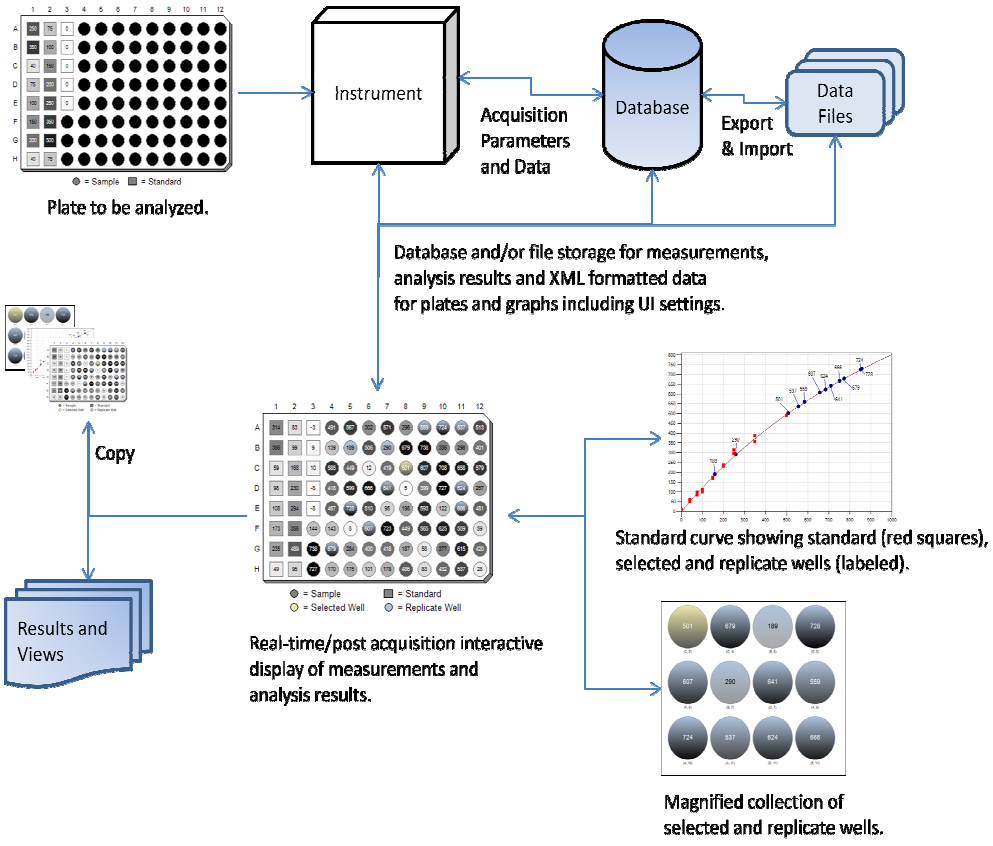
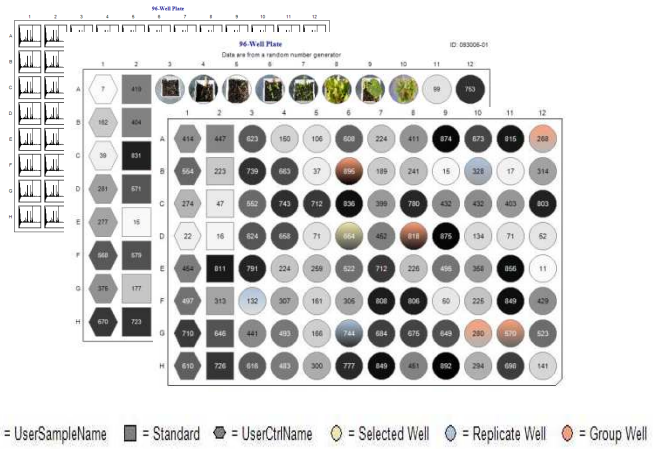
Example Views Created with BxMicroTitrePlate

version 3.2

Example Analysis Workflow using Plate Control



Example Plates Showing Features



BioXing

www.bioxing.com

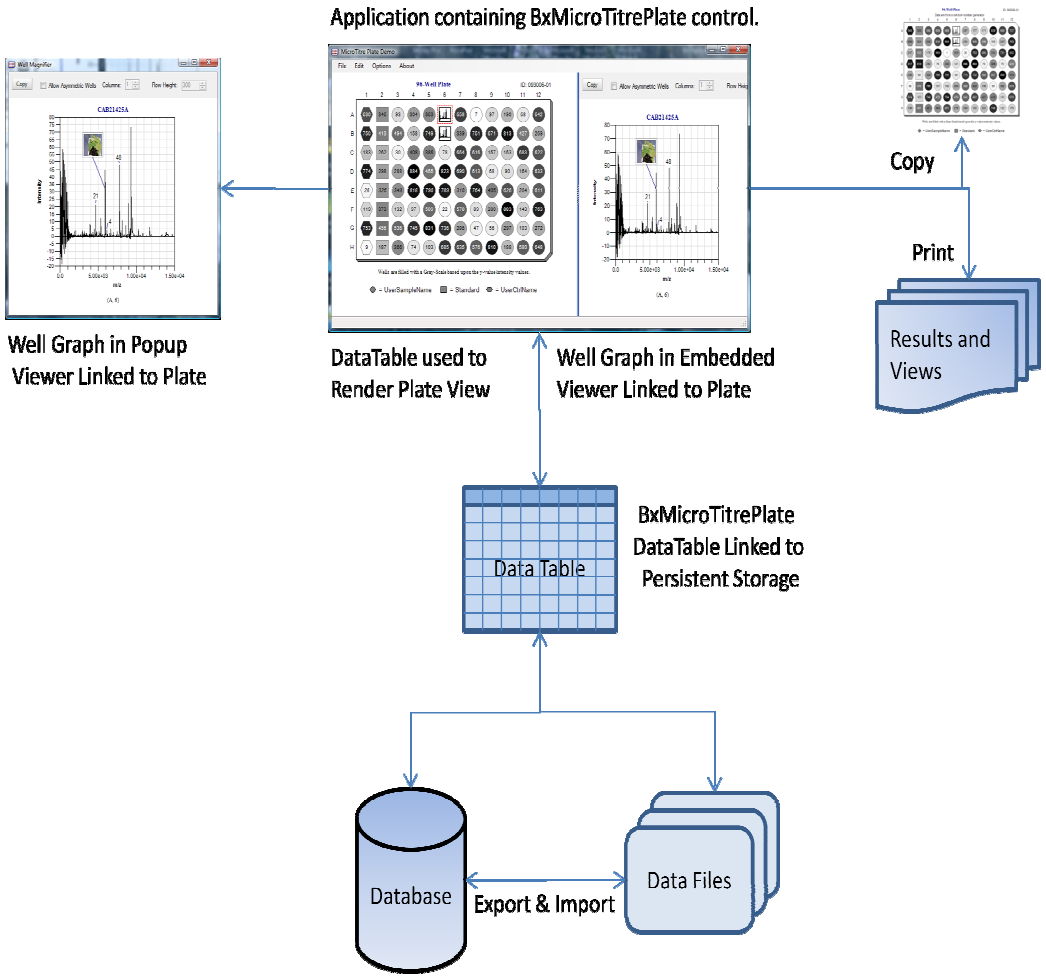
Biotechnology and Bioinformatics utilize microtitre plates as a standard format for reference and unknown sample storage and processing, instrumentation, analysis, aggregation and retrieval of data. Since microtitre plates play such a central role, BioXing has developed a highly customizable interactive and enhanced microtitre plate component, called *BxMicroTitrePlate*, which can be easily incorporated into .NET Windows applications. The component is useful for rendering an interactive microtitre plate graphic in applications that perform operations or measurements using microtitre plates. In particular for instrument control, for data acquisition monitoring and analysis summary, multiple plate comparisons, as a navigation tool, and as an interface to facilitate accessing and integrating related well content information.

BxMicroTitrePlate utilizes well shapes, well gray scale coloring and well annotation to concisely convey summary information and individual detail about a well and any related wells. In addition, wells may display images that reflect the sample source or images taken over a time line for comparison when using multiple plates or wells may display two-dimensional (XY data) graphs that could, for example, be a result of real-time data acquisition and analysis. In addition, a well or set of wells can be blinked and/or colored to reflect well activity during acquisition and analysis. Each well can display a customizable descriptive tooltip and can trigger events that can be used to retrieve, link and add information to the well, thereby facilitating the integration of disparate data. XY data graphs can be annotated with text or image peak labels when displayed in a Well Magnifier View. The underlying structure of the component uses a Data Table and provides change events that can be used for linking to and updating connected persistent data storage such as a database or files. The component provides a UI for defining customization settings and exporting them in an XML data stream that can be saved in a database or file which can then be used for initializing the component within applications.

Due to its flexible design the control can also be used to represent generic interactive arrays of 1 x m (single row), n x1 (single column) or n x m dimensions where n and m are the number of rows and columns in the array. Through customization property settings the array does not have to have the appearance of a microtitre plate.

This document contains views that illustrate available customizations and features that are selected or defined by setting values for its properties and performing operations through its methods. A property is nothing more than an option that has a dynamic value such as the color of a well or whether a feature should be visible or not; while a method is a function that performs a task such as copying the view of the plate to the clipboard.

The component is a .NET User Control contained within a dynamic link library which is easily added to an application during development and comes with two supporting documents. The first is a Programmer's manual that describes the design of the plate with descriptions and default settings of its properties and methods and has example coding snippets. The second document provides a detail description of the complete API (Application Programming Interface) for the component.



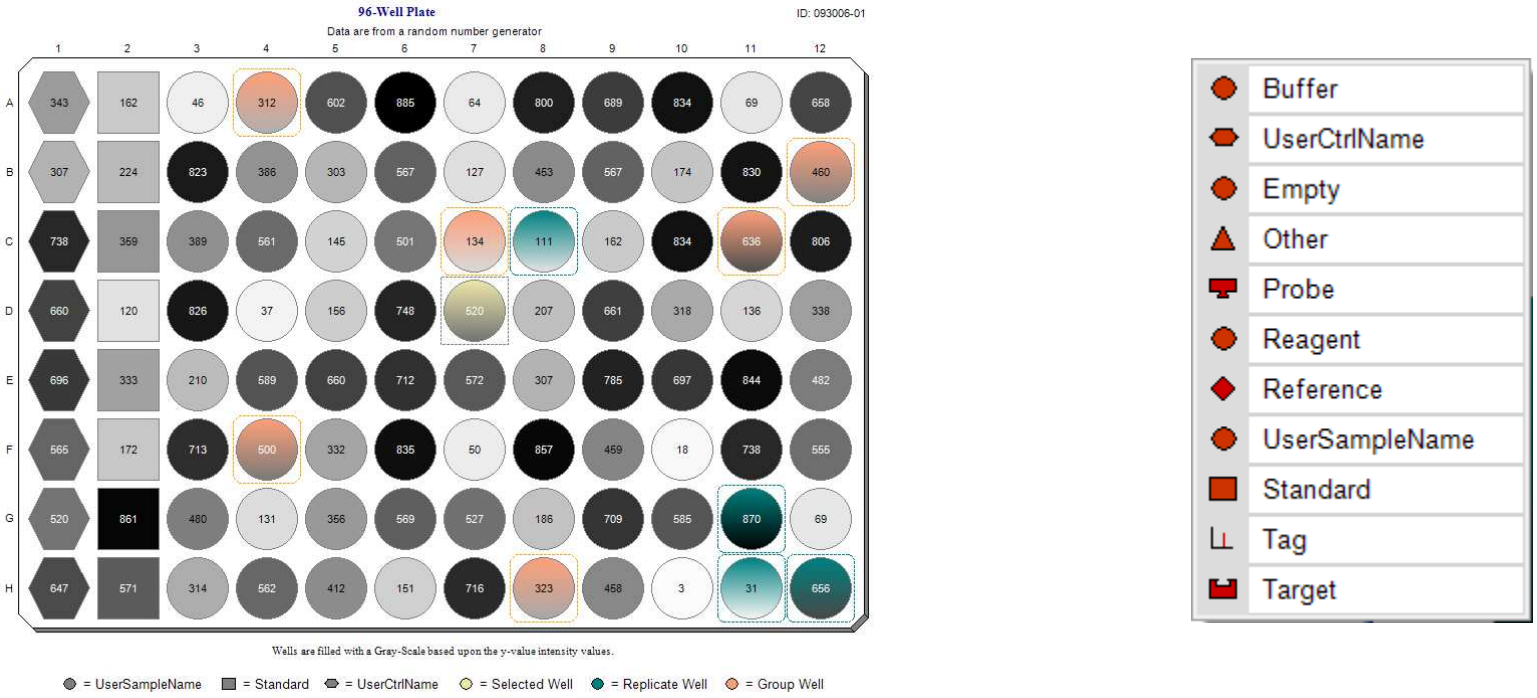
BxMicroTitrePlate uses an internal DataTable and property value settings for creating plate views and objects in the magnifier viewers.

This figure shows the connection model of linking the DataTable to persistent data storage consisting of a database and data files. The DataTable contains intensity values, annotation, well type, replicate and group numbers for each plate row-column index. It may also contain images and links to XY data.

In the center is an application with a BxMicroTitrePlate control that has options selected for showing embedded and popup magnifier viewers. The plate shows different well shapes for well content type, gray scale intensity value shading and annotation from data obtained from the DataTable connected to persistent storage. XY data linked to the selected well are rendered as a graph in the well and viewers using BxPlot2D.

Note: Multiple wells can be selected for displaying in the viewers to provide a comparison view.

The plate image can be copied to the clipboard and printed within reports containing results and views. In addition, the content in the embedded viewers can also be copied and printed.



This view shows an example of the interactive BxMicroTitrePlate control with 96-Wells, a Title, Plate ID, SubTitle, Caption and a plate Legend. Within the plate different shapes (available list shown on the right) are used to designate the type of Well and the numbers and shading within the wells reflect the value of their respective intensity measurements. The legend text associated with the well shapes can be programmatically defined as illustrated by 'UserSampleName' and 'UserCtrlName' which replaced default names of 'Sample' and 'Control' respectively. The Yellow colored well reflects that it was selected and the Green and Orange colored wells reflect replicate and group wells respectively that are linked to the selected well. In addition, the Yellow, Orange and Green colored wells have a gradient appearance where the bottom gray-scale color indicates the value of the intensity measurement and they have colored dashed line rectangles to further emphasize selection . Replicate wells are wells that have identical content as the selected well and group wells are wells that have content that are related to the selected well such as samples taken over a time line or they have different concentrations. In summary, this view shows labeling of the plate view, wells with different types of purpose, use of color and numeric annotation to quickly obtain measurement information and a comparison of linked wells.

FEATURES

The control has embedded support for 96-Well, 384-Well and 1536-Well plate sizes and support for specifying customized plate sizes.

Individual wells trigger and provide Mouse_Move, Mouse_Down and Mouse_Up events. A Well structure is passed back with each event that contains its plate row/column index, its plate data table row index and its rectangular location on the plate. In addition, an individual well or a collection of wells can be uniquely colored and blinked. That is, when specific wells need to be viewed as being active, the wells can be assigned a color and a blinking operation can be started and stopped programmatically. Blinking can use the BxMicroTitrePlate internal blinking methods or the developer can connect methods that are defined by the calling application.

The plate border can be customized with corner cuts at one or more corners and the plate background can have an image or be colored thus providing the ability to more closely represent the type of plate being used.

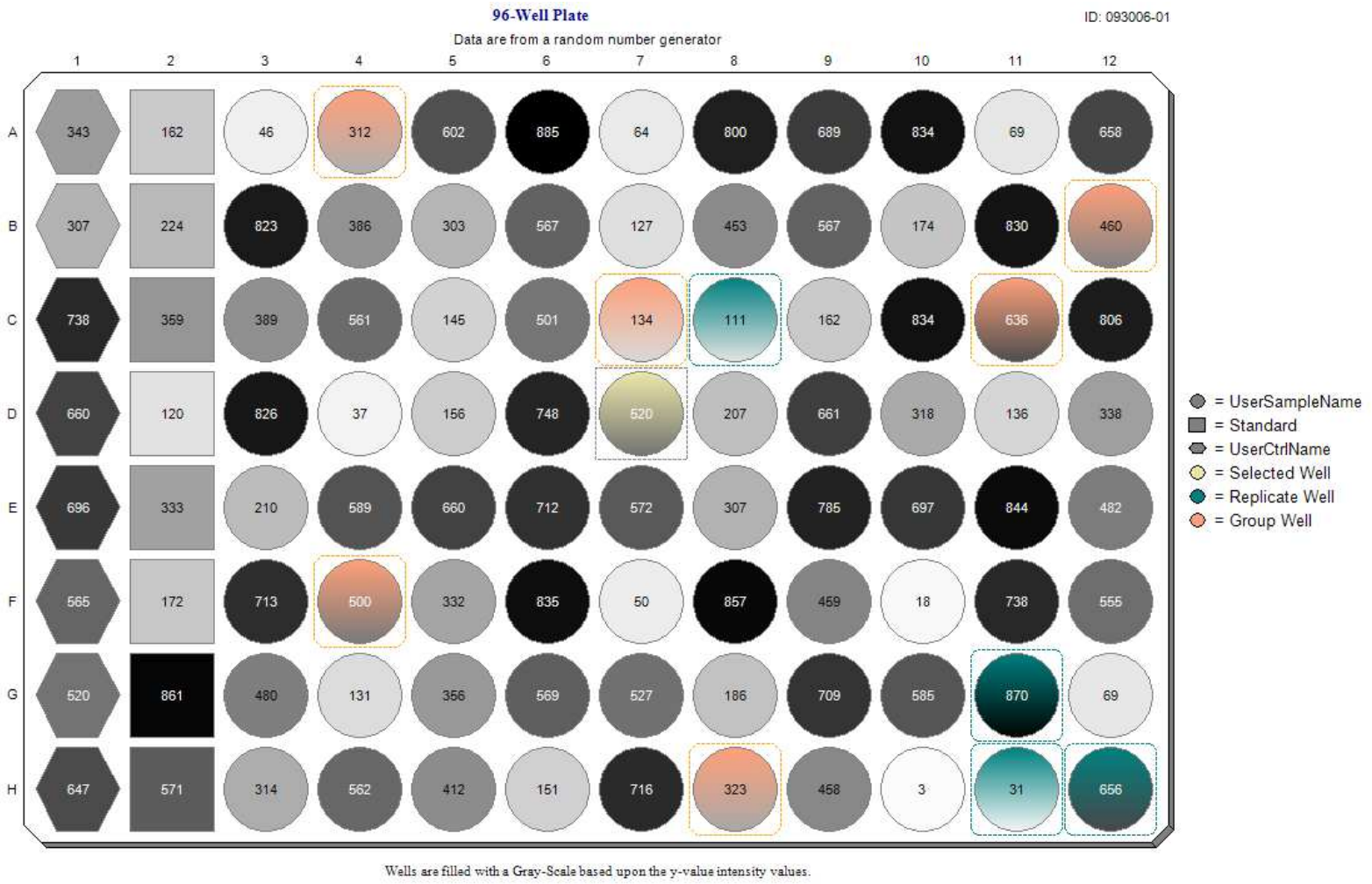
Annotation text within the wells is selectable and there are options to have the control automatically scale the font size smaller or larger as the size of the well changes. Wells can also contain images and graphs. Well magnifier viewers can be activated to display well content in more detail and to more easily compare a collection of wells. Well tooltip content (text displayed when the mouse is over a well) is also customizable.

The Title, Plate ID, SubTitle, Caption, and Legend can all be programatically set, turned On/Off and their properties such as Font Style, Background Color, Text Color and Alignment can all be defined. Also, plate borders, well borders, selection frames (dashed line rectangles around wells) can be turned On/Off and their colors can be defined.

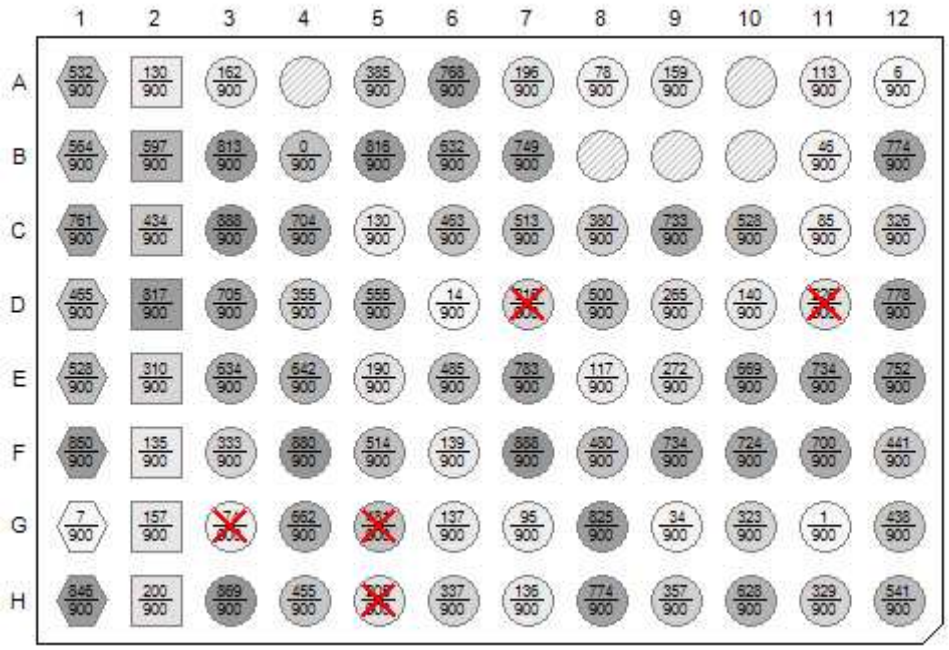
In addition the component supports drag-dropping and pasting of images in the most common formats and of text containing XY data for graphs for displaying within wells.

It also has methods that can be used for copying and printing of the plate view.

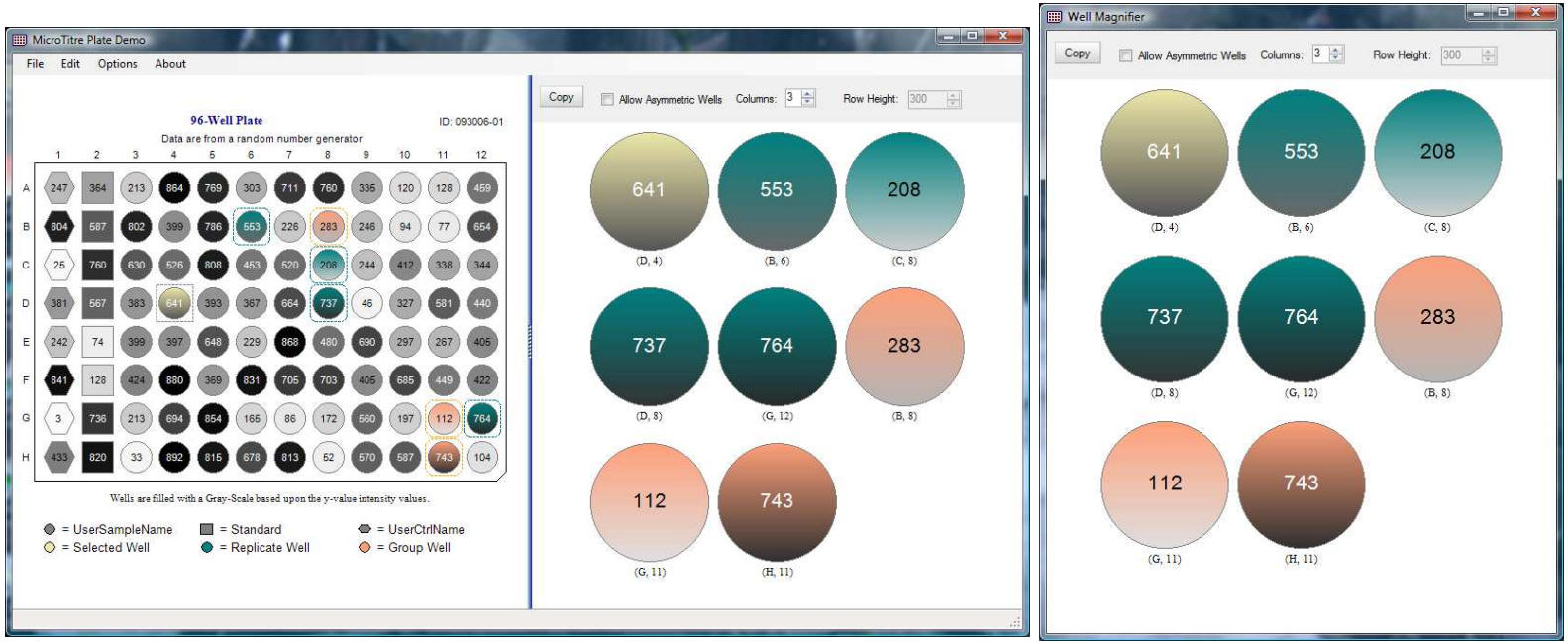
The system comes with a Customization dialog box containing a UI that permits user setting and defining of virtually all properties. These settings can be Saved to and Loaded from an XML file or an XML Data Stream that can be used with a database through the component's Save and Load methods respectively.



This view is the same as the previous view, except that the *Legend_Vertical* property has been set to true which automatically places the legend centered on the right side of the plate.

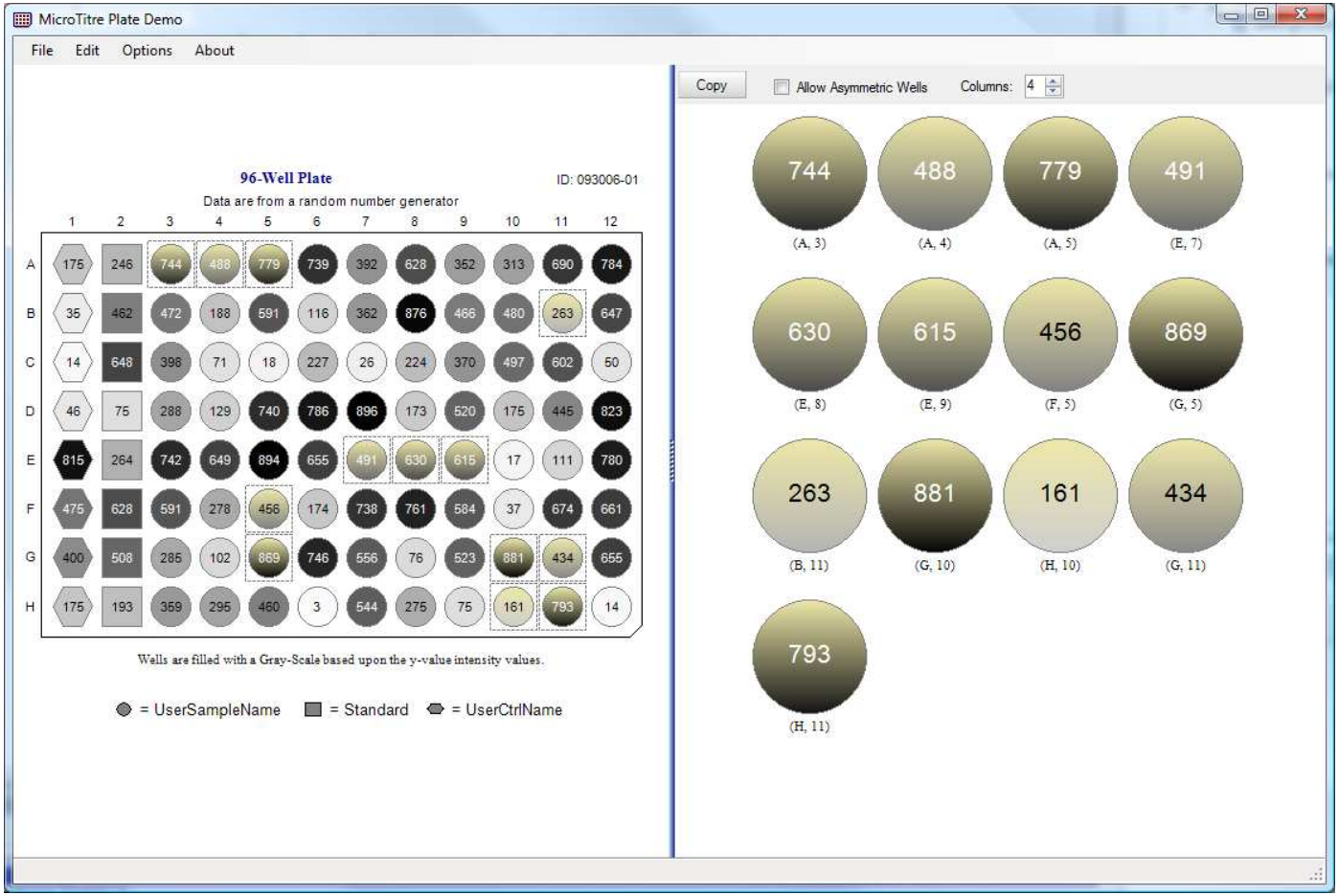


This plate view shows excluded wells (marked with a Red X) for example from any analysis or as bad samples, wells that are empty (marked with a cross hatch), annotation within wells showing a ratio of two values and shading corresponding to a measurement value. The hexagonal wells are wells containing control samples and the square wells are wells containing samples used as standards.

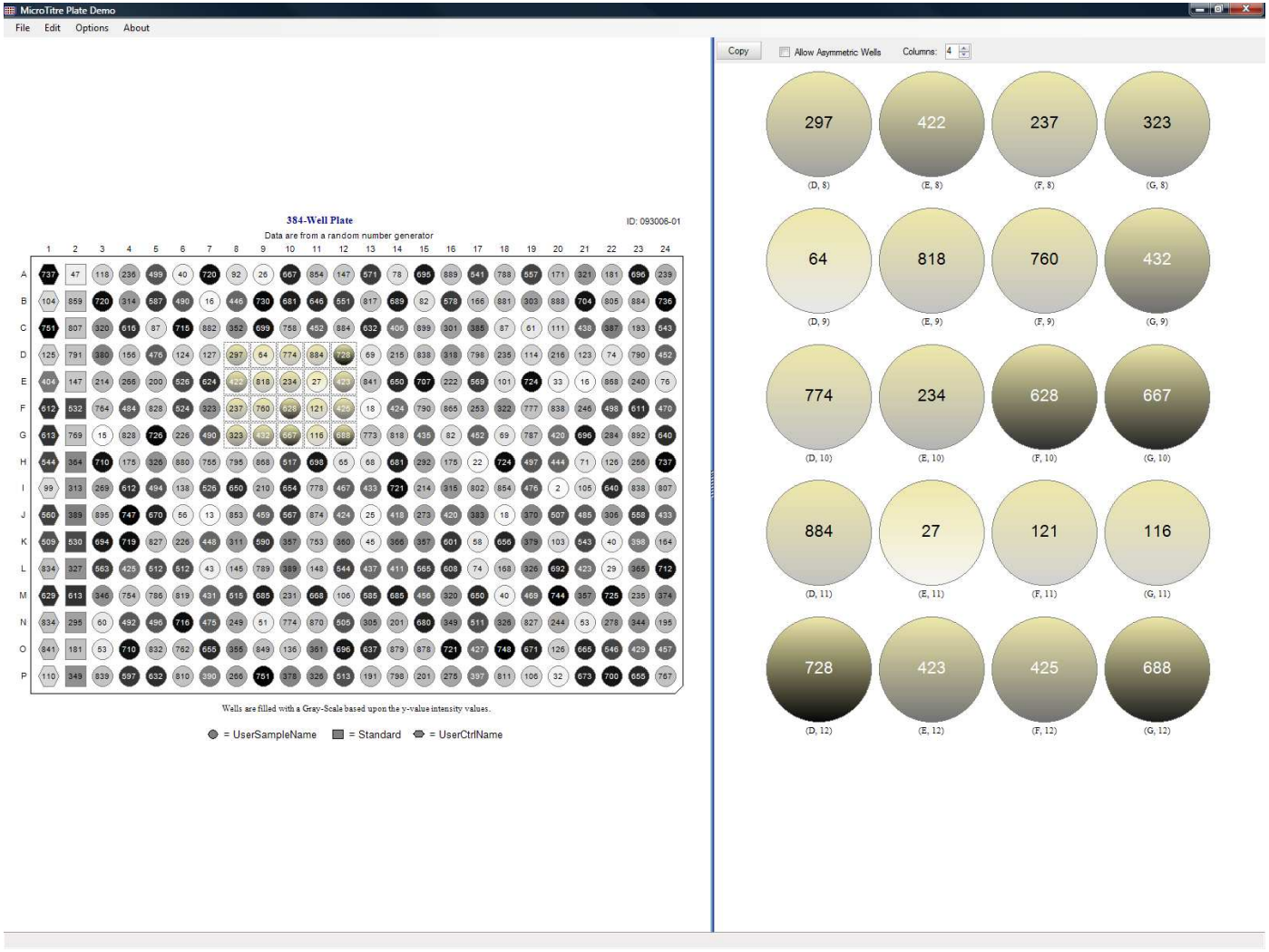


BxMicroTitrePlate has options for creating an embedded magnifier viewer control or a popup magnifier viewer window which can be used to obtain larger views of well annotation, graphs and images and can be used to compare a collection of wells. The embedded viewer, shown in the right panel of the demo application, can be programmatically added to any Windows object that supports adding of controls while the popup viewer (shown to the right of the application) is a linked Window to the application that appears on the Desktop that can be moved anywhere on the screen including to another monitor. Both viewers can be displayed independently or simultaneously, can be independently sized and are automatically synchronized which faciltates showing on different monitors. When a Well Magnifier viewer is activated, then all selected wells including replicates and group wells, if they are to be shown, will be magnified in the viewer(s) where the well size is based upon the size of the individual viewer. In this example there are 8 selected wells arranged in three columns as indicated by the column Numeric_Up_Down selector. The asymmetric option relaxes the restriction that well height must equal well width that is useful when showing graphs or asymmetric images as seen in views presented below. The Copy button copies the content of the magnifier view to the clipboard.

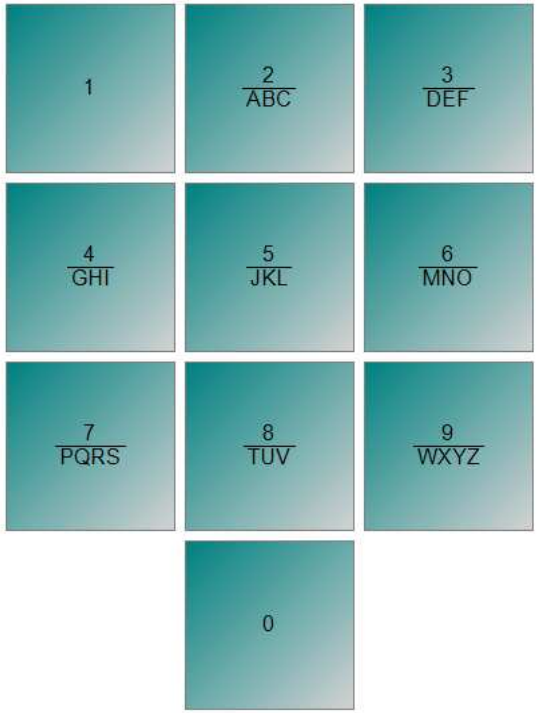
Note: If there are no selected wells, then as the Mouse moves over a well, it will automatically be shown in the viewer where its well shape and content will automatically be magnified to fit the viewer. This permits a quick detail view of a well's content as the mouse moves over it which is especially useful for plates with more than 96 wells or when it has an image or graph.



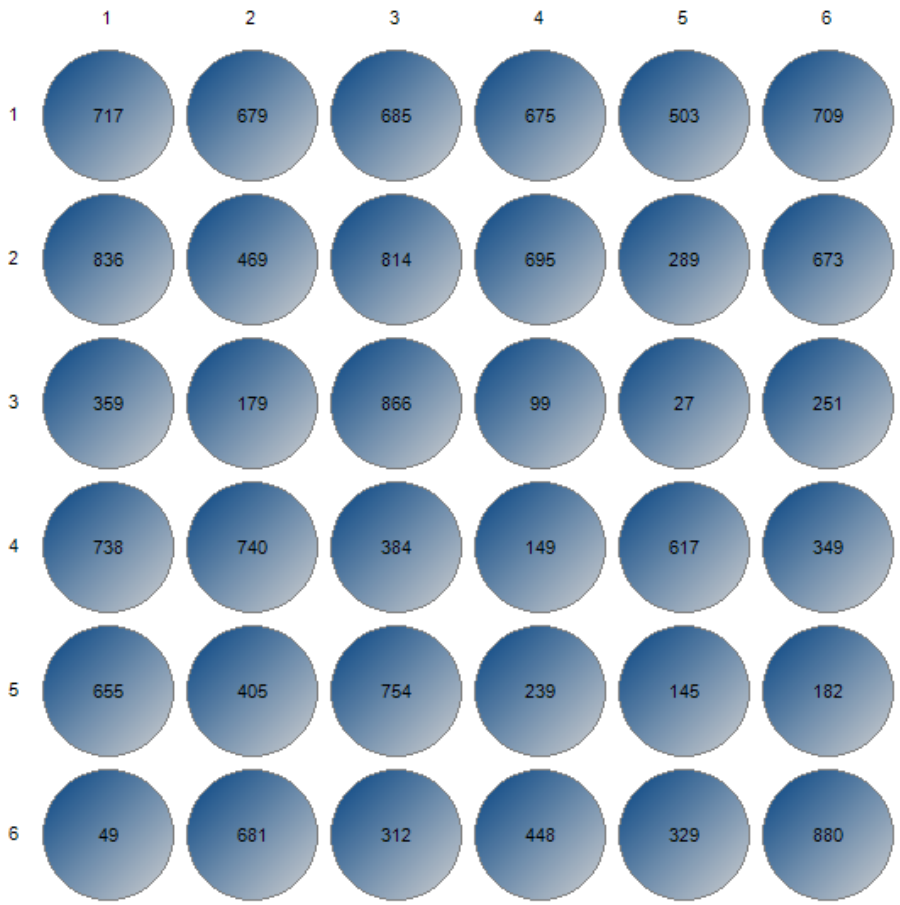
This view shows a collection of selected wells being compared in the maginifier viewer. A single well is selected by clicking on the well, while a collection of wells can be selected by holding down the Ctrl-Key and dragging the mouse while pressing down on the Left-Mouse button to create a rubberband around the wells to select. Repeating the rubberband operation with the Ctrl-Key depressed adds newly selected wells to the collection.



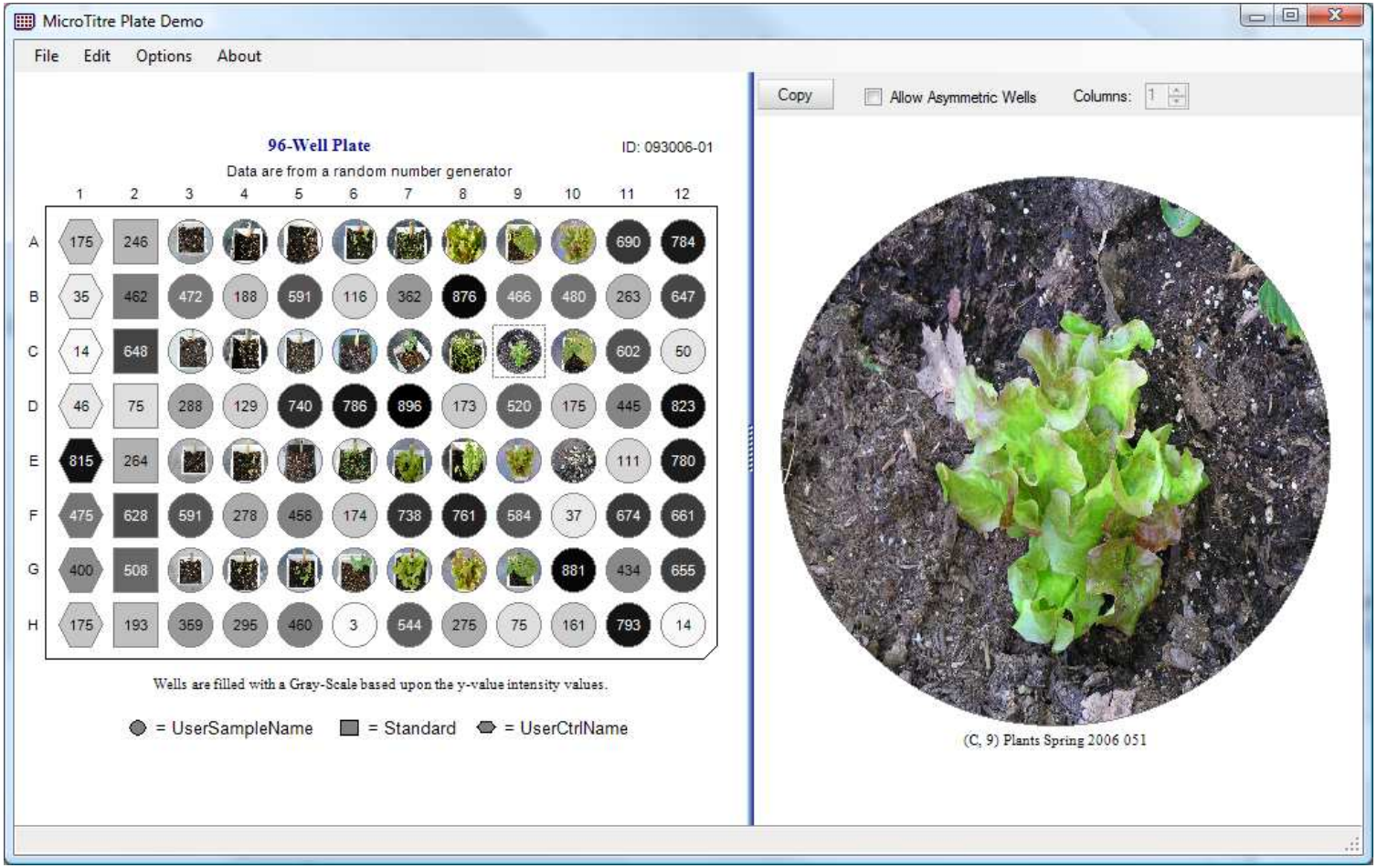
This view shows a 384-Well plate with selected wells being magnified. BxMicroTitrePlate supports 96-,384- and 1536-Well plate sizes through simple property value selection, but it also supports custom plate sizing as indicated in the following view.



This view shows a custom 4 x 3 matrix of wells with wells (4,1) and (4,3) hidden and all borders turned off. In addition, text labeling fields (Title, ID, Subtitle, Caption, Legend) have been turned off. A two line annotation is supported with the option of putting a line between them.

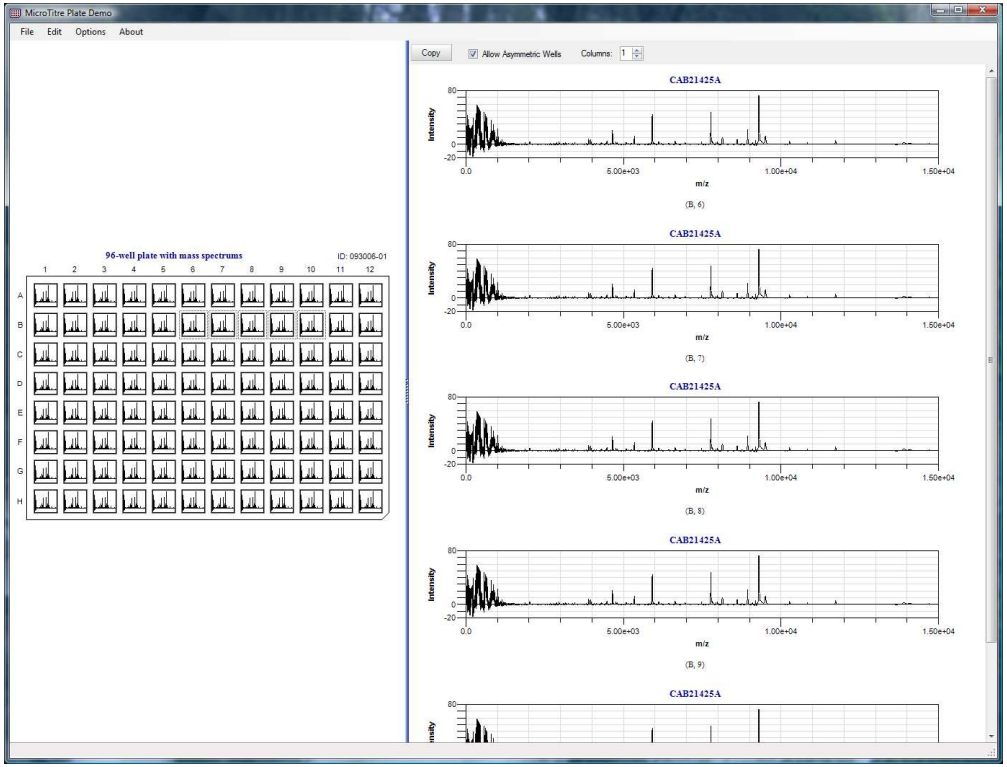


This view shows a custom 6 x 6 matirix of gradient blue Wells with all plate borders turned off and numbers used for row labeling. In addition, text labeling fields (Title, ID, Subtitle, Caption, Legend) have been turned off.



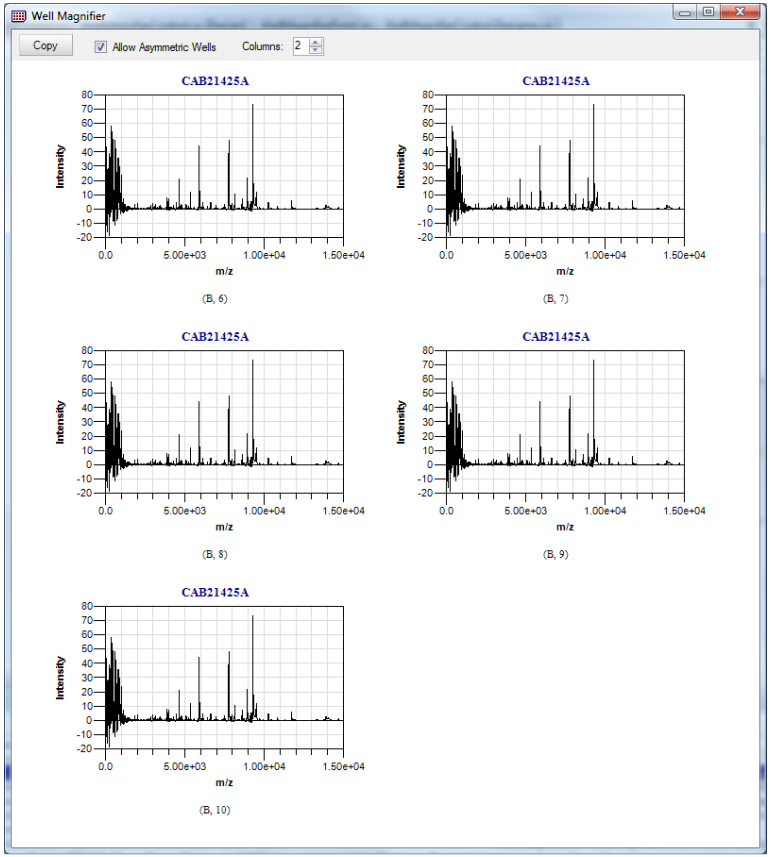
This view shows a plate containing images within wells where currently supported images can be of type .bmp, .jpg, .gif, .tif and .png. In this view pictures of plants at various stages of growth are shown and the (C,9) well is selected and displayed in the embedded well magnifier viewer.

Note: If there are no selected wells, then as the Mouse moves over a well, its well shape and content will automatically be magnified in the well viewer.

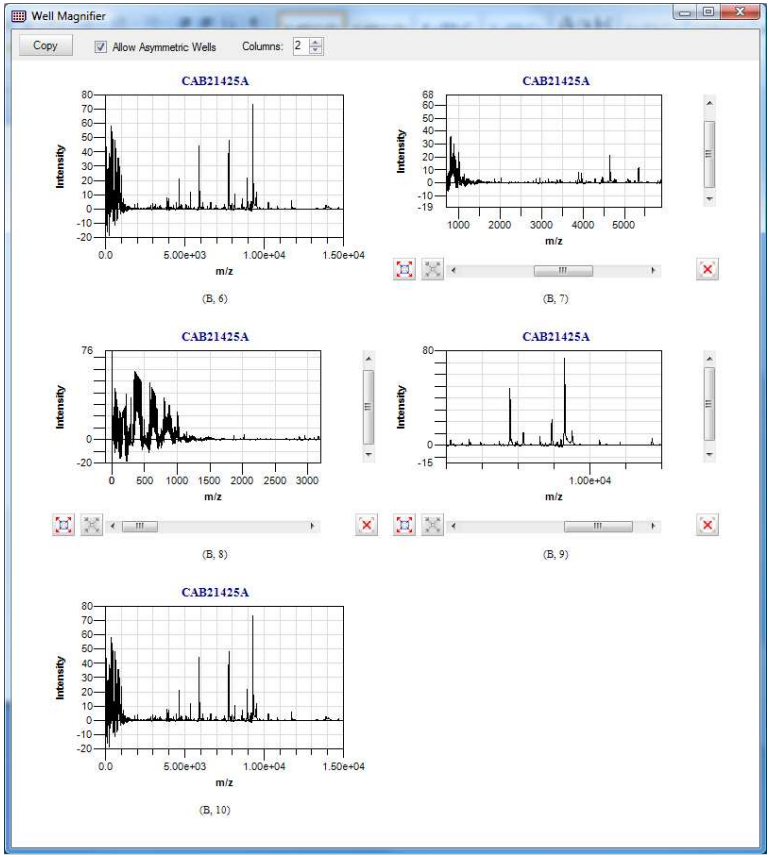


This screen capture shows a 96-Well plate with a mass spectrum graph within each well and a Well Magnifier Viewer embedded within the application in the right panel. Wells B6-B10 are selected in the plate and magnified in the viewer. Since the number of columns is one, they are stacked and a scroll bar is used to view graphs that are not visible. The graphs are displayed with the 'Asymmetric Option' (well height does not equal well width) turned on to obtain a better graph view. In addition, each magnified graph is displayed within a BxPlot2D interactive control (developed by BioXing) which provides for independent zooming and graph option settings such as Title, line color, caption, etc. It also supports labeling of reference data points, selected data points and the graph area with text and images. Refer to the next figure in this document to see the zooming feature and the last view for an example of data point labeling.

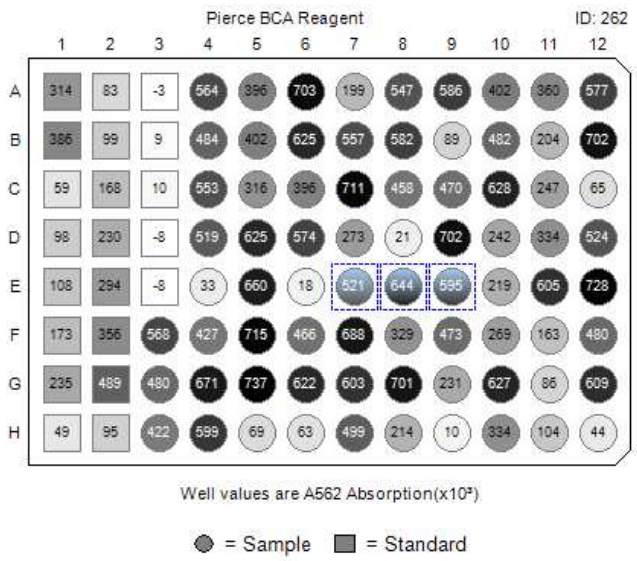
The number of columns can be changed by using the Numeric_Up_Down control and asymmetry is turned On/Off through the check box. The copy button will copy all wells in the viewer to the clipboard including the graphs that are not visible.

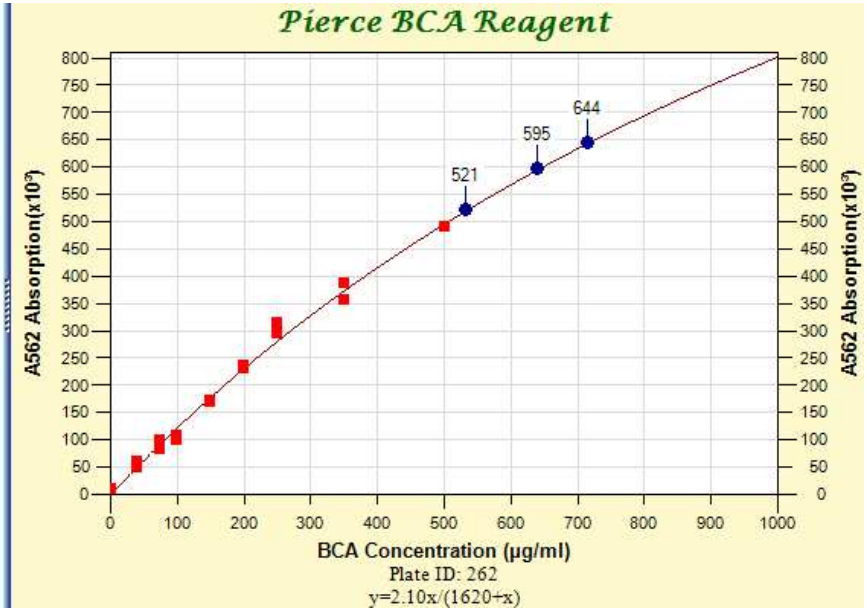


Screen capture of the Well Magnifier popup (not embedded within application) showing five mass spectral graphs in two columns with asymmetric turned on. The popup is automatically created through a BxMicroTitrePlate property option which permits it to be moved anywhere on the screen (or screens for multiple monitors) and resized. The number of columns can be changed by using the Numeric_Up_Down control and asymmetry is turned On/Off through the check box. The copy button will copy exactly what is shown in the viewer to the clipboard.



Same view as the one on the left, but since each graph is within a BxPlot2D control, each can be independently zoomed in as shown in (B,7), (B,8) and (B,9). In the zoomed in graphs there are vertical and horizontal scrollbars along with buttons to quickly move from one zoom setting to another. The button on the right with a red X removes all zoom settings and returns the plot to its initial display view.

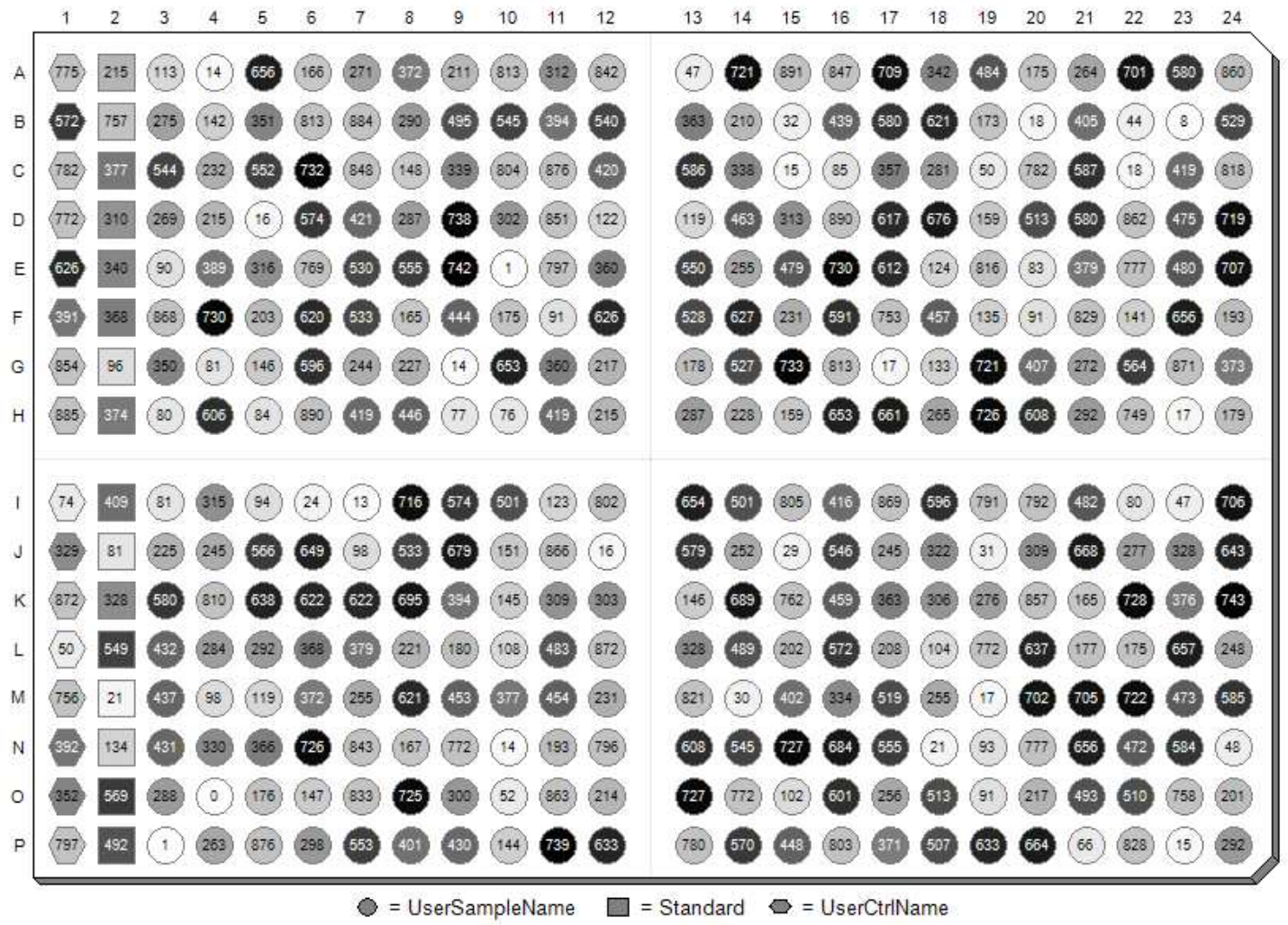




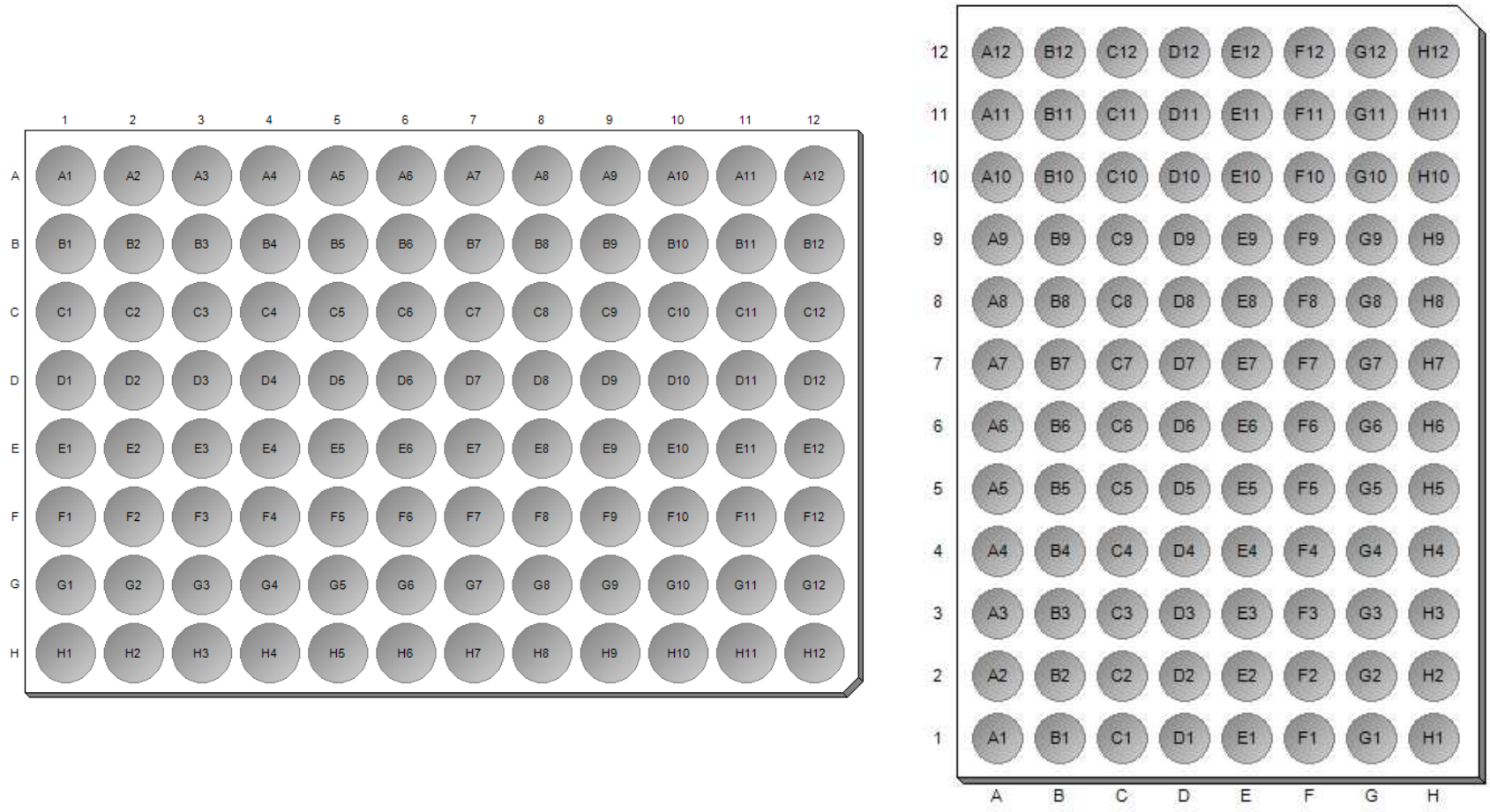
This view, from a standard curve application, shows the result of well selection being used to update the graph view of the data. The plate on the left has standards in wells as indicated by the square shaped wells and samples in the remaining wells. Wells are shaded according to their measured value and are annotated with the numeric value of the measurement. The graph on the right represents a standard curve with red squares that correspond to the values of the standards in the plate. When the three wells were selected, as indicated by their blue-black gradient color and surrounding blue dashed line rectangles, a selection event was triggered which caused the application to mark the corresponding three data points with measured value labels in blue on the standard curve graph.

Note:

BxPlot2D is a customizable control with similar properties as BxMicroTitrePlate and provides for editable labels that can contain text or images linked to data points and to the graph area. All labels can be easily moved and labels that contain images can be resized.



This view shows a 384-well plate rendered with four regions defined by two blocks of 12 columns and two blocks of 8 rows. The optional grid lines are drawn between the blocks for emphasis. Properties are provided that enable defining of any number of row and column blocks.



The default orientation of a plate is shown on the left side of the view where rows are labeled top to bottom and columns are labeled from left to right. The plate on the right side of the view shows the plate rotated 90 degrees counter-clockwise where the rows represent the columns which are labeled bottom to top and where the columns represent the rows with the labels at the bottom in a left to right order. Setting the values of the properties RotatePlate and ShowColLabelsBottom to true creates the rendering on the right.