iC Process, meaning the iC Process Service is started.
Instrument	Choose a specific ParticleTrack G600 or E25 instrument from the drop-down list for which data will be viewed or analyzed. When a connection is established with the server, the instrument field will display list of available instruments. The instrument does not have to be online in order to connect to it.
Status	The current status of the instrument: Stopped, Paused, Service or Online (Batch Status: Running or Paused; Current Batch name.
View	Click **View** to display the current real-time batch or continuous run processing on the instrument. When clicked, a new experiment is created in iC FBRM and populated with the live data from the iC Process for FBRM run. **View** is only enabled for online instruments.
Import: Batch or Time	Instrument can be run in either continuous or batch mode. • If the instrument is running in batch mode, select **Batch**. • If the instrument is running in continuous mode, select **Time**. Import fields vary depending on which mode you select.
Start Date/ Start Time	When you select the **Time** Import mode, archived continuous run data imports to an iC FBRM experiment. **Start Date:** Select from a drop-down list of available runs. **Start Time:** Select from a drop-down list, can be any time within the continuous run.
Duration	Select number of hours of data to import from the Start Time forward, up to a maximum of 24 hours. This is the duration of the experiment data to import and not necessarily the actual duration of the run.

	Trends Only	• If checked, the import only includes trend data. • If left unchecked, diagnostic value trend data and Process variable trend data from the run are added to the Result Set.
	Import Trends	Import trends from multiple *.icFBRM experiment files generated by iC Process for FBRM into a single iC FBRM Result Set. This is a two-phase process: I. Import iC Process Data by Batch or Time as described above and save the experiments on your local hard drive. II. Import batch trends from saved experiments. a) Click **Import Trends** on the Process task pane ("Import from file" section). b) Select the files containing the desired trends. c) Click Open to import the trends into a new Result Set.

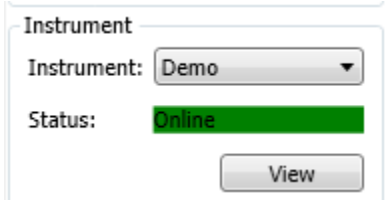
DISPLAYING LIVE IC PROCESS FOR FBRM DATA IN AN EXPERIMENT

Live data from a running iC Process for FBRM batch can be viewed in an experiment. If a batch is active, the experiment loads the batch and updates it continuously as new measurements are recorded. If a batch is not active, the experiment will start displaying live data from the instrument as samples are acquired.

A connection with the iC Process for FBRM server and an instrument must first be established to view live data. To connect to the iC Process for FBRM server, enter the name of the iC Process for FBRM server (localhost) in the iC Process for FBRM task pane and click **Connect**.

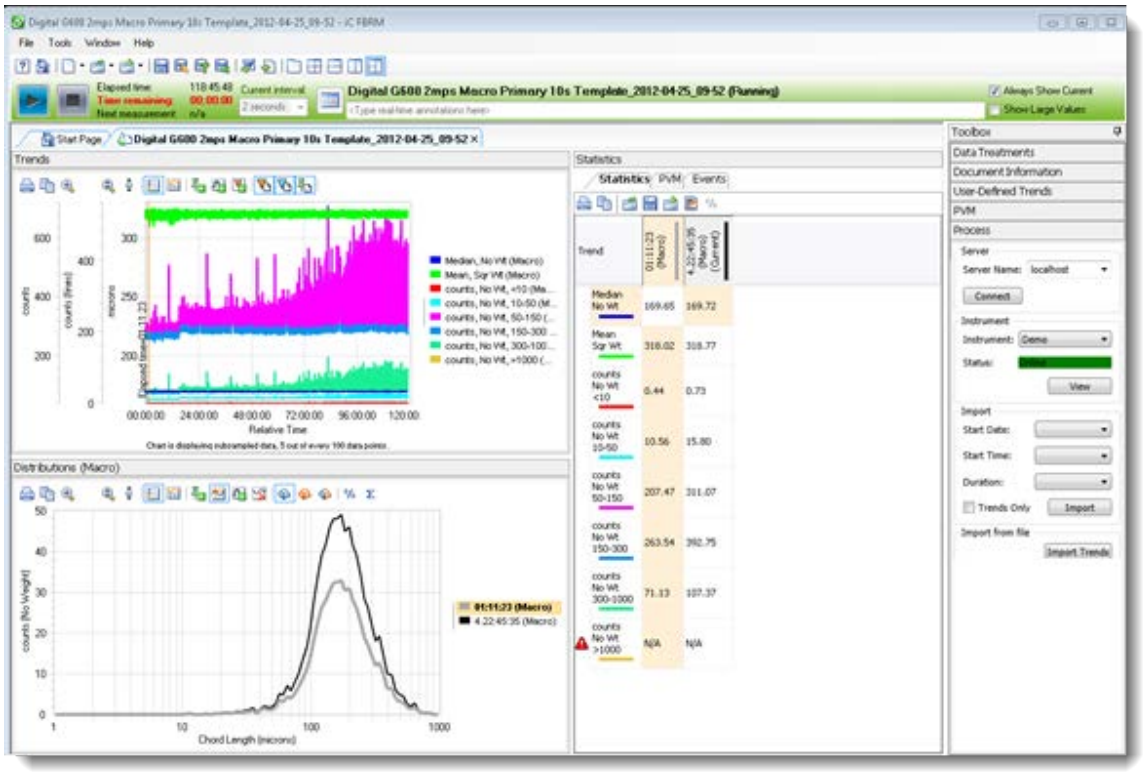


Once a connection with the iC Process for FBRM server is established, the instrument name appears in the Instruments field and its status appears on the task pane.



Click **View** to display live data from the instrument. Note that an instrument does not have to be to select it but the **View** button is only enabled for online instruments. When the button is clicked, a new iC FBRM experiment is created and populated with the live data from the instrument. The name of the experiment is based on the template and the date/time the run was started.

While connected to the iC Process for FBRM server, all iC experiment analysis functions are available.



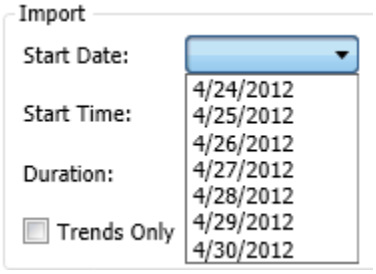
- Data treatments
- Statistics definitions
- User-defined trends
- And so on…

VIEWING ARCHIVAL DATA FROM IC PROCESS FOR FBRM

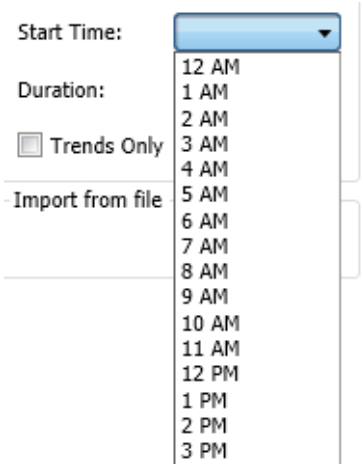
Archival data from an iC Process for FBRM batch can be viewed in an iC experiment. In order to view an archived batch, a connection must be opened between the iC application and the iC Process for FBRM server as previously described. The instrument does not have to be online to import a batch.

Continuous Data:

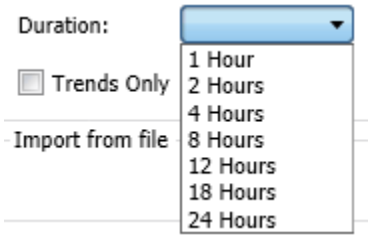
To import archived continuous data, select the start date of the run from the Start Date drop-down list. The list shows all available archived runs.



Next select a start time for the data import. Data will be imported starting at this time stamp in the run and continue for the specified duration.



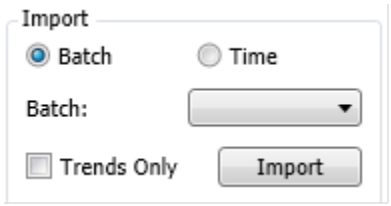
Finally select the duration for the experiment.



Trends Only—If left unchecked, the diagnostic value trend data and the process variable trend data from the run are added to the Result Set. Check the box to import only trends to a Result Set.

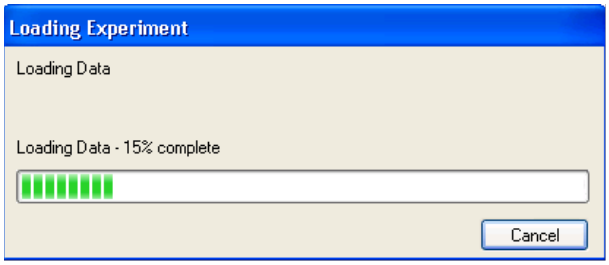
Batch Data:

To import batch data, select the Batch button. Then choose the batch name to import from the drop-down list.

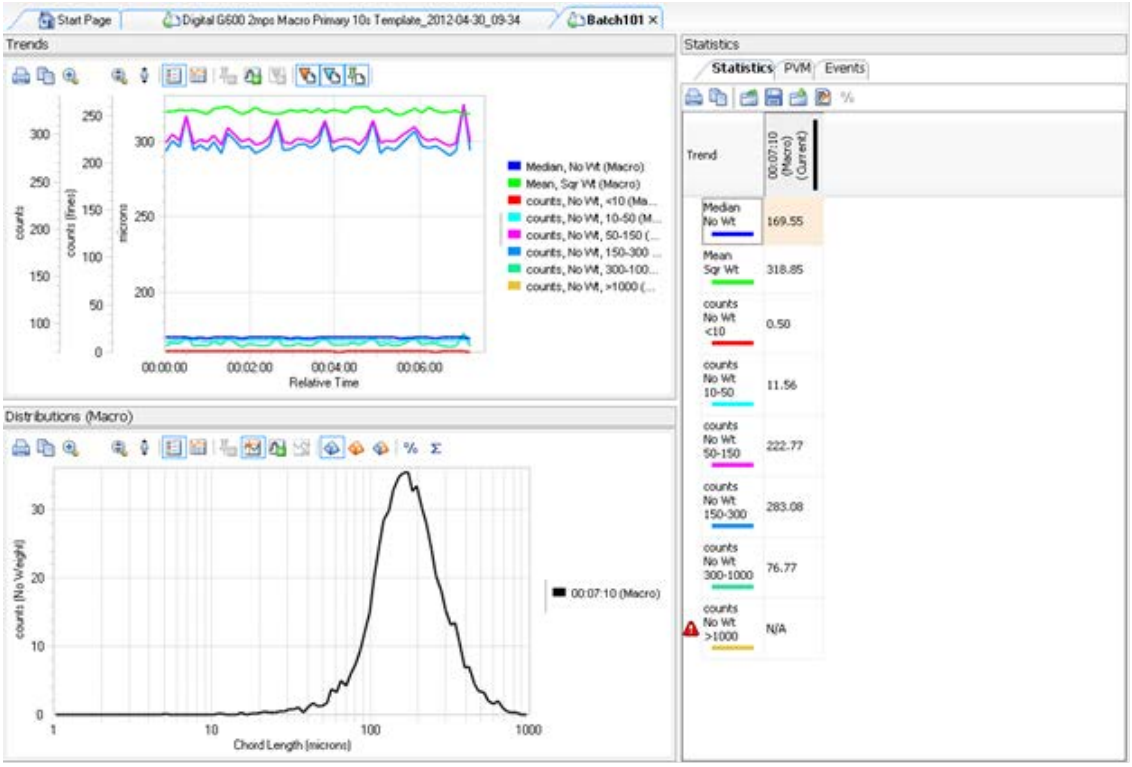


Trends Only—If left unchecked, the diagnostic value trend data and the process variable trend data from the run are added to the Result Set. Check the box to import only trends to a Result Set.

Click **Import** to bring the data into a new experiment. A progress window appears during the import operation.



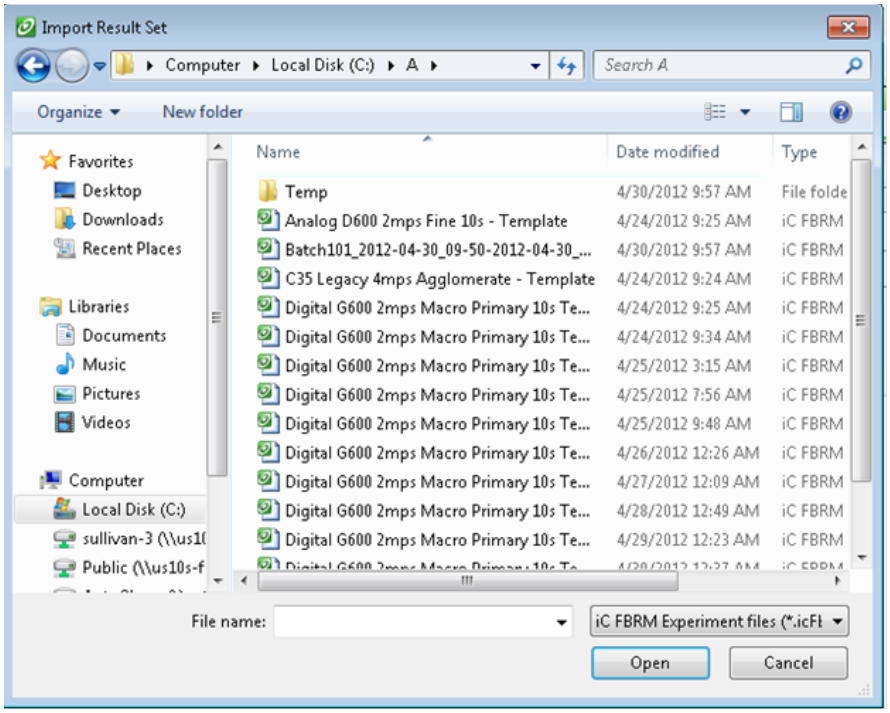
A new experiment containing the imported data opens. The experiment name is based on the batch ID.



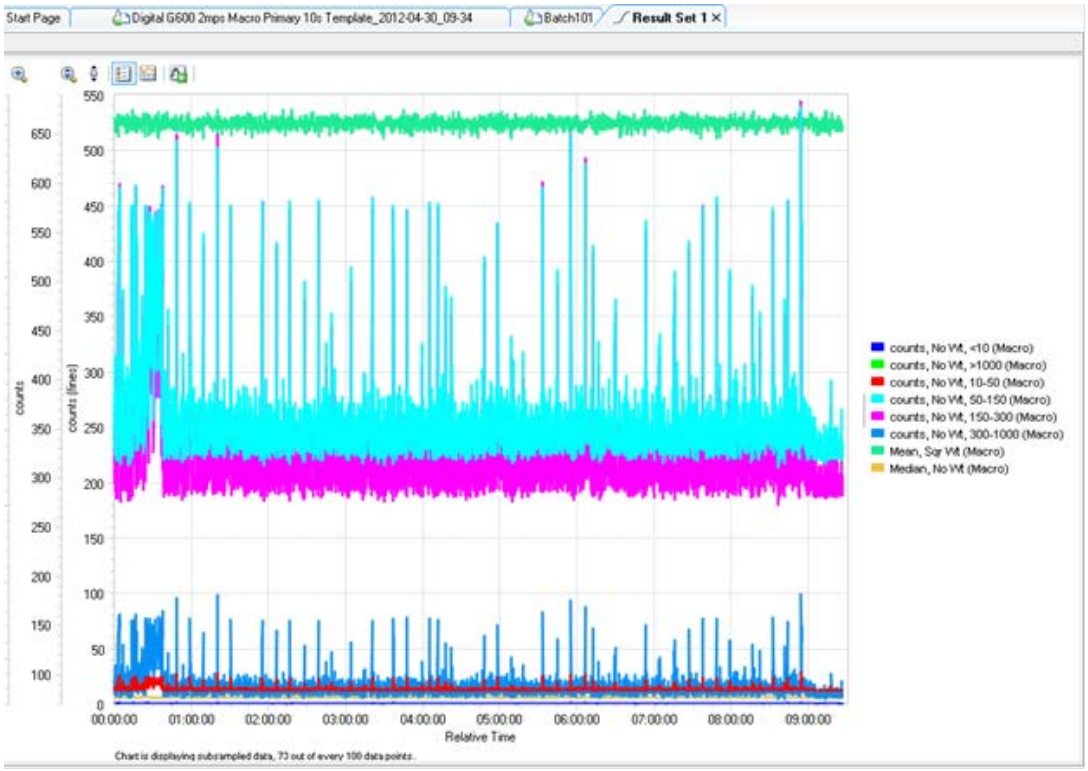
IMPORTING IC PROCESS FOR FBRM TRENDS INTO A RESULT SET

Trends from one or more experiments containing iC Process for FBRM trends can be imported into a Result Set. To import batch trends, click the **Import Trends** button on the iC Process for FBRM task pane.

A standard File Open window appears.



Select the files containing the desired trends. Use the Shift and Control keys to select multiple experiments. Click the Open button to import the trends into a new Result Set. Trends with the same name will be stitched together across the time spans of all the selected files.



Interaction with Other iC Applications

iC FBRM has the ability to interact with other applications in the iC software family. Data can be shared between iC and iControl applications. The three common situations are:

- iC and iControl applications are on the same PC
- iC and iControl applications are on different PCs on the same network
- iC and iControl applications are on different PCs connected via an Ethernet cross-over cable

iC applications can be running on the same PC or connected through a network using TCP/IP. The degree of interaction available depends on the actual iC applications involved. The sections that follow describe the features associated with iC FBRM.

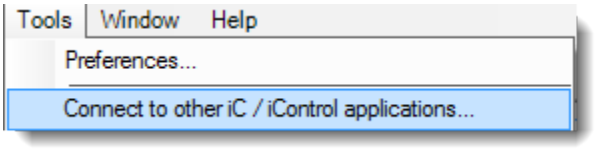
Connections to other iC applications are controlled using the Connect to other iC/iControl Applications dialog accessed from the Tools menu.

THE CONNECT TO OTHER IC/ICONTROL APPLICATIONS DIALOG

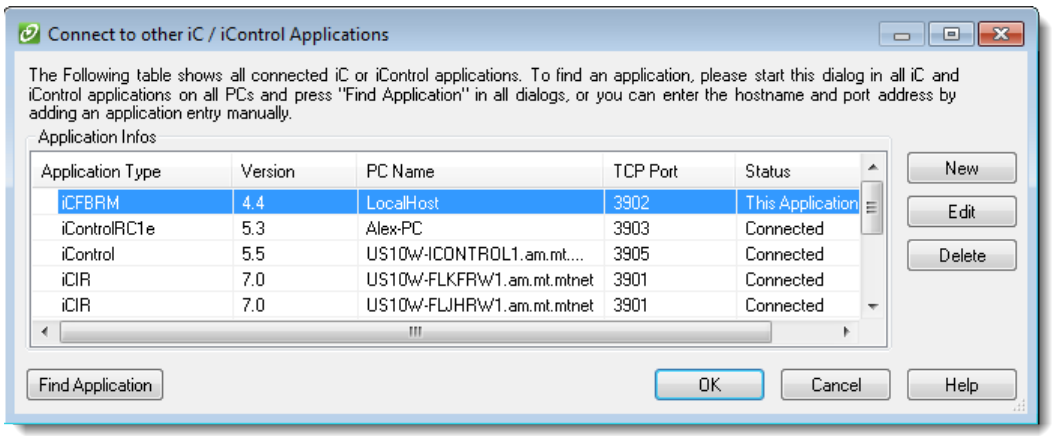
Below are the steps to get iC/iControl applications to connect.

1. Start the iC or iControl application on each PC.
2. To establish a link, iC 4.x versions of software must broadcast their existence.

   For iC applications—Go to the main Tools menu and select **Connect to other iC/iControl Applications…**



   a) Click the **Find Application** button on each PC, if applicable, to begin a network scan for all applications. Repeat for all applications to be connected.

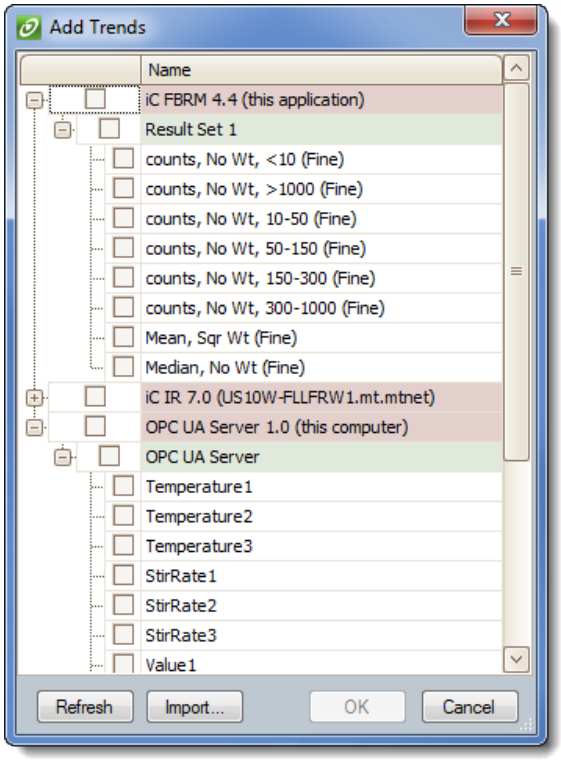


   b) Once the initial scan is performed, the Application Type list displays all iC /iControl applications currently running the user next clicks the Find Applications process on the network. On each PC, the corresponding applications should appear on the list and the Status column should show Connected.

Note: If an application connection cannot be made, the Application Type column entry is "Unknown." Please refer to iC FBRM Install Guide for Administrators for information on 'Configuring the Windows Firewall."

There is no need to rescan all the networked PCs in the future unless a new iC application or PC running iC applications is added to the network. In this case, a scan must be run on all PCs to update the "phone book" file.

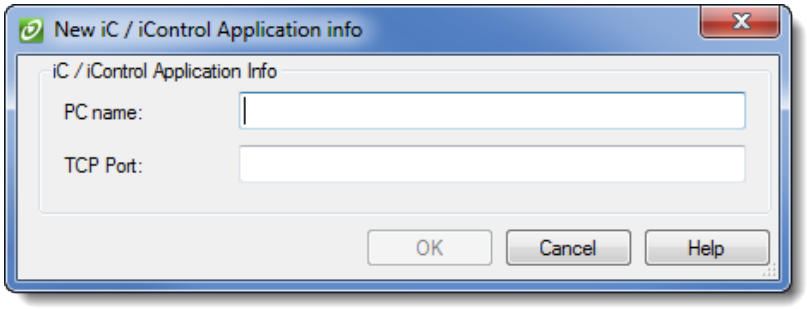
Once communications between the iC applications has be established, trend data for all the applications appear in the Add Trends dialog box for a Result Set.



For iControl—Refer to the iC FBRM 4.4 Install Guide for Administrators for instructions on how to configure iControl to connect to iC FBRM.

Defining a New Connection

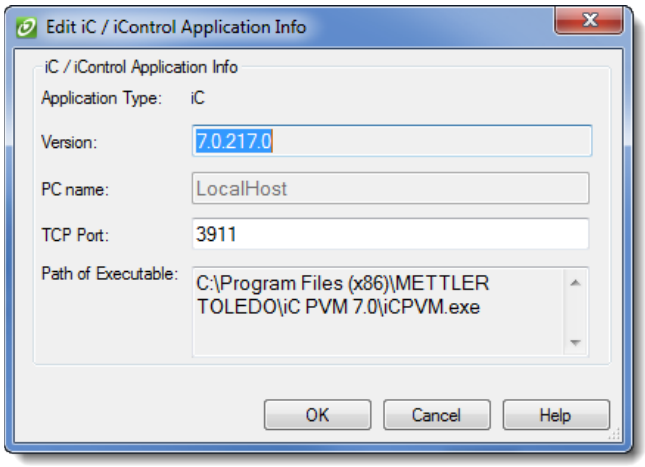
A new application can be manually defined by clicking the **New** button on the Connect to other iC/iControl Applications dialog box. The New iC/iControl Applications dialog box opens.



Enter the network name for the PC and the port number that the application uses. When you click **OK**, the system verifies the connection to the application. If a connection cannot be made to the application, an error appears on the Connect to other iC/iControl Applications dialog box.

Editing iC/iControl Application Info

The user can edit the port number for an application connection by clicking the Edit button on the Connect to other iC/iControl Applications dialog. The Edit iC/iControl Application Info dialog is opened. The dialog contains information about the application and has one editable field, TCP Port. Normally the TCP Port is auto-detected when the system scans for applications. If a port needs to be changed for some reason, the new port number can be edited here. When the **OK** button is clicked, the TCP Port is verified by the system.



CONTROLLING IC FBRM FROM AN ICONTROL EXPERIMENT

The application link to iC FBRM allows you to synchronously start, control and stop your iC experiments from within the iControl experiment and it allows you to monitor live profile trends.

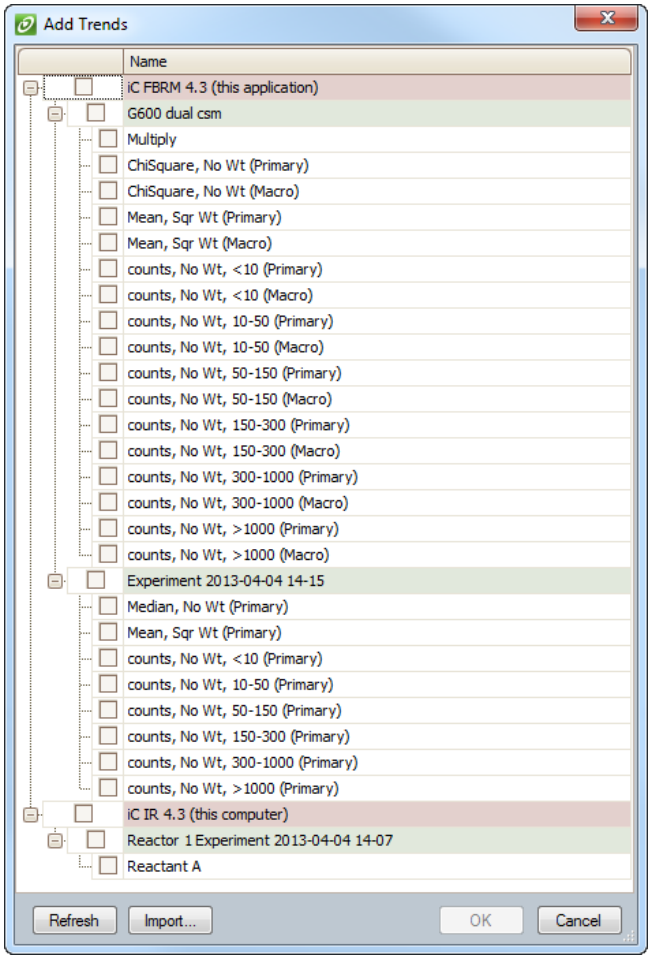
Both iC FBRM and iControl must be started from their respective computers.

Note: If the application is on a networked computer, then you have to ensure that the network firewalls allow iControl and iC to communicate with each other.

Refer to the iControl documentation for detailed information about controlling an iC FBRM experiment with iControl. Note that when an experiment is started from iControl, all samples taken while the experiment is in the initial paused state are automatically discarded.

SHARING TREND DATA WITH OTHER IC/ICONTROL APPLICATIONS

iC applications and iControl have the ability to share trend data with other applications in the iC software family. If the iC applications are running on the same PC, trend data from all open experiments in all running iC applications will automatically appear in the Result List and Trends Viewer Add Trends dialog for all the iC applications. This feature is useful for comparing trend data from various types of instrumentation. It should be understood that care must be taken when comparing trends from different types of instrumentation.



If an iC FBRM experiment is started from within an iControl experiment, the iControl experiment's trends imported into the iC FBRM experiment are grouped together with the iC FBRM trends for purposes of reference time shifting. This applies to trends imported into a Result Set or trend.

The iC FBRM trends and iControl reference trends are all grouped together while time shifting.

It is important to note that this grouping only happens when the user started the iC FBRM experiment from within iControl AND the user brings the iControl trend into iC Experiment DURING the run (live data). If trend data is added after the run is complete, the grouping will not occur.

iC Data Center™

iC Data Center is a central storage tool with a dashboard for your completed iC™ and iControl™ experiment files. When you purchase, install, and configure the optional iC Data Center software, each iC IR™, iC FBRM™, or iControl instrument can 'turn on' the data center. After an iC or iControl instrument is configured for iC Data Center, all completed experiments automatically move to a configured central location and optional email notification goes to a specified user. iC Data Center not only stores the experiments files, but can also prepare Microsoft® Word® or Microsoft® Excel® files from the experiment files.

Configuring iC Data Center

Configuration is required in iC Data Center and also in the iC or iControl software. Before configuring a connection within iC IR, iC FBRM, or iControl, complete the prerequisite setup in iC Data Center.

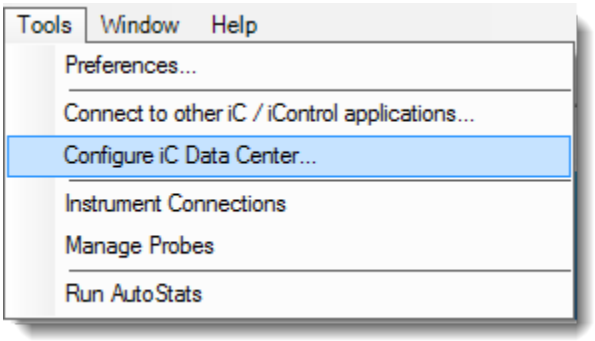
Prerequisites:

- iC Data Center Server must be running.
- The iC Data Center Target Experiment Location/Shared Folder must be set up as 'shared' through the Microsoft operating system. The iC Data Center Server must have write permissions to the location.
- Other optional configuration settings:
  - Experiment Name pattern
  - Project Name field and pattern
  - User Name field and Domain Name
  - Email enabled (If enabled, Domain Name and SMTP server are required.)
  - Configuration on how incoming experiments shall be organized and named based on experiment metadata such as Project, User, date/time, etc.

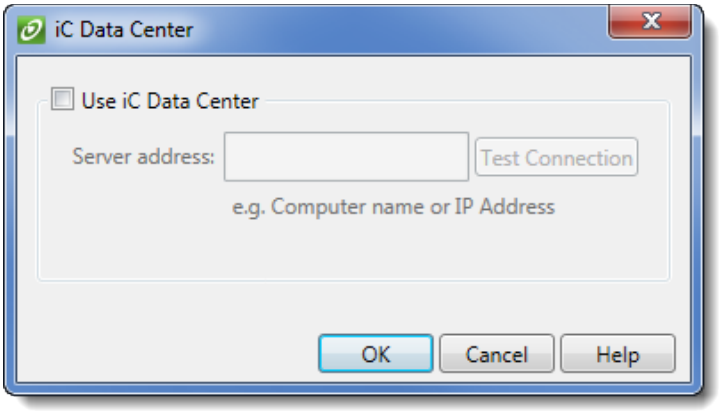
Please follow the instructions in iC Data Center to configure the above options for iC or iControl.

After iC Data Center server configuration is complete, do the final setup within iC FBRM, iC IR, or iControl. Follow the steps below to configure a connection to the iC Data Center server.

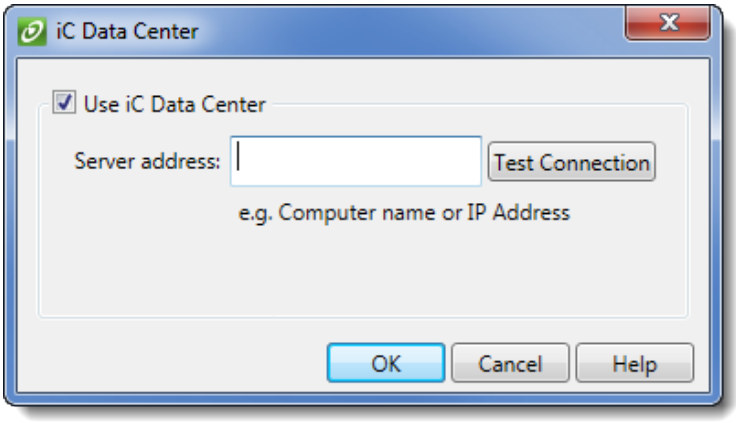
1. Select Tools > Configure iC Data Center.



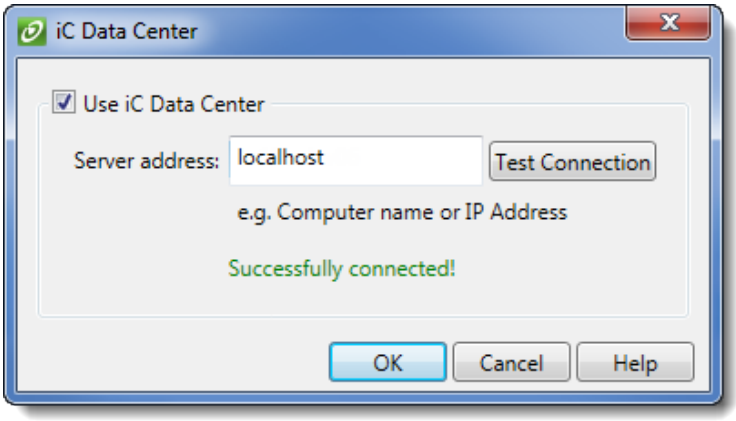
2. Click 'Use iC Data Center.'



3. Enter the computer name or IP address of the iC Data Center server.



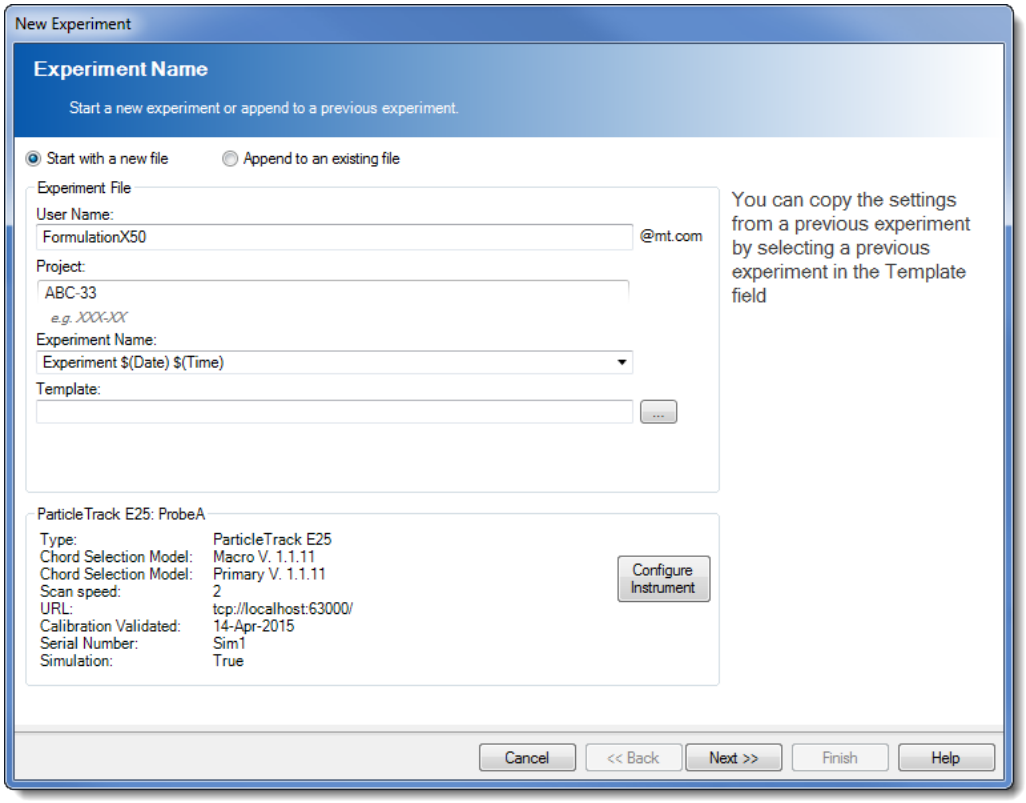
4. Click **Test Connection**.



After confirming the connection to iC Data Center, completed experiments will automatically go to the designated iC Data Center shared folder. An 'Uploading Experiment' tab communicates the upload and displays a completion message. If applicable, a warning message appears. The new location will be updated in the recent files links on the iC Start Page. When you start an experiment, the Folder path for storing the experiment no longer appears. Refer to the Start Experiment Wizard.

Start Experiment Wizard (iC DC)

After iC Data Center™ configuration is complete (Tools > Configure iC Data Center), the first page of the wizard appears. The Experiment File section displays the Experiment naming convention defined in the iC Data Center Configuration. Notice the Folder location does not appear because the file storage location is automatically the designated iC Data Center shared folder.



Use the first New Experiment wizard page (Experiment Name) to define the name and location of the experiment document. The page also displays the current instrument configuration and includes a Configure Instrument button, if instrument configuration tasks exist.

In many cases, you can simply click **Next** to use the default settings and go to the next wizard page. The steps below go through each section of the page for your reference.

1. Most new experiments start as a new file. However, you have the option to append a new experiment to an existing file if necessary.
2. Experiment File—Template: To start the experiment based on a previous experiment, browse to the location of the template file.

Instrument Information

To change your instrument settings before recording an experiment, click **Configure Instrument** on the Start Page or from this window.

It is important to note that if a multi-probe configuration is connected to the control computer, both probes must be configured before running an experiment. If an attempt is made to start an experiment without first configuring both probes, an error message appears and identifies the probe that needs configuration.

Troubleshooting Notes

iC FBRM reports errors and messages to keep you informed of system information. This topic also includes common troubleshooting tips.

ERROR MESSAGES

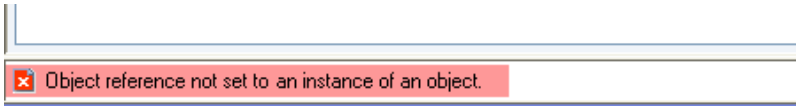
The iC software has extensive error handling capabilities. These capabilities range from verifying correct program execution and hardware functionality to the validity of variables entered by the user for data manipulation. The content of error and warning messages provides valuable information for AutoChem personnel when diagnosing problems.

Instrument-type errors turn the Live Experiment toolbar red and display the error as a tooltip on the toolbar. In addition, the errors are logged in the Events Viewer and in the iC Log Manager logs. Instrument type errors consist of actual failures with the hardware and communication errors between the iC software and the instrument. Communication errors include failures with the PC communications port and cabling issues. Many times the tooltip will provide hints for resolving the problem.

System type errors generate an error dialog as shown below.

Normally the user should try and continue. If the error dialog continues to pop up, the user should quit. Clicking the **Quit** button closes the iC application. The user can then restart the iC application and try and continue operation.

General error and warning messages display in the status bar at the bottom of the main window.



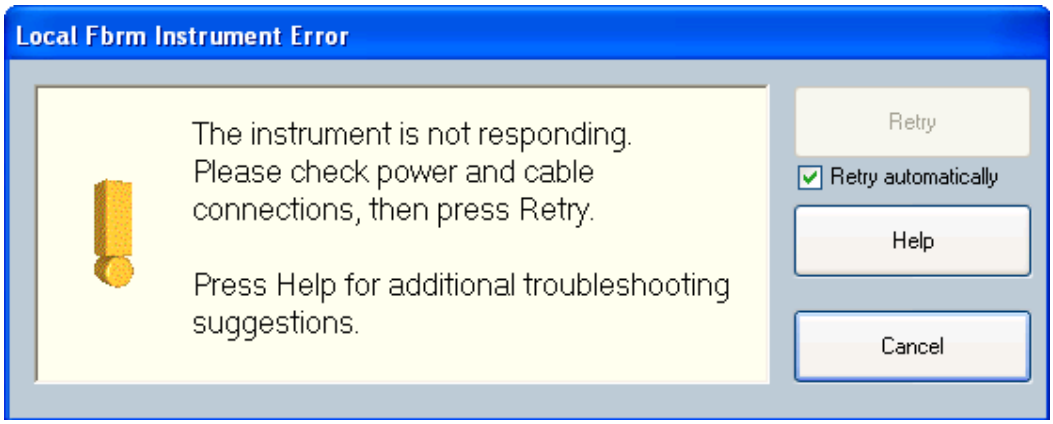
These errors are also recorded in the Events Viewer and in the iC Log Manager logs.

Info	12:50:13 PM 10/26/2007	Experiment Started
SystemAnnotation	12:50:13 PM 10/26/2007	Experiment Paused
Error	12:50:20 PM 10/26/2007	Object reference not set to an instance of an object.
Error	12:50:20 PM 10/26/2007	Object reference not set to an instance of an object.

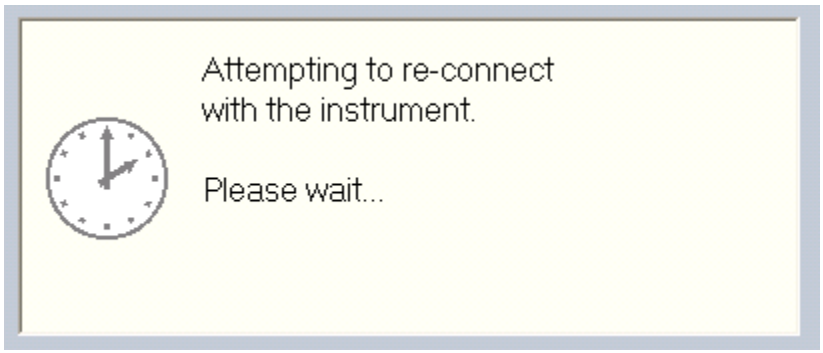
The section, The Customer Care Log File Utility describes how to send Log Manager reports to AutoChem.

INSTRUMENT ERROR

If communication with the FBRM Service 4.4 is lost, an error dialog appears.



The iC FBRM software will attempt to re-establish communications with the server either automatically or manually as specified in the dialog. The dialog will display a message when attempting to reconnect.

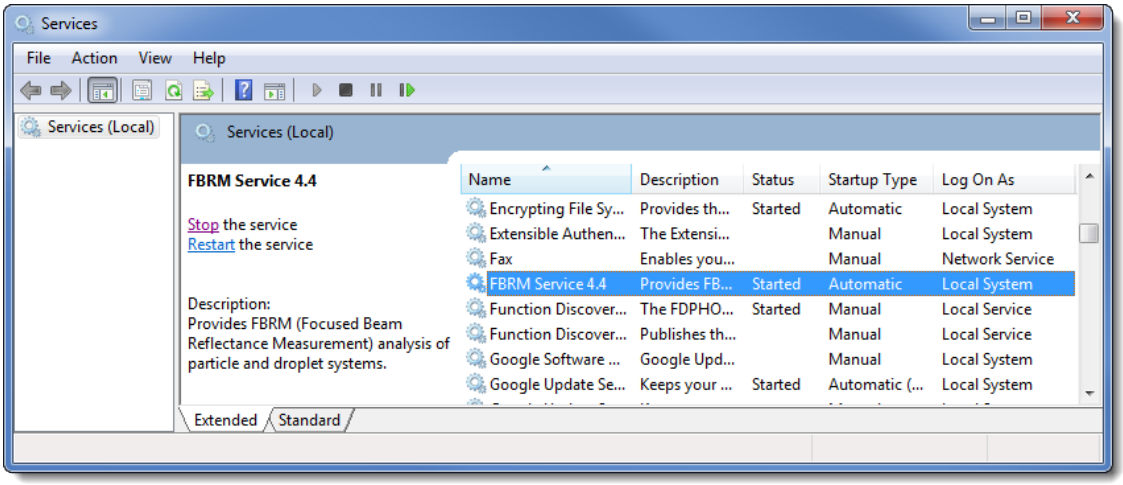


If the iC FBRM successfully connects to the server, a success message is displayed and the dialog closes. The experiment continues to run.

Note: If the server stops responding during the execution of an experiment, it can be restarted manually. iC FBRM shall attempt to reconnect to the FBRM Service 4.4 and resume the experiment. If the reconnection failed and a new experiment cannot be resumed, the user can start a new experiment and append to the previous experiment. If a new experiment cannot be started on a probe because the probe is claimed to be used by the failed experiment, user can run the configure instrument wizard to reclaim a probe from the failed experiment..

If iC FBRM cannot communicate with the FBRM Service 4.4, first verify the following:

1. Verify that the FBRM Service 4.4 is running by checking the Services tool located in the Windows Control Panel/Administrative Tools menu.



2. Verify that the communications cable is properly connecting the FBRM Service 4.4 PC and the computer running iC FBRM.

3. Turn off power to the PC running the FBRM Service 4.4. Wait 15 seconds. Turn power back on.
   a. Wait another minute allowing iC FBRM to retry establishing communications.
   b. If communications are still not re-established, do the following:

4. Exit iC FBRM.
   a. Turn off power to the hardware. Wait 15 seconds. Turn power back on.
   b. Restart iC FBRM.

If the problem persists, contact customer service (use the Contact information on the iC FBRM Start Page).

MISCELLANEOUS WORKAROUNDS

Problem: I linked to a template for another experiment and every time I click **Next** I get a warning informing that a "More Recent Backup Exists".

Workaround This error occurs when there is a backup version of the template file available with a more recent modified date than the specified file. Try opening the template from the **File Open** option. You will probably get this same message the first time. Click **Yes** to open the backup file. Then click **Save**. The software will automatically save to the original path (not the backup path). From that point on, you won't see this message again.

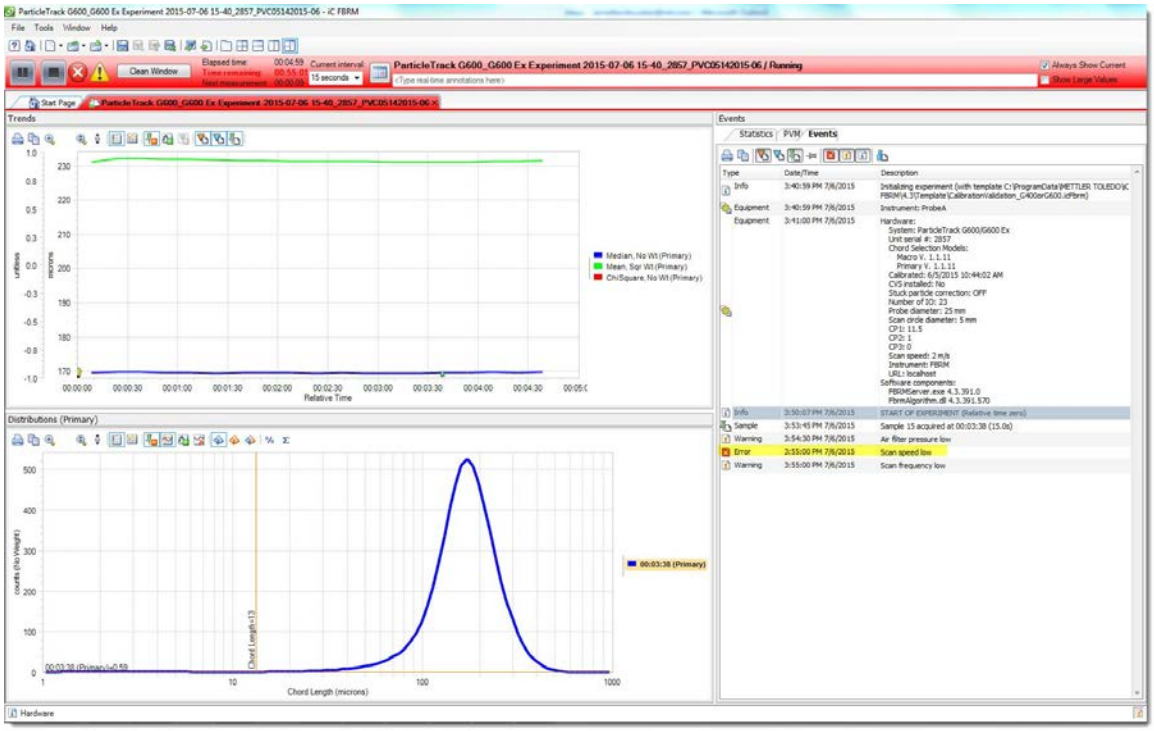
Problem: Communication errors occur when the earlier Version 6 FBRM software is open and iC FBRM is also trying to communicate to the probe.

Workaround: Close the Version 6 FBRM software, only one FBRM application can be run at a time.

DATA ACQUISITION ERRORS

When a data acquisition or experiment error condition is detected, the system does not save the distribution data since these values are considered invalid. No statistics (trends) are calculated for the invalid distribution data. However, hardware diagnostics values are collected.

In the example below, an error occurred around time 03:55. Entries were inserted into the event log indicating that the scan speed was low. No distributions were saved and trend value is flat. When there is no distribution data available, no trends are calculated for the measurement. Diagnostics values from the hardware system were saved—for the probe air pressure and scan frequency. These values provide important troubleshooting data when diagnosing the cause of the error.

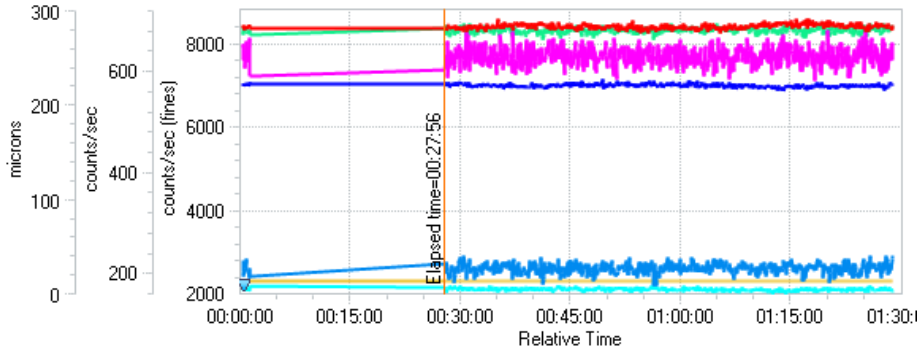


POSSIBLE DATA LOSS DURING AN APPLICATION FAILURE

If the iC FBRM client application becomes inoperable or loses communications with the FBRM server for an extended period of time, possible loss in the data can occur. While the iC FBRM client is inoperable, the FBRM server continues to collect data and stores the data in its buffer. The data buffer can hold up to 600 measurements. When the data buffer is full, the oldest measurement is discarded to make space for the newest ones.

- If the iC FBRM client restores its communication to the FBRM server before the server's data buffer is full, all the measurements will be drawn from the buffer and sent to the iC FBRM client so no data is lost.

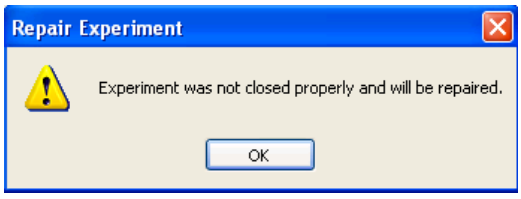
- If the iC FBRM client is inoperable longer than the time period equal to 600 times the sample interval, the data buffer in the server gets filled up. Old measurements are discarded to make space for new measurements. When iC FBRM client resumes the communication to the FBRM server again (this needs to be earlier than the original experiment end time), the latest 600 measurements are drawn from the buffer and added to the experiment. No data will be available for the time period between when the client application failed and the measurements acquired in excess of the 600. Below is an example.



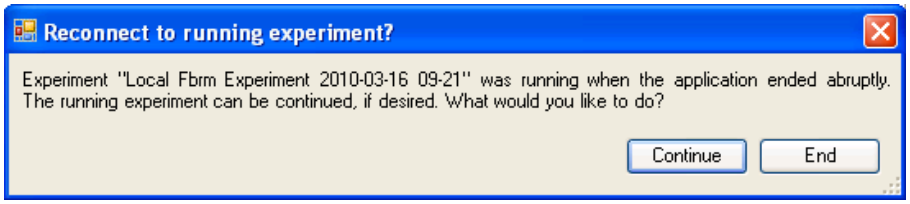
To avoid data loss, the user should attempt to restore the connection between the iC FBRM client and the FBRM server as soon as possible.

Depending on when the crash occurred in relation to the autosave function of the client (every 5 minutes), there may be more distributions than sample acquired messages in the Events Viewer.

When the iC FBRM client is restarted, a message dialog is displayed indicating that an error occurred with the experiment.



When the OK button is clicked, the experiment data is loaded from the server and the user is given the option of continuing the experiment or ending it.



G400/G600/E25 INSTRUMENT FAILS TO RECONNECT AFTER A POWER FAILURE

In certain circumstances, the FBRM Server may not recognize a ParticleTrack instrument after restarting from a power failure. If this occurs, the FBRM server will fail to restart. To correct the problem, perform the following steps.

- Disconnect the USB and power cable.
- Close all applications and shutdown the PC.
- Reconnected the USB and power cable.
- Restart the PC.
- Restart the iC FBRM application.

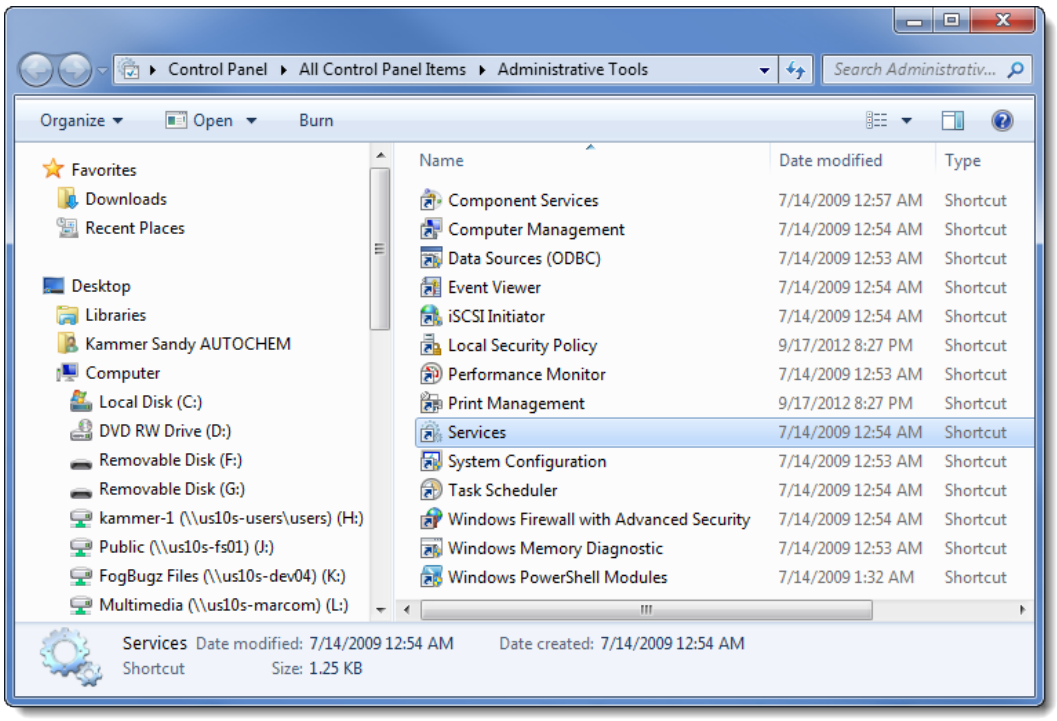
CHANGING TIME ZONES AND REGIONAL SETTINGS

Changes to the time zone/regional settings should be avoided during the execution of an experiment.

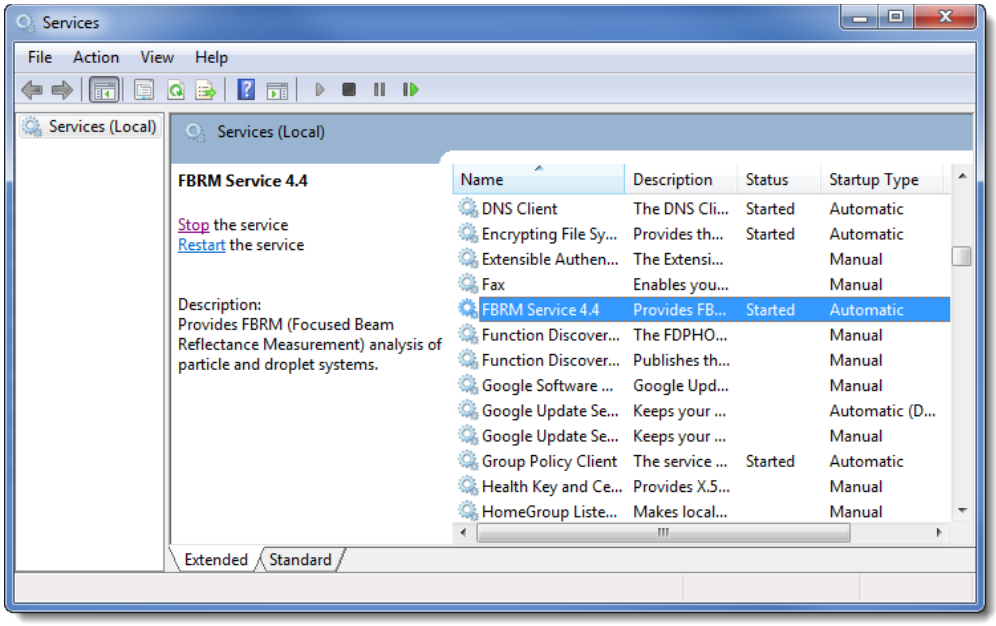
If changes are made to the time zone or other regional settings, the FBRM server must be restarted for the changes to take effect.

To restart the FBRM server:

1. Exit the iC FBRM application.
2. Stop the FBRM Server.
3. From the Windows Control Panel, open the **Administrative Tools**.
4. Select the **Services** option.



5. Select FBRM Service 4.4 from the list of services and click the Restart option.



EXPERIMENT STOPS RUNNING (IC FBRM/ IC PROCESS FOR FBRM CONFIGURATIONS ONLY)

If there is an iC FBRM experiment running, when a iC Process for FBRM run is started, it will stop the iC FBRM experiment. iC Process will take control of the FBRM Server.

There will be a warning displayed in the Events Viewer informing the user "The experiment was stopped on the server. This is most likely because iC Process for FBRM took control." This behavior is by design.

IC FBRM SERVER FAILS TO START

Older versions of the National Instrument (NI) driver that was shipped with version 4.2 of the iC FBRM software is incompatible with iC FBRM 4.3 and later. If this driver is installed on the PC, the FBRM Server will not start. The 4.3 and later versions of iC FBRM and iC process for FBRM automatically check for the presence of this outdated driver and display a warning dialog box as required. The NI drivers must be manually uninstalled using the Control Panel.

IC FBRM SERVER LOSES COMMUNICATIONS WITH THE INSTRUMENT

On some PCs it might be possible for the system to put USB communications into the Sleep Mode during long experiments. This is the Windows default setting, and it could result in communication errors with the instrument.

On the PC that will be controlling an instrument, you must adjust the power settings to ensure the computer will **never go into sleep mode**.

1. Search 'Power Options,' and select 'High Performance.'

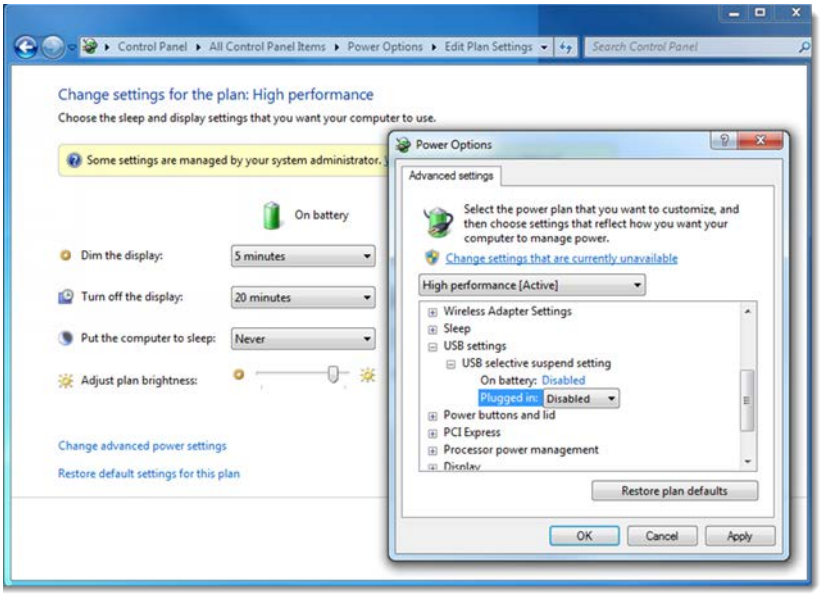
2. Select Change plan settings link.

3. Set 'Put the computer to sleep' to **Never**.

4. Select Change advanced power settings link and set as follows:

   - Sleep → **Sleep after** = Never
   - Sleep → **Hibernate after** = Never
   - USB Settings → USB selective suspend setting = 'Disabled'
   - For laptop computers: Power button and lid options → **Lid Close Action** = 'Do nothing'

5. Click OK and Save changes.



METTLER TOLEDO

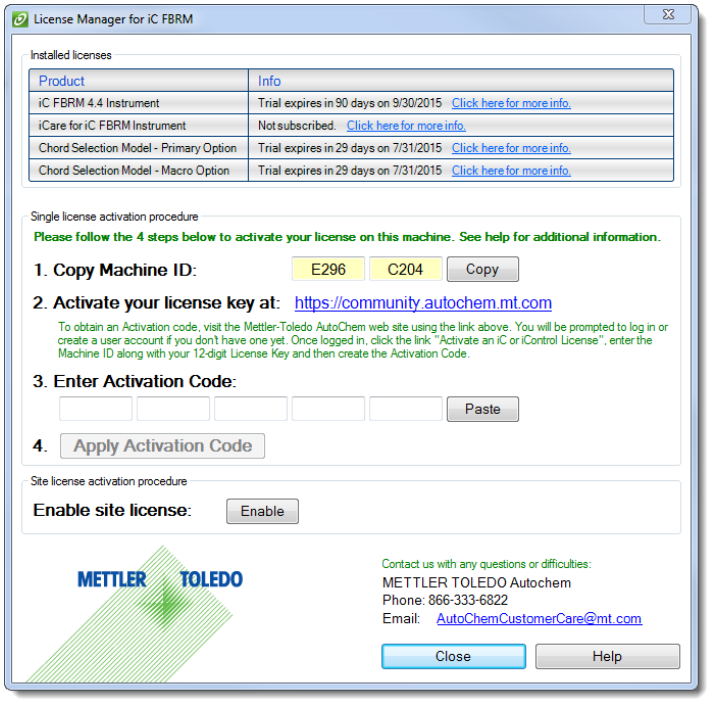
iC Licensing

iC applications incorporate a licensing scheme to control distribution and use of the software.

There are different types of licenses.

- Instrument version—Enables the software application to connect to a live instrument and run experiments.
- Office version—Enables the user to run the software application without a connection to an instrument. Experiment data obtained from a computer with an Instrument license can be viewed and analyzed.
- Trial version—A trial version is equivalent to an Instrument license with a 30-day time limit.
- Module licenses—Add-on modules, licensed separately. For example, additional Chord Selection Model (CSM) licenses may become available.
- iCare subscription—A special annual subscription license that entitles you to all release upgrades and service packs for Instrument and Office versions of iC and iControl software as well as priority telephone and email support.
- Site license—Specific companies with large software agreements with METTLER TOLEDO may also have a Site License for one or more products.

Use the iC License manager to view and manage iC licenses. Acquire the Machine ID from the License Manager window and use the software key provided with the software. Then, activate a software license through the AutoChem Customer Care website.



Detailed instructions on activating a license are contained in the Installation Guide portion of the Documentation Portfolio.

Note: If the user activates a CSM license from iC FBRM, the new CSM option will not be displayed in the iC Process for FBRM client until the iC Process server and iC Process for FBRM client is restarted.

Appendix A: Data Processing in the iC FBRM Software

Data processing in iC FBRM involves special terminology and statistical formulae described in this section.

The following terminology provides a brief chronological outline of the steps in FBRM measurement prior to data processing using iC FBRM software:

Chord Length—A straight line between any two points on the edge of a particle.

Optical Chord Length—Optical effects of the particle system (e.g., refractive index of the solution and particle, backscatter properties of the particle at the observed wave length, etc.) will influence the optically measured chord length. The optical chord length is a straight line between any two points on the edge of a particle as measured by the FBRM optical system.

Count—A term used to describe the measure of a single chord. Each count represents a single chord of a given chord length in microns.

Channel—A bin with a specific upper and lower limit in microns. Counts with a chord length between specific limits are put in a specific channel.

Primary Chord Length Distribution—This distribution is comprised of 1324 channels covering the range from 0 to $n \bullet 1024$ µm on a linear scale where n = 1, 2, 3, 4 for a scan speed of $n \bullet 2m / s$. The FBRM hardware measures each optical chord length individually then stores the counts of equivalent chord lengths in the appropriate channel. The result is a count by chord length distribution called a primary chord length distribution. This is displayed as a number by micron distribution (number of counts by chord length in microns).

Measurement (or Record)—iC FBRM accumulates counts in a primary chord length distribution for an amount of time specified by the user. Once this time span is completed, the measurement is completed and the primary chord length distribution is passed from the FBRM hardware to the iC FBRM software. At this point, the FBRM hardware will start the next measurement. Once a measurement is saved to a file, it is referred to as a record. The record includes all measured data, as well as all instrument configuration information relating to this measurement.

Moments—A finite summation of discrete points.

PRIMARY CHORD LENGTH DISTRIBUTION

The FBRM hardware provides 1324 primary channels of data from 0 to $n \bullet 1024$ µm on a linear scale, where n = 1,2, 3, 4 for scanning speeds $n \bullet 2m / s$. The scale is broken into two ranges, $[0,\ n \bullet 100]$ µm and $[n \bullet 100,\ n \bullet 1024]$ µm. The bottom 400 channels in the $[0,\ n \bullet 100]$ µm range provide finer, $n \bullet 1/4$ resolution, whereas the upper 924 channels provide a coarser, $n \bullet 1$ µm resolution, but cover a wider micron range $[n \bullet 100,\ n \bullet 1024]$ µm.

The following **Primary Chord Length Distribution** table outlines these properties:

Range [µm]	**[0, n • 100]**	**[n • 100, n • 1024]**
Channel width [µm]	n • 1/4	n
Number of channels	400	924

CONVERTING COUNTS TO COUNTS PER SECOND

In iC FBRM 4.2 and later, counts are reported as counts per 2m scan length. (Previous versions of the software reported counts/second.) This change in standard reporting was made due to the introduction of FBRM systems that can scan at higher and lower scan speeds. By definition, changing the scan speed will change the number of particles measured per second (that is, doubling the scan speed from 2 m/s to 4 m/s should double the number of chords counted per second). To permit direct comparison between results collected at different scan speeds, the counts are now reported as counts per 2m scan length. A 2m reference distance is used to provide exactly the same results when using the traditional scan speed of 2 m/s, and it allows direct comparison of results measured at alternative scan speeds.

CHANNEL GROUPING

Channel grouping gives the user the ability to group the primary chord length distribution of 1324 channels into a channel grouping more appropriate to the application under investigation. Channel grouping is characterized by four parameters: *A, B, N,* and the Channel Progression (linear or logarithmic).

Examples for channel groupings are as follows:

Channel Grouping	A	B	N	Channel Progression
1-1000 µm 90 Log Ch.	1	1000	90	Logarithmic
0-500 µm 100 Linear Ch.	0	500	100	Linear
0-30 µm 120 Linear Ch.	0	30	120	Linear

N denotes the number of channels that divides the interval [*A, B*], where *A* is the left boundary of the lowest channel (in µm) and *B* is the right boundary of the highest channel (in µm). The channel progression is either linear or logarithmic.

In the following discussion, the index $i = 1, \ldots, N$ indexes the first, second, ..., N^{th} channel and its left channel boundary. Because the right channel boundary of channel i is always identical to the left channel boundary of channel $i+1$, there is a total of $N+1$ channel boundaries with:

c_i = left channel boundary for channels $i = 1, \ldots, N$

c_{i+1} = right channel boundary for channels $i = 1, \ldots, N$

Linear Progression

The interval [*A, B*] is divided into *N* channels of equal difference *d* between the left and right channel boundary:

$$d = (B - A) \cdot \frac{1}{N} \tag{1}$$

The channel boundaries are calculated as follows:

$$c_i = A + d \cdot (i - 1) \tag{2}$$

for

$$i = 1, 2, \ldots, N + 1$$

The channel midpoint of channel *i* is defined as the point that divides the channel via equal differences:

$$c_{i+1} - M_i = M_i - c_i$$

(3)

Solving Eq.(6) for M_i yields:

$$M_i = \frac{c_{i+1} + c_i}{2}$$

(4)

Logarithmic Progression

The interval [*A*,*B*] is divided into *N* channels of equal ratio *r* between the left and right channel boundary with:

$$\log r = (\log B - \log A) \cdot \frac{1}{N}$$

(5)

Noteworthy here is the similarity to Eq. (4) except that all variables with chord-length dimension are now operated on by the logarithm and *d* has been renamed *r*. Eq. (8) holds regardless of the base of the logarithm used (base 10, *e*, or other). Solving for *r* yields:

$$r = \left(\frac{B}{A}\right)^{\frac{1}{N}}$$

(6)

Modifying Eq. (5) by replacing chord-length variables with their logarithm and renaming *d* to *r*, the channel boundaries are calculated as follows:

$$\log c_i = \log A + \log r \cdot (i - 1)$$

(7)

Solving Eq. (10) for c_i yields:

$$c_i = A \cdot r^{i-1}$$

(8)

for

$$i = 1, 2, \ldots, N + 1$$

Using this formula, it is indeed easy to verify that the ratio between the right and left channel boundary is constant:

$$\frac{c_{i+1}}{c_i} = \frac{A \cdot r^{(i+1)-1}}{A \cdot r^{i-1}} = \frac{r^i}{r^{i-1}} = r$$

(9)

The channel midpoint of channel *i* is defined as the point that divides the channel via equal ratios. It can be derived from Eq.(6), by considering that - on a logarithmic scale - the midpoint should again divide the channel via equal differences:

$$\log c_{i+1} - \log M_i = \log M_i - \log c_i$$

(10)

Applying the exponential function to both sides yields:

$$\frac{c_{i+1}}{M_i} = \frac{M_i}{c_i}$$

(11)

Solving for M_i we get:

(12)

$$M_i = \sqrt{c_i \cdot c_{i+1}}$$

(13)

Especially for logarithmic progression, the channel boundaries c_i do not necessarily coincide with a primary channel boundary. In this case, a primary channel can contribute to more than one channel in proportion to its overlap with either grouped channel.

In the following sections, the grouped channel counts are denoted as n_i, with I = 1, 2, ..., N. A detailed description of the regrouping algorithm is given in the section Example near the end of this appendix.

Channel Weights

Channel weighting emphasizes the change in one region of the distribution while de-emphasizing the change in another region of the distribution by applying a channel-specific weight w_i to counts n_i. The weighted channels y_i are obtained via:

$$y_i = w_i \cdot n_i$$

(14)

For channels

$$y_i = w_i \cdot n_i$$

The weights w_i are obtained from the channel midpoints M_i via:

$$w_i = \frac{M_i^{\gamma}}{\sum_{j=1}^{N} M_j^{\gamma}} \cdot N$$

(15)

The upcoming table shows how the different types of channel weight procedures can be calculated by varying γ.

Calculating Channel Weight Procedures

Method	γ
1/Length Weight	-1
No Weighting	0
Length Weight	1
Square Weight	2
Cube Weight	3

Using $M_i^0 \equiv 1$ it is easy to verify that for $\gamma = 0$, $w_i = 1$ is obtained for $i = 1, 2, \ldots, N$.

The rationale for the summation term in the denominator and the multiplication by N is the following:

If we were to use raw weights $\omega_i = M_i^{\gamma}$ the weights would become very large for square and cube weights, which in turn would make the counts per channel and derived quantities (e.g., total counts) very large. For this reason, we have scaled the weights (not the counts) so the sum over the weights remains the same as if no weighting was chosen. That sum has to be N since each weight for 'No Weighting' has to be 1. The operation is equivalent to normalizing raw weights ω_i by their average.

$$w_i = \omega_i / \bar{\omega}$$

with

$$\bar{\omega} = \frac{\sum_{i=1}^{N} \omega_i}{N}$$

and their raw weights

$$\omega_i = M_i^{\gamma}$$

(16)

The result is a much better behaved weighting function.

Relative Counts

For display purposes, the user has the option to convert the weighted counts per channel y_i to relative counts r_i, which indicates the counts as a percentage of the total counts:

$$r_i = \frac{y_i}{\sum_{j=1}^{N} y_j} \cdot 100 \qquad (17)$$

LIMITED CHANNEL RANGE (ISOLATION OF A POPULATION OF INTEREST)

When the statistics are calculated, each statistic can be calculated from a limited channel range chosen from the current channel grouping. In other words, each statistic can have its own sub range of channels out of the N total channels. A sub range is specified by channel indices a and b, with a denoting the index of the first channel and b the index of the last channel of the sub range. Channel indices i, a, and b are limited via:

$$1 \le a \le I \le b \le N \qquad (18)$$

The user does not enter the channel range by the respective channel indices a and b, but rather in terms of their channel boundaries c_a and c_b (in µm units). Therefore, it can happen that the user-specified channel boundaries do not coincide with any actual channel boundary c_i (e.g., when the channel grouping is changed or when the user does not have the exact channel boundary available). In these cases, the user-specified lower boundary is corrected towards the closest boundary c_i that is *smaller* than the specified value. Likewise, the user-specified upper boundary is corrected towards the closest boundary c_i that is *larger* than the specified value. Any user-specified channel boundary that lies outside the maximum allowed range $[c_1,c_{N+1}]$ is corrected towards the nearest of either c_1 or c_{N+1}. After these corrective steps, the user-specified channel sub range lines up with existing channel boundaries c_a and c_b, and their corresponding indices are a and b. Choosing a channel sub range precedes statistics calculation.

STATISTICS CALCULATION

The statistics calculation is chosen individually for each trend and acts upon the channel range of weighted channels y_i with midpoints M_i with $i = a, a + 1, \ldots, b - 1, b$. The output of this operation is always a single number. The following subsections, which correspond with the statistic options available in the FBRM CI software, discuss each of the different statistics.

Mean

The mean chord length $\bar{C}$ is obtained from counts per channel y_i and midpoints M_i as follows. A proof of this formula is given in Eq. (27) and Eq. (28):

$$\bar{C} = \frac{\sum_{i=a}^{b} y_i M_i}{\sum_{i=a}^{b} y_i}$$

(19)

It is legitimate to perform the sums only from $i = a$ to $i = b$, because taking the channel sub range is equivalent to considering $y_i = 0$ for $i = 1, \ldots, a - 1, b + 1, \ldots, N$.

It can be shown (proof is given below) that the mean $\bar{C}$ can be expressed directly in terms of the unweighted counts n_i via

$$\bar{C} = \frac{\sum_{i=a}^{b} n_i M_i^{\gamma+1}}{\sum_{i=a}^{b} n_i M_i^{\gamma}}$$

(20)

Where $\gamma = -1, 0, 1, 2, 3$ for 1/length weight; no weighting; and length, square, and cube weight.

Proof:

$$w_i = \frac{M_i^{\gamma}}{\sum_{j=1}^{N} M_j^{\gamma}} \cdot N = M_i^{\gamma} \cdot G$$

(21)

Where

$$w_i = \frac{M_i^{\gamma}}{\sum_{j=1}^{N} M_j^{\gamma}} \cdot N = M_i^{\gamma} \cdot G$$

=

$$\bar{C} = \frac{\sum_{i=a}^{b} y_i M_i}{\sum_{i=a}^{b} y_i} = \frac{\sum_{i=a}^{b} n_i w_i M_i}{\sum_{i=a}^{b} n_i w_i} = \frac{\sum_{i=a}^{b} n_i M_i^{\gamma} \cdot G \cdot M_i}{\sum_{i=a}^{b} n_i M_i^{\gamma} \cdot G}$$

=

$$= \frac{G \cdot \sum_{i=a}^{b} n_i M_i^{\gamma} M_i}{G \cdot \sum_{i=a}^{b} n_i M_i^{\gamma}} = \frac{\sum_{i=a}^{b} n_i M_i^{\gamma+1}}{\sum_{i=a}^{b} n_i M_i^{\gamma}}$$

(22)

Definitions

- **Unweighted Mean chord (No Weighting)**—The sum of the *unweighted* counts per channel multiplied by the midpoint of that channel, divided by the sum of all *unweighted* counts.
- **Length Weight Mean Chord (Length Weight)**—The sum of the *length* weighted counts per channel multiplied by the midpoint of that channel, divided by the sum of the *length* weighted counts.
- **Length Square Weight Mean Chord (Square Weight)**—The sum of the length *square* weighted counts per channel multiplied by the midpoint of that channel, divided by the sum of the length *square* weighted counts.
- **Length Cube Weight Mean Chord (Cube Weight)**—The sum of the *cube* weighted counts per channel multiplied by the midpoint of that channel, divided by the sum of the length *cube* weighted counts.

Mode

The mode is the midpoint of the channel with the highest counts. The first step is to find the channel index i_{max} belonging to the channel with the highest count y_i.

$$i_{\max} = \arg\max y_i$$

(23)

Where the search is performed over channels $a \le i \le b$. The mode is the center point of the corresponding channel:

$$C_{\text{mode}} = M_{\text{i min}}$$

(24)

Chi Square (ChiSquare)

The Chi Square statistic χ^2 provides a measure of similarity between two distributions based on the shape of the distributions. The more the measured distribution y_i deviates from a reference distribution R_i, the larger χ^2 becomes.

BACKGROUND

The Chi Square statistic originally applies to an experiment with a finite number *N* of possible outcomes, performed *n* times, where $Y_1, Y_2, \ldots, Y_N$ are the number of experiments that resulted in each possible outcome, with probabilities of each outcome $p_1, p_2, \ldots, p_N$. The definition is:

$$\chi^2 = \sum_{i=1}^{N} \frac{\left(Y_i - np_i \right)^2}{np_i} \quad n = \sum_{i=1}^{N} Y_i \quad ;$$

(25)

The observed results Y_i will generally diverge form the expected results np_i at least by chance or by a significant change in the experimental conditions. The probability *Q* that a certain value of χ^2 is due to chance is expressed as a rather complicated integral solution involving the Gamma function, and therefore cannot be solved in close form. Values of *Q* are usually found tabulated for the number of degrees of freedom of the experiments (*N* - 1) and values of χ^2.

But even if the value of *Q* is not calculated, χ^2 can provide a useful measure of the deviation of an experiment from an expected or reference result. Over a series of experiments it is possible to establish a typical value of χ^2 which, if exceeded, indicates a change in the experimental conditions.

APPLICATION TO CHORD-LENGTH DISTRIBUTIONS

Equation (31) can also be applied to chord-length distributions. In Eq.(31) Y_i can be interpreted as the measured number Y_i at individual chords that fall into a range determined by channel *i* with channel midpoint M_i. We can interpret p_i to be the probability of a chord to fall into channel *i* and *n* can be interpreted to be the total number of chords to be distributed across those channels. Then the term np_i becomes the expected number of counts in channel *i*. If a reference distribution *R* is representative enough to serve as estimator of p_i, we can use each of its channels R_i to represent np_i. For a given sample distribution y_i and a reference distribution R_i, χ^2 is calculated as follows:

$$\chi^2 = \sum_i \frac{(y_i - R_i)^2}{R_i}$$

(26)

χ^2 is thus a measure for the combined relative deviation of individual elements of the sample distribution from the reference distribution. We arrive at the reference distribution R_i by submitting the reference distribution to the same operations as the sample distribution y_i. Eq.(32) also applies to a limited range of channels, in which case it becomes:

$$\chi^2 = \sum_{i=a}^{b} \frac{(y_i - R_i)^2}{R_i}$$

(27)

If the sample distribution y_i and the reference distribution R_i were taken with different measurement durations, the value of χ^2 would thus become measurement-time dependent. This change in χ^2 not only reflects the desired measure of variation in distribution shape, but also a difference in absolute number of counts. Therefore, a time-normalized $\hat{\chi}^2$ is defined as:

$$\hat{\chi}^2 = \sum_{i=a}^{b} \frac{(\hat{y}_i - \hat{R}_i)^2}{\hat{R}_i}$$

(28)

$$\hat{y}_i = \frac{y_i}{T_m} \quad \hat{R}_i = \frac{R_i}{T_{m,R}} ;$$

(29)

Where T_m is the measurement duration and $T_{m,R}$ the measurement duration of the reference distribution.

One problem arises if one or more of the elements $\hat{R}_i$ of the reference distribution are zero. $\hat{\chi}^2$ is not defined in this case. Another problem can arise if $\hat{R}_i > 0$, but very close to zero (for example: 0.001). This could dramatically drive up the magnitude of $\hat{\chi}^2$, just based on a single channel. A possible modification of the Chi Square statistic could be to simply ignore those elements $\hat{y}_i$ of the sample distribution for which $\hat{R}_i = 0$ (or close to zero) and sum over the remaining relative deviations. However, by doing so, we are ignoring possibly important information contained in those channels i of the sample distribution $\hat{y}_i$ for which the corresponding $\hat{R}_i$ is 0.

To overcome this problem, we followed a different approach.

Channels $\hat{R}_i$ in the reference distribution that are below a threshold (the current implementation uses a threshold of $\varepsilon = 1$ to force any fractional counts to be combined with other channels) are combined with the nearest channel $\hat{R}_j$ that satisfies $j < i$ and $\hat{R}_j \geq \varepsilon$. If there is no such channel (as would be the case if one or more of the left-most channels fall below the threshold), they are combined with the nearest channel $\hat{R}_j$ that satisfies $j > i$ and $\hat{R}_j \geq \varepsilon$. One all channels that need to be combined to form a new distribution R' are identified, a new sample distribution y_j' is constructed by combining those same channels in the sample distribution $\hat{y}_i$.

The following table illustrates this for $\varepsilon = 1$ and a channel sub range from channels $a = 1$ to $b = 8$:

Channel sub range

i	1 →	2	← 3	4	5	6	← 7	← 8
$\hat{R}_i$	0.1	70	0.2	20	30	15	0.0	0.02
$\hat{y}_i$	3	60	25	29	32	17	4	3

The underlined entries indicate values $\hat{R}_i$ that fall below the threshold and therefore necessitate the channel be combined with the nearest channel (indicted by arrows) above the threshold ε.

The table below shows the new distributions and the channels that were combined to form the new channels:

Distributions after combining channels

j	**1**	**2**	**3**	**4**
Channels *i* used to form this channel	1,2,3	4	5	6,7,8
R′j	70.3	20	30	15.02
y′j	88	29	32	24

It is now possible to determine a modified χ'^2:

$$\chi'^2 = \sum_{j=1}^{4} \frac{(y'_j - R'_j)}{R'_j} = 14.01$$

(30)

The usefulness of these modifications to the Chi Square statistic will depend on the application. In any case, a large number of controlled experiments should be carried out to determine typical values of χ^2. Changes of χ^2 must be observed for controlled changes to the experimental environment, so limiting values of χ^2 to distinguish random derivations from significant changes of the experiment can be established.

RUNNING CHI-SQUARE

The Running Chi-Square (Advanced) statistic calculates the chi-square test for the current distribution compared to a previous distribution *n* records back from the current distribution. In addition to the standard weighting and sub-ranging settings, this statistic requires a value for *n*, the number of distributions back from the current. Chi-square test is actually a ratio. Therefore, if two distributions are identical, the value is 1 (default).

Standard Deviation (StdDev)

Standard deviation and variance are indicators of the spread of a distribution about the mean. The narrower the distribution, the smaller the variance and standard deviation become. Variance s^2 is obtained from channel counts y_i, mean chord length $\bar{C}$ and midpoints M_i as follows:

$$s^2 = \frac{\sum_{i=a}^{b} y_i (M_i - \bar{C})^2}{\sum_{i=a}^{b} y_i}$$

(31)

A proof is given in Proof of the Equation used for Mean Chord Length and Standard Deviation. The positive square root of the variance is called the standard deviation and is denoted by:

$$s = \sqrt{s^2} \tag{32}$$

%Counts<C, %Counts≥C, Percentile, and Median

The *%Counts<C* function returns the percentage *P* of all chords with chord length smaller than *C*. The inverse of this function is the Percentile function, which returns the chord length *C*, below which *P* percent of the chords lie. The median is the *P*=50th percentile and thus represents a special case of the percentile function. Finally, *%Counts≥C* is obtained from *%Counts<C* via:

$$(\%\text{Counts} \geq C) = 100 - (\%\text{Counts} < C) \tag{33}$$

The first step for both the *%Counts<C* and Percentile functions is to calculate the cumulative distribution Q_i from the channel counts y_i and the channel boundaries c_i. The cumulative distribution function Q_i contains the total counts between the left channel boundary c_a of the lowest channel a and the left channel boundary c_i of channel i, where $a \leq i \leq b$ and b is the index of the highest channel in the channel sub range.

Q_i is calculated from distribution y_i via:

$$Q_i = \sum_{k=a}^{i-1} y_k \tag{34}$$

Limit cases are

$$Q_i = 0 \tag{35}$$

for

$$i \leq a$$

and

$$Q_i = N_{Total} \tag{36}$$

where N_{Total} is the total counts between channels a and b.

Next, we derive a normalized distribution function that expresses the cumulative counts as percentage of the total counts:

$$\tilde{Q}_i = 100 \cdot \frac{Q_i}{N_{Total}} \tag{37}$$

Usage of $\tilde{Q}_i$ is best illustrated with a concrete example. We start with a linear channel grouping of 100 channels between 0-1000 μm that yields the following channel boundaries:

Linear Channel Grouping

i	**1**	**2**	**a=3**	**4**	**5**	**B=6**	**7**	**…**	**100**
Left channel boundary c_i	0	10	20	30	40	50	60	…	**990**
Right channel boundary c_{i+1}	10	20	30	40	50	60	70	…	1000

Assume that in the statistics setup we selected a limited channel range from 20 - 60 μm, leading to channel indices a = 3 and b = 6. The table below shows the calculation of Q_i and $\tilde{Q}_i$ from channel counts y_i, using equations Eq.(40) and Eq.(43):

Calculation from Channel Counts

i	**Left Bd. c_i**	**Right Bd. c_{i+1}**			
a=3	20 μm	30 μm	7	0	0%
4	30 μm	40 μm	23		2.8%
5	40 μm	50 μm	140		12%
b=6	50 μm	60 μm	80		68%
7	60 μm	--	--		100%

The most important columns are columns 2 and 6, which are summarized in the next table.

Columns 2 and 6 from 'Calculation from Channel Counts' Table

Column	**1**	**2**	**3**	**4**	**5**
Chord length	20 μm	30 μm	40 μm	50 μm	60 μm
Percent Counts<Chord Length	0%	2.8%	12%	58%	100%

This table allows us to determine the percentage of total counts below a selected chord length. For instance, the table shows that 68% of all counts are below 50 μm. Conversely, it also shows that the 68th percentile is 50 μm.

An additional challenge arises when we seek to compute values such as *%Counts* < 47 μm or the 90th percentile, because there is no entry in the table for either of these values. To calculate intermediate values, we must employ linear interpolation. The use of linear interpolation is also suggested in [1].

In the first example we demonstrate the *%Counts* < *C* function by calculating the *%Counts* < 47 μm. The two-point pairs left and right of 47 μm are in columns 3 and 4, namely {40 μm, 12%} and {50 μm, 68%}. When we linearly interpolate between two points $\{x_1, y_1\}$ and $\{x_2, y_2\}$ on an *XY* graph, any intermediate point $\{x,y\}$ on the line divides both the X-interval $[x_1,x_2]$ and the Y-interval $[y_1,y_2]$ into sub intervals $[x_1,x]$ and $[y_1,y]$, such that each have the same proportion to the respective interval:

$$\frac{x-x_1}{x_2-x_1} = \frac{y-y_1}{y_2-y_1} \qquad (38)$$

Applied to the above point pairs, we get:

$$\frac{47\,\mu m - 40\,\mu m}{50\,\mu m - 40\,\mu m} = \frac{P\%\text{-}12\,\%}{68\%\text{-}12\,\%}$$

(39)

Solving for *P* yields:

$$P = 51.2\,\%$$

(40)

In a second example, we seek to calculate the 90th percentile. The closest two pairs are in columns 4 and 5, namely {50 µm, 68%} and {60 µm, 100%}. Using the previous equation for linear interpolation, we get:

$$\frac{C\,\mu m - 50\,\mu m}{60\,\mu m - 50\,\mu m} = \frac{90\%\text{-}68\,\%}{100\%\text{-}68\,\%}$$

(41)

Solving for *C* yields:

$$C = 56.875\,\mu m$$

(42)

First Derivative Operation

This optional operation allows statistical values to be replaced by the difference between the last measured statistical value and the previous statistical value. While this is only a crude estimate for the first derivative, it can nonetheless be used to indicate sudden changes in the trend.

Let v_k and v_{k-1} be the current and previous trend values and T_k and T_{k-1} the corresponding time stamps (in seconds). Then the first derivative is estimated via:

$$v'_k = \frac{v_k - v_{k-1}}{T_k - T_{k-1}}$$

(43)

Proof of the Equation used for Mean Chord Length and Standard Deviation

Let *X* be a discrete random variable with possible outcomes $x_1, x_2, \ldots, x_N$ and p_i the relative frequency of outcome x_i. Applied to our chord length distribution, we can say that we have outcome x_i if a single chord falls into the chord length interval given by the channel boundaries of channel *i*. Let y_i be the frequency at which we have outcome x_i, i.e. the number of chords falling into channel *i*. The *relative* frequency can be determined from the frequency of y_i of measuring x_i:

$$p_i = \frac{y_i}{\sum_{j=1}^{N} y_j}$$

(44)

The mean is defined as:

$$\bar{x} = \sum_{i=1}^{N} x_i p_i \tag{45}$$

The standard deviation is defined as:

$$s^2 = \sum_{i=1}^{N} (x_i - \overline{x})^2 p_i \tag{46}$$

We can consider each channel midpoint M_i as a chord-length measurement x_i that occurs with frequency y_k.

Combining Eq.(50) and Eq.(51) and replacing $x_i \rightarrow M_i$ and $\overline{x} \rightarrow \overline{C}$ the mean chord length becomes:

$$\overline{C} = \frac{\sum_{i=1}^{N} y_i M_i}{\sum_{i=1}^{N} y_i} \tag{47}$$

Similarly, combining Eq.(50) and Eq.(52) yields the variance.

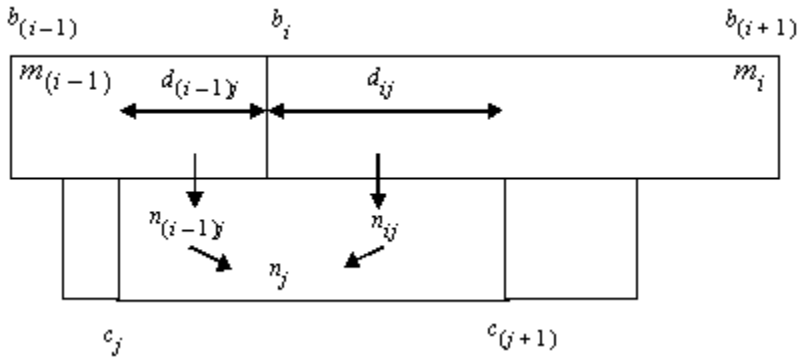
Channel Count Conversion

When converting from the primary 1324 channels to a user-selectable channel distribution (e.g., 38-channel, logarithmic progression), the channel counts need to be redistributed based on the relative location of the new channel boundaries to the original channel boundaries.

In the following discussion, let b_i be the primary channel boundaries of the 1324 channels, with $0 \le i < 1324$ and c_j the channel boundaries of the user-selectable channel grouping (e.g., 38 channels with $0 \le j < 38$). Especially if c_j follows a logarithmic progression, the channel boundaries usually will not coincide because the 1324 channels are either only 1-µm or 1/4-µm wide (assuming a 2 m/s scanning speed). Therefore, a more elaborate scheme is necessary to distribute the channel counts.

While the target channels are wider than the source channels in most cases, the following calculations hold true for either instance and can be used for conversion between any two sets of channel boundaries, no matter how irregularly spaced they may be.

The figure below shows a simple example of how the primary channel counts (m_i) are redistributed to yield the regrouped channel counts (n_j):



The counts m_i of channel i are distributed into those channels j that overlap with channel i. The channel width of channel i is:

$$w_i = b_{i+1} - b_i \tag{48}$$

If d_{ij} if the overlap between channel i and channel j, then the fraction of counts channel j receives from channel i is the proportion of that overlap to the channel width:

$$n_{ij} = m_i \cdot \frac{d_{ij}}{w_i} \tag{49}$$

If channels i and j have no overlap, then:

$$d_{ij} = 0$$

and therefore

$$n_{ij} = 0 \tag{50}$$

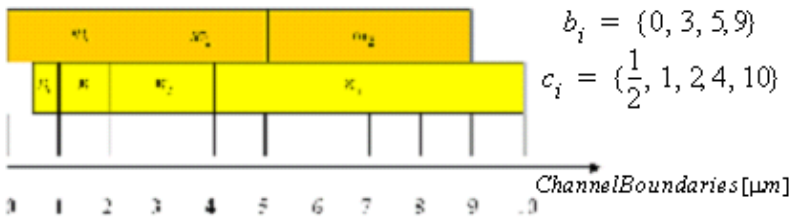
Note that any given channel j can receive contributions from more than one channel, if it overlaps more than one channel. To compute the total counts channel j receives, we sum up the contributions from all the source channels i:

$$n_j = \sum_i n_{ij} \tag{51}$$

To get the entire re-grouped channel counts, we have to repeat the above process for all j.

Example

The following example shows how to calculate the channel counts n_j from the source channel counts m_i. The figure below shows the channel widths for source and target channels.



The non-zero transition widths d_{ij} are summarized in this table:

Non-zero Transition Widths d_{ij}

d_{ij}	**i=0**	**i=1**	**i=2**
j=0	0.5 µm		
j=1	1.0 µm		
j=2	1.0 µm	1.0 µm	
j=3		1.0 µm	4.0 µm

The corresponding transition counts m_{ij} are calculated using Eq.(56), shown here again:

$$n_{ij} = m_i \cdot \frac{d_{ij}}{w_i} \tag{52}$$

The non-zero values of n_{ij} as well as grouped channels n_j are summarized in this table:

Non-Zero Values for n_{ij} and resulting grouped counts n_j

	i=0	**i=1**	**i=2**	
w_i	3.0 µm	2.0 µm	4.0 µm	
j=0				
j=1				
j=2				
j=3				

The right-most column shows the new channel counts n_j in terms of the old channel counts m_i.

Moment Statistic Equation

$$m_i = \int_0^{\infty} n(L)\, L^i\, dL$$

i th moment of the distribution (order of the moment)

i th cumulative distribution

$$m_i(L) = \int_0^{L} n(L)\, L^i\, dL$$

For the Chord Distribution Length (CDL), the integration becomes

$$m_i(L) = \sum_0^{L} n(L)\, L^i$$

L particle size (chord length – midpoint for each channel)

n(L) chord counts at size of L

REFERENCES

[1] Kennedy, John B. and Neville, Adam M. Basic Statistical Methods for Engineers and Scientists, 1986, 3rd Edition (Harper and Row, Publishers, New York)

Appendix B: Guidance Document for the use of iC FBRM™, iC IR™, iC Raman and iC Quant in 21CFR11-regulated environments

This document outlines the means by which users of METTLER TOLEDO iC FBRM, iC IR, iC Raman and iC Quant software can achieve compliance with specific aspects of Title 21, Part 11 of the Code of Federal Regulations (commonly known as 21CFR11). All references in *italics* are taken from the regulation.

Definitions (*from Sec. 11.3*):

(4) Closed System means an environment in which system access is controlled by persons who are responsible for the content of electronic records that are on the system.

(6) Electronic record means any combination of text, graphics, data, audio, pictorial, or other information representation in digital form that is created, modified, maintained, archived, retrieved, or distributed by a computer system.

SUBPART B--ELECTRONIC RECORDS

Sec. 11.10 -- Controls for closed systems

iC FBRM and iC IR software are closed systems; therefore, these provisions apply.

a) Validation of systems to ensure accuracy, reliability, consistent intended performance, and the ability to discern invalid or altered records.

The software was developed and tested following approved and controlled SDLC practices within the AutoChem ISO9001:2008 certified Quality Management System. Invalid or altered records are detected by the software using CRC algorithm technology. When the software detects invalid or altered records, the user is presented with a warning dialog as well as a notation in the Document Information pane. The user can choose to open the experiment even with invalid or altered data; however, the notation in the Document Information pane remains.

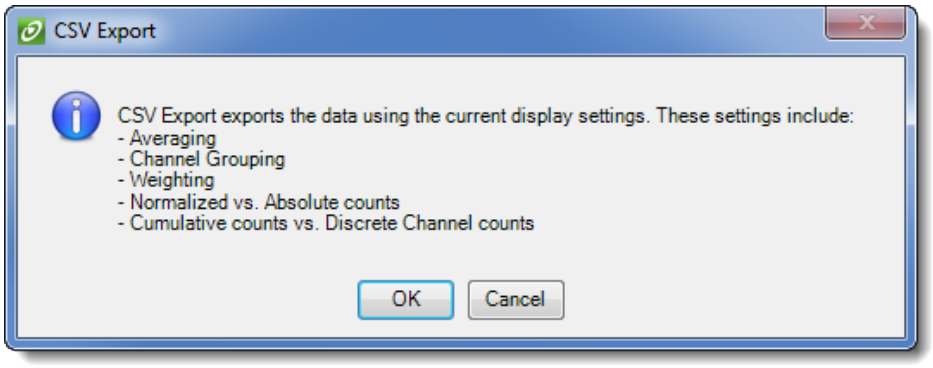
b) The ability to generate accurate and complete copies of records in both human readable and electronic form suitable for inspection, review, and copying by the agency. Persons should contact the agency if there are any questions regarding the ability of the agency to perform such review and copying of the electronic records.

Records can be viewed in electronic form within the software. Analyzed data records can be printed by using the export function in our software and print capabilities in third-party software (such as Excel). Audit trails and other document information can be printed using the Copy to Clipboard function in our software and print capabilities in third-party software (such as Word or PowerPoint).

Instructions for exporting to Excel:

1. Open the experiment that you wish to export.
2. Click on File - > Export.

3. Acknowledge the pop-up message.



4. Enter the name of the file to which you wish to export. Click Save.
5. The data will now be available for viewing and printing from Excel.

Instructions for copying to clipboard:

1. Open the experiment that you wish to export.
2. Right-click on the area you wish to copy.
3. Choose 'Copy to Clipboard' and select how you want the data to be copied (as bitmap, as metadata, as text (data only)).
4. Paste into the third party software. The copied information can now be viewed and printed.

c) *Protection of records to enable their accurate and ready retrieval throughout the records retention period.*

Records created by the software are saved as files. It is up to the customer to create SOPs surrounding the proper storage and archiving of such files.

To set the default location for file storage:

1. Click on Tools - > Preferences.
2. Set the default document location as specified in the customer SOP.

d) *Limiting system access to authorized individuals.*

Access to the software is provided to licensed users through the use of the Windows NT logon and authentication. Management of user IDs, passwords and control of physical access must be addressed through customer SOPs.

e) *Use of secure, computer-generated, time-stamped audit trails to independently record the date and time of operator entries and actions that create, modify, or delete electronic records. Record changes shall not obscure previously recorded information. Such audit trail documentation shall be retained for a period at least as long as that required for the subject electronic records and shall be available for agency review and copying.*

All raw data is secure and cannot be altered once the experiment has been saved as per customer SOPs. Any change in the presentation of data, i.e. statistics, averaging, etc., is written to the audit log. The user can re-create the presentation of data at a later time. The audit trail cannot be edited, only appended to and is retained as long as the experiment document. Retention of document files is addressed in 11.10c

above. The audit log can be reviewed within the software and can be copied using the 'Copy to Clipboard' instructions shown above in 11.10b.

f) Use of operational system checks to enforce permitted sequencing of steps and events, as appropriate.

Customer SOPs ensure proper instrument calibration validation and usage. iC software assists by including providing wizards to that guide the user through instrument configuration and experiment set-up.

g) Use of authority checks to ensure that only authorized individuals can use the system, electronically sign a record, access the operation or computer system input or output device, alter a record, or perform the operation at hand.

The software relies on Windows NT logon security for authorization. Management of user IDs, passwords and control of physical access is addressed through customer SOPs.

h) Use of device (e.g., terminal) checks to determine, as appropriate, the validity of the source of data input or operational instruction.

The software warns the user if the instrument has not had its calibration validated within the last 3 months. Customer SOPs must be in place to ensure proper instrument calibration validation and usage.

i) Determination that persons who develop, maintain, or use electronic record/electronic signature systems have the education, training, and experience to perform their assigned tasks.

Education and training of customer personnel is provided at startup by qualified MT employees. Education and training for iC software developers is addressed through the AutoChem QMS.

j) The establishment of, and adherence to, written policies that hold individuals accountable and responsible for actions initiated under their electronic signatures, in order to deter record and signature falsification.

Establishment of policies related to personnel accountability is the responsibility of the customer.

k) Use of appropriate controls over systems documentation including:

(1) Adequate controls over the distribution of, access to, and use of documentation for system operation and maintenance.

(2) Revision and change control procedures to maintain an audit trail that documents time-sequenced development and modification of systems documentation.

Document management is addressed through customer SOPs. This includes document version control. Version control of iC software and documentation is addressed by the AutoChem QMS.

SUBPART C--ELECTRONIC SIGNATURES

iC FBRM and iC IR software do not have electronic signature capability.

Learn More with our
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Our on-demand webinars (online seminars) provide application and industry information relevant to you. These interactive presentations, provided by industry experts and our own applications team, give you an opportunity to learn more about your specific area of interest.

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