



Your comments and suggestions on the operation of this software are welcome. Please address them to:

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Introduction to Simulator OPC Server

The ICONICS OPC Simulator is an OPC-compliant server simulator that serves data to OPC clients. The Simulator OPC server was implemented using advanced programming concepts of the current version of the OPC specification for use in developing next generation industrial software applications.

The OPC Simulator communicates with OPC clients, and internal simulation occurs generating different devices. The OPC Simulator is based on several simulation signals, such as Sine, Random, Ramp and a square wave signal. It also has dummy output digital bits and registers that allow "writing to." The OPC Simulator server/client is an ideal way to learn about the OPC standard, and it can be used to test other OPC-compliant clients.

Key features of the OPC Simulator include:

- Advanced OPC data quality and data conversion to client's request.
- OPC Simulator server utilizes advanced free-threading capabilities.
- Supports multiple groups for easy configuration and manageability.
- Internally simulated for configuration and testing.
- Supports, Sine, Ramp, Random and Square signals in addition to static.
- Read/write functionality.
- Tag multiplier allows you to create hundreds of tags in seconds.
- OPC client for rapid testing of your OPC data connections.
- User interface for viewing tags, groups, and simulated values.
- Full online help.
- Change Device, Group and Tag properties online.
- Flexible engineering units and signal ranges.

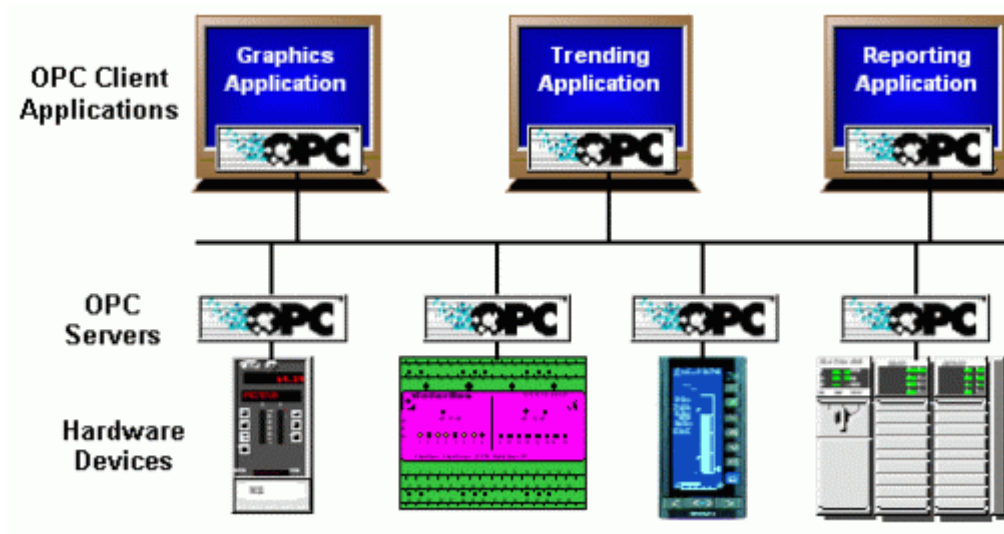
The Simulator OPC Server product contains two parts: a user interface configuration module and the actual OPC server, the runtime module.

The **configuration module** allows you to create a database that holds configuration data of the tags. Such as the tag name, the ranging, and the alarm settings. The **runtime module** uses a runtime database to access the actual values of the tags configured. Structures of both databases are indicated in the following sections.

Changes made to the configuration are accepted only after a restart of the OPC server. However, changes made to the runtime database are accepted online.

What Is OLE for Process Control?

OLE™ for Process Control (OPC) is a standards-based approach for connecting data sources (e.g., PLCs, controllers, I/O devices, databases, etc.) with HMI client applications (graphics, trending, alarming, etc.). It enhances the interface between client and server applications by providing a universally supported and well-documented mechanism to communicate data from a data source to any client application. Included are not only a detailed guide on how to pass the data, but also specific information on other attributes to supplement those data, such as range information, data type, quality flags, and date and time information. The figure below shows the OPC Architecture, which was introduced by the OPC Foundation. By following the OPC Architecture, a device needs only one standard driver, which is an OPC-compliant server. All OPC-compliant client applications can then be connected to that device, either locally or over a network. Furthermore, connections can be made to more than one OPC server at the same time.



OPC-Based Client-Server Architecture

Any OPC client application can connect to any OPC server. In other words, OPC offers true Plug-and-Play capability in the fields of HMI and industrial automation. OPC server types include OPC Data Access (DA), OPC Alarm and Events (AE), and OPC Historical Data Access (HDA).

Simulator Configurator

The OPC Simulator Configurator is used to configure the data items (tags). This configuration is stored to the configuration (.sim) database. The OPC Simulator runtime module will read this database on startup.

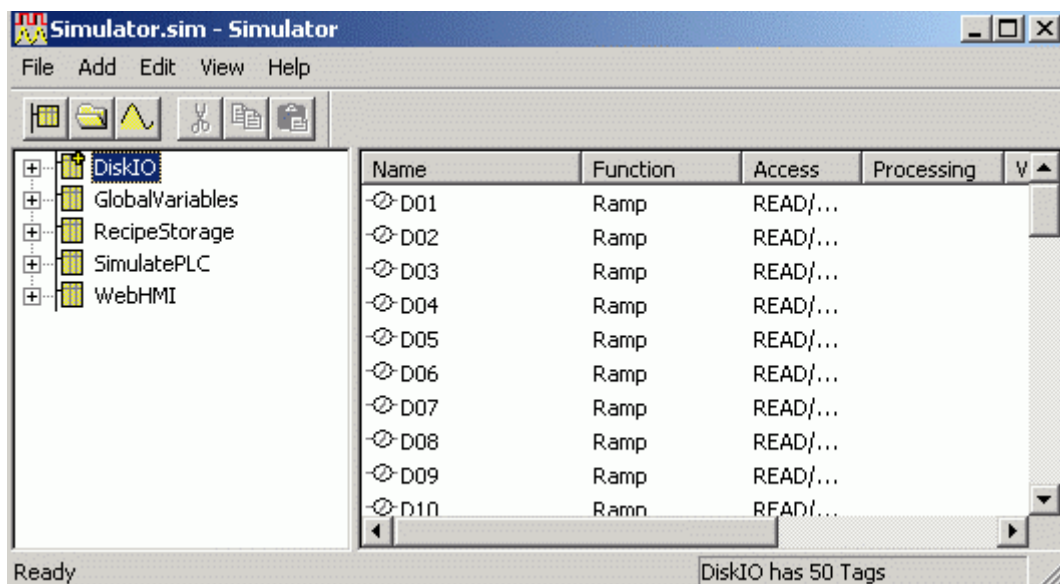
Starting the Simulator Configurator

To open the OPC Simulator Configurator from the Windows **Start** menu, select **Programs > ICONICS GENESIS32 > OPC Simulator**.

The Configurator screen will open, as shown in the figure below. The screen consists of a split window with a tree control view in the left-hand pane and a configuration view in the right-hand pane. The installation provides a default, configured file ("Simulator.sim") that provides a standard format for the configuration database. The Configurator also includes a toolbar and menus with many command functions. For a description of the toolbar and menu functions, please see the sections below.

The OPC Simulator uses an Explorer style user interface to display a hierarchical tree of devices and groups and their associated tags. Tags represent registers and coils within a device. Groups are like subdirectories that logically group tags. A device may have subgroups that all have tags within them, but all of the tags really belong to their device when they are scanned to perform I/O.

Devices and groups are displayed in the left hand pane in a tree control. Tags are displayed in the right hand pane. Right clicking on any object brings up a menu appropriate for the context. Tags can be cut, copied, deleted, or edited. Tags that are cut or copied can be pasted into the selected device or group. Tags can also be dragged to a device or group. Following the drag and drop standard, drag means move, while drag with the **CTRL** key depressed means copy. Multiple tags can be selected for these operations. If tags are dragged or pasted and there is a name conflict, a dialog prompts you to rename, overwrite, skip, or cancel.



OPC Simulator Configurator

Toolbar

The OPC Simulator Configurator toolbar, shown below, contains the following command buttons:

- **New Device:** Creates a new device in the tree control.
- **New Group:** Creates a new subfolder in the tree control.
- **New Tag:** Creates a new tag.
- **Cut:** Deletes the current selection, sending it to the clipboard.
- **Copy:** Copies the current selection to the clipboard.
- **Paste:** Pastes the current contents of the clipboard.

For more information on menu functions, please refer to the **Menus** section below.



OPC Simulator Toolbar

Menus

The menu bar of the Configurator contains the following menus:

- File
- Add
- Edit
- View
- Help

Note: You can also access many of the menu commands by right-clicking items in the tree control of the Configurator and selecting command functions from the pop-up menus.

File Menu

The **File** menu commands are listed in the table below.

File Menu Commands

Command	Shortcut Keys	Function
New	CTRL+N	Creates a new configuration database.
Open	CTRL+O	Opens an existing database (.sim) file.
Save		Saves the current database.

Save As		Saves the current database under a different name as a .sim file.
Import CSV		Imports data into your configuration database from a Microsoft Excel file (.csv).
Reimport CSV		Reimports data into your configuration database from the previously imported Microsoft Excel file (.csv).
Export CSV		Exports configuration data from your database to a Microsoft Excel file (.csv).
Re-export CSV		Re-exports data from your database to the previously exported Microsoft Excel file (.csv).
Exit		Closes the application. The current configuration database is automatically saved.

Add Menu

The **Add** menu commands are listed in the table below.

Add Menu Commands

Command	Shortcut Keys	Function
New Device	CTRL+D	Creates a new device in the tree control.
New Group	CTRL+G	Creates a new subfolder in the tree control.
New Tag	CTRL+T	Creates a new tag.
Multiply	CTRL+M	Opens the Multiply Tag dialog box, which allows you to duplicate the selected tag in the tree control.

Multiplying Tags

The Configurator allows you to multiply tags in the tree control. Multiplication provides a simple way of developing configurations where there are many similar items in a given category. To multiply a selected tag, choose **Multiply** from the **Add** menu.

Tag Multiplier

This opens the **Multiply Tag** dialog box, as shown in the figure below. The Tag Multiplier provides an easy and fast method for creating many tags without having to individually enter all of them. The dialog contains the following items:

- **Base Name:** This is the prefix part of the tag name that will stay the same in all tags (defaults to the name of the original tag selected).
- **Duplicate:** This simply generates the tag according to the following criteria selected from the drop-down list: **Amplitude, Phase, or None.**
- **Duplicator Factor:** This represents the increment index for duplicating the tags.
- **First Number:** This is the number to be appended to the first generated tag. Other tags will have consecutive numbers starting from this number up (defaults to 1).
- **Numeric Places:** This is the number of digits that will be appended to base name (defaults 3).
- **Number of Tags:** This is how many tags will be generated (defaults to 100).

The function generates copies of the originally selected tag, substituting new tag names and amplitude or phase. All other tag properties remain the same. For example, when following values are entered, notice the 4 numeric places after the base name:

Base Name: Sine

First Number: 100

Numeric Places: 4

Duplicate Factor: 30

Number of Tags: 300

The following 300 tags will be generated when duplicating according to Phases:

Sine0100 with Phase 30

Sine0101 with Phase 60

Sine0102 with Phase 90

Etc..... up to

Sine0399 with Phase 360

Edit Menu

The **Edit** menu commands are listed in the table below.

Edit Menu Commands

Command	Shortcut Keys	Function
Cut	CTRL+X	Cuts the selected object from the view and places it on the clipboard.
Copy	CTRL+C	Copies the selected object to the clipboard.
Paste	CTRL+V	Pastes the last object placed on the clipboard.
Delete	DEL	Deletes the selected object.
Properties	CTRL+P	Opens the Properties dialog box for the selected item.

View Menu

The **View** menu commands are listed in the table below.

View Menu Commands

Command	Function
Monitor	Monitors runtime values of tags.
Status Bar	Toggles the status bar at the bottom of the Configurator window.

Help Menu

The **Help** menu commands are listed in the table below.

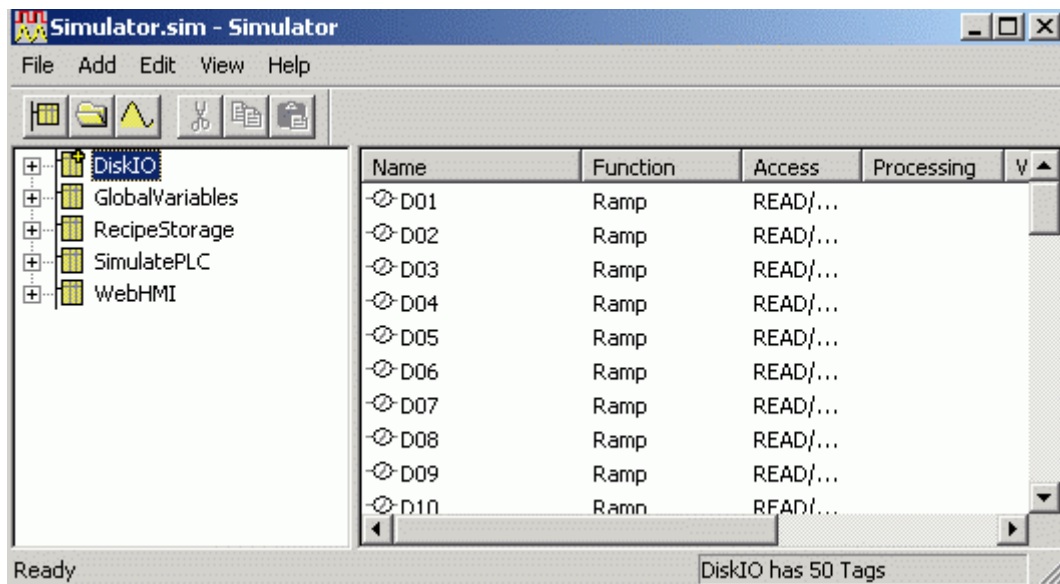
Help Menu Commands

Command	Function
About Application	Launches the About Box , which contains information about the product version number and copyright.
Help Contents	Launches the online Help for the Configurator.

Creating a New OPC Simulator Configuration

To launch the ICONICS Simulator OPC Server from the Windows **Start** menu, select **Programs > ICONICS GENESIS-32 > OPC Simulator**.

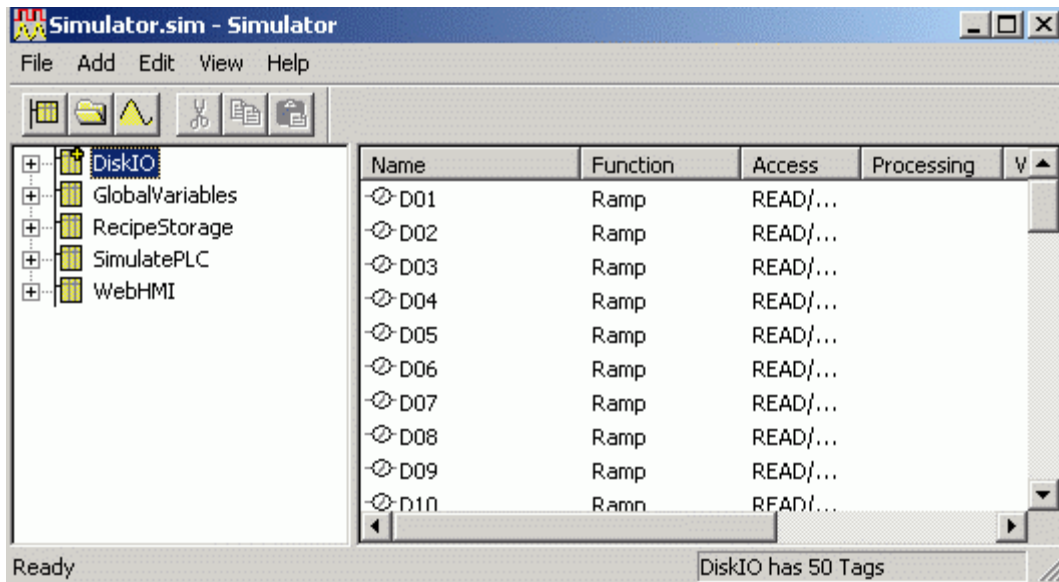
This will open the configuration screen for the OPC Simulator, as shown in the figure below. Note that there are definitions already created for this server. Various portions of the GEN32Demo use these tags. As such, you should leave these configurations intact so the various examples used in the GEN32Demo will function properly.



OPC Simulator Configurator

Creating a New Device

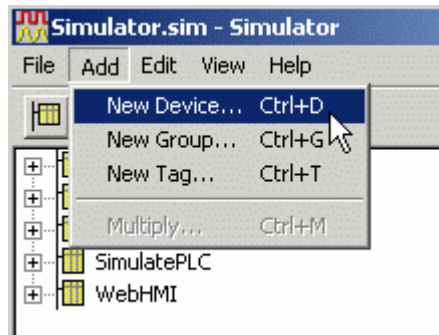
The names in the left pane of the OPC Simulator Configurator (e.g. **Disk IO**, **Global Variables**, **Recipe Storage**, **Simulate PLC**), shown in the figure below, represent simulated "devices." In the real world, "devices" could mean "Programmable Logic Controllers (PLCs)," "I/O Boards," or "Sensor Networks," etc. A device may have any name, but avoid names with spaces or punctuation such as "|!.,".



OPC Simulator Configurator

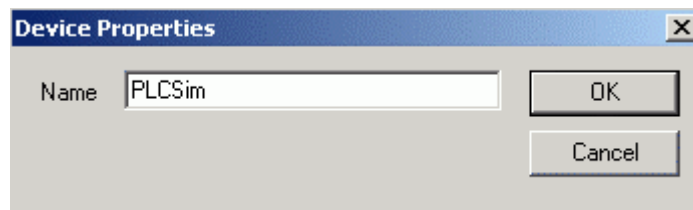
To create your own simulated device to hook up to the simulated network of I/O:

1. From the **Add** menu, select **New Device**, as shown in the figure below.



Creating a New Device

2. In the **Device Properties** dialog, type a name for the device (e.g. "PLCSim") and then click **OK**, as shown in the figure below. The new device will appear in the tree control of the Configurator.



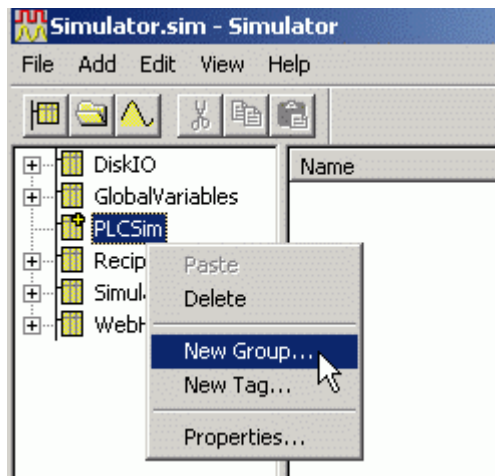
Device Properties

Creating Groups

A device can contain any number and level of groups, just like subdirectories. A group only has a name, which must be unique among its parent's groups (just like subdirectories).

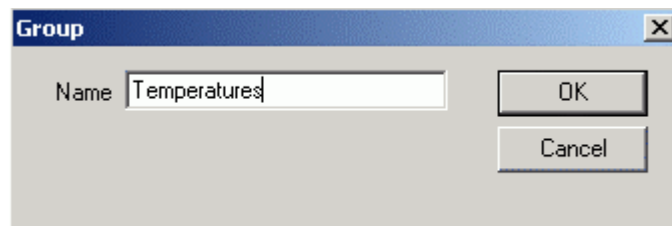
With ICONICS OPC Servers, you can organize your I/O tags into convenient folders, making them easy to work with, connect to, view, and manage, etc. The example below shows how to create two groups:

1. Right-click a device and select **New Group** from the pop-up menu, as shown in the figure below.



Creating a New Group

2. This opens the **Group** dialog box. Name the group (e.g. "Temperatures"), as shown in the figure below. Click **OK**. The new group will appear under the device.



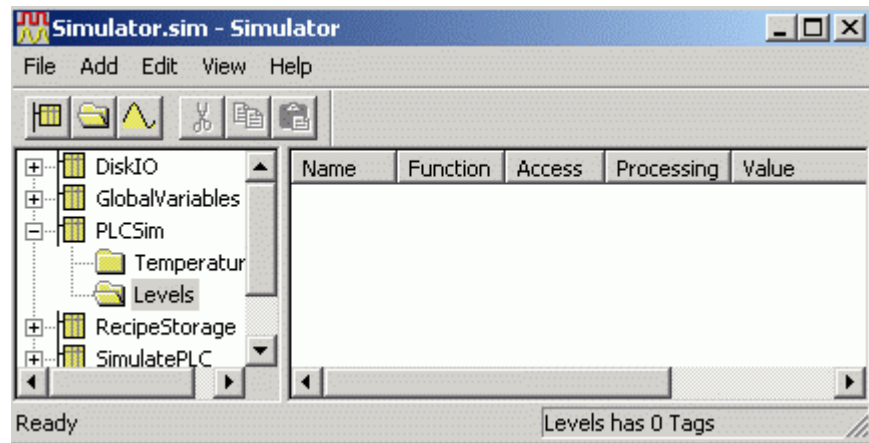
Naming the New Group

With this OPC server, you can actually create groups within groups. This hierarchical organization of groups makes it even easier to organize your I/O. Simply select the group/folder you wish to create another group in, and select **New Group** from the **Add** menu.

In the example below, another group is added at the "root" level of the device:

1. Right-click the device and select **New Group** from the pop-up menu. (**Note:** If you do not first click on the device, the new group is added as a sub-folder to the "Temperatures" group.)

2. In the **Group** dialog box, give this second group a name (e.g. "Levels"). Click **OK**. Your screen should look similar to the one shown in the figure below.



Selecting the Device for the Second Group

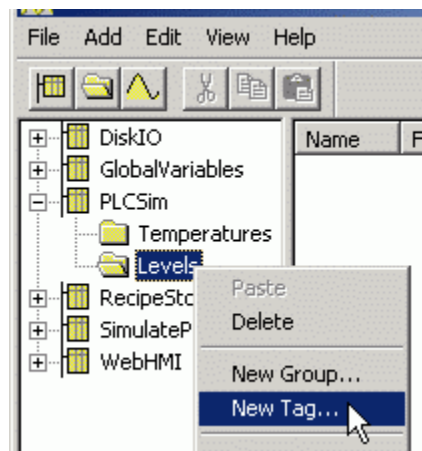
Creating Tags

The OPC Simulator allows you to create “dummy” tags, which can be used in a variety of ways, including:

- Testing your system
- Global variable storage (accessible from any OPC client on the network)
- Recipe storage
- Operator manual-entry data storage

Several example tags are created below:

1. Right-click the **Levels** group and select **New Tag** from the pop-up menu, as shown in the figure below.



Adding a New Tag to the "Levels" Group

2. This opens the **Tag Properties** dialog box, as shown in the figure below. A tag has a name, which must be unique within its group, a description, an amplitude, a phase and data type. Bits are always boolean. For example:

- **Name:** Tank 1
- **Description:** Water Level
- **Simulation Signal:** Sine
- **Data Type:** FLOAT

The screenshot shows the 'Tag Properties' dialog box. It contains the following fields and controls:

- Name:** Tank 1
- Description:** Water Level
- Amplitude:** 1
- Phase:** 0
- Simulation signal:** Sine (selected from a dropdown)
- Data Type:** FLOAT (selected from a dropdown)
- Scaling:**
 - ☐ Enable
 - Settings... button
- Access:**
 - ☒ Read
 - ☐ Write
 - ☐ Read/Write
- Init Value:** 0
- Buttons:** OK, Cancel

Tag Properties

The defined tags use a variety of data types and simulation signals. Only read and write registers are simulated. (Write registers are not modified by the server's simulation mode.) A register's data type can be 2 Bytes (Word), 4 Bytes (Dword), or a 4 Byte floating point number. Other data types are INT, BIT, LONG and Strings.

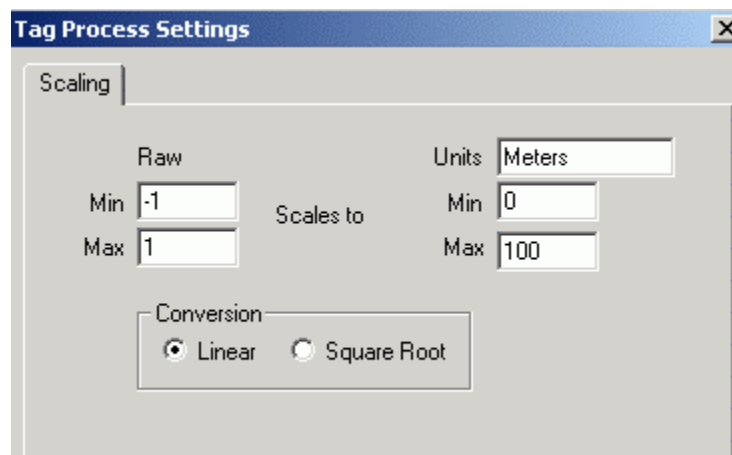
For simulation signal types to check the connectivity of clients to the OPC Simulator, you can select Ramp, Random, Sine or a Square wave signal. These simulation types determine how the tag value will be generated and how frequently it will change.

Data Type	Sine	Random	Ramp
Boolean	Toggles every 6 seconds	Random on/off	Toggles every 6 seconds
Short	0 to 100, period is 2 min	Random from 0 to 100	Increments at scan rate
Long	-1 to 1, period is 2 min	Random from 0 to 100	Increments of scan rate and amplitude

Note on naming: The OPC item name, or itemID, is made up of "device.group.tag" where the server uses periods as delimiters. Some clients may use other delimiters between server name, access path, and itemID. This is similar to the case of Excel's DDE syntax "application|topic|item". To avoid possible naming conflicts in clients, the access path and itemID should be free of spaces and punctuation.

3. The OPC specification also provides for passing OPC clients the scaling used for each OPC tag. This aids in setting up ranges for animated graphics, trend logging scaling, etc. You will now add scaling to this tag. Under the **Scaling** section, check the **Enable** check box, and then click on the **Settings** button.
4. The **Tag Process Settings** dialog box appears, as shown in the figure below. The sine wave signal you have configured will go from -1 to 1. Fill in the fields, as shown in the figure below, so this scales to 0 to 100 meters. Click **OK**.

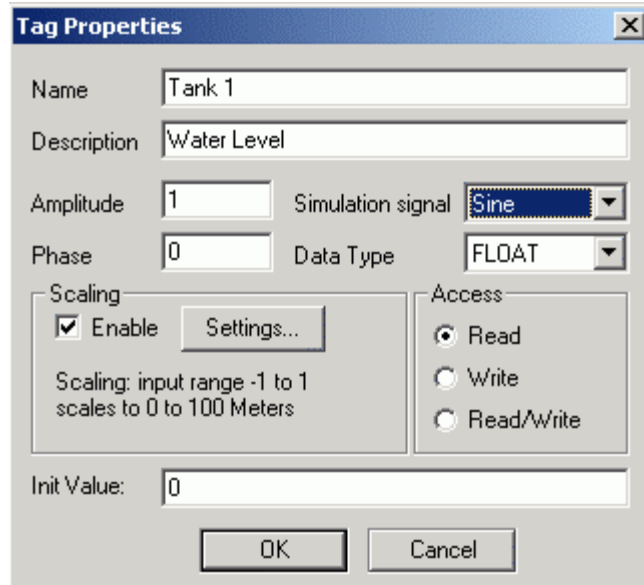
Tags can be scaled in the server, to convert to Engineering Units, for example. Scaled tags will be converted to double precision floating point numbers when they are scaled.



The screenshot shows the 'Tag Process Settings' dialog box with the 'Scaling' tab selected. The 'Raw' section has 'Min' set to -1 and 'Max' set to 1. The 'Scales to' section has 'Min' set to 0 and 'Max' set to 100. The 'Units' dropdown is set to 'Meters'. The 'Conversion' section has 'Linear' selected with a radio button and 'Square Root' unselected.

OPC Tag Scaling

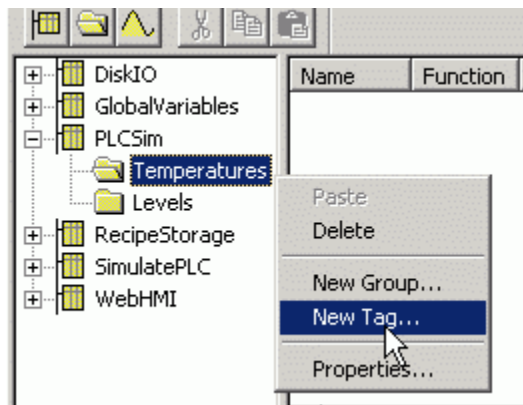
5. The **Tag Properties** dialog box now appears as shown in the figure below. Click **OK** to save this tag.



Defining the Tag Properties

Next, you will add a several tags to the **Temperatures** group/folder, using a special feature of our OPC servers.

1. Right-click the **Temperatures** group and select **New Tag** from the pop-up menu, as shown in the figure below.

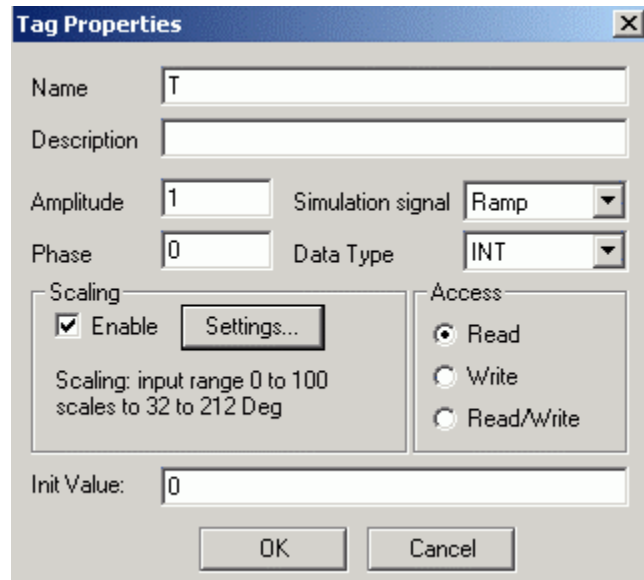


Adding a New Tag to the "Temperatures" Group

2. This opens the **Tag Properties** dialog box, as shown in the figure below. Change the following parameters:

- **Name:** T
- **Enable Scaling:** 0 to 100 scales to 32 to 212 Deg.

Your tag should appear, as shown in the figure below. This is simply a "base tag," i.e., one that you will "multiply" to produce several tags. Click **OK**.



Tag Properties

Name:

Description:

Amplitude: Simulation signal:

Phase: Data Type:

Scaling: ☒ Enable

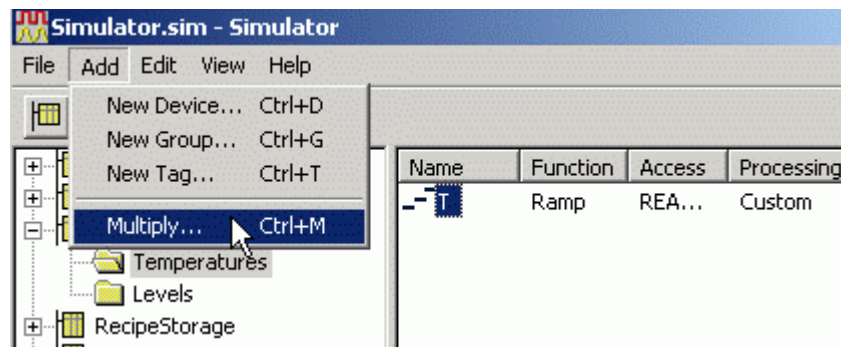
Scaling: input range 0 to 100 scales to 32 to 212 Deg

Access: ☒ Read ☐ Write ☐ Read/Write

Init Value:

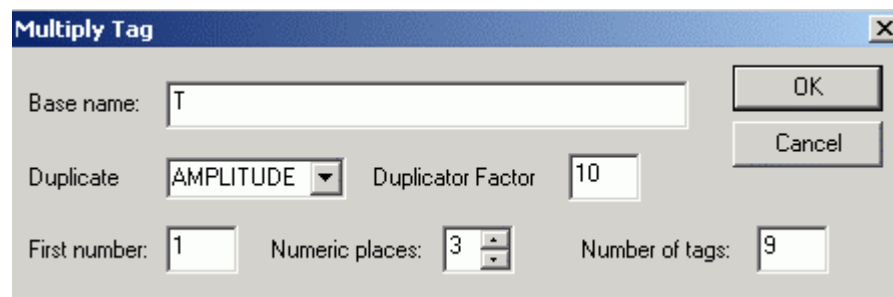
Base Tag

- Next, you will take this base tag and multiply it to create a series of OPC tags. To do this, first select the tag **T** by clicking on it in the right-hand window frame, then choose **Multiply** from the **Add** menu, as shown in the figure below.



Multiplying a Base Tag

- Set the **Number of tags** to 9, as shown in the figure below. Click **OK**.



Multiply Tag

Base name:

Duplicate: Duplicator Factor:

First number: Numeric places: Number of tags:

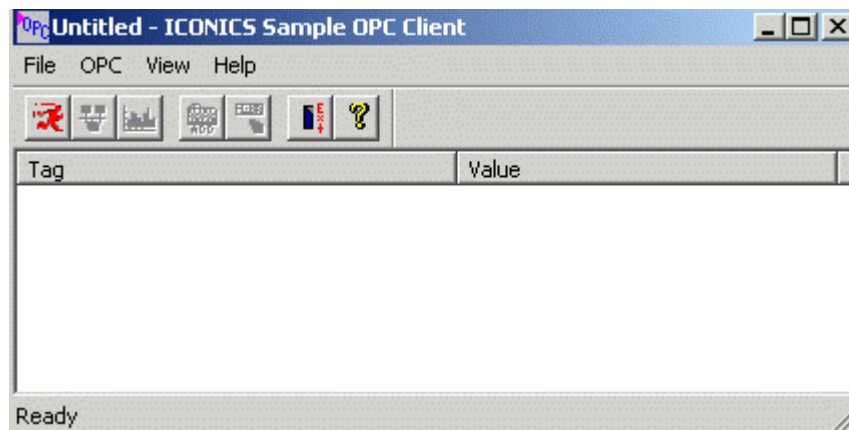
Multiply Tag Dialog Box

5. This creates 9 tags, named "T001," "T002," "T003," and so on. You can delete the first base tag, "T," if you wish, by right-clicking on it and selecting **Delete** from the pop-up menu.
6. The final step is to select **Save** from the **File** menu to save your changes.

There are other features in the Simulator OPC Server, such as **Monitor Mode** (for viewing the OPC values without requiring a separate OPC client), importing and exporting tags to CSV files, etc.

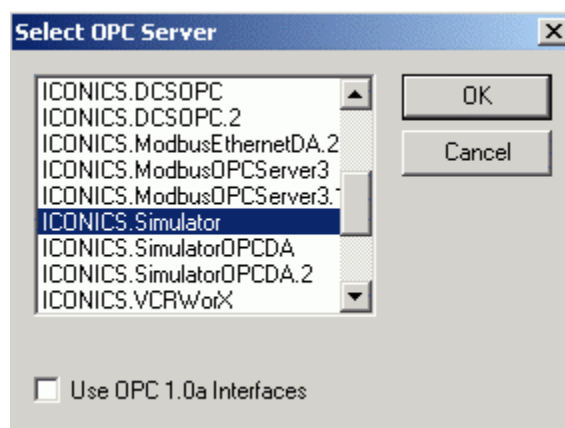
Sample OPC Client

The **Sample OPC Client** is used as a test case to debug servers and demonstrate some of the OPC capabilities. Start the OPC client, as shown in the figure below.



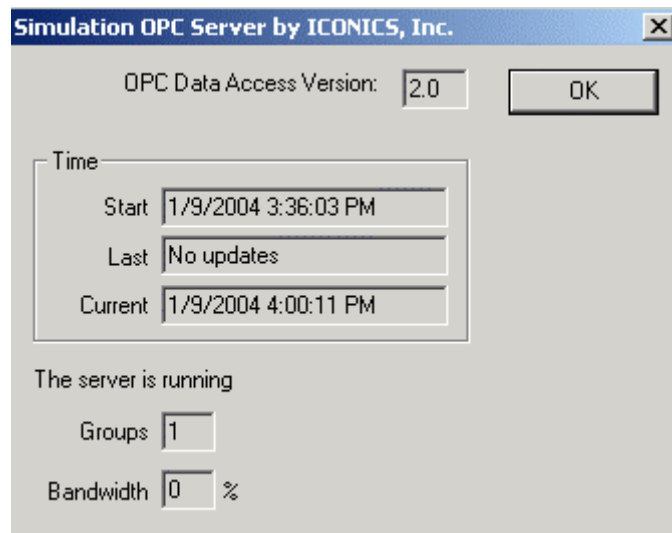
Sample OPC Client Screen

From the **OPC** menu, select **Connect**. The **Select OPC Server** dialog box appears showing all registered OPC servers, as shown below. Select **Simulator OPC Server** and then click **OK**. This connects the OPC client to the Simulator OPC Server.



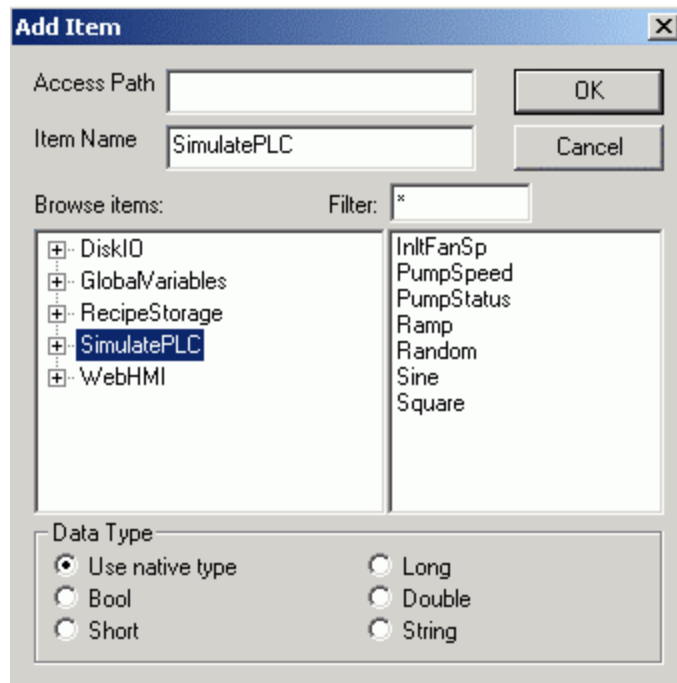
Select OPC Server Dialog Box

From the **OPC** menu, choose **Server Status** to view the OPC server status dialog box, shown in the figure below. The server status dialog box continuously updates the server start time, the time of last update, the current time, the number of groups, and the bandwidth for the selected server. Use this window to verify that the server is running and is connected to the OPC client. Click **OK** to close the server status dialog box.



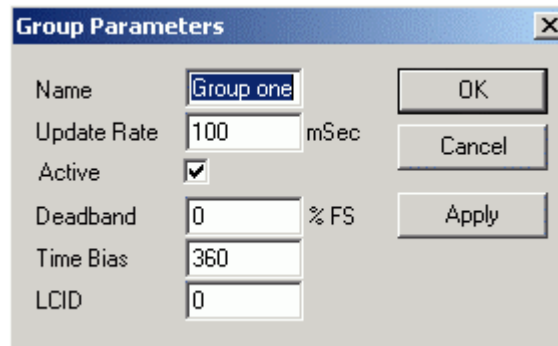
Server Status Dialog Box

From the **OPC** menu, choose **Add Item**. The **Add Item** dialog box appears, as shown in the figure below. The **Add Item** dialog box displays the devices, data blocks, and data tags defined in the current server configuration. These are filtered by expression "*" and by data type. You can enter an access path, type, or select an item name, and choose the data type in which you want to view the requested tag. In the **Browse Items** list, select the device, group, and tag. The full name appears in the **Item Name** field. Click **OK**. The item appears as a **Tag** in the OPC Client window with updating data values. You can add more tags by repeating the steps described above.



Add Item Dialog Box

From the **OPC** menu, choose **Group Parameters**. This command displays the parameters of the group of tags.



Group Parameters for the Selected Server

The **Update Rate** determines how fast data are sent to the client (in milliseconds). The **Active** state (checked) initiates active communications between the client and the server. You can change the **Active** state or the **Update Rate**, for example, and click **Apply** to send changes to the server. If the group is not active, data are not sent to the client. You can choose to **Disconnect** from the **OPC** menu to restore all selections and to disconnect from the server.

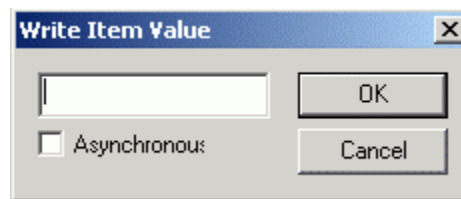
While a client is connected to a server, you cannot exit the server or open new configurations in the server. You can modify the existing server configuration while client(s) are connected; however, you cannot delete any device or tag in use. For example, you can take a device offline or change a tag's scaling values without shutting down a client that may be controlling many devices.

Start another instance of the OPC client and make the same server connection as those defined in the first client instance. You can add items, change the group update rate and active states, and view the server status in each instance of the OPC clients independently of the other instances. For example, the number of groups is "1" in each client because each one only has one group.

The only way that one client affects another is through data and data changes. Make sure both clients are showing the same tag.

To write a value to an item or tag, highlight a tag in the client and choose **Write Value to Item** from the **OPC** menu. This allows you to write a value for the data item, as shown in the figure below. Enter a numeric value and click **OK**. The client displays the new value at the update rate defined above. The client writes the value typed in the **Write Item Value** dialog box to the correct item in the Group object. The method of writing data is determined by the **Asynchronous** check box. When data are written synchronously, the call to the server blocks until the operation has completed, which may take a long time. When data are written asynchronously, the call to the server returns quickly and the operation is carried out on another thread. When the write has finished, the client's advise interface is notified with the results.

Note: A client defined with a very slow update rate does not receive the value immediately.



Writing a Value to a Data Item

How the Client Connects to and Gets Data From a Server

When OPC servers are installed on the system, they are registered so that clients can find them and users can view them in a list. To make a client/server connection, the user must first choose a server. The server name selected is used to get a class ID which, in turn, is used to create a COM object. If the user selects a server that is not currently running, the system starts the server and then creates the object in that server on behalf of the client.

Once the COM object is created, the client application has an IOPCServer interface, as defined in the OPC specification. This is the main interface to an OPC server, and this document refers to this as the Server interface. (The other interface is Group.) An OPC client always creates a group in the server and registers an advise interface with it to get asynchronous data notification.

When an item is added, the dialog displays either a hierarchy or a flat list of names, depending on the server. The names are queried from the Server object using the filter string and requested data type. When the user either types or selects a name, an item by that name is added to the Group object. This item is also read immediately to get an initial value.

Items in a group are scanned by the server; when their values change, the advise interface in the client is notified. A data structure containing the data for each item whose value or quality has changed (and only those items) is passed to the client's advise interface. The client unpacks and uses the data.

Server Status and Group Parameters

The Server status dialog periodically queries the Server object for status and displays the results. The **Group Parameters** dialog box queries the group state and displays the results. The **OK** button and **Apply** button in the **Group Parameters** dialog box write the parameters from the dialog to the Group object and read the parameters back. This primarily controls the scanning and updating of data. When a group is inactive, it does not send data notifications to the client and, typically there is no reason to scan the items when the group is inactive. The **Update Rate** in the **Group Parameters** dialog box specifies the rate at which data notifications should be sent back to the client, assuming that data have changed. This is also the rate at which items are scanned on behalf of this client.

Disconnecting the Client from the Server

You can disconnect from the selected server by choosing **Disconnect** from the OPC menu. The **Disconnect** command unregisters the advise interface, releases the Group object, and then releases the Server object. Releasing an object means that the client is no longer interested in the object, so the system can delete the object in the server.

Monitor Mode

When tags are configured, their data can be viewed in Monitor mode. Choose **Monitor** from the **View** menu to toggle this mode. In monitor mode, the tag values are displayed in the tag view, updating periodically. The data are displayed in the appropriate format for the data type. Boolean data are either "on" or "off." Integer and floating point numbers are displayed in their native format. Scaled tags are displayed in floating point with the Engineering Units field. When in monitor mode, just the tags in view are scanned for data. Selecting a different device or group will remove any previous tags and add the tags now in view to the scan list. Monitoring is completely independent of OPC items that are scanned for data. Monitoring is also independent of a device's simulator mode.