

PI DataLink 2017 SP1

User Guide

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PI DataLink 2017 SP1 User Guide

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Version: 5.4.1

Published: 28 December 2017

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Introduction

Welcome to PI DataLink! This section provides an overview of PI DataLink, describes features of this release, and discusses installation and configuration.

Topics in this section

- PI DataLink overview
- About this release
- PI DataLink installation
- Microsoft Excel add-in configuration
- Security recommendations
- About this document

PI DataLink overview

PI DataLink is a Microsoft Excel add-in that enables you to retrieve information from your PI System directly into a worksheet. Combined with the computational, graphic, and formatting capabilities of Microsoft Excel, PI DataLink offers powerful tools for gathering, monitoring, analyzing, and reporting PI System data.

With PI DataLink, you can:

- Retrieve PI point values from a PI Data Archive server
- Retrieve attribute values from a PI Asset Framework (PI AF) server
- Retrieve system metadata to create a structured view of PI System data:
  - PI point names and attributes
  - PI Module Database paths, aliases, and properties
  - PI AF attributes and elements
- Reference these items using PI DataLink functions to calculate and filter data
- Update retrieved values when the worksheet recalculates
- Retrieve notifications that you subscribed to with PI Notifications

PI DataLink includes a user interface to help you build functions and retrieve data. PI DataLink embeds functions in worksheet cells and can provide active updates of real-time data from your PI System.

You can also use the rich calculation and formatting capabilities of Excel to organize and present PI System data to fit your purpose or audience.

There are two ways to work with PI DataLink functions in Excel worksheets:

- Install a stand-alone version of PI DataLink on a local PC.
- Use a web browser to view the worksheet with PI DataLink Server (DLS), a separate product that lets you view worksheets created with PI DataLink.

Contact your OSIsoft sales representative for more information.

PI DataLink Server (DLS)

PI DataLink Server is a server version of PI DataLink for use with Microsoft SharePoint Server 2007 or later. PI DataLink Server supports all PI DataLink and PI BatchView functions provided by Excel add-ins in a typical PI client configuration.

With PI DataLink Server, you can use a web browser to retrieve and view PI Data Archive data contained in a Microsoft Excel worksheet. You can expand access to real-time PI System data to many different consumers, regardless of location, or familiarity with either Microsoft Excel or PI DataLink functions.

This server version of PI DataLink uses Microsoft SharePoint technologies including Excel Services and the Excel Web Access Web Part. Together, these Microsoft components support a majority of standard worksheet features. PI DataLink Server augments these services, adding connectivity and support for PI DataLink functions.

Excel workbooks published to SharePoint document libraries can be accessed independently, or added to web part pages. The Excel Web Access web part supports connections that allow parameters to be exchanged between a workbook and other web parts, integrating worksheets with PI DataLink functions into the PI WebParts environment.

Contact your OSIsoft sales representative for more information about PI DataLink Server.

About this release

This release of PI DataLink installs an add-in for Microsoft Excel 2007 SP3 or later. This add-in cannot run in earlier versions of Excel. Topics in this section describe system requirements, upgrade compatibility with previous releases, and supported data types.

Topics in this section

- System requirements for PI DataLink
- Upgrade compatibility
- Supported data types

System requirements for PI DataLink

For up-to-date system requirements, see the OSIsoft Tech Support page PI DataLink System Requirements (https://techsupport.osisoft.com/Products/PI-Visualization/PI-DataLink/System-Requirements).

Upgrade compatibility

PI DataLink is backwards compatible. This version of PI DataLink can read workbooks created in older versions without any conversion. However, the reverse is not necessarily true. Once you modify a worksheet in the current version, it may no longer work in older versions of PI DataLink.

This version of PI DataLink uses PI AF SDK. PI DataLink 2010 and earlier versions used either PI SDK or PI API. Different behaviors might require you to change existing worksheets that you created with PI DataLink 2010 or earlier versions:

- Returned error messages might differ. You might need to change worksheets that look for certain strings (for example, in Excel VBA code or macros).
- PI DataLink does not create connections to PI SDK or PI API. You might need to change VBA code in workbooks that depend on an existing PI SDK or PI API connection to create a new, explicit connection to PI SDK or PI API.
- Some time formats, such as `10:`, are no longer supported. You need to change any time inputs that use unsupported formats.
- Default user connections to PI Data Archive are no longer supported. If prompted, you can enter a user name and password. However, OSIsoft recommends that you configure PI mappings to connect to PI Data Archive.

The 64-bit version of PI DataLink does not let you create an ActiveX trend object. The 64-bit version will only show an image of the last trend in an existing worksheet, and will not update those trends.

Supported data types

PI DataLink supports the following PI point data types:

- Digital (defined states)
- Int (16 and 32)
- Float (16, 32 and 64)
- String (text)
- Timestamp

PI DataLink does not support the blob type.

PI DataLink supports the following PI AF attribute value types:

- Byte
- Int (16, 32, and 64)
- Single
- Double
- String*
- DateTime*
- Boolean*
- Enumeration*

*Not supported by Calculated Data function

PI DataLink does not support the PI AF attribute value types Guid, Attribute, Element, File, or Array.

PI DataLink installation

Before you use PI DataLink, you must install PI DataLink from a distribution CD or a setup kit downloaded from OSIsoft. If desired, you can use a silent installation. You can also install the language pack to enable support for languages other than English. In addition, you need to consider your PI Data Archive configuration and ensure that you have proper access to PI points.

Topics in this section

- Install PI DataLink
- Silent installation
- View PI DataLink in a supported language
- Connection preferences to PI Data Archive collectives
- PI Data Archive configuration

Install PI DataLink

Launch the setup program to install PI DataLink. On 64-bit operating systems, the setup program automatically installs both the 32-bit and 64-bit version of PI DataLink. You can modify the `setup.ini` file if you want to install only one version. If you have a previous version of PI DataLink installed on your computer, the setup program automatically upgrades your installation and retains the preference settings from previous versions. The setup program does not install the PI DataLink (Legacy) add-in, even when upgrading from a previous installation that had the add-in enabled, unless you modify the `setup.ini` file.

Procedure

1. Find the setup kit. You can:
   - Download the kit from the OSIsoft Tech Support Downloads page (https://techsupport.osisoft.com/Downloads/All-Downloads/).

     You can filter the Downloads page to show installation kits.
   - Insert the distribution CD.
2. Extract the files to your computer.
3. If needed, modify the `setup.ini` file to do the following:
   - Install one version of PI DataLink (32-bit or 64-bit).
   - Install and activate the PI DataLink (Legacy) add-in (for the 32-bit version of PI DataLink in 32-bit Microsoft Office). The PI DataLink (Legacy) add-in is required to use tag functions, module database functions, or trends.

     Caution:
     The PI DataLink (Legacy) add-in uses older technologies, such as ActiveX, that have known security risks. ActiveX controls can have unrestricted access to your computer and therefore can access your local file system and change your operating-system-registry settings. If a hacker uses an ActiveX control to take over your computer, the damage can be significant.

To modify the `setup.ini` file, follow the example in the file.

4. Run the `setup.exe` program. The setup program installs PI DataLink under the root directory `PIPC`, typically in:

   `C:\Program Files\PIPC\Excel`

   The program installs the online Help file in the appropriate language directory under the `../PIPC/Help` directory. You can download the PDF version and release notes from the OSIsoft Tech Support Downloads page (https://techsupport.osisoft.com/Downloads/All-Downloads/).

After you finish

- To change the default PI DataLink settings, see Change PI DataLink settings for all users on a computer.
- To view PI DataLink in a language other than English, install the PI DataLink MUI Language Pack. See View PI DataLink in a supported language.

Silent installation

You can install this software with the Windows silent installation feature. Sometimes called an unattended installation, silent installation requires no feedback during the setup process. System administrators with an automated software distribution application might use silent installation to deploy software automatically to large numbers of corporate desktops.

To launch a silent installation, type:

```
Setup.exe -f silent.ini
```

The `silent.ini` file is included in the setup kit. You can make site-specific alterations to the file as needed. See the `silent.ini` file for further information and descriptions of available arguments.

View PI DataLink in a supported language

PI DataLink supports multiple languages. Install the PI DataLink MUI (multilingual user interface) language pack to view the PI DataLink user interface in the same language as Microsoft Excel. If PI DataLink does not support a language, the PI DataLink user interface appears in English.

Procedure

1. Set the desired language in Microsoft Excel:
   a. Install the Microsoft Office language pack.
   b. Use the Microsoft Office language setting tool to change the language of Microsoft Excel.
2. Download the PI DataLink MUI language pack from the OSIsoft Tech Support Downloads page (https://techsupport.osisoft.com/Downloads/All-Downloads/).
3. Install the PI DataLink MUI language pack.

Connection preferences to PI Data Archive collectives

If PI DataLink connects to a PI Data Archive collective, PI DataLink sets a connection preference upon the first connection to the collective. The preference depends on the component that initiates the connection:

- PI DataLink functions set the preference to `Any`.
- Search sets the preference to `Any`.
- Connection Manager (accessed from the Settings window) sets the preference to `Prefer Primary` or to the setting in PI System Explorer, if set differently. For information on setting the preference in PI System Explorer, see the PI Server topic "Manage connection preferences for PI System Explorer" in Live Library (https://livelibrary.osisoft.com).
- Trend control legacy objects set the preference to `Prefer Primary`.
- Tag Search (accessed from the legacy tag functions) sets the preference to `Prefer Primary`.
- PI Connection Manager (accessed from the legacy Tag Search) sets the preference to `Prefer Primary`.

PI Data Archive configuration

PI DataLink can retrieve data from PI Data Archive 3.4.380 and later. However, PI DataLink must be able to connect to the proper PI Data Archive server and users must have proper access to points. This might require configuration changes for:

- **Firewall database**

  The firewall database on each PI Data Archive computer must be configured to allow access from client computers that run PI DataLink.

- **Authentication and authorization**

  Those using PI DataLink must be able to authenticate their identity with PI Data Archive and have access to PI Data Archive. Assign users the least-privileged access possible, such as read-only permissions. For authentication, OSIsoft recommends that you use PI mappings (available in PI Data Archive version 3.4.380 and later). You can also use PI trusts or PI password authentication. OSIsoft does not recommend PI password authentication as that method is less secure.

- **Point definitions**

  Points must be defined to give authorized users read access, and write access, if necessary.

For more information, consult the PI Data Archive documentation, including the PI Server topic "PI Data Archive security" in Live Library (https://livelibrary.osisoft.com).

Microsoft Excel add-in configuration

PI DataLink has three application add-ins to Microsoft Excel.

Name	Location	Type
PI DataLink	`..\PIPC\Excel\OSIsoft.PIDataLink.UI.vsto`	COM Add-in
PI DataLink (Legacy)	`..\PIPC\Excel\OSIsoft.PIDataLink.UI(Legacy).vsto`	COM Add-in
PI DataLink Notifications	`..\PIPC\Excel \OSIsoft.PIDataLink.Notifications2007.UI.vsto`	COM Add-in

The setup program always installs the PI DataLink and the PI DataLink Notifications add-ins. To have the setup program also install the PI DataLink (Legacy) add-in, modify the `setup.ini` file, following the example in the file.

To use all PI DataLink features, these application add-ins must be active. The setup program always activates the PI DataLink add-in.

If PI Notifications is installed on your computer, the setup program also activates the PI DataLink Notifications add-in. If not, you must activate that add-in after you install PI Notifications. When you install PI Notifications to support the PI DataLink Notifications add-in, OSIsoft recommends that you only install the PI Notifications Client feature.

The setup program installs and activates the PI DataLink (Legacy) add-in if you modified the `setup.ini` file to do so. The add-in must be active to use tag functions, Module Database objects, or trends.

In rare cases, Microsoft Excel might disable an add-in. You must enable an add-in before you can activate it.

Note:
To activate an application add-in, you must have administrator privileges on the computer. If you are not an administrator, right-click `Excel.exe` in Windows Explorer, and then click **Run as administrator** to run Microsoft Excel as an administrator.

See also

Tag functions

PI Module Database objects

Trends

Notifications

Topics in this section

- View add-in status
- Enable a disabled add-in
- Activate an inactive add-in

View add-in status

Check the status of an add-in to learn whether it is active, inactive, or disabled.

Procedure

1. Click the **File** tab and then click **Options**. (In Microsoft Excel 2007, click the **Microsoft Office Button**, and then click **Excel Options**.)
2. On the Excel Options window, click **Add-Ins**.
3. Search the list of add-ins to find the current status of an add-in. Each add-in will be listed under one of the following:
   - **Active Application Add-ins**
   - **Inactive Application Add-ins**
   - **Disabled Application Add-ins**

Enable a disabled add-in

If an add-in is disabled, you must enable the add-in before you can make it active.

Procedure

1. Click the **File** tab and then click **Options**. (In Microsoft Excel 2007, click the **Microsoft Office Button**, and then click **Excel Options**.)
2. On the Excel Options window, click **Add-Ins**.
3. From the **Manage** list, select **Disabled Items**, and then click **Go**.
4. Select the check box next to the add-in.
5. Click **Enable**.

Activate an inactive add-in

Activate an inactive add-in to make the add-in available in Microsoft Excel.



Note:
To activate an application add-in, you must have administrator privileges on the computer. If you are not an administrator, right-click `Excel.exe` in Windows Explorer, and then click **Run as administrator** to run Microsoft Excel as an administrator.

Procedure

1. Click the **File** tab and then click **Options**. (In Microsoft Excel 2007, click the **Microsoft Office Button**, and then click **Excel Options**.)
2. On the Excel Options window, click **Add-Ins**.
3. From the **Manage** list, select **Com Add-ins**, and then click **Go**.
4. Select the check box next to the add-in.
5. Click **OK**.

Security recommendations

Your PI System might store sensitive data that you want to protect. OSIsoft designs its products to minimize the risk of unauthorized access. Topics in this section describe the recommended practices to maximize data security when working with PI DataLink.

Topics in this section

- Excel file security
- Excel add-in security
- Account privileges
- Organizational security practices
- Strategies for logging

Excel file security

Excel workbooks can contain sensitive data that must be protected when residing on a client computer. The underlying security offered by the PI System is not applicable after retrieving the information into a worksheet. Therefore, OSIsoft recommends that you secure each workbook file. You can:

- Secure your Excel workbook files with passwords. Passwords will allow only authorized users to view or modify any data in the workbook. For more information, see the Microsoft Office article Protect a workbook (https://support.office.com/en-us/article/Protect-a-workbook-7e365a4d-3e89-4616-84ca-1931257c1517).
- Use the most secure practices for setting workbook passwords:
  - Set a password to open the workbook and a password to modify the workbook.
  - Use a mix of uppercase and lowercase letters, numbers, and symbols in your passwords.
  - Select the **Encrypt document properties** check box to prevent unauthorized users from viewing summary and custom file properties of the workbook.
- Enable Information Rights Management (IRM) on your Excel workbooks. IRM lets individuals and administrators specify workbook access permissions, which can help to prevent unauthorized people from printing, forwarding, or copying sensitive PI System data. After you restrict the permission for a file with IRM, the access and usage restrictions are enforced regardless of where the information is because the access permission is stored in the file itself. For more information, see the Microsoft Office article Information Rights Management in Office 2010 (http://office.microsoft.com/en-us/excel-help/information-rights-management-in-office-2010-HA010354260.aspx). If required, you can set an expiration date for the data in the Excel file. In the Microsoft Office article, see the procedure Set an expiration date for a file (http://office.microsoft.com/en-us/excel-help/information-rights-management-in-office-2010-HA010354260.aspx#BMexpire).
- Use Internet Protocol Security (IPSec) encryption on the link between computers that host PI DataLink and file stores that contain Excel workbooks if storing Excel workbooks on remote drives. For more information, see the Microsoft TechNet article What Is IPSec (https://technet.microsoft.com/library/cc776369.aspx).

- Apply secure file permissions on your Excel workbooks to ensure that unauthorized users do not have access to the contents of the files. For more information, see the Microsoft TechNet article File and Folder Permissions (http://technet.microsoft.com/en-us/library/bb727008.aspx).
- Apply a digital signature to the Excel workbook file. For more information, see the Microsoft Support article Description of digital signatures and code signing in workbooks in Excel (http://support.microsoft.com/kb/820738).

Excel add-in security

You use the Excel Trust Center to control the behavior of add-ins. To prevent unauthorized software from acting on your Microsoft Excel worksheets, OSIsoft recommends that you require add-ins to be signed by trusted publishers. Specifically, in the Trust Center, use the Add-ins page to do the following:

- Require application add-ins to be signed by trusted publishers.
- Disable notification for unsigned add-ins.

If you install PI DataLink outside of the standard `C:\Program Files` directory and you require add-ins to be signed by trusted publishers, then you must manually add the PI DataLink certificate to the store of trusted certificates. See Add PI DataLink certificate to store of trusted certificates.

For more information, see the Microsoft Office article View, manage, and install add-ins in Office programs (http://office.microsoft.com/en-us/excel-help/view-manage-and-install-add-ins-in-office-programs-HA010354315.aspx).

Add PI DataLink certificate to store of trusted certificates

If you configure Microsoft Excel to require add-ins to be signed by a trusted publisher and you install PI DataLink outside of the standard `C:\Program Files` directory, then you must manually add the PI DataLink certificate to the store of trusted certificates.

Procedure

1. Open a command window as administrator.
2. From a command prompt, navigate to the directory that contains the PI DataLink certificate (`pidlcert.cer`).

   You can find the certificate in the `Excel` subfolder of the installation folder (defined by the **`PIHOME`** environment variable).
3. Enter the following command:

   ```
   C:\Windows\System32\certutil.exe -addstore TrustedPublisher
   pidlcert.cer
   ```

Account privileges

To avoid damage from malicious users, assign users the least-privileged access possible, such as read-only permissions.

Organizational security practices

To prevent attackers from gaining access to the system, OSIsoft recommends that your organization adopt thorough security practices:

- Physically secure your computers. Attackers who gain access to computers that run PI DataLink could gain access to all PI System data retrieved and stored in Excel files on that computer.
- Restrict computer access to authorized employees and guests. Procedures should prevent lost or stolen computers from accessing the company network.
- Apply the most recent security updates to all computers. Subscribe to the Security Notification service to stay informed about new security updates for operating systems and other components. For more information, see the Microsoft TechNet article Microsoft Technical Security Notifications (http://technet.microsoft.com/en-us/security/dd252948).
- Protect against unauthorized administrators. Unauthorized administrators can launch numerous attacks. For example, they might do the following:
  - Install and run malicious software.
  - Configure remote access to take remote control of a computer.
- Audit all administrative activity and routinely review the audit logs. Require all administrators to undergo a background check before hiring and periodic rechecks as a condition of employment.
- Provide multiple layers of security. Relying solely on perimeter security, such as firewalls, increases risks if the firewall is compromised. You can provide another layer of defense by designing your network to isolate less secure clients from more secure clients. Personal firewalls on client computers add an additional layer. Enhance security further with intrusion-detection software and host-based intrusion-detection software that helps filter out suspicious activity; running antivirus software is essential. Finally, educating users about computer security is a critical part of a network security strategy.
- Create and maintain secure baselines for all systems. Specify each baseline with a detailed description of how to configure and administer the computer. The description must include all relevant configuration settings for a secure computer. To create a secure baseline, use the most secure operating system possible. More recent operating systems are more likely to be designed with security in mind and to contain features that make the operating system secure. Keep the operating system and applications up-to-date by applying security updates as they become available.
- Use strong passwords or passphrases. Never use blank passwords. For more information about password concepts, see the Microsoft TechNet article Account Policies (https://technet.microsoft.com/en-us/library/dd349793(v=ws.10).aspx).
- Control access to PI DataLink Excel files. Implement access-control procedures to ensure that all Excel files are stored securely and that attackers cannot modify the file contents or search for information within the file.

Strategies for logging

Organizations need to develop an appropriate strategy for logging. You can use log files for:

- Tracking. You might use log files to provide statistical data about transactions.
- Verification. You might use log files to provide a full record of transactions to recreate the transactions.
- Proving the validity of a transaction.

PI DataLink sends all data requests through the PI AF SDK. Though PI DataLink maintains no separate log files, you can use PI AF SDK and PI Data Archive log files to get information about PI DataLink transactions. Consult the PI AF SDK and PI Data Archive documentation for more information.

About this document

The *PI DataLink User Guide* provides a detailed description of product features and a complete reference to PI DataLink functions. The content of the PDF and Help versions of the guide is identical.

This document assumes that you have knowledge about PI System concepts. Consult the PI Data Archive and PI AF documentation for more information about those products. Knowledge of PI Data Archive and PI AF will help you understand terms used in PI DataLink.

You might also find the training materials helpful. These include the exercises that OSIsoft uses in PI DataLink training courses.

You can download the training materials and documentation for other OSIsoft products from the OSIsoft Tech Support Downloads page (https://techsupport.osisoft.com/Downloads/All-Downloads/). You can also view documentation in Live Library (https://livelibrary.osisoft.com).

Terminology change

OSIsoft is revising its terminology to reflect the growth of the PI System from its original single-server architecture. In the revised terminology, PI Data Archive refers to the component that stores time-series data (formerly called PI Server), and PI Server refers to both PI Data Archive and PI Asset Framework. This document uses the revised terminology.

Basics

When you use PI DataLink, you define PI DataLink functions that extract PI System data into function arrays in an Excel worksheet. A function array is a cluster of cells that contain the output from a single PI DataLink function. The following sections introduce basic PI DataLink concepts and features. Familiarize yourself with these sections before using PI DataLink to build a worksheet and retrieve PI System data.

These sections describe:

- User interface features
- Core features for working with PI DataLink
- Different approaches to build a PI DataLink worksheet, depending on your goals, needs, and resources

Videos

To learn about PI DataLink, you can also watch the PI DataLink playlist on the OSIsoft Learning YouTube channel:

https://www.youtube.com/playlist?list=PLMcG1Hs2Jbcs_qbRKOvGo9T5xWc0oBlF_

Topics in this section

- User interface
- Overview of PI DataLink functions
- Searches
- PI DataLink settings
- Manage connections to servers

User interface

PI DataLink adds specific menu commands, windows, and task panes to Microsoft Excel.

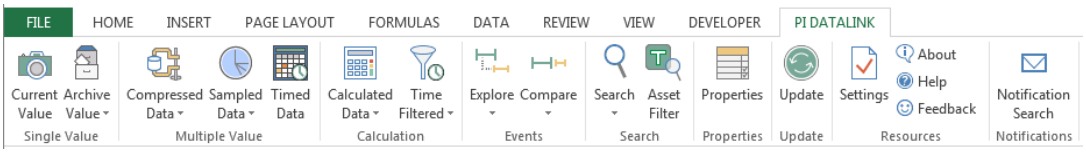
The following sections describe core elements of the PI DataLink interface.

Topics in this section

- PI DataLink tab
- Function task panes
- Right-click menu

PI DataLink tab

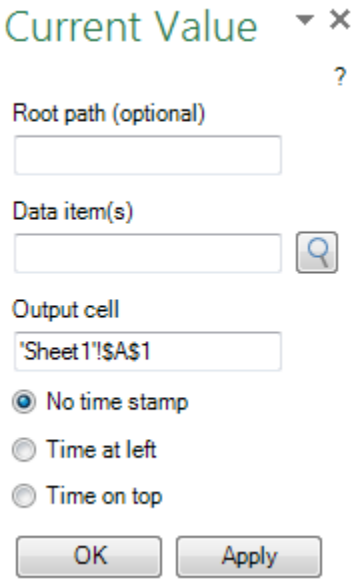
PI DataLink inserts the **PI DataLink** tab in the Microsoft Excel ribbon.



- Click the **PI DataLink** tab to access the PI DataLink commands.
- Click a command to open the corresponding task pane or window.
- Place the cursor over a command to display a descriptive tooltip.

Function task panes

Use function task panes to define PI DataLink functions.



A task pane is a panel of controls that you can move and dock. You can continue to work on a worksheet while a task pane is open.

To open a function task pane:

- Click the desired output cell, and then click a function command on the **PI DataLink** tab to add a function.
- Click a cell in an existing function array to open the corresponding task pane and edit the function inputs.

  Note:
  You can turn off automatic display of task panes if you prefer. See Manage PI DataLink settings from Excel.

- Right-click a function-array cell, and then click the function name to manually open the task pane.

In an open function task pane:

- Enter or change input values, and then:

  - Click **OK** to save the input values, write the resulting function array, and close the task pane.
  - Click **Apply** to save the input values and write the resulting function array without closing the task pane.
- Click the arrow button to select the **Move**, **Size**, or **Close** commands.
- Drag the title bar to undock the task pane.
- Double-click the title bar to dock the task pane.
- Place your cursor at the edge and drag to resize the pane.

Right-click menu

PI DataLink adds several commands to the standard Microsoft Excel right-click menu. You can use these commands to manage function arrays in a worksheet.

To open the right-click menu with the PI DataLink commands, right-click anywhere in a PI DataLink function array.

PI DataLink adds the following commands to the right-click menu:

- **Select DataLink Function**

  Selects the entire function array.

  You should select an array before you copy, cut, or paste it to a new worksheet location.

- **Recalculate (Resize) Function**

  Rewrites the entire function array: PI DataLink retrieves new values from PI Data Archive or PI AF and automatically resizes the array to fit the returned data.

- **Function Name**

  Opens the corresponding function task pane and shows inputs for the function array.

Trends offer an alternative right-click menu.

See also

Trend right-click menu

Function task panes

Overview of PI DataLink functions

PI DataLink functions extract PI System data into Excel. You can use a function task pane to easily enter the inputs that define the function. Alternatively, as you become more experienced you might enter a function directly into the Excel formula bar.

The following sections describe:

- Common features in PI DataLink function task panes
- How real-time data is acquired and presented
- How PI DataLink functions can be used within a worksheet

See also

Function task panes

Manual function entry

Topics in this section

- Data items
- Input entry
- Time inputs
- Appended data
- Display formats
- Interpolated values

Data items

PI DataLink functions return data about specified PI System data items, either PI points or PI AF attributes. Functions might return recorded values from a database or computed values based on specified criteria or a specified expression.

When you define a function, you specify the paths to data items with the **Data item**, **Expression**, and **Filter expression** fields along with the optional **Root path** field. You can specify:

- Fully qualified paths in the **Data item**, **Expression**, or **Filter expression** fields. A fully qualified path begins with two backslashes (\\) and evaluates to either a PI point or a PI AF attribute.
- Partial paths in the **Data item**, **Expression**, or **Filter expression** fields and the common base path in the **Root path** field. PI point names or PI AF attribute names are examples of partial paths. PI DataLink combines the common base path with the partial path to set the full path that evaluates to either a PI point or PI AF attribute.

PI DataLink requires a full path to find the data item. To find a PI point, PI DataLink must know the PI Data Archive server to search and the point name. To find a PI AF attribute, PI DataLink must know the PI AF server, the database, the element, and any subelements or parent attributes. Use a pipe (|) to separate attributes from elements or parent attributes.

You can leave the **Root path** field blank if the **Data item**, **Expression**, and **Filter expression** fields contain a fully qualified path or a PI point on the default PI Data Archive server.

If specified, the **Root path** field indicates the common path to the specified data items.

Type of data item	Content of root-path field
PI point	PI Data Archive server that stores the point or a blank to indicate the default PI Data Archive server. Valid entries include: • `MyPIDataArchiveServer` • `\\MyPIDataArchiveServer`

Type of data item	Content of root-path field
PI AF attribute	PI AF server and database along with any elements, subelements, and parent attributes not specified in **Data item**. Valid entries include: • `\\MyPIAFServer\MyDatabase` • `\\MyPIAFServer\MyDatabase\MyElement` • `\\MyPIAFServer\MyDatabase\MyElement\MySubElement` • `\\MyPIAFServer\MyDatabase\MyElement|MyParentAttribute` • `\\MyPIAFServer\MyDatabase\MyElement|MyParentAttribute1|MyParentAttribute2` **Note:** The PI AF server and database must be in the same field. You cannot specify the PI AF server in the **Root path** field and the database in the **Data item** field.

See also

Expressions

Input entry

Labeled inputs on function task panes accept appropriate values for the function. For many inputs, you can enter either a value or a reference to a worksheet cell that contains the value. Some inputs have a default value shown when the task pane opens. Inputs marked **(optional)** are optional, and do not require a value.

For inputs with edit fields , you can:

- Enter text directly in the edit field, such as a PI AF attribute name or the address of an output cell.
- Click the edit field, and then click a worksheet cell or range that contains appropriate values, such as PI AF attribute names, time stamps, or output cell locations.
- Click the edit field to open a list of valid values that you can select from (only available for the **Root path** and **Database** fields).
- Click  to open the Search tool, and then select data items found in a search of a connected PI Data Archive server or PI AF server.

For inputs with lists , you can:

- Select a choice from the list, such as a calculation or a sampling method.
- Click  and then click a worksheet cell or range that contains appropriate values, such as a mode, time unit, boundary type, or property.

Note:
In edit fields, enter strings without any quotes. However, in worksheet cells, enter strings with a leading quote (') to force Excel to interpret the contents as a string.

For example, to specify a PI point in the **Data item(s)** field, you can:

- Enter the string for the point name.
- Click  to open the Search tool, and search the PI Data Archive server for the point.
- Enter a reference to a worksheet cell that contains the point name:
  a. Click the **Data item(s)** field.
  b. Click the cell on the worksheet.

     PI DataLink automatically enters the cell reference into the edit field.

Time inputs

Many PI DataLink functions require **Start time** and **End time** inputs to retrieve an array of values over a specific time period. Other PI DataLink functions require a **Time stamp** input to retrieve values at a specific time. Follow these guidelines when specifying time inputs:

- Enter a valid PI time expression. Expressions can include fixed times, reference-time abbreviations, and time offsets. Use fixed times, such as `10-Dec-16 19:12` to always retrieve data from a certain date, and use reference-time abbreviations and time offsets, such as `t` and `-3h`, to retrieve data relative to the current time.
- A time offset entered alone in an **End time** input specifies a time relative to the **Start time** input.
- A time offset entered alone in a **Start time** or **Time stamp** input specifies a time relative to the current time.
- If the start time is more recent than the end time, PI DataLink displays results in reverse chronological order.
- Precede time expressions entered in worksheet cells with a single quote to indicate a string (for example, `'10-Dec-99 19:12` or `'-3h`).
- Cell references may also use the absolute Excel time format (such as `39299.6146`, equivalent to `8/5/2007 2:45:00 PM`). Excel stores time stamps in this format, which represents the cumulative number of days since 1900. Excel can display the same time stamps using any date-time format assigned to the cell.
- Some time entries, such as `9:45`, can represent both a valid time and a valid range of worksheet rows. In a task pane field, precede such entries with a single quote, such as `'9:45`, to force PI DataLink to interpret as a time.

Some PI DataLink functions require a **Time interval** input, which you specify with a single value:

- Enter a value and time unit, such as a `1d` or `30m`; never include a reference time. For example, to specify an interval of 32 minutes, enter `32m` or reference a cell containing that string.
- To enter intervals in terms of frequency, convert the frequency to equivalent seconds. For example, enter a frequency of 25 Hz as a `0.04s` interval (=1/25 of a second).



Note:
PI DataLink supports only the default 1900 date system supported by Excel. PI DataLink does not support Excel's 1904 date system, and returns incorrect time stamps if this system is used.

See also

Time-stamp specification

Time-interval specification

Appended data

PI DataLink can append information about the values retrieved. This appended data can provide context to retrieved values. Appended data can include:

- Time stamps that show when values were recorded
- Time stamps that show the start and end times of an interval
- Time stamps that show when the minimum and maximum values occurred
- The percentage of good values over a sampling interval
- Value attributes
- Manually entered annotations
- Source server names

PI DataLink displays the specified appended data in the columns (or rows) adjacent to the primary values that the function returns:

- Time data are displayed in columns to the left of (or rows above) primary values.
- Other related data are displayed in columns to the right of (or rows below) primary values.

Display formats

Use the Settings window to specify the time and number formats that PI DataLink uses to format data in function arrays. There are two settings:

- **Number format**

  The format for numbers in function output. The default setting, `General`, formats numbers (and all non-time stamp data) to match the formatting of the **General** category in the Excel Format Cells window.

- **Time format**

  The format for time stamps in function output. The default setting, `dd-mmm-yy hh:mm:ss`, matches the standard PI time stamp format. You can add `.000` to the end of the string (`dd-mmm-yy hh:mm:ss.000`) to display subsecond time stamps. Note that Excel does not support microsecond precision formats.

You can customize these format strings using any valid Excel format codes from the Format Cells window in Excel.

For details on the Settings window, see Manage PI DataLink settings from Excel.

You can also apply individual number and time formats to any worksheet cell, including those containing PI DataLink functions, with the Format Cells window. See your Excel documentation for more information on formatting numbers and times. PI DataLink overwrites or applies individual cell formats as follows:

- When writing a function array after you click **OK** or **Apply** on a task pane, PI DataLink overwrites any individual number or time formats applied to a cell in the function array with the settings from the Settings window.
- When writing a function array after you right-click a function array and then click **Recalculate (Resize) function**, PI DataLink finds the top-left cell in the array with a number format and applies that format, either an individual format or the format from the Settings window, to all array cells with number formatting. Similarly, PI DataLink finds the top-left cell in the array with a time format and applies that format, either an individual format or the format from the Settings window, to all array cells with time formatting.

Interpolated values

Many PI DataLink functions can return interpolated values, useful for PI points associated with time stamps. For example, you might request that the Archive Value function return an interpolated value at a particular time stamp rather than the last recorded value that precedes the time stamp. The interpolated value depends on the time stamps of the recorded values and possibly on the type of PI point:

- For time stamps before the first recorded value, the function returns either `Pt Created` or `No Data`.
- For time stamps between two recorded values, the function determines the value at the time stamp using linear interpolation between the recorded values. For points that store discrete values, such as digital state points or step points, the function returns the last recorded value that precedes the time stamp.
- For time stamps after the last recorded value, the returned value depends on the point type:
  - For historical PI points, the function returns the most recent value.
  - For future PI points, the function returns `No Data`.

Searches

PI DataLink offers two ways for you to search for data items:

- **Search tool**

  With the Search tool, you can find PI points or PI AF attributes, either by searching for matching text or by exploring a PI Data Archive or a PI AF database. Depending on how you open the tool, it inserts the found points or attributes into your worksheet or into a function task pane.

- **Asset Filter Search function**

  With the Asset Filter Search function, you can find PI AF elements that match a criteria, and filter those elements based on attribute values. The function can return the filtered elements or selected attributes of the filtered elements. The function can paste the filtered assets into your worksheet as values or as a function array.

Topics in this section

- Search for data items
- Search for assets by filtering

Search for data items

Use the Search tool to search any specified PI Data Archive server or PI AF server for data items. You can insert data items into your worksheet and later reference these data items in PI DataLink functions. You can also insert a data item directly into a function task pane.

Before you start

Connect to any PI Data Archive server or PI AF server that you want to search. See Manage connections to servers.

Procedure

1. Open the Search tool:
   - To insert one or more items into a worksheet, select the upper leftmost cell of the range in the worksheet where you want to insert the data items, and then on the **PI DataLink** tab, in the **Search** group, click **Search**.
   - To insert one or more items into a function task pane, click the  button next to the **Data item(s)** field.
2. Set the search scope, shown in the path at the top.

   Upon first use, the tool starts at the Home node, which shows all the PI Data Archive servers (indicated by ) and PI AF servers (indicated by ) listed in Connection Manager. You must limit the search to a single PI Data Archive server or single PI AF server, and can limit the search further to a single database on a PI AF server, and then to specific elements and parent attributes.

   Upon subsequent uses, the tool starts each session with the search scope set to the last PI Data Archive server, PI AF server, or PI AF database that you searched.

   You can:

   - Use the browse pane to limit the search
   - Use the scope path to limit the search

   If you set the search scope to an element or attribute, the results pane lists that element's or attribute's immediate child attributes.
3. As necessary, search for data items in the scope to list in the results pane.
   a. In the field at the top of the tool, type text that identifies data items you want to find in the selected scope.

      You can use wildcard characters to augment your search. For example:

      - Type `sinusoid` to find all data items named `sinusoid`.
      - Type `sinusoid*` to find any data items that start with "sinusoid" such as `sinusoid` or `sinusoidu`.
      - Type `*u` to find any data items that end with "u" such as `sinusoidu`.
      - Type `*` to find all data items.

   b. If your search scope is a PI Data Archive server, set the lists and fields under **Filters** to specify any additional criteria the retrieved PI points must match.

The **Quick Filters** list at the upper-right corner of the pane contains predefined common searches. You can select a predefined search, and the Search tool automatically populates the lists and fields for that search.

The pane has six lists that contain built-in and system-assigned point attributes, attributes from the base and classic point classes, and virtual attributes for the point value, time stamp, and status (**Is good**). Select an attribute from a list and specify criteria for that attribute. You can enter wildcard characters; the search does not add any implicit wildcard characters.

The final list contains point types. Select the type of stored value you want to find.

For example, select **Descriptor** and then enter `*vapor*` to return only PI points that contain the word *vapor* anywhere in the **`descriptor`** point attribute

For more information about PI point attributes, see the PI Server topic "Point classes and attributes" in Live Library (https://livelibrary.osisoft.com).

c. Click **Search**  to initiate the search.

The tool searches within the specified scope for data items that match the text you typed and returns the found data items in the results pane. The tool searches the entire hierarchy below the search scope. (In contrast, when you browse the hierarchy, the results pane only shows the immediate child attributes of the search scope.) The tool finds:

- PI points with names that match.
- PI AF attributes with names that match.
- PI AF attributes with descriptions that match (if you are using PI AF Server 2015 or later)
- PI AF attributes that have parent elements with names, descriptions, categories, or templates that match.



Note:
Searches of PI Data Archive return no more than 100,000 PI points. To be certain that you see all results, constrain your search to return fewer PI points.

4. If desired, change columns displayed in the results pane:
   - Right-click the results pane, and then click a column name to add it or clear it from the displayed columns.
   - Drag column headers to change the order of the displayed columns.
5. If desired, move the **Data item length** slider to split the path of the data item between the **Root path** and **Data item** columns:
   - Select **Full path** to specify a full path in the **Data item** column.
   - Select **Name only** to specify only the attribute or point name in the **Data item** column, with the rest of the path in the **Root path** column.
   - Select intermediate positions for other content splits between the columns.

   The content of these columns determines the content added to the task-pane fields or the worksheet columns.
6. If inserting PI AF attributes into the worksheet and you split the data-item content, specify how to insert the **Root path** content into the worksheet:

- Select **Drop-down list** to insert a drop-down list of paths (from the **Root path** column) followed by the data items (from the **Data item** column) into the designated worksheet cells.

  If you reference the inserted drop-down list and data items in a PI DataLink function, the worksheet will dynamically update the retrieved values when you select a different path in the list.

  Note:
  PI DataLink inserts the list of root paths in column ALL of your worksheet. If that column contains data, PI DataLink inserts the paths in the next available column to the right.

- Select **Column or row** to insert the content from the **Root path** and **Data item** columns into the designated worksheet cells.

  In this case, PI DataLink always inserts the **Root path** content in the first worksheet column and the **Data item** content in the second worksheet column.

7. Select the items that you want to insert and click **OK**.

See also

Create an asset-relative display

Use the browse pane to limit the search

The browse pane is on the left side of the Search tool. The browse pane shows what the current search scope includes (the top of the window shows the corresponding scope path). For scopes in a PI AF server, the browse pane only shows databases, elements, or attributes that contain attributes in the hierarchy beneath them. Therefore, the browse pane will never list elements or attributes with no child attributes.

You can use the browse pane to limit the scope of a search (and set the scope path). For example, you can limit a search to a particular PI AF server or a particular database on that server, or a particular element within that database. As you navigate a PI AF server hierarchy in the browse pane, the results pane updates to show any attributes directly under the currently selected scope path.

Procedure

- In the browse pane:
  - Click a server to limit the search to that server.

    The tool updates the scope path at the top of the window to list the selected server and updates the browse pane. If you clicked a PI AF server (indicated by), the browse pane shows all the databases on that server. If you clicked a PI Data Archive server (indicated by), the browse pane shows filters that you can use to limit retrieved PI points based on attribute values.

  - Click a database (indicated by) to limit the search to that database.

    The tool updates the browse pane to show all the top-level elements in the selected database, and updates the scope path at the top of the window to list the selected database.

  - Click an element (indicated by) to limit the search to that element.

The tool updates the browse pane to show all the parent elements and parent attributes under the selected element, updates the scope path at the top of the window to list the selected element, and lists any attributes under the selected element in the results pane.

Note that the browse pane only shows attributes that are parent attributes, whereas the results pane shows both parent and non-parent attributes under the selected element.

- Click an attribute (indicated by) to limit the search to that attribute.

  The tool updates the browse pane to show any parent attributes under the selected attribute, updates the scope path at the top of the window to list the selected attribute, and lists any attributes under the selected attribute in the results pane.

Use the scope path to limit the search

The scope path is at the top of the Search tool.



The scope path shows where the Search tool looks for data items. You can use the scope path to limit the scope of a search. For example, you can limit a search to a particular PI AF server or a particular database on that server, or a particular element within that database. As you navigate a PI AF server hierarchy in the scope path, the results pane updates to show any attributes directly under the currently selected scope path.

Procedure

- In the scope path:
  - Click **Home** to navigate to the Home node. At the Home node, the browse pane shows all the PI Data Archive servers and PI AF servers listed in Connection Manager. You cannot search at the Home node. The broadest scope for searching is either a single PI Data Archive server or single PI AF server.
  - Click the arrow next to **Home**, and then click a particular server to reset the scope to that server.
  - Click the server to reset the scope to that entire server.
  - Click the arrow next to a PI AF server, and then click a particular database to reset the scope to that database.
  - Click the database to reset the scope to the entire database.
  - Click the arrow next to the database, and then click a particular element to reset the scope to that element.
  - Click an element to reset the scope to the entire element.
  - Click the arrow next to an element, and then click a subelement or attribute to reset the scope to that subelement or attribute.
  - Click a parent attribute to reset the scope to all its subattributes.
  - Click the arrow next to a parent attribute and select a particular subattribute to reset the scope to that subattribute.

Search for assets by filtering

Use the Asset Filter Search function to search a PI AF database for elements and to filter the returned elements by attribute value. You can choose to output either the filtered elements or selected attributes of the filtered elements. You can also choose whether to paste the output into the worksheet as static values or as a function array, which can update automatically.

Procedure

1. Select the upper leftmost cell of the range in the worksheet where you want to insert retrieved assets.
2. On the **PI DataLink** tab, in the **Search** group, click **Asset Filter** to open the Asset Filter Search task pane.
3. In the **Root path** field, enter the common path to the elements you want to find.

   The common path must contain the server and database, and can contain any parent elements. Specify in the format `\\ServerName\DatabaseName\ParentElementName`.

   For example, to find elements at the root level of the database `MyDatabase` on the server `MyPIAFServer`, enter `\\MyPIAFServer\MyDatabase`; to find elements under the `Boilers` element in that same database, enter `\\MyPIAFServer\MyDatabase\Boilers`.
4. Specify the PI AF elements to retrieve:
   a. From the **Element template** list, select the template of retrieved elements.

      You must select a template to filter elements based on attribute values. Note that if you select a base template, the function also retrieves elements from derived templates.
   b. In the **Element name** field, enter the name of elements to retrieve. Use wildcard characters to specify part of the name.
   c. From the **Element category** list, select the category of elements to retrieve.
   d. In the **Element description** field, enter text found in the description of all elements to retrieve. Use wildcard characters to specify part of the description.
   e. Select the **Limit to root level** check box to only retrieve elements at the level specified in the **Root path** field. Clear the check box to retrieve child elements as well.
   f. Optional: In the **Attribute value filters** table, specify conditions for the attribute values of elements to retrieve.

      You must select an element template before specifying any attribute-value condition. You can only filter using values of attributes defined in the selected element template or in a base template of the selected element template.

      You can specify up to five conditions. For each condition, set three fields:

      - From the **Attribute** list, select an attribute found in elements based on the selected element template.
      - From the **Operator** list, select the relational operator, such as **=**, **<**, or **>**. For attributes that store string, Boolean, or enumerated values, the only valid operators are **=** and **<>**.
      - In the **Value** field, enter the value to filter for. You can use wildcard characters for string attributes.

For example, to retrieve elements that have the `Manufacturer` attribute that starts with `ABC` and a `ZipCode` attribute between and including 94102 and 94188, enter three conditions:

Manufacturer = `ABC*`

ZipCode >= `94102`

ZipCode <= `94188`

For best performance, limit attributes to those that have values stored in the PI AF database (that is, omit attributes with data references). If you specify an attribute with a data reference, the function uses the preference setting for maximum filter search count to limit the number of elements searched for matching attribute values. See Manage PI DataLink settings from Excel.

5. Specify the worksheet output:
   a. From the **Attributes to display** list, select the attributes to include and set the order to display the attributes.

      If you select no attributes, the Asset Filter Search function only returns the matching elements. If you select at least one attribute, the function returns the selected attributes for each element.

      By default, the list includes the attributes in the selected element template. You can:

      - Select the **Select all** check box to include all the listed attributes.
      - Select a check box to include an attribute, or clear a check box to exclude an attribute.
      - Type the name of an attribute next to the blank check box at the bottom of the list.
      - Select an attribute and click  to move the attribute up in the list of displayed attributes.
      - Select an attribute and click  to move the attribute down in the list of displayed attributes.
      - Select an attribute and click  to remove the attribute from the list of displayed attributes.

   b. Indicate how to paste the matching elements or attributes into the worksheet:

      - Click **Column** to insert the full path to the elements or attributes into the designated worksheet cells.
      - Click **Drop-down list** to insert a drop-down list that contains the paths to the attributes (that is, the unique server, database, and parent elements) followed by the selected attributes into the designated worksheet cells.

        Only select **Drop-down list** if you have selected at least one attribute.

        From another PI DataLink function, you can reference the inserted drop-down list from a **Root path** field and the attributes from a **Data item** field to create an asset-relative display: the worksheet will dynamically update the retrieved values when you select a different path in the list. See Asset-relative displays.

   c. Indicate the output format:

- Click **Function array** to paste a function array. This is the output format of other PI DataLink functions. With a function array, you can easily update the inputs from the task pane and recalculate the output.
- Click **Values** to paste the output as values. You can easily copy values for use elsewhere.



Tip:
Function arrays are particularly useful when the function results change frequently. However, function-array recalculation, which occurs each time you open a worksheet, can be slow. By contrast, values are useful when you do not expect results to change and do not want to wait for function-array recalculation.

d. Verify that the **Output cell** field contains the upper leftmost cell of the range in the worksheet where you want to insert returned assets.

6. Click **OK** to insert the matching elements or attributes into the worksheet and close the task pane.

PI DataLink settings

Settings control many PI DataLink behaviors, including the time and number formats, the time zones returned, the strings that functions return, when the task pane opens, and how search results are pasted. Each person on a computer has individually saved settings. Users can view and change these settings directly from Excel.

PI DataLink retrieves the settings from the `OSIsoft.PIDataLink.xml` file, saved in each user's `AppData` directory:

`%UserProfile%\AppData\Local\OSIsoft,_Inc\PIDataLink`

Administrators can change the settings for all users on a particular computer or delete the settings for all users on a particular computer.

Topics in this section

- Manage PI DataLink settings from Excel
- Time-zone-setting limitations
- Change PI DataLink settings for all users on a computer
- Delete PI DataLink settings for all users on a computer

Manage PI DataLink settings from Excel

Use the Settings window to specify global preferences and default output formatting for PI DataLink functions. These settings apply to a particular user on a particular computer. From this window, you can also clear the cache of configuration data for PI points and non-time-based data from PI AF.

Procedure

1. On the **PI DataLink** tab, in the **Resources** group, click **Settings**.
2. To clear the PI DataLink cache manually, click **Clear Cache**.

By default, PI DataLink caches configuration data for PI points and non-time-based data from PI AF (that is, data other than PI point data references and events). This cache improves performance. Before calculating a function, PI DataLink checks when the cache was last cleared; if the cache has not been cleared within the last six hours, PI DataLink automatically clears the cache. To clear the cache and obtain updated data sooner, clear the cache manually.

3. To update settings, enter the preferred setting and click **OK**.

Setting	Description
Copy PI Data Archive name (Legacy add-in only)	Select to paste the name of the PI Data Archive data source into an adjacent worksheet cell when you insert PI point names from tag functions into a worksheet.
Display #N/A instead of blanks	Select to show `#N/A` (not applicable) rather than blanks in cells without values when a recalculation returns fewer values than a function array can show. This feature is particularly useful if you use the Excel charting package to plot function results.
Locale independent	Select to interpret input time strings according to PI time format rules, regardless of the locale settings of the client workstation. PI time assumes all strings are English and use the date-time format `dd-mmm-yyyy hh:mm:ss`. Clear the check box to parse date-time formats according to regional settings on the client workstation, falling back to PI time format rules only if necessary.
Disable automatic task pane display on click	Select to turn off the automatic opening of the function task pane when you click a function cell.
Disable "Resize to show all values" message	Select to display no warning message when a recalculation returns more values than a function array can show.
Client time zone	Select to interpret the input time stamps and display output time stamps in the client-workstation time zone. Some functions will display certain time stamps in the PI Data Archive server time zone. See Time-zone-setting limitations for these exceptions.
PI Data Archive time zone	Select to interpret the input time stamps and display output time stamps in the PI Data Archive server time zone. This setting only applies to data items or expressions that contain either a PI point or a PI AF attribute that is a PI point data reference. If the data item or expression contains a PI AF attribute that is not a PI point data reference, PI DataLink interprets the input and output time stamps as being in the client-workstation time zone. This option is relevant only if a PI Data Archive server has a time-zone setting different from the client workstation.
UTC time zone	Select to interpret the input time stamps and display output time stamps in coordinated universal time (UTC). Some functions do not support this setting. See Time-zone-setting limitations for details about these exceptions.
In a row	Select to paste multiple results from a search into a row of values in the worksheet.
In a column	Select to paste multiple results from a search into a column of values in the worksheet. Default value.

Setting	Description

Number format	Enter the format for numbers in function output. The format string may be any valid number format code from the Excel Format window (see Display formats).
	
	During installation, PI DataLink enters the default number format from Excel in this field, unless you have set a different format preference previously in PI DataLink on this computer. If your version of Excel runs a different locale, this format includes correct syntax to reflect the locale. For example:
	
	`35.03`
	
	would appear as
	
	`35,03`
	
	in French Excel.

Time format	Enter the format for time stamps in function output. The time format string may be any valid date-time format code from the Excel Format window.
	
	During installation, PI DataLink enters the standard PI time stamp format in this field, unless you have set a different format preference previously in PI DataLink on this computer. If your version of Excel runs a different locale, this format includes correct syntax to reflect the locale. For example:
	
	`dd-mmm-yy hh:mm:ss`
	
	would appear as
	
	`jj-mmm-aa hh:mm:ss`
	
	in French Excel.

Maximum event count	Enter the maximum number of events that the Explore Events and Compare Events functions return to the preview and to the worksheet.
Maximum filter search count	Enter the maximum number of elements that the Asset Filter Search function returns to the worksheet, except when you specify an attribute-value filter for an attribute with a data reference. In this case, enter the total number of elements among which you want to search for an attribute with a data reference; note that if you set this number too low, the function might return fewer results than expected.
Calculate (F9)	Select to recalculate all volatile functions (and any functions that reference them) during each recalculation that the Automatic Update feature initiates. The Current Value function is the only volatile PI DataLink function.
Full calculate (Ctrl+Alt+Shift +F9)	Select to recalculate all functions, regardless of volatility, during each recalculation that the Automatic Update feature initiates.
Interval (seconds)	Enter the number of seconds between each recalculation that the Automatic Update feature initiates. The minimum value is five seconds. Enter `0` to have PI DataLink compute an automatic interval based on the duration of previous calculation times.

Time-zone-setting limitations

Certain limitations apply to the time-zone setting:

- The Notifications Search function does not presently support the UTC time-zone setting. The Notifications Search function always uses the client time zone.
- If an annotation contains a time stamp, the Compressed Data function always displays that time stamp in the PI Data Archive server time zone.
- The Properties function always displays values of PI point attributes that contain time stamps (such as creation date and change date) in the PI Data Archive server time zone.
- Trends created with the PI DataLink (Legacy) add-in always display data in the PI Data Archive server time zone.
- The PI DataLink module database functions (Alias to Tag function and Property to Value function) do not support the UTC time-zone setting. These functions use the client time zone when the UTC time zone is selected.

Change PI DataLink settings for all users on a computer

Administrators can use a batch file to change the PI DataLink settings for all users on a computer.

Procedure

1. Create the `OSIsoft.PIDataLink.xml` file that contains the preferred settings for all users.

   You might copy the file from a user account folder (`%UserProfile%\AppData\Local\OSIsoft,_Inc\PIDataLink`), or you can create one starting with the following default file:

```
<Settings xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <CTPDockWidth>200</CTPDockWidth>
  <CTPFloatLeft>-1</CTPFloatLeft>
  <CTPFloatTop>-1</CTPFloatTop>
  <CTPFloatWidth>200</CTPFloatWidth>
  <CTPFloatHeight>-1</CTPFloatHeight>
  <CTPDockPosition>right</CTPDockPosition>
  <CopyItemsInRow>0</CopyItemsInRow>
  <CopyServerName>0</CopyServerName>
  <UseServerTime>0</UseServerTime>
  <DisplayEndTime>0</DisplayEndTime>
  <DisplayNA>0</DisplayNA>
  <LocaleIndependent>0</LocaleIndependent>
  <DisableAutoReinit>0</DisableAutoReinit>
  <DisableResizeMessage>0</DisableResizeMessage>
  <NFormat>General</NFormat>
  <TFormat>dd-mmm-yy hh:mm:ss</TFormat>
  <AutoUpdateCalculateMode>0</AutoUpdateCalculateMode>
  <AutoUpdateInterval>0</AutoUpdateInterval>
  <LastSearchFullPath>false</LastSearchFullPath>
  <LastSearchPath> </LastSearchPath>
  <LastEFDatabase> </LastEFDatabase>
  <MaxEFCount>1000</MaxEFCount>
  <MaxAFSearchCount>10000</MaxAFSearchCount>
</Settings>
```

2. Create a batch file to distribute the preferred settings file to all users.

For example, you might create a batch file called `deploySettings.bat`:

```
@echo off

IF NOT EXIST "%CD%\OSIsoft.PIDataLink.xml" (
ECHO OSIsoft.PIDataLink.xml file not found in this directory.
EXIT /B 2
)

SET ProfileBase=%SystemDrive%\Users
SET AppDir=APPDATA\Local
SET DefaultUsername=Default

ECHO Deploying XML settings to all users.
for /f "tokens=*" %%a in ('dir /b /ad-h "%ProfileBase%"') do if 1==1 (

REM No need to copy to Public and All Users folders
ECHO %%a | findstr /i "all.users public" >nul 2> nul
if errorlevel 1 (
mkdir "%ProfileBase%\%%a\%AppDir%\OSIsoft,_Inc"
mkdir "%ProfileBase%\%%a\%AppDir%\OSIsoft,_Inc\PIDataLink"
xcopy /f /y "%CD%\OSIsoft.PIDataLink.xml" "%ProfileBase%\%%a\%AppDir%
\OSIsoft,_Inc\PIDataLink\"
)

)

REM Apply to default user
mkdir "%ProfileBase%\%DefaultUsername%\%AppDir%\OSIsoft,_Inc"
mkdir "%ProfileBase%\%DefaultUsername%\%AppDir%\OSIsoft,_Inc\PIDataLink"
xcopy /f /y "%CD%\OSIsoft.PIDataLink.xml" "%ProfileBase%\%DefaultUsername%\
%AppDir%\OSIsoft,_Inc\PIDataLink\"
```

3. Save the batch file in the same directory as the `OSIsoft.PIDataLink.xml` file that contains the preferred settings.
4. From Windows Explorer, right-click the batch file and then click **Run as administrator**.

   The script irreversibly overwrites any existing settings for all users on this computer and replaces the settings with the preferred settings. New users on this computer will have the same settings.
5. If you do not want new accounts (created after running this script) to have these preferred settings, remove the `OSIsoft.PIDataLink.xml` file from the `Default` user account (found in `C:\Users\Default\AppData\Local\OSIsoft,_Inc\PIDataLink`).

Delete PI DataLink settings for all users on a computer

Administrators can delete the PI DataLink settings for all users on a computer. The next time users open PI DataLink, they will have the default settings from a new installation.

Procedure

1. Create a batch file that deletes the `OSIsoft.PIDataLink.xml` file.

```
@echo off

SET ProfileBase=%SystemDrive%\Users
SET AppDir=APPDATA\Local
SET DefaultUsername=Default

ECHO Deleting XML settings file from all users.
for /f "tokens=*" %%a in ('dir /b /ad-h "%ProfileBase%"') do if 1==1 (
```

```
ECHO Deleting "%ProfileBase%\%%a\%AppDir%\OSIsoft,_Inc".
rmdir "%ProfileBase%\%%a\%AppDir%\OSIsoft,_Inc" /s /q
)

ECHO Deleting "%ProfileBase%\%DefaultUsername%\%AppDir%\OSIsoft,_Inc".
rmdir "%ProfileBase%\%DefaultUsername%\%AppDir%\OSIsoft,_Inc" /s /q
```

2. From Windows Explorer, right-click the batch file and then click **Run as administrator**.

Manage connections to servers

Use Connection Manager to manage connections to any PI Data Archive server or PI AF server, including the selection of the default PI Data Archive server and PI AF server.

Procedure

1. On the **PI DataLink** tab, in the **Resources** group, click **Settings** to open the Settings window.
2. Click **Connection Manager** to open the Servers window, which shows defined server connections and the current status of those connections, including the default servers.
3. Modify connections, as desired:
   - Click **Add Asset Server** to open the PI AF Server Properties window, where you can define a connection to a PI AF server.
   - Click **Add Data Server** to open the PI Data Archive Properties window, where you can define a connection to a PI Data Archive server.
   - Select a server not currently connected, and click **Connect** to connect to that server.

     To connect with PI AF servers, PI DataLink uses the Windows credentials of the logged-in user. To connect with PI Data Archive servers, PI DataLink can use a PI trust or a default user in addition to the Windows credentials of the logged-in user.
   - Select a server not currently the default connection, and click **Set as Default** to make that server the default connection (either PI Data Archive server or PI AF server).
   - Select a server and click **Properties** to view the connection properties for that server.
   - Right-click a server and then click **Remove** to remove the connection definition to that server.

Worksheet creation

This section discusses the process you might use to create worksheets with PI DataLink and some specific types of displays you can create with PI DataLink. The topics about displays include procedures to create those displays.

Topics in this section

- Process of creating worksheets
- Retrieval of large amounts of data
- Asset-relative displays
- Events in worksheets

Process of creating worksheets

When you are familiar with the basic tools and concepts of PI DataLink, you are ready to build a worksheet that uses PI DataLink functions.

Consider your goals

Ask yourself:

- What data do you want to display in a worksheet in order to monitor performance or answer a business question?
- Where does the data reside?
- How can you most effectively display the information, both to communicate essential points and provide needed background context?

The answers will help you to determine which PI DataLink functions can return the data most relevant to your task.

Select an approach

Techniques you might use to build your worksheet include:

- Function-based

  Add PI DataLink function to the worksheet, and build the display around the functions as needed. For example, you might add point information to help clarify what the data represents. This approach is useful if you are still exploring your requirements or learning how PI DataLink works.

- Structure-based

  Add structure as you build a worksheet. Use the Search tool to insert data items that frame the subject in your worksheet, and then add functions that retrieve the corresponding data. This approach requires a bit more planning and familiarity with PI DataLink, but once you add data items to the worksheet, you can use them to build functions more easily through cell references. You can easily reuse worksheets built this way.

- Report-based

Place PI DataLink functions on the second worksheet in your workbook, and reference the results from those functions on the first worksheet. Use Excel security features to hide and protect the function syntax and business logic in the second worksheet from most users. This approach is useful if you are a system administrator or build worksheets for other users. This strategy also works well for documents distributed through PI DataLink Server.

See also

PI DataLink functions

Search for data items

PI DataLink Server (DLS)

Retrieval of large amounts of data

For each data item in a function, PI DataLink must make a call to either PI Data Archive or PI Asset Framework to retrieve values. When PI DataLink retrieves values for large numbers of data items, processing each call separately can result in a long retrieval time. To reduce this time, PI DataLink makes bulk calls for certain functions under certain conditions.

The following conditions must be satisfied to make a bulk call:

- Function inputs specify data items, and not expressions or filter expressions
- Function input specifies data items with a reference to a cell range
- PI DataLink settings specify time stamps in client time zone

With the above conditions satisfied, the following functions make bulk calls:

- Current Value
- Archive Value
- Calculated Data (without time interval specified)

PI DataLink returns values from a bulk call in a single function array.

Bulk calls result in performance improvements when functions retrieve values for more than 1,000 data items or in environments with latency between PI DataLink and data sources. When functions retrieve values for more than 10,000 data items, bulk calls reduce retrieval time by an order of magnitude. Therefore, when creating worksheets that retrieve values for large numbers of data items, consider using these functions under the required conditions.

Asset-relative displays

An asset-relative display shows the values for a set of PI AF attributes along with the corresponding asset (a PI AF element). You can select a different asset to show the values for that asset.

\\DLAFPI\MyTest\Reactors\React1	
Manufacturer	ACME
Manufacturer|Serial Number	A123456
Temperature Attribute	49.12171555

Asset-relative display for React1 element

\\DLAFPI\MyTest\Reactors\React2	
Manufacturer	ACME
Manufacturer|Serial Number	A123458
Temperature Attribute	153.0063477

Asset-relative display for React2 element

Asset-relative displays require a common set of attribute names for assets. For example, to create an asset-relative display you can use PI AF elements based on the same element and attribute templates.

Create an asset-relative display

To create an asset-relative display, insert a set of data items that have a common structure into your worksheet with a root-path drop-down list, and then add a PI DataLink function that references these cells. After you create the asset-relative display, you can select a different asset from the list to see the attribute values for that asset.

Procedure

1. Insert a set of data items with a common structure into your worksheet.
2. Configure a PI DataLink function that references the inserted data items.

See also

Search for data items

Insert a set of data items with a common structure into your worksheet

Asset-relative displays require the worksheet to contain a set of data items (PI AF attributes) that have a common structure along with a root-path drop-down list for those data items.

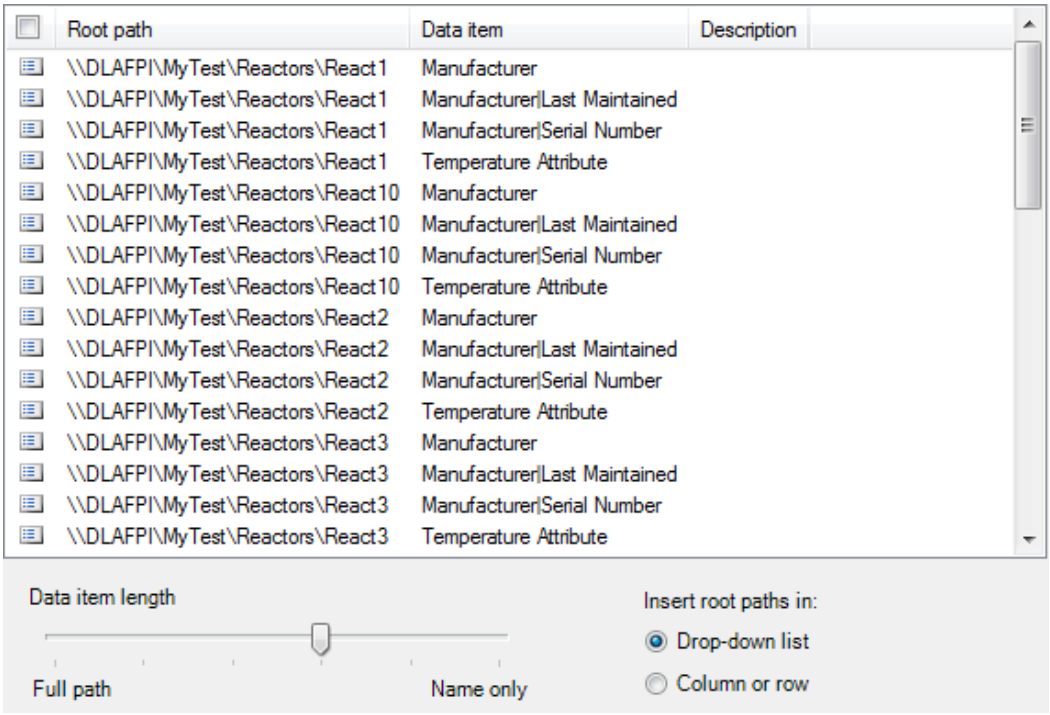
Procedure

1. Select a cell in the worksheet where you will insert the data items.
2. On the **PI DataLink** tab, click **Search** to open the Search tool.
3. Set the search scope, specify the data items you want to find, and click **Search** .

For asset-relative displays, you want to find PI AF attributes that have a common parent element and the same attribute structure. These attributes might have the same attribute template. For example, you might find all the reactors at your facility.

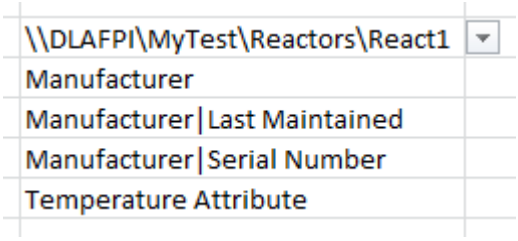
4. Split the paths of the data items such that the assets for the display appear in the **Root path** column.

   Move the **Data item length** slider until the **Root path** column shows the unique elements for the listed attributes. Typically this will be at or near the **Name only** setting.



5. Select the data items that you want to insert into the worksheet.
6. Under **Insert root paths in**, select **Drop-down list**.
7. Click **OK**.

   PI DataLink inserts the unique data items into the worksheet below a drop-down list that contains the unique assets (from the root-path column).



Note:
PI DataLink inserts the list of root paths in column ALL of your worksheet. If that column contains data, PI DataLink inserts the paths in the next available column to the right.

Configure a PI DataLink function that references the inserted data items

Asset-relative displays require you to configure a PI DataLink function to retrieve data for the data items and root path you inserted in your worksheet: a set of data items with a common structure and the root-path for that structure.

Procedure

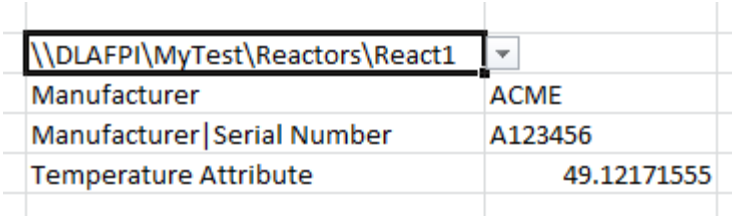
1. Click the worksheet cell next to the first data item in the range that you inserted.
2. On the **PI DataLink** tab, click the function that you want to use to retrieve values.

   The function task pane opens with the clicked cell specified in **Output cell**.
3. In the function task pane, click the **Data item(s)** field and then select the worksheet range that contains the data items you just inserted.

   PI DataLink inserts the cell range into the field.
4. In the function task pane, click the **Root path** field and then select the worksheet cell that contains the root-path drop-down list.

   PI DataLink inserts a cell reference into the field.
5. Specify other function inputs, as desired.
6. Click **OK** to insert the function array into the worksheet.

   You can select a different asset from the list to see attribute values for that asset.



   You can select a different asset from the list to see attribute values for that asset.

Events in worksheets

You can use PI DataLink to create displays for viewing, understanding, and analyzing events stored in PI AF. Your system configuration and the type of data collected determine which events your system stores. For example, your system might have events that store information about batch processes or events created from calculations.

You can use two PI DataLink functions to retrieve events:

- **Explore Events function**

  Useful for exploring events anywhere in your event hierarchy, the Explore Events function returns one event per row. You can use the Explore Events function to examine the data in a simple hierarchy, such as to analyze the events for a particular element. For example, you might examine the downtime of a particular boiler.

Event name	Start time	End time	Primary element	ReasonCode	ShutDownType
BoilerShutDown.5.20130403.1	03-Apr-13 18:00:00	03-Apr-13 19:00:00	Boiler5	P	Planned
BoilerShutDown.5.20130404.1	04-Apr-13 18:00:00	04-Apr-13 19:00:00	Boiler5	P	Planned
BoilerShutDown.5.20130404.2	04-Apr-13 22:04:00	04-Apr-13 23:31:00	Boiler5	E	Emergency
BoilerShutDown.5.20130405.1	05-Apr-13 18:00:00	05-Apr-13 19:00:00	Boiler5	P	Planned

Exploring events related to an element

You can also use the Explore Events function to examine the events in a full hierarchy, such as to analyze the child events for a type of event. (The event template often indicates the type of event.) For example, you might examine the startup phases of turbines.

Event name	Child 1	Event template	Start time	End time	Primary element	Duration
TurbineStartup.1.1		TurbineStartUp	04-Apr-13 06:00:00	04-Apr-13 06:28:00	Turbine1	0 0:28:00
TurbineStartup.1.1	Phase1	StartUpPhase1	04-Apr-13 06:00:00	04-Apr-13 06:12:00	Turbine1	0 0:12:00
TurbineStartup.1.1	Phase2	StartUpPhase2	04-Apr-13 06:12:01	04-Apr-13 06:20:30	Turbine1	0 0:08:29
TurbineStartup.1.1	Phase3	StartUpPhase3	04-Apr-13 06:20:31	04-Apr-13 06:28:00	Turbine1	0 0:07:29
TurbineStartup.3.1		TurbineStartUp	04-Apr-13 06:07:00	04-Apr-13 06:38:30	Turbine3	0 0:31:30
TurbineStartup.3.1	Phase1	StartUpPhase1	04-Apr-13 06:07:00	04-Apr-13 06:18:10	Turbine3	0 0:11:10
TurbineStartup.3.1	Phase2	StartUpPhase2	04-Apr-13 06:18:11	04-Apr-13 06:25:34	Turbine3	0 0:07:23
TurbineStartup.3.1	Phase3	StartUpPhase3	04-Apr-13 06:25:35	04-Apr-13 06:38:30	Turbine3	0 0:12:55

Exploring events with child events

- **Compare Events function**

  Useful for comparing hierarchical events, the Compare Events function can return attributes from related events in a single row. In displays created from the Compare Events function, each row can show a retrieved event along with information from that event's child events and parent events. Including this information can help you compare the retrieved events. For example, including information about a startup event's phase events can help you compare multiple startup events.

  The Compare Events function identifies attributes by path. Therefore, attribute names and hierarchical location affect the display. The capabilities of the function differ depending on the structure of the events and their attributes:

  - **Events that have child events with identical names**

    If you have a set of events that have identically named child events, then you can compare those events by including child-event information and parent-event information. Specify the criteria to find the events with identically named child events. The Compare Events function can then include information about child events in the same row as each matched event. For example, you might compare turbine-startup events that have identically named phase events, such as `Phase1`, `Phase2`, and `Phase3`.

.|Event name	.|Event template	.|Start time	.|End time	.|Duration	.\Phase1|Duration	.\Phase2|Duration	.\Phase3|Duration	.|Primary element
TurbineStartUp.3.3	TurbineStartUp	03-Mar-14 18:16:00	03-Mar-14 19:29:00	0 1:13:00	0 0:30:00	0 0:27:00	0 0:28:00	Turbine3
TurbineStartUp.5.3	TurbineStartUp	05-Mar-14 06:01:00	05-Mar-14 08:33:00	0 2:32:00	0 0:58:00	0 0:40:00	0 0:53:00	Turbine5

Comparing events by including child-event information

    The Compare Events function can also include information about parent events in the same row as a matched event. You might include information from the parent event to

provide more information about the matched events. For example, for the matched turbine-startup events, information about the parent process event might enhance your comparison.

..|Event name	..|Event template	..|Start time	.|Event name	.|Event template	.|Start time	.|Duration	.|Primary element	.\Phase1|Duration
Process.East.3	MachineCycle	01-Mar-14 00:01:00	TurbineStartUp.3.3	TurbineStartUp	03-Mar-14 18:16:00	0 1:13:00	Turbine3	0 0:30:00
Process.South.3	MachineCycle	01-Mar-14 00:01:00	TurbineStartUp.5.3	TurbineStartUp	05-Mar-14 06:01:00	0 2:32:00	Turbine5	0 0:58:00

Comparing events by including child-event and parent-event information

- **Events that have child events with different names**

  If you have a set of events that have child events with different names, then you can only compare events by including parent-event information. Specify the criteria to find the lowest-level events in the hierarchy. The Compare Events function can then include information from parent events in the same row as each matched event. For example, suppose you have first-phase events with different names, such as `Phase1`, `P1`, `PhaseX`, and `PhaseA`. You can compare the phase events and include information about the parent startup event.

..|Event name	..|Event template	..|Duration	.|Event name	.|Event template	.|Duration	.|RPM	.|Primary element
TurbineStartUp.3.3	TurbineStartUp	0 1:13:00	Phase1	StartUpPhase1	0 0:30:00	1035	Turbine3
TurbineStartUp.4.3	TurbineStartUp	0 1:55:00	P1	StartUpPhase1	0 0:40:00	1075	Turbine4
TurbineStartUp.5.3	TurbineStartUp	0 2:32:00	Phase1	StartUpPhase1	0 0:58:00	1095	Turbine5
TurbineStartUp.6.3	TurbineStartUp	0 1:52:00	PhaseX	StartUpPhase1	0 0:37:00	1046	Turbine6
TurbineStartUp.8.1	TurbineStartUp	0 2:51:00	PhaseA	StartUpPhase1	0 1:02:00	850	Turbine8
TurbineStartUp.8.1	TurbineStartUp	0 2:51:00	PhaseA	StartUpPhase1	0 0:40:00	1334	Turbine8

Comparing events by including parent-event information

Topics in this section

- Explore events related to an element
- Explore events with child events
- Compare events by including child events
- Compare events by including parent events
- Search for events of a specific parent event
- Reserved attribute names

Explore events related to an element

You can use the Explore Events function to explore and analyze events related to a particular PI AF element. For example, suppose you want to analyze the downtime of a particular boiler. You can retrieve all the downtime events for that boiler into Microsoft Excel and create a chart to analyze the data. In this case, you might find events that match an element name and event name.

Procedure

1. Select a cell in the worksheet where you want PI DataLink to start inserting the function array that contains the events.
2. On the **PI DataLink** tab, in the **Events** group, click **Explore** to open the Explore Events task pane.
3. Specify the criteria to find the events you are interested in. As you enter criteria, the **Preview** list updates to show the events that match the entered criteria.
   a. In the **Database** field, enter the PI AF database that stores the events.

      Specify in the format `\\ServerName\DatabaseName`. Click the field to open a list of databases that contain event templates in connected PI AF servers.

   b. In the **Search start** and **Search end** fields specify the time period that you want to search for active events.

      Enter a PI time expression. For example, to retrieve events that were active during the last month, enter `*-1mo` in the **Search start** field and `*` in the **Search end** field.

      > **Tip:**
      > To find events with a more specific relationship to this time period, such as events that started or ended during this time period, expand **More search options** and select an alternative method from the **Search mode** list.

   c. As necessary, specify additional criteria to refine the events that the function returns (shown in the **Preview** list).

      See Explore Events task-pane reference for a complete list of available fields.

      For example, use the **Event name** field to limit returned events to those with a particular name. You might enter `*shut*` to find all events that contain `shut` in their name, such as `shutdown` and `BoilerShutdown`. If you leave the default entry, `*`, the function will find events with any name.

      Similarly, use the **Element name** field to limit returned events to those associated with particular elements. You might enter `Boiler5` to analyze events associated with that boiler.

4. Specify the worksheet output:
   a. From the **Columns to display** list, select the columns to include in the function array and set the column order.

      The list contains the names of attributes. By default, the list includes the virtual attributes generated for all events and the event attributes from the selected event template. You can:

      - Select the **Select all** check box to include all the listed attributes as columns in the returned function array.
      - Select a check box to include the attribute, or clear a check box to exclude an attribute as a column in the returned function array.
      - Click  to open the Add Attributes window where you can select additional attributes to include as columns in the function array. See Add attribute columns to the Explore Events task pane.

- Type the name of an event attribute next to the blank check box at the bottom of the list.
- Right-click an attribute, click **Insert attribute** to insert a blank attribute above the selected attribute, and then type the name of an event attribute.
- Select an attribute and click  to move the attribute up in the list.
- Select an attribute and click  to move the attribute down in the list.
- Select an attribute and click  to remove the attribute from the list.
- Right-click an attribute and then click **Delete attribute** to remove the attribute from the list.

If the length of the selected column names exceeds 759 characters, the function cannot process columns individually. In this case, the task pane prompts you to specify all columns as a group. With columns specified as a group, the list says **All event attributes and template attributes**, and the returned function array includes all the default attributes and their children attributes, but no additional attributes that you specified.

b. Verify that the **Output cell** field contains the worksheet cell where you want to insert the top-left corner of the function array.

If you clicked a cell before opening the task pane, PI DataLink automatically inserts that cell into this field.

5. Click **OK** to insert the function array into the worksheet.

Event name	Start time	End time	Primary element	ReasonCode	ShutDownType
BoilerShutDown.5.20130403.1	03-Apr-13 18:00:00	03-Apr-13 19:00:00	Boiler5	P	Planned
BoilerShutDown.5.20130404.1	04-Apr-13 18:00:00	04-Apr-13 19:00:00	Boiler5	P	Planned
BoilerShutDown.5.20130404.2	04-Apr-13 22:04:00	04-Apr-13 23:31:00	Boiler5	E	Emergency
BoilerShutDown.5.20130405.1	05-Apr-13 18:00:00	05-Apr-13 19:00:00	Boiler5	P	Planned

After you finish

Use Excel features to analyze your data. For example, you might create a chart.

Add attribute columns to the Explore Events task pane

Use the Add Attributes window to add event attributes to the **Columns to display** list in the Explore Events task pane. You can then include those attributes in the function array inserted into the worksheet.

Before you start

Open the Explore Events task pane and specify events to retrieve into the worksheet.

Procedure

1. Next to the **Columns to display** list in the task pane, click  to open the Add Attributes window.

   The window lists the events that match the criteria currently specified in the task pane.

2. Expand an event to see the event attributes stored for that event.

You can include any event attribute as a column in the function array. When included in the function array, an attribute column shows values stored for an event.

3. Select the check box next to any attribute that you want to add to the **Columns to display** list in the task pane.

   The Explore Events function identifies attributes by name. An event and attribute name uniquely define a value. Therefore, you only need to add a particular attribute one time. When you select an attribute, the window automatically selects that attribute everywhere it appears in the event hierarchy.

   Note:
   PI DataLink does not synchronize selections in this window with the **Columns to display** list in the task pane. In this window, you can select an attribute already available or selected in the column list in the task pane; doing so adds the same attribute more than once to the column list in the task pane.

4. Click **OK** to insert the attribute into the **Columns to display** list and select that column.

Explore events with child events

You can use the Explore Events function to analyze events with child events by examining them in a hierarchical format. For example, suppose you want to analyze the startup phases of turbines, and you have configured each phase as a child event of an overall startup event. You can retrieve all the turbine startup events along with their child events (the phase events) into Microsoft Excel, and then analyze that data. In this case, you might retrieve events by event template.

Procedure

1. Select a cell in the worksheet where you want PI DataLink to start inserting the function array that contains the events.
2. On the **PI DataLink** tab, in the **Events** group, click **Explore** to open the Explore Events task pane.
3. Specify the criteria to find the events you are interested in. As you enter criteria, the **Preview** list updates to show the events that match the entered criteria.
   a. In the **Database** field, enter the PI AF database that stores the events.

      Specify in the format `\\ServerName\DatabaseName`. Click the field to open a list of databases that contain event templates in connected PI AF servers.

   b. In the **Search start** and **Search end** fields specify the time period that you want to search for active events.

      Enter a PI time expression. For example, to retrieve events that were active during the last month, enter `*-1mo` in the **Search start** field and * in the **Search end** field.

      Tip:
      To find events with a more specific relationship to this time period, such as events that started or ended during this time period, expand **More search options** and select an alternative method from the **Search mode** list.

   c. As necessary, specify additional criteria to refine the events that the function returns (shown in the **Preview** list).

      See Explore Events task-pane reference for a complete list of available fields.

For example, use the **Event template** list to limit returned events to those based on a particular event template. You might select the template named `TurbineStartUp` to analyze turbine startup events.

4. Specify the worksheet output:
   a. From the **Columns to display** list, select the columns to include in the function array and set the column order.

      The list contains the names of attributes. By default, the list includes the virtual attributes generated for all events and the event attributes from the selected event template. You can:

      - Select the **Select all** check box to include all the listed attributes as columns in the returned function array.
      - Select a check box to include the attribute, or clear a check box to exclude an attribute as a column in the returned function array.
      - Click  to open the Add Attributes window where you can select additional attributes to include as columns in the function array. See Add attribute columns to the Explore Events task pane.
      - Type the name of an event attribute next to the blank check box at the bottom of the list.
      - Right-click an attribute, click **Insert attribute** to insert a blank attribute above the selected attribute, and then type the name of an event attribute.
      - Select an attribute and click  to move the attribute up in the list.
      - Select an attribute and click  to move the attribute down in the list.
      - Select an attribute and click  to remove the attribute from the list.
      - Right-click an attribute and then click **Delete attribute** to remove the attribute from the list.

      If the length of the selected column names exceeds 759 characters, the function cannot process columns individually. In this case, the task pane prompts you to specify all columns as a group. With columns specified as a group, the list says **All event attributes and template attributes**, and the returned function array includes all the default attributes and their children attributes, but no additional attributes that you specified.

   b. From the **Number of child event levels** list, select the number of child-event levels to include in the function array.

      Select **0** to retrieve no child events, select **1** to retrieve child events from the first level (that is, events immediately below the matched events), and so on. You can identify events with child events in the **Preview** list by a + next to the event name. Child events do not need to match the specified criteria.

      The function adds a column for each level retrieved. When retrieving child events, the function inserts each child event into a separate row. In rows containing child events, the added column contains the child event name.

   c. Verify that the **Output cell** field contains the worksheet cell where you want to insert the top-left corner of the function array.

If you clicked a cell before opening the task pane, PI DataLink automatically inserts that cell into this field.

5. Click **OK** to insert the function array into the worksheet.

Event name	Child 1	Event template	Start time	End time	Primary element	Duration
TurbineStartup.1.1		TurbineStartUp	04-Apr-13 06:00:00	04-Apr-13 06:28:00	Turbine1	0 0:28:00
TurbineStartup.1.1	Phase1	StartUpPhase1	04-Apr-13 06:00:00	04-Apr-13 06:12:00	Turbine1	0 0:12:00
TurbineStartup.1.1	Phase2	StartUpPhase2	04-Apr-13 06:12:01	04-Apr-13 06:20:30	Turbine1	0 0:08:29
TurbineStartup.1.1	Phase3	StartUpPhase3	04-Apr-13 06:20:31	04-Apr-13 06:28:00	Turbine1	0 0:07:29
TurbineStartup.3.1		TurbineStartUp	04-Apr-13 06:07:00	04-Apr-13 06:38:30	Turbine3	0 0:31:30
TurbineStartup.3.1	Phase1	StartUpPhase1	04-Apr-13 06:07:00	04-Apr-13 06:18:10	Turbine3	0 0:11:10
TurbineStartup.3.1	Phase2	StartUpPhase2	04-Apr-13 06:18:11	04-Apr-13 06:25:34	Turbine3	0 0:07:23
TurbineStartup.3.1	Phase3	StartUpPhase3	04-Apr-13 06:25:35	04-Apr-13 06:38:30	Turbine3	0 0:12:55

Compare events by including child events

You can use the Compare Events function to compare events that have child events with the same names. The Compare Events function identifies attributes by path. Therefore, the function can return attributes from related events in a single row. For example, suppose you have turbine startup events that have phase events (child events that occur during the startup event). The Compare Events function can present a row for each startup event and show values from the corresponding phases in separate columns within each row. You can use this returned function array to easily compare the startup events.

Procedure

1. Select a cell in the worksheet where you want PI DataLink to start inserting the function array that contains the events.
2. On the **PI DataLink** tab, in the **Events** group, click **Compare** to open the Compare Events task pane.
3. Specify the criteria to find the events you are interested in. As you enter criteria, the **Preview** list updates to show the events that match the entered criteria.
   a. In the **Database** field, enter the PI AF database that stores the events.

      Specify in the format `\\ServerName\DatabaseName`. Click the field to open a list of databases that contain event templates in connected PI AF servers.

   b. In the **Search start** and **Search end** fields specify the time period that you want to search for active events.

      Enter a PI time expression. For example, to retrieve events that were active during the last month, enter `*-1mo` in the **Search start** field and * in the **Search end** field.

      Tip:
      To find events with a more specific relationship to this time period, such as events that started or ended during this time period, expand **More search options** and select an alternative method from the **Search mode** list.

   c. As necessary, specify additional criteria to refine the events that the function returns (shown in the **Preview** list).

      See Compare Events task-pane reference for a complete list of available fields.

      For example, use the **Event template** list to limit returned events to those based on a particular event template. You might select the template named `TurbineStartUp` to analyze turbine startup events.

4. Use the **Columns to display** list to specify the columns in the returned function array.

   The list contains the names of attributes. By default, the list includes the virtual attributes generated for all events and the event attributes from the selected event template. The function identifies attributes by path. See Path notation for Compare Events function for information about supported path notations.

   a. Click  to open the Add Attributes window and select the child-event attributes that you want to compare among parent events.

      See Add child-event attributes as columns in the Compare Events task pane.

   b. Insert any parent-event attributes that you want included in the function array.

      See Add parent-event attributes as columns in the Compare Events task pane.

   c. Select the columns to include in the function array and set the column order.

      You can:

      - Select the **Select all** check box to include all the listed attributes as columns in the returned function array.
      - Select a check box to include the attribute, or clear a check box to exclude an attribute as a column in the returned function array.
      - Type the name of an event attribute next to the blank check box at the bottom of the list.
      - Select an attribute and click  to move the attribute up in the list.
      - Select an attribute and click  to move the attribute down in the list.
      - Select an attribute and click  to remove the attribute from the list.
      - Right-click an attribute and then click **Delete attribute** to remove the attribute from the list.

5. Verify that the **Output cell** field contains the worksheet cell where you want to insert the top-left corner of the function array.

   If you clicked a cell before opening the task pane, PI DataLink automatically inserts that cell into this field.

6. Click **OK** to insert the function array into the worksheet.

.|Event name	.|Event template	.|Start time	.|End time	.|Duration	.\Phase1|Duration	.\Phase2|Duration	.\Phase3|Duration	.|Primary element
TurbineStartUp.3.3	TurbineStartUp	03-Mar-14 18:16:00	03-Mar-14 19:29:00	0 1:13:00	0 0:30:00	0 0:27:00	0 0:28:00	Turbine3
TurbineStartUp.5.3	TurbineStartUp	05-Mar-14 06:01:00	05-Mar-14 08:33:00	0 2:32:00	0 0:58:00	0 0:40:00	0 0:53:00	Turbine5

Add child-event attributes as columns in the Compare Events task pane

Use the Add Attributes window to add child-event attributes to the **Columns to display** list in the Compare Events task pane. (Then you can include those columns in the function array inserted into the worksheet.) After you specify criteria for events in the task pane, this window lists the matched events and their child events. You can use this window to add any event

attribute from these events. Most commonly, you use this window to add child-event attributes that will help you compare the matched events.

Before you start

Open the Compare Events task pane and specify events to retrieve into the worksheet.

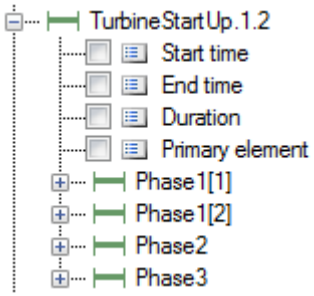
Procedure

1. Next to the **Columns to display** list in the task pane, click  to open the Add Attributes window.

   The window lists the events that match the criteria currently specified in the task pane.

2. Expand an event to see the event attributes stored for that event along with any child events.

   If two or more child events have the same name, PI DataLink automatically adds an index to the child-event name. To create the index, PI DataLink sorts those events by ascending start time, then ascending end time, and then ascending identifier.

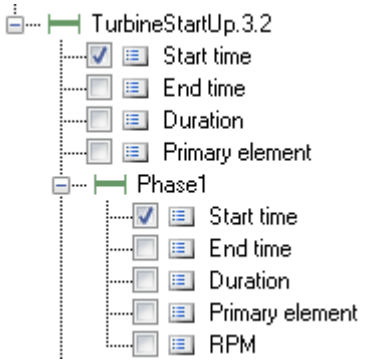


Event with two child events named Phase1

   You can include any event attribute as a column in the function array. When included in the function array, that column will show values stored for the event attribute.

3. Select the check box next to any attribute that you want to add to the **Columns to display** list in the task pane.

   The Compare Events function identifies attributes by name and path relative to the matched event. For example, suppose you select the `Start time` attribute under both a matched event and its child event.



Select start-time attribute of matched and child event

This adds two columns:

- `.|Start time`

  In the worksheet, this column contains the start time of the matched event listed in each row.

- `.\Phase1|Start time`

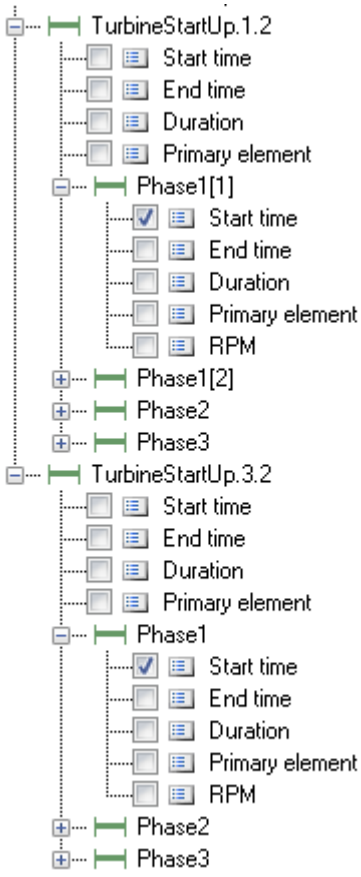
  In the worksheet, this column contains the start time of the `Phase1` child event of the matched event listed in each row.

.|Event name	.|Start time	.\Phase1|Start time
TurbineStartUp.3.2	20-Dec-13 14:38:00	20-Dec-13 14:39:00
TurbineStartUp.9.2	12-Feb-14 11:07:00	12-Feb-14 11:07:00

Worksheet with child-attribute column

You can add attributes from anywhere in the hierarchy. The window does not synchronize selections: if the path and attribute name are the same, you can add the same attribute more than once.

When events have inconsistent event hierarchies, use care when selecting attributes of child events. If any event contains multiple child events with the same name, then select attributes under a duplicated child event (that is, an indexed child event) to ensure that you can view data for all events. For example, suppose you select the `Start time` attribute under a duplicated child event (the `Phase1[1]` child event of the `TurbineStartUp.1.2` event) and a nonduplicated child event (the `Phase1` child event of the `TurbineStartUp.3.2` event).



Select start-time attribute of duplicated child event and nonduplicated child event

This adds two columns that return different results:

- `.\Phase1[1]|Start time`

  In the worksheet, this column contains the start time of the first `Phase1` child event of the matched event listed in each row. If the matched event has only one child event with this name, then the column lists the start time of that event in this column.

- `.\Phase1|Start time`

  In the worksheet, this column contains the start time of the only `Phase1` child event of the matched event listed in each row. If the matched event has more than one child event with this name, the column reports `Duplicate event exists: specify index for Phase1`.

.|Event name	.\Phase1[1]|Start time	.\Phase1|Start time
TurbineStartUp.5.2	20-Dec-13 07:15:00	Duplicate event exists: specify index for Phase1
TurbineStartUp.1.2	20-Dec-13 08:15:00	Duplicate event exists: specify index for Phase1
TurbineStartUp.3.2	20-Dec-13 14:39:00	20-Dec-13 14:39:00

Worksheet with indexed and nonindexed child attribute

The indexed attribute ensures that you return the desired data.

4. Click **OK** to insert the attribute into the **Columns to display** list and select that column.

Add parent-event attributes as columns in the Compare Events task pane

To help compare events in a worksheet, you can include columns that contain information about the parent events of matched events. Use the **Columns to display** list in the Compare Events task pane to insert attributes of parent events (and their parent events or any higher level event in the hierarchy).

Note:
The Compare Events function does not retrieve data from parent-event attributes for events with relationships defined through event-frame references.

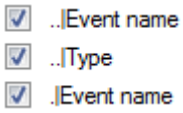
Before you start

Open the Compare Events task pane and specify events to retrieve into the worksheet.

Procedure

1. From the **Columns to display** list in the Compare Events task pane, add parent-event attributes using the method appropriate for the attribute:

To insert:	Do this:
Same attribute name at parent level	a. Right-click the attribute and then click **Clone for parent event**. PI DataLink inserts the parent-event attribute of the same name above the selected attribute. For example if you right-click the **.|Event name** attribute (the `Event name` attribute of the matched event) and click **Clone for parent event**, PI DataLink inserts the **..|Event name** attribute (the `Event name` attribute of the parent event). ☑ ..|Event name ☑ .|Event name You can repeat to add the same attribute from events higher up the hierarchy. For example, if you right-click the **..|Event name** attribute and click **Clone for parent event**, PI DataLink inserts the **..\..|Event name** attribute (the `Eventname` attribute of the grandparent event). ☑ ..\..|Event name ☑ ..|Event name ☑ .|Event name

To insert:	Do this:
Unique attribute name	a. Right-click the attribute above which you want to insert the parent-event attribute, and then click **Insert attribute**. PI DataLink inserts a blank attribute at the primary event level (`.|`). b. Enter the correct path and name of the parent-event attribute. For example, to include the `Type` attribute of the parent event, enter `..|Type`. 

For information on path syntax, see Path notation for Compare Events function.

Compare events by including parent events

You can use the Compare Events function to present information about parent events in the same row as an event. You can use this capability to compare any events from matching hierarchies, including events with different names. For example, suppose you have turbine startup events that have phase events, but some phase events have different names. With the Compare Events function, you can return a row for each phase event and show values from the parent event in separate columns within each phase-event row. The returned information can help you compare phase events.

Procedure

1. Select a cell in the worksheet where you want PI DataLink to start inserting the function array that contains the events.
2. On the **PI DataLink** tab, in the **Events** group, click **Compare** to open the Compare Events task pane.
3. Specify the criteria to find the events you are interested in. As you enter criteria, the **Preview** list updates to show the events that match the entered criteria.
   a. In the **Database** field, enter the PI AF database that stores the events.

      Specify in the format `\\ServerName\DatabaseName`. Click the field to open a list of databases that contain event templates in connected PI AF servers.

   b. In the **Search start** and **Search end** fields specify the time period that you want to search for active events.

      Enter a PI time expression. For example, to retrieve events that were active during the last month, enter `*-1mo` in the **Search start** field and * in the **Search end** field.

      Tip:
      To find events with a more specific relationship to this time period, such as events that started or ended during this time period, expand **More search options** and select an alternative method from the **Search mode** list.

   c. As necessary, specify additional criteria to refine the events that the function returns (shown in the **Preview** list).

      See Compare Events task-pane reference for a complete list of available fields.

For example, use the **Event template** list to limit returned events to those based on a particular event template. You might select the template named `StartUpPhase1` to analyze first-phase startup events.

4. Use the **Columns to display** list to specify the columns in the returned function array.

   The list contains the names of attributes. By default, the list includes the virtual attributes generated for all events and the event attributes from the selected event template. The function identifies attributes by path. See Path notation for Compare Events function for information about supported path notations.

   a. Insert the parent-event attributes that you want included in the function array.

      See Add parent-event attributes as columns in the Compare Events task pane.

      For example, you might right-click some of the virtual attributes and then click **Clone for parent event** to insert the corresponding parent-event attributes, such as:

      ```
      ..|Event name
      ..|Start time
      ..|Primary element
      ```

   b. Select the attributes to include as columns in the function array and set the column order.

      You can:

      - Select the **Select all** check box to include all the listed attributes as columns in the returned function array.
      - Select a check box to include the attribute, or clear a check box to exclude an attribute as a column in the returned function array.
      - Type the name of an event attribute next to the blank check box at the bottom of the list.
      - Select an attribute and click  to move the attribute up in the list.
      - Select an attribute and click  to move the attribute down in the list.
      - Select an attribute and click  to remove the attribute from the list.
      - Right-click an attribute and then click **Delete attribute** to remove the attribute from the list.

5. Verify that the **Output cell** field contains the worksheet cell where you want to insert the top-left corner of the function array.

   If you clicked a cell before opening the task pane, PI DataLink automatically inserts that cell into this field.

6. Click **OK** to insert the function array into the worksheet.

..|Event name	..|Event template	..|Duration	.|Event name	.|Event template	.|Duration	.|RPM	.|Primary element
TurbineStartUp.3.3	TurbineStartUp	0 1:13:00	Phase1	StartUpPhase1	0 0:30:00	1035	Turbine3
TurbineStartUp.4.3	TurbineStartUp	0 1:55:00	P1	StartUpPhase1	0 0:40:00	1075	Turbine4
TurbineStartUp.5.3	TurbineStartUp	0 2:32:00	Phase1	StartUpPhase1	0 0:58:00	1095	Turbine5
TurbineStartUp.6.3	TurbineStartUp	0 1:52:00	PhaseX	StartUpPhase1	0 0:37:00	1046	Turbine6
TurbineStartUp.8.1	TurbineStartUp	0 2:51:00	PhaseA	StartUpPhase1	0 1:02:00	850	Turbine8
TurbineStartUp.8.1	TurbineStartUp	0 2:51:00	PhaseA	StartUpPhase1	0 0:40:00	1334	Turbine8

Search for events of a specific parent event

You can use the Explore Events and Compare Events functions to show information only about events with a specific parent event. To limit retrieved events to a particular parent event, open the function task pane and specify the path to the parent event in the **Database** field. You can specify the path using a cell reference.

Procedure

1. Retrieve the event path to the parent event into a worksheet.
   a. Use the Explore Events function to find the parent event.
   b. From the **Columns to display** list, select the **Event path** check box to include the column in the output.

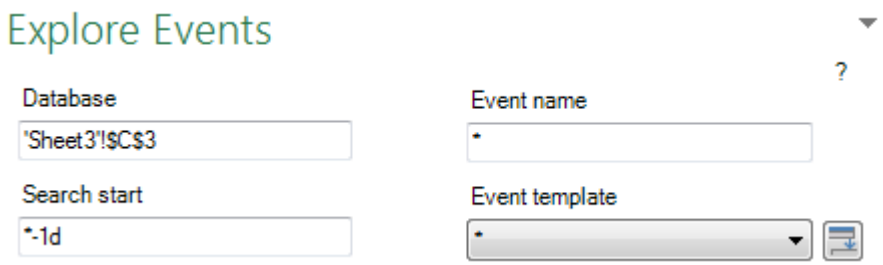
      You can also include other columns.
   c. Click **OK** to retrieve the data into the worksheet.

Event name	Event path
TurbineStartUp.1.1	\\MyServer\MyDB\EventFrames[TurbineStartUp.1.1]
Phase1	\\MyServerl\MyDB\EventFrames[TurbineStartUp.1.1]\Phase1
TurbineStartUp.3.1	\\MyServer\MyDB\EventFrames[TurbineStartUp.3.1]
Phase1	\\MyServer\MyDB\EventFrames[TurbineStartUp.3.1]\Phase1
Phase2	\\MyServer\MyDB\EventFrames[TurbineStartUp.1.1]\Phase2

2. Reference the parent event path in the Explore Events or Compare Events function.
   a. In the same worksheet or another worksheet, click the cell where you want PI DataLink to start inserting the function array that contains the child events.

      Remember that the new array must not overlap any other function array.
   b. On the **PI DataLink** tab, in the **Events** group, click either **Explore** or **Compare** to open the corresponding function task pane.
   c. In the **Database** field, clear the existing entry to the current database, and then click the cell in **Event path** column that corresponds to the parent event for which you want to find events.

      PI DataLink inserts a cell reference to the worksheet cell into the task pane.



3. Specify any other criteria to find the desired child events and the columns to display, and then click **OK** to insert the function array into the worksheet.

Reserved attribute names

PI DataLink automatically generates some virtual attributes for events and uses reserved names to identify these virtual attributes. To prevent conflicts with event-defined attributes, do not define events that use the following reserved names as attribute names:

- Acknowledged by
- Acknowledged date
- Annotations
- Duration
- Element template
- End time
- Event categories
- Event name
- Event path
- Event template
- Is acknowledged
- Primary element
- Primary element path
- Severity
- Start time

PI DataLink functions

With PI DataLink functions, you can query any PI Data Archive server or PI AF server, apply calculations to retrieved results, and return values to worksheet cells. Like other Excel functions, PI DataLink functions return results in function arrays, which you can recalculate to update values as needed. Use function task panes to define inputs for PI DataLink functions and paste them into a worksheet.

The function descriptions in this section describe inputs specific to each function.

See also

Function task panes

Function arrays

Function reference

Topics in this section

- Current Value function
- Archive Value function
- Compressed Data function
- Sampled Data function
- Timed Data function
- Calculated Data function
- Time Filtered function
- Explore Events function
- Compare Events function
- Asset Filter Search function
- Properties function

Current Value function

The Current Value function returns the most recent value of a historical PI point or PI AF attribute. For a future PI point, the value returned depends on the time stamps of recorded values relative to the current time:

- If all recorded values have time stamps before the current time, the function returns the last recorded value.
- If recorded values have time stamps that straddle the current time, the function returns an interpolated value.
- If all recorded values have time stamps after the current time, the function returns no data.

Current Value is a volatile function: the function recalculates and updates values whenever Excel calculates or recalculates any cell in the worksheet. To force an immediate recalculation, press F9.

This function supports bulk calls.

Input	Description
Root path	The common path to specified data items. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.
Data item(s)	One or more PI point names or PI AF attribute names, for which the function returns values. To specify multiple data items, enter a range of cells that contain PI point names or PI AF attribute names. The function returns values for each. Required.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
No time stamp	Click this option to return only values. The function returns values in a column for a column of referenced data items, or returns values in a row for a row of referenced data items.
Time at left	Click this option to return two columns: the time stamp in the left column and the value in the right column.
Time on top	Click this option to return two rows: the time stamp in the top row and the value in the bottom row.

See also

PICurrVal()

Retrieval of large amounts of data

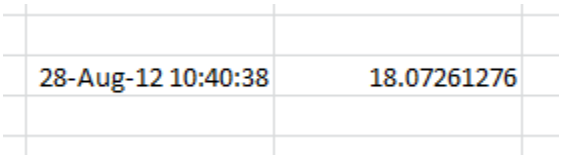
Interpolated values

Current Value example

To see the current value of the PI point `sinusoid`, set the following inputs for the Current Value function:

Input	Value
Data item(s)	`sinusoid`
Time at left	Selected

The function returns the following array:



28-Aug-12 10:40:38	18.07261276

Archive Value function

- If you select the **Data item** option, the Archive Value function returns the value of a PI point or a PI AF attribute at a specified time stamp. This function supports bulk calls.
- If you select the **Expression** option, the Archive Value function returns the computed value of a performance equation at a specified time stamp.

Input	Description
Root path	The common path to specified data items, including those in expressions. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.
Data item(s)	One or more PI point names or PI AF attribute names, for which the function returns values. To specify multiple data items, enter a range of cells that contain PI point names or PI AF attribute names. The function returns values for each. Required if you select the **Data item** option.
Expression(s)	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each. Required if you select the **Expression** option.
Time stamp	The time stamp for which the function returns values. Specify either a fixed time or a time expression relative to the current time. See Time inputs. Required.

Input	Description
Retrieval mode	The method the function uses to determine returned values. Choices include: • **previous** Returns the value that exactly matches or precedes the specified time stamp. • **previous only** Returns the value that precedes the specified time stamp. • **interpolated** Returns the interpolated value at the specified time. See Interpolated values. • **auto** Returns the interpolated value at the specified time, or follows the **previous** method. (Uses the **previous** method for data items with step attributes.) • **next** Returns the value that exactly matches or follows the specified time stamp. • **next only** Returns the value that follows the specified time stamp. • **exact time** Returns only a value that exactly matches the time stamp, or returns `No events found` if no value exists at that time stamp. Available if you select the **Data item** option.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
No time stamp	Click this option to return only values. The function returns values in a column for a column of referenced data items or expressions, or returns values in a row for a row of referenced data items or expressions.
Time at left	Click this option to return two columns: the time stamp in the left column and the value in the right column.
Time on top	Click this option to return two rows: the time stamp in the top row and the value in the bottom row.

See also

- PIArcVal()

Specify data items.

- PIExpVal()

  Specify an expression.

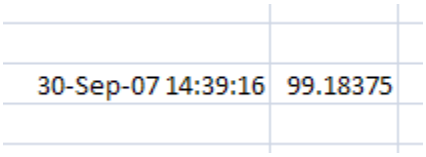
- Retrieval of large amounts of data

Archive Value example

To see the value of the PI point `sinusoid` at a specific time, set the following inputs for the Archive Value function:

Input	Value
Data item(s)	`sinusoid`
Time stamp	`30-Sep-07 15:13`
Retrieval mode	`previous`
Time at left	Selected

The function returns the following array:



Compressed Data function

- If you select the **Time range** option, the Compressed Data function returns all the values of a PI point or PI AF attribute along with a count of values that occur during a specified time period.
- If you select the **Number of values** option, the Compressed Data function returns a specific number of point values or attribute values beginning at a certain time.

Note:
Values stored in the archive of PI Data Archive undergo a compression algorithm that removes all values that represent the same slope. Values stored in the PI Data Archive snapshot have not undergone this compression algorithm. If you specify the current time in the time period of the Compressed Data function, the function retrieves a snapshot value for that time. That snapshot value might not be subsequently stored in the archive due to compression.

Input	Description
Root path	The common path to specified data items, including those in expressions. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.

Input	Description
Data item(s)	One or more PI point names or PI AF attribute names, for which the function returns values. To specify multiple data items, enter a range of cells that contain PI point names or PI AF attribute names. The function returns values for each. Required.
Start time	The start of the time period for which the function returns values. See Time inputs. Required.
End time	The end of the time period for which the function returns values. See Time inputs. Required if you select the **Time range** option.
Number of values	The number of values that the function returns, beginning at **Start time**. Required if you select the **Number of values** option.
Backwards in time	Select this check box to return values recorded at **Start time** and earlier. Available if you select the **Number of values** option and enter a value in the **Number of values** field. If you enter a cell reference in the **Number of values** field, this check box is disabled. Instead, enter a negative number in the referenced cell to have the same effect.
Filter expression	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
Mark as filtered	Select this check box to insert the label `Filtered` in place of a value or block of values that the function filtered from the output based on **Filter expression**.
Boundary type	The method that the function uses to determine which values to return near the start time or end time: • **inside**(default) Returns values at start and end times, if they exist, or the nearest values that occur within the range. • **outside** Returns the nearest values that occur immediately outside the range. • **interpolated** Returns interpolated values at the start and end times. See Interpolated values. • **auto** Returns interpolated values, but uses the `inside` method for data items with step attributes.

Input	Description
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
Hide count	Select this check box to hide the count of returned values and show only returned values. Available if you select the **Time range** option.
Show time stamps	Select this check box to show the time stamp that corresponds to each returned value. PI DataLink shows time stamps to the left of values displayed in a column or above values displayed in a row.
Show value attributes	Select this check box to show the extended status bits associated with returned values. Possible status bits include: • **A** Annotated. Indicates the value has a comment. • **S** Substituted. Indicates the value has changed from its originally recorded value. • **Q** Questionable. Indicates that there is some reason to doubt the accuracy of the value. PI DataLink shows value attributes in a column to the right of the values.
Show annotations	Select this check box to show annotations associated with returned values. Annotations contain notes or comments that describe a data value. PI DataLink shows annotations in a column to the right of the value.
Column	Click this option to return values in a column.
Row	Click this option to return values in a row. **Note:** If you specify a range of items in **Data item(s)** or a range of expressions in **Expression(s)**, PI DataLink automatically selects **Column** or **Row** to match the orientation of the specified range.

See also

- PICompDat()

  Specify a time range without a filter expression.

- PICompFilDat()

  Specify a time range with a filter expression.

- PINCompDat()

  Specify a number of values without a filter expression.

- PINCompFilDat()

Specify a number of values with a filter expression.

Compressed Data example

To see the most recent 10 values of the PI point `sinusoid`, set the following inputs for the Compressed Data function:

Input	Value
Number of values	Selected
Data item(s)	`sinusoid`
Start time	`$A$10` (assuming cell A-10 has the current time)
Number of values	`10`
Backwards in time	Selected
Boundary type	**inside**
Show time stamps	Selected
Column	Selected

The function returns the following array:

27-Aug-12 14:19:38	96.92956
27-Aug-12 13:33:08	86.30853
27-Aug-12 10:40:38	18.07261
27-Aug-12 09:31:38	1.893003
27-Aug-12 08:31:38	1.524215
27-Aug-12 07:31:38	14.14445
27-Aug-12 04:58:08	75.70212
27-Aug-12 03:45:08	96.17171
27-Aug-12 02:40:08	99.25044
27-Aug-12 01:31:08	85.70325

Note that you could select the **Time range** option and specify the appropriate **Start time** and **End time** to return the same values.

Sampled Data function

- If you select the **Data item** option, the Sampled Data function returns evenly-spaced, interpolated values for a PI point or PI AF attribute over a regular interval.
- If you select the **Expression** option, the Sampled Data function returns evenly-spaced, interpolated values of a performance equation over a regular interval.

See Interpolated values.

Input	Description
Root path	The common path to specified data items, including those in expressions. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.
Data item(s)	One or more PI point names or PI AF attribute names, for which the function returns values. To specify multiple data items, enter a range of cells that contain PI point names or PI AF attribute names. The function returns values for each. Required if you select the **Data item** option.
Expression(s)	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each. Required if you select the **Expression** option.
Start time	The start of the time period for which the function returns values. See Time inputs. Required.
End time	The end of the time period for which the function returns values. See Time inputs. Required.
Time interval	The frequency that the function returns calculated values during the time period. Enter a value and time unit. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval in the time period. See Time-interval specification. Required.
Filter expression	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
Mark as filtered	Select this check box to insert the label `Filtered` in place of a value or block of values that the function filtered from the output based on **Filter expression**.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
Show time stamps	Select this check box to show the time stamp that corresponds to each returned value. PI DataLink shows time stamps to the left of values displayed in a column or above values displayed in a row.

Input	Description
Column	Click this option to return values in a column.
Row	Click this option to return values in a row. **Note:** If you specify a range of items in **Data item(s)** or a range of expressions in **Expression(s)**, PI DataLink automatically selects **Column** or **Row** to match the orientation of the specified range.

See also

- PISampDat()

  Specify a data item with a filter expression.

- PISampFilDat()

  Specify a data item without a filter expression.

- PIExpDat()

  Specify an expression.

Sampled Data example

To see periodic, interpolated values over the previous 24 hours for the PI point `sinusoid`, set the following inputs for the Sampled Data function:

Input	Value
Data item(s)	`sinusoid`
Start time	`-1d`
End time	`$A$10` (assuming cell A-10 has the current time)
Time interval	`3h`
Show time stamps	Selected
Column	Selected

The function returns the following array:

26-Aug-12 14:03:42	92.40146637
26-Aug-12 17:03:42	73.10555267
26-Aug-12 20:03:42	7.732470989
26-Aug-12 23:03:42	26.54699326
27-Aug-12 02:03:42	92.09828186
27-Aug-12 05:03:42	73.467659
27-Aug-12 08:03:42	7.398549557
27-Aug-12 11:03:42	27.19914818
27-Aug-12 14:03:42	93.86413574

The array contains a value for each 3-hour interval.

Timed Data function

- If you select the **Data item** option, the Timed Data function returns actual or interpolated sample values for a PI point or PI AF attribute at specified time stamps.
- If you select the **Expression** option, the Timed Data function returns values of a performance equation computed at specified time stamps.

Input	Description
Root path	The common path to specified data items, including those in expressions. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.
Data item(s)	One or more PI point names or PI AF attribute names, for which the function returns values. To specify multiple data items, enter a range of cells that contain PI point names or PI AF attribute names. The function returns values for each. Required if you select the **Data item** option.
Expression(s)	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each. Required if you select the **Expression** option.
Time stamp(s)	The time stamps for which the function returns values. Enter a time stamp or a reference to one or more worksheet cells that contain time stamp values. See Time inputs. Required.
Retrieval mode	The method the function uses to retrieve data: • **interpolated** Returns interpolated values that correspond to specified time stamps. For data items with the step attributes, retrieves the value preceding the specified time stamp. See Interpolated values. • **exact time** Returns only values that exactly match specified time stamps; returns `No events found` if no value exists. Available if you select the **Data item** option.

Input	Description
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.

See also

- PITimeDat()

  Specify a data item.

- PITimeExpDat()

  Specify an expression.

Timed Data example

To see values that correspond to an array of time stamps for the PI point `sinusoidu`, set the following inputs for the Timed Data function:

Input	Value
Data items(s)	`sinusoidu`
Time stamps	`$A$3..$A$12` (cells A-3 through A-12 contain the time stamps for an array of compressed data)
Retrieval mode	**interpolated**

The function returns the following timed-data array in the column to the right:

27-Aug-12 14:19:38	96.92956		0.806815326
27-Aug-12 13:33:08	86.30853		2.124000072
27-Aug-12 10:40:38	18.07261		58.63540268
27-Aug-12 09:31:38	1.893003		83.12264252
27-Aug-12 08:31:38	1.524215		96.88283539
27-Aug-12 07:31:38	14.14445		97.71135712
27-Aug-12 04:58:08	75.70212		48.53567886
27-Aug-12 03:45:08	96.17171		19.80453873
27-Aug-12 02:40:08	99.25044		3.524959087
27-Aug-12 01:31:08	85.70325		2.132091284

The time-data array is based on time stamps in the first column.

Calculated Data function

- If you select the **Data item** option, the Calculated Data function returns one or more evenly-spaced, calculated values based on PI point or PI AF attribute values and specified calculation preferences. If you specify no filter expression and no time interval, the function supports bulk calls.
- If you select the **Expression** option, the Calculated Data function returns one or more evenly-spaced, calculated values based on an evaluated performance equation and specified calculation preferences.



Note:
Click + next to **Advanced** to access all function inputs.

Input	Description
Root path	The common path to specified data items, including those in expressions. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.
Data item(s)	One or more PI point names or PI AF attribute names, for which the function returns values. To specify multiple data items, enter a range of cells that contain PI point names or PI AF attribute names. The function returns values for each. Required if you select the **Data item** option.
Expression(s)	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each. Required if you select the **Expression** option.
Start time	The start of the time period for which the function returns values. See Time inputs. Required.
End time	The end of the time period for which the function returns values. See Time inputs. Required.
Time interval	The frequency that the function returns calculated values during the time period. Enter a value and time unit. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval in the time period. See Time-interval specification.
Filter expression	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.

Input	Description
Conversion factor	A factor that the function applies to returned values. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day). Required. For example, common conversion factors include: • 1.0 for values that store units/day • 24 for values that store units/hour • 1440 for values that store units/minute • 86400 for values that store units/second
Calculation mode	The type of calculation that the function performs: • **total** Sums values during the interval. • **minimum** Finds the minimum value during the interval. • **maximum** Finds the maximum value during the interval. • **standard deviation** Computes the standard deviation of values during the interval. • **range** Computes the maximum value minus the minimum value during the interval. • **count** Counts the number of seconds in the interval if the **Calculation basis** field is set to **time-weighted**. Counts the number of values stored during the interval if the **Calculation basis** field is set to **event-weighted**. • **average (time-weighted)** Computes the time-weighted average of the recorded values during the interval. • **average (event-weighted)** Computes the event-weighted average of the recorded values during the interval.

Input	Description
Calculation basis	The calculation method: • **time-weighted** Default for all calculation modes except for event-weighted average. The function weights each recorded value by the length of time that the value applies. The function interpolates values at the interval boundaries. • **event-weighted** The function weights each recorded value equally. Select this option for batch values. This method requires at least one recorded value in a time period (two recorded values for standard deviation calculations). If you enter an expression in the **Expression(s)** field and set the **Expression sampling** field to **interpolated**, then the function interpolates values at the time interval boundaries when there are no recorded values.
Expression sampling	The method that the function uses to determine when to evaluate an expression: • **compressed** The function evaluates the expression during the time period at time stamps where PI points or PI AF attributes in the expression have stored values. If there are no stored values, the function returns either no value or an interpolated value. For best results, select **interpolated** rather than **compressed** during time periods with few stored values. • **interpolated** The function evaluates the expression at evenly spaced sampling intervals, determined by **Expression sampling frequency**. See Interpolated values. **Tip:** For most accurate results, select **interpolated** and set the **Expression sampling frequency** field to a small frequency. Available if you select **Expression** or if you specify a **Filter expression**.
Expression sampling frequency	The frequency that the function evaluates an expression. Required if you set **Expression sampling** to **interpolated**. For example, set to `10m` (10 minutes) to compute an interpolated value every 10 minutes.
Minimum percent good	The minimum percentage of good data required in each time interval to calculate and return a value for that interval. The function returns the label `Insufficient good data` for an interval that does not meet this percentage.

Input	Description
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
Show start time	Select this check box to show the start time of the time interval used to calculate the returned value. PI DataLink shows the start time in a column to the left or in a row above returned values. Only available if you specify **Time interval**.
Show end time	Select this check box to show the end time of the time interval used to calculate the returned value. PI DataLink shows the end time in a column to the left or in a row above returned values. Only available if you specify **Time interval**.
Show min/max time	Select this check box to show the time stamp that corresponds to the minimum or maximum value during the interval used to calculate the value. Only available for three values of **Calculation mode**: • **maximum** Shows the time stamp of the maximum value. • **minimum** Shows the time stamp of the minimum value. • **range** Shows the time stamps of the minimum value and the maximum value.
Show percent good	Select this check box to show the percentage of time that good values were returned during the array time period. PI DataLink shows the percent-good values in a column to the right or in a row below returned values. Good values are recorded values that PI Data Archive determined were valid, and not in an error state. You might use the percentage of good values to assess the reliability of calculations built on PI point values, particularly if you use calculated values in further calculations. For example, if a time period includes bad data, the resulting time-weighted total equals the total divided by the fraction of the interval where good data is available. This normalization assumes that the average over the time period with bad data is equivalent to the average value over the entire period. Thus, the average becomes less reliable if a large fraction of the time period contains bad data.
Column	Click this option to return values in a column.
Row	Click this option to return values in a row. **Note:** If you specify a range of items in **Data item(s)** or a range of expressions in **Expression(s)**, PI DataLink automatically selects **Column** or **Row** to match the orientation of the specified range.

See also

- PIAdvCalcVal()

  Specify a data item to retrieve a single value
- PIAdvCalcFilVal()

  Specify a data item and filter expression to retrieve a single value
- PIAdvCalcExpVal()

  Specify an expression to retrieve a single value
- PIAdvCalcExpFilVal()

  Specify an expression and a filter expression to retrieve a single value
- PIAdvCalcDat()

  Specify a data item and time interval to retrieve multiple values
- PIAdvCalcFilDat()

  Specify a data item, time interval, and filter expression to retrieve multiple values
- PIAdvCalcExpDat()

  Specify an expression and time interval to retrieve multiple values
- PIAdvCalcExpFilDat()

  Specify an expression, time interval, and filter expression to retrieve multiple values
- Retrieval of large amounts of data

Calculated Data example

To see the hourly range of values from midnight today until the present time for the PI point `sinusoid`, set the following inputs for the Calculated Data function:

Input	Value
Data item(s)	`sinusoid`
Start time	`t`
End time	`*`
Time interval	`1h`
Calculation mode	**range**
Calculation basis	**time-weighted**
Show start time	selected
Show end time	selected
Column	selected

The function returns the following array:

27-Aug-12 00:00:00	27-Aug-12 01:00:00	24.07529
27-Aug-12 01:00:00	27-Aug-12 02:00:00	18.15997
27-Aug-12 02:00:00	27-Aug-12 03:00:00	7.87962
27-Aug-12 03:00:00	27-Aug-12 04:00:00	6.306436
27-Aug-12 04:00:00	27-Aug-12 05:00:00	17.04949
27-Aug-12 05:00:00	27-Aug-12 06:00:00	24.06163
27-Aug-12 06:00:00	27-Aug-12 07:00:00	24.06163
27-Aug-12 07:00:00	27-Aug-12 08:00:00	18.65239
27-Aug-12 08:00:00	27-Aug-12 09:00:00	6.653669
27-Aug-12 09:00:00	27-Aug-12 10:00:00	6.846051

In this example, the function calculates the range for each one-hour interval. You can specify any available calculation over any interval.

Time Filtered function

The Time Filtered function returns the amount of time that a performance equation evaluates to `true` during a specified time period.

Note:

- Results from the Time Filtered function vary slightly depending on your PI Data Archive version.
- Results from corresponding performance-equation functions and asset-analytics functions, such as **`TimeGE`** or **`TimeGT`**, are more accurate than those from the Time Filtered function

Input	Description
Root path	The common path to specified data items, including those in expressions. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.
Expression(s)	A Boolean performance equation that the function evaluates. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each. Required.
Start time	The start of the time period for which the function returns values. See Time inputs. Required.

Input	Description
End time	The end of the time period for which the function returns values. See Time inputs. Required.
Time interval	The frequency that the function returns calculated values during the time period. Enter a value and time unit. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval in the time period. See Time-interval specification.
Time units	The units of time in which the function returns the result. Required.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
Show start time	Select this check box to show the start time of the time interval used to calculate the returned value. PI DataLink shows the start time in a column to the left or in a row above returned values. Only available if you specify **Time interval**.
Show end time	Select this check box to show the end time of the time interval used to calculate the returned value. PI DataLink shows the end time in a column to the left or in a row above returned values. Only available if you specify **Time interval**.
Show percent good	Select this check box to show the percentage of time that good values were returned during the array time period. PI DataLink shows the percent-good values in a column to the right or in a row below returned values. Good values are recorded values that PI Data Archive determined were valid, and not in an error state. You might use the percentage of good values to assess the reliability of calculations built on PI point values, particularly if you use calculated values in further calculations. For example, if a time period includes bad data, the resulting time-weighted total equals the total divided by the fraction of the interval where good data is available. This normalization assumes that the average over the time period with bad data is equivalent to the average value over the entire period. Thus, the average becomes less reliable if a large fraction of the time period contains bad data.
Column	Click this option to return values in a column.
Row	Click this option to return values in a row. **Note:** If you specify a range of items in **Expression(s)**, PI DataLink automatically selects **Column** or **Row** to match the orientation of the items.

See also

- PITimeFilterVal()

  Return a single value.

- PITimeFilter()

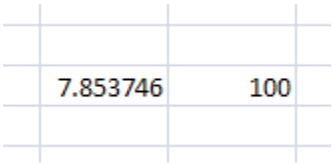
  Specify a time interval and return multiple values.

Time Filtered example

To see the number of hours that the value of the PI point `sinusoid` exceeded 75 during the previous seven days, set the following inputs for the Time Filtered function:

Input	Value
Expression	`'sinusoid' > 75`
Start time	`-7d`
End time	*
Time units	`h`
Show percent good	Selected
Column	Selected

The function returns the following array:



In this example, the function calculates that the value of `sinusoid` exceeded 75 for 7.85 hours over the previous 7 days, and 100 percent of the values were good during this period.

Explore Events function

The Explore Events function returns events that meet specified criteria in a PI AF database. Use the Explore Events function to view and explore events in a hierarchical format. The function returns one event per row.

Use the fields at the top of the Explore Events task pane to specify which PI AF events you want to retrieve. As you specify the criteria for events, the task pane's **Preview** list shows the matching events. Modify the criteria to adjust the matching events before inserting the function array into the worksheet. Use the fields at the bottom of the task pane to specify the columns to include and the position of the inserted function array.

For more details, see the following topics:

- Events in worksheets

  PI DataLink can display data from PI AF events with either the Explore Events function or the Compare Events function.

- Explore events related to an element

Follow this procedure to use the Explore Events function to analyze events related to a particular PI AF element.

- Explore events with child events

  Follow this procedure to use the Explore Events function to analyze events with child events.

- Explore Events task-pane reference

  The fields in the task pane let you specify the events to retrieve and the columns and data to return to the worksheet.

- Reserved attribute names

  To avoid conflicts with automatically generated attributes, do not define events that use reserved attribute names.

- Explore Events example

  Set the Explore Events function inputs to see the events that have been active during the past month and that are based on a particular template.

- Manage PI DataLink settings from Excel

  Use the Settings window to set the maximum number of events that the function returns.

Explore Events task-pane reference

The Explore Events function returns events in a hierarchical format. A preference setting limits the number of events retrieved in the **Preview** list and returned to the worksheet.

Note:
Expand **More search options** to access all function inputs.

Input	Description
Database	The PI AF database from which the function returns events. Specify in the format `\\ServerName\DatabaseName`. Click the field to see a list of databases that contain event templates on connected PI AF servers. You must specify the database before the function can find any matching events. **Tip:** To limit returned events to those under a specific parent event, you can specify the event path of that parent event in the **Database** field. See Search for events of a specific parent event.
Search start	A PI time expression that specifies the time that the function starts searching the database for events. For example, specify `*-12h` to search for events from database records starting 12 hours ago.
Search end	A PI time expression that specifies the time that the function stops searching the database for events. For example, specify * to search for events up to the current time.
Limit to database level	Select this check box to only search the database root level for matching events. If you clear this check box, the function searches for matching events at any level of the hierarchy.
Event name	The name of matched events. You can specify partial names with wildcard characters.

Input	Description
Event template	An event template of matched events. Note that if you select a base event template, the function includes events from derived templates. When you select an event template, the **Columns to display** list updates to reflect attributes of the selected template. The update removes any attributes you previously inserted.
Element name	A PI AF element referenced by the matched events. You can specify partial names with wildcard characters. If using PI AF server version 2.8 or later, you can specify the path to a specific element.
Element template	An element template of an element referenced by matched events. Note that if you select a base element template, the function includes events that reference elements from derived templates. PI AF server version 2.6 or later is required to filter on element templates.
Event category	The category of matched events.
Minimum duration	The minimum duration of matched events. Specify a value and time-unit abbreviation.
Maximum duration	The maximum duration of matched events. Specify a value and time-unit abbreviation.
Search mode	The method that the function uses to find matching events relative to the time period specified by the search start and search end: • **active in range** Find events that are active any time during the specified time period. • **entirely in range** Find events that start and finish during the specified time period. • **starting in range** Find events that start during the specified time period and finish either during or after the specified time period. • **ending in range** Find events that finish during the specified time period and start either before or during the specified time period. • **in progress** Find events that start during the specified time period but have not yet finished. Only available with PI AF server version 2.6 or later.

Input	Description
Sort order	The method that the function uses to sort matched events: • **name ascending** Order events by the event name, from A to Z. • **name descending** Order events by the event name, from Z to A. • **start time ascending** Order events by start time, from earliest to latest. • **start time descending** Order events by start time, from latest to earliest. • **end time ascending** Order events by end time, from earliest to latest. • **end time descending** Order events by end time, from latest to earliest.
Severity	The severity of matched events. Specify an operator and severity type. The function filters matched events based on the specified condition. Severity types correspond to a value, listed from highest to lowest. For example, if you enter **< Warning**, the function matches events less severe than `Warning`: either `Information` or `None`.
Attribute value filters	Up to four attribute conditions that the function uses to filter matched events. **Note:** You must specify an event template before you can specify an attribute-value filter. For each filter, specify: • **Attribute** An event attribute for which the function filters matched events. Available attributes depend on the selected event template. • **Operator** The relational operator that the function applies to the specified attribute value. Available operators depend on the attribute data type. • **Value** The value that the function uses to search for matching attributes. For example, if you set the **Operator** field to **=**, then the function limits events to those with the specified attribute equal to this value.
Acknowledgment filters	Limit matched events to those that can be acknowledged: • Select the **Acknowledged** check box to match events that have been acknowledged. • Select the **Unacknowledged** check box to match events that have not been acknowledged. • Select both check boxes to match any event that can be acknowledged, regardless of its current acknowledgment state.
Limit to annotated	Select this check box to match only annotated events. Clear this check box to match all events, with or without annotations.

Input	Description
Columns to display	The columns in the returned function array. The list contains the names of attributes. By default, the list includes the virtual attributes generated for all events and the event attributes from the selected event template. You can: • Select the **Select all** check box to include all the listed attributes as columns in the returned function array. • Select a check box to include the attribute, or clear a check box to exclude an attribute as a column in the returned function array. • Click  to open the Add Attributes window where you can select additional attributes to include as columns in the function array. See Add attribute columns to the Explore Events task pane. • Type the name of an event attribute next to the blank check box at the bottom of the list. • Right-click an attribute, click **Insert attribute** to insert a blank attribute above the selected attribute, and then type the name of an event attribute. • Select an attribute and click  to move the attribute up in the list. • Select an attribute and click  to move the attribute down in the list. • Select an attribute and click  to remove the attribute from the list. • Right-click an attribute and then click **Delete attribute** to remove the attribute from the list. If the length of the selected column names exceeds 759 characters, the function cannot process columns individually. In this case, the task pane prompts you to specify all columns as a group. With columns specified as a group, the list says **All event attributes and template attributes**, and the returned function array includes all the default attributes and their children attributes, but no additional attributes that you specified.
Number of child event levels	The number of levels of child events that the function includes in the function array. Child events do not need to match the specified criteria. The function returns each child event into a separate row, and adds an additional column for each level returned. In rows containing child events, the added column contains the child-event name.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.

See also

Events in worksheets

Add attribute columns to the Explore Events task pane

Manage PI DataLink settings from Excel

Explore Events example

To see events based on the event template `PowerPlantShutDown` in the database `Production` on PI AF server `AFSRV1` and active during the past month, set the following inputs for the Explore Events function:

Input	Value
Database	`\\AFSRV1\Production`
Search start	`*-1mo`
Search end	`*`
Event template	**PowerPlantDownTime**

The function returns the following array:

Event name	Start time	End time	Duration	Event template	Primary element
PowerPlantShutDown - 20130403.2	03-Apr-13 18:00:00	03-Apr-13 19:00:00	0 1:00:00	PowerPlantShutDown	Big Creek Power Plant
PowerPlantShutDown - 20130404.2	04-Apr-13 18:00:00	04-Apr-13 19:00:00	0 1:00:00	PowerPlantShutDown	Big Creek Power Plant
PowerPlantShutDown - 20130405.2	05-Apr-13 18:00:00	05-Apr-13 19:00:00	0 1:00:00	PowerPlantShutDown	Big Creek Power Plant

Compare Events function

The Compare Events function returns events that meet specified criteria in a PI AF database. Use the Compare Events function to view events in a flat format. The function returns one event per row, but can return attributes from related events in that same row. Specifically, to facilitate event comparison, the function can return attributes from child events or parent events in the same row as the returned event.

Use the fields at the top of the Compare Events task pane to specify which PI AF events you want to retrieve. As you specify the search criteria for events, the task pane **Preview** list shows the matching events. Modify the criteria to adjust the matching events before inserting the function array into the worksheet. Use the fields at the bottom of the task pane to specify the columns to include and the position of the inserted function array.

For more details, see the following topics:

- Events in worksheets

  PI DataLink can display data from PI AF events with either the Explore Events function or the Compare Events function.

- Compare events by including child events

  Follow this procedure to use the Compare Events function to compare events that have child events with the same names.

- Compare events by including parent events

  Follow this procedure to use the Compare Events function to compare events from matching hierarchies when child events have different names.

- Compare Events task-pane reference

  The fields in the task pane let you specify the events to retrieve and the columns and data to return to the worksheet.

- Path notation for Compare Events function

  Use specific path notation in attribute names to designate the location in the event hierarchy.

- Reserved attribute names

  To avoid conflicts with automatically generated attributes, do not define events that use reserved attribute names.

- Compare Events example

  Set the Compare Events function inputs to compare temperature-alert events.

- Manage PI DataLink settings from Excel

  Use the Settings window to set the maximum number of events that the function returns.

Compare Events task-pane reference

The Compare Events function returns events in a flat format. A preference setting limits the number of events retrieved in the **Preview** list and returned to the worksheet.

Note:
Click + next to **More search options** to access all function inputs.

Input	Description
Database	The PI AF database from which the function returns events. Specify in the format `\\ServerName\DatabaseName`. Click the field to see a list of databases that contain event templates on connected PI AF servers. You must specify the database before the function can find any matching events. **Tip:** To limit returned events to those under a specific parent event, you can specify the event path of that parent event in the **Database** field. See Search for events of a specific parent event.
Search start	A PI time expression that specifies the time that the function starts searching the database for events. For example, specify `*-12h` to search for events from database records starting 12 hours ago.
Search end	A PI time expression that specifies the time that the function stops searching the database for events. For example, specify * to search for events up to the current time.
Limit to database level	Select this check box to only search the database root level for matching events. If you clear this check box, the function searches for matching events at any level of the hierarchy.
Event name	The name of matched events. You can specify partial names with wildcard characters.
Event template	An event template of the matched events. Note that if you select a base event template, the function includes events from derived templates. When you select an event template, the **Columns to display** list updates to reflect attributes of the selected template. The update removes any attributes you previously inserted.

Input	Description
Element name	A PI AF element referenced by the matched events. You can specify partial names with wildcard characters. If using PI AF server version 2.8 or later, you can specify the path to a specific element.
Element template	An element template of an element referenced by matched events. Note that if you select a base element template, the function includes events that reference elements from derived templates. PI AF server version 2.6 or later is required to filter on element templates.
Event category	The category of matched events.
Minimum duration	The minimum duration of matched events. Specify a value and time-unit abbreviation.
Maximum duration	The maximum duration of matched events. Specify a value and time-unit abbreviation.
Search mode	The method that the function uses to find matching events relative to the time period specified by the search start and search end: • **active in range** Find events that are active any time during the specified time period. • **entirely in range** Find events that start and finish during the specified time period. • **starting in range** Find events that start during the specified time period and finish either during or after the specified time period. • **ending in range** Find events that finish during the specified time period and start either before or during the specified time period. • **in progress** Find events that start during the specified time period but have not yet finished. Only available with PI AF server version 2.6 or later.
Sort order	The method the function uses to sort returned events: • **name ascending** Order events by the event name, from A to Z. • **name descending** Order events by the event name, from Z to A. • **start time ascending** Order events by start time, from earliest to latest. • **start time descending** Order events by start time, from latest to earliest. • **end time ascending** Order events by end time, from earliest to latest. • **end time descending** Order events by end time, from latest to earliest.

Input	Description
Severity	The severity of matched events. Specify an operator and severity type. The function filters matched events based on the specified condition. Severity types correspond to a value, listed from highest to lowest. For example, if you enter **< Warning**, the function matches events less severe than `Warning`: either `Information` or `None`.
Attribute value filters	Up to four attribute conditions that the function uses to filter matched events.  **Note:** You must specify an event template before you can specify an attribute-value filter. For each filter, specify: • **Attribute** An event attribute for which the function filters matched events. Available attributes depend on the selected event template. • **Operator** The relational operator that the function applies to the specified attribute value. Available operators depend on the attribute data type. • **Value** The value that the function uses to search for matching attributes. For example, if you set the **Operator** field to **=**, then the function limits events to those with the specified attribute equal to this value.
Acknowledgment filters	Limit matched events to those that can be acknowledged: • Select the **Acknowledged** check box to match events that have been acknowledged. • Select the **Unacknowledged** check box to match events that have not been acknowledged. • Select both check boxes to match any event that can be acknowledged, regardless of its current acknowledgment state.
Limit to annotated	Select this check box to match only annotated events. Clear this check box to match all events, with or without annotations.

Input	Description
Columns to display	The columns in the returned function array. The list contains the names of attributes. By default, the list includes the virtual attributes generated for all events and the event attributes from the selected event template. The function includes the path of attributes; the function identifies unique attributes by name and position in the hierarchy. You can: • Select the **Select all** check box to include all the listed attributes as columns in the returned function array. • Select a check box to include the attribute, or clear a check box to exclude an attribute as a column in the returned function array. • Click  to open the Add Attributes window where you can select additional attributes to include as columns in the function array. See Add child-event attributes as columns in the Compare Events task pane. • Right-click an attribute and then click **Clone for parent event** to insert the attribute for the parent event as a column in the function array. See Add parent-event attributes as columns in the Compare Events task pane. • Type the name of an event attribute next to the blank check box at the bottom of the list. • Right-click an attribute, click **Insert attribute** to insert a blank attribute above the selected attribute, and then type the name of an event attribute. • Select an attribute and click  to move the attribute up in the list. • Select an attribute and click  to move the attribute down in the list. • Select an attribute and click  to remove the attribute from the list. • Right-click an attribute and then click **Delete attribute** to remove the attribute from the list. If the length of the selected column names exceeds 759 characters, the function cannot process columns individually. In this case, the task pane prompts you to specify all columns as a group. With columns specified as a group, the list says **All event attributes and template attributes**, and the returned function array includes all the default attributes and their children attributes, but no additional attributes that you specified.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.

See also

Events in worksheets

Add child-event attributes as columns in the Compare Events task pane

Manage PI DataLink settings from Excel

Path notation for Compare Events function

The Compare Events function identifies attributes by path; therefore, attribute names must always include path information, specified relative to the matched event shown in each row. When specifying attributes, use the notation that designates the proper location in the event hierarchy.

Supported path notation

Notation	Description
`.|`*A1*	The *A1* attribute of the matched event.
`..|`*A1*	The *A1* attribute of the matched event's parent event.
`..\..|`*A1*	The *A1* attribute of the matched event's grandparent event.
`.\`*E1*`|`*A1*	The *A1* attribute of the matched event's *E1* child event.

You can combine the notation to designate attributes further up the hierarchy. For example, you can specify the `Duration` attribute for different events in the hierarchy:

- Great-grandparent event: `..\..\..|`*Duration*
- Matched event: `.|Duration`
- Child event named `Phase1`: `.\Phase1|Duration`

Compare Events example

To see attributes from child events in a format that lets you easily compare the parent events, use the Compare Events function. Suppose you have temperature-alert events and each has a single child event that indicates a temperature threat when the pump temperature reaches a certain level. You can retrieve a function array that shows the start time, duration, and temperature recorded for the temperature-threat event stored for each temperature-alert event. The parent events have names that start with `TempAlert` and the child events are named `TempThreat`. To retrieve the function array for events stored during the past week in the `Production` database on the PI AF server `AFSRV1`, enter the following inputs:

Input	Value
Database	`\\AFSRV1\Production`
Search start	`*-1w`
Search end	`*`
Event name	`TempAlert*`

Input	Value
Column headers	Select the following: • **Event name** • **.|Start time** • **.|End time** • **.|Duration** • **.|Primary element** • **.\TempThreat|Start time*** • **.\TempThreat|Duration*** • **.\TempThreat|Temperature*** *Added to list from the Add Attributes window.

The function returns the following array:

Event name	.|Start time	.|End time	.|Duration	.|Primary element	.\TempThreat|Start time	.\TempThreat|Duration	.\TempThreat|Temperature
TempAlert-001	19-Aug-13 05:11:00	19-Aug-13 09:12:23	0 4:01:23	Pump5	19-Aug-13 06:12:00	0 2:22:00	175
TempAlert-002	19-Aug-13 06:17:00	19-Aug-13 09:52:00	0 3:35:00	Pump6	19-Aug-13 05:48:00	0 2:50:10	210
TempAlert-003	19-Aug-13 12:27:00	19-Aug-13 14:28:46	0 2:01:46	Pump5	19-Aug-13 12:44:00	0 0:45:28	225

Asset Filter Search function

The Asset Filter Search function returns assets (that is, PI AF elements or attributes) that meet specified criteria. The criteria can include element name, element template, element category, and element description, as well as the value of attributes. You can insert the returned assets into the worksheet as static values or as a function array.

Use the fields at the top of the Asset Filter Search task pane to specify which PI AF element you want to retrieve. Use the fields at the bottom of the task pane to specify the attributes to retrieve, the output format, and the position.

For more details, see the following topics:

- Searches

  You can search for data items with either the Search tool or the Asset Filter Search function.

- Search for assets by filtering

  Follow this procedure to use the Asset Filter Search function to specify the elements to retrieve and the output for the worksheet.

- Manage PI DataLink settings from Excel

  Use the Settings window to set the maximum number of elements and attributes that the function returns.

Properties function

The Properties function returns the property value of a specified data item.

Input	Description
Root path	The common path to specified data items. Valid entries include: • PI Data Archive server name if the data item is a PI point. • PI AF server and database if the data item is a PI AF attribute. • Blank if the data item is a PI point on the default PI Data Archive server. See Data items.
Data item(s)	One or more PI point names or PI AF attribute names, for which the function returns property values. Reference a range of cells that contain PI point names or PI AF attribute names to display values for each. By default, PI DataLink writes values in rows for a column of referenced data items, and in columns for a row of referenced data items.
Property	The property for which the function returns values. The listed properties depend on the entered data item: • Single PI point. The list contains the point attributes from the point class of the entered point. **Note:** This list substitutes **uom** for **EngUnits**. Select **uom** if you want to see the value of the **EngUnits** point attribute. • Single PI AF attribute. The list contains four PI AF attribute properties: **categories**, **description**, **uom**, and **pipoint**. • Reference to multiple cells. The list depends on the type of data item in the first referenced cell: ◦ PI point. The list contains the point attributes from the **PointClass** of that point. ◦ PI AF attribute. The list contains four PI AF attribute properties: **categories**, **description**, **uom**, and **pipoint**. If the list is blank, PI DataLink could not find the data item. Select the desired property or specify a cell reference to a cell that contains the property.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.

See also

PITagAtt()

Properties example

To see attribute values of some PI points listed in your worksheet, set the following inputs for the Properties function:

Input	Value
Data item	`B3..B5` (cell array containing points)
Property	**description**

The function returns the following array:

BA:CONC.1	Concentration Reactor 1
BA:LEVEL.1	Level Reactor 1
BA:TEMP.1	Temperature Reactor 1

In this case, the point names are in a column to the left. You could use a separate Properties function to show additional attributes in subsequent columns.

Worksheet usage and maintenance

This section discusses how PI DataLink functions work within a worksheet and how to manage and maintain your worksheet over time.

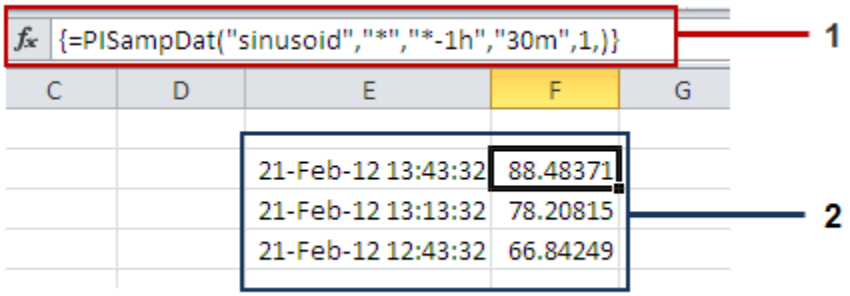
Topics in this section

- Function arrays
- Calculation frequency
- Worksheet sharing

Function arrays

A function array is the cluster of cells that contains the output from a single PI DataLink function. When you add a function to a worksheet, PI DataLink enters the function formula into the specified output cells. The function queries the PI Data Archive server or PI AF server and returns values in a function array. The size of the array depends on the function, the number of matching values available, the number of values requested, and the output requested.

The worksheet shows the returned values in the cells of a function array. However, these cells actually contain the function formula. You can view the function formula in the Excel formula bar when you click a cell.



1. Function formula in formula bar
2. Returned values in function array

Topics in this section

- Common function array tasks
- Update inputs to a function array
- Array size
- Resize arrays

Common function array tasks

Function arrays can be moved within, copied, or removed from a worksheet.

To select an array, do one of the following:

- Click and drag to select every cell in the array. Keep in mind that the array may have empty values, which must also be selected.
- Right-click any part of the array and then click **Select DataLink Function** to select all cells in the array.

Once selected, you can easily manage the array:

- Manually remove initial **$** characters in the formula bar to make cell references relative.

  Note:
  After you make a change in the formula bar, press Ctrl + Shift + Enter to apply that change.

- Right-click any cell in the array and then click the desired **Cut**, **Copy**, **Delete**, **Clear**, or **Format** command.
- Right-click a new cell and then click **Paste** to reinsert a cut or copied array.
- Place the pointer at the edge of the selected array, and when the pointer becomes a movement pointer, drag the array to a new cell to move it.

  Note:
  You must move or clear an entire function array, including all cells, otherwise PI DataLink returns an error message: `You cannot change part of an array.`

- Open the function task pane and update the **Output cell** field to place the array in a new location. See Update inputs to a function array.

You can also copy the values from a function array if you want to use them elsewhere in a worksheet. After you copy and paste the values, they are no longer part of a function array; they are simply cell values and are not updated. To copy array values:

- Select the function values you want, copy them, and use the **Paste Special** command to paste values in the desired location.

  You do not need to select the entire array column or row to copy values.

Update inputs to a function array

Use the function task pane to update a function array with new input values.

Procedure

1. Open the function task pane for an array:
   - With the automatic-task-pane display enabled, click a cell or multiple cells.
   - With the automatic-task-pane display disabled, select a cell or multiple cells, right-click, and choose the function name.

   The function task pane shows the current inputs for the selected function array.

If you selected a single cell, PI DataLink automatically detects adjacent function arrays that differ only by source (that is, by data item or expression) and selects those arrays for editing.

If you selected multiple cells, PI DataLink only selects the arrays with the same source (that is, the same values for data item or expression) as the selected cells.

2. Change input values as desired to update the selected arrays, and click **OK** or **Apply**.

   If you changed the **Output cell** field, the results depend on the location of the new cell reference:

   - If the new cell reference is part of the original array, then PI DataLink moves the entire array, placing the upper-leftmost cell of the array in the newly referenced cell.
   - If the new cell reference is not part of the original array, then PI DataLink copies the array and pastes the copy, locating the upper-leftmost cell in the newly referenced cell. The original array remains in its original location.

Array size

When a PI DataLink function writes a function array, it automatically sizes the array to fit the returned data. Functions write the function array when you click **OK** or **Apply** on a task pane or when you click **Recalculate (Resize) Function** on the shortcut menu.

Other methods that recalculate or update a function do not write a new function array. These methods only update array values; the array size remains unchanged. For example, if you specify function inputs with cell references and change the value in a cell, the function will update returned values but the size of the array remains the same. The update might return more or fewer values than the function array on the worksheet can show. Settings control what PI DataLink returns:

- If the update returns fewer values, PI DataLink either returns blanks or `#N/A` in the cells without values.
- If the update returns more values than the function array can show, PI DataLink returns the text `Resize to show all values` at the bottom of the array unless the preference settings disable the message.

Empty values can change the appearance of a worksheet. To maintain a constant size, consider setting function inputs to limit returned data. For example, in the Compressed Data function, you can specify the number of values to retrieve rather than a time period during which you retrieve all values.

See also

Calculation frequency

Resize arrays

Manage PI DataLink settings from Excel

Resize arrays

An update or recalculation of a PI DataLink function might return more or fewer values than a function array can show. Use the **Recalculate (Resize) Function** command to rewrite the entire

function array: PI DataLink retrieves new values from PI Data Archive or PI AF and automatically resizes the array to fit the returned data.

Procedure

- Right-click a cell in the function array and then click **Recalculate (Resize) Function**.

  The function rewrites the function array, using current inputs, and automatically resizes the array to fit the returned data.

Calculation frequency

PI DataLink writes a function array and calculates the current values for the function whenever you click **OK** or **Apply** on the function task pane. To keep the data current, you must recalculate the function array. Subsequent sections discuss approaches to recalculate a function array.

For detailed information on how Excel manages calculation, see the Excel Recalculation (http://msdn.microsoft.com/en-us/library/bb687891.aspx) topic in the MSDN library.

Topics in this section

- Automatic Update feature
- Triggered recalculation
- Recalculate manually

Automatic Update feature

The Automatic Update feature automatically initiates a recalculation of functions and trends at a specified interval. Automatic Update applies to any workbook opened by the same Excel session. Automatic Update pauses when you open a menu, task pane, or window, or you have the current worksheet in edit mode. Automatic Update cannot update protected workbooks, which are read-only.

Your preference settings affect Automatic Update:

- Type of update

  A preference setting determines which functions update during Automatic Update. There are two choices:

  - **Calculate (F9)**

    Select this option to recalculate all volatile functions and any functions that reference them during each recalculation.

  - **Full Calculate (Ctrl+Alt+Shift+F9)**

    Select this option to recalculate all functions, regardless of volatility, during each recalculation.

- Frequency of update

  In the **Interval** field, enter the number of seconds between automatic recalculation. The minimum value is five seconds. Enter `0` to have PI DataLink automatically set the interval to twice the calculation duration, with a minimum interval of five seconds. OSIsoft recommends you use the automatic interval to ensure that Excel remains responsive 50% of the time.

If the recalculation takes longer than the specified interval, a message prompts you to switch to the automatic interval or to turn off Automatic Update.

See also

Manage PI DataLink settings from Excel

Activate Automatic Update

Cancel Automatic Update

Activate Automatic Update

Activate the Automatic Update feature to recalculate PI DataLink functions automatically at a specified interval.

Procedure

- On the **PI DataLink** tab, click the **Update** button.

  Excel immediately recalculates all PI DataLink functions in any workbooks opened in the current Excel session. Then, Excel automatically recalculates these functions at the interval specified in your preference settings.

  When the Automatic Update feature is enabled, the **Update** button is highlighted and the status bar shows an indicator message.

See also

Manage PI DataLink settings from Excel

Cancel Automatic Update

Cancel the Automatic Update feature to stop automatic recalculation of PI DataLink functions.

Procedure

- On the **PI DataLink** tab, click the highlighted **Update** button to clear the selection.
- Press ESC to cancel a recalculation in progress. PI DataLink finishes the calculation for the currently-processing function, writes `Calculation aborted` in unprocessed function array cells, and turns off Automatic Update.

Triggered recalculation

Excel recalculates volatile functions, and any function or chart that references a volatile function, whenever you edit any worksheet cell or press F9. Volatile functions include the Excel time functions, `now()` and `today()`. The Current Value function is a volatile function; other PI DataLink functions are not. You can trigger recalculation of non-volatile PI DataLink functions by referencing a volatile function within the non-volatile PI DataLink functions.

Base PI DataLink functions on volatile Excel functions

You can maximize the refresh frequency and keep function arrays and charts current by basing your PI DataLink functions on a volatile Excel function.

Note:
To maximize the frequency of updates when Automatic Update is not in use, check your Excel calculation preferences to ensure that both the worksheet and application are set to **Automatic** rather than **Manual** calculation. Keep in mind that this might impact performance and make large worksheets difficult to use.

Procedure

1. Use the Excel formula bar to enter a volatile function in a worksheet cell.

   For example, you can use (`today()+1/3`) to represent 8 a.m. the same day, or `now()` as a cell reference to replace the current PI time, *.

   To create an absolute time stamp that triggers updates, add and subtract `now()`, such as `2-feb-12 00:30:30 + now() - now()`.

2. Reference the cell when you define the **Start time** or **End time** inputs of a PI DataLink function.

Recalculate manually

At any time, you can manually recalculate PI DataLink functions.

Procedure

- Press F9 to force all volatile functions (and any functions that reference them) to recalculate.
- Press Ctrl+Alt+Shift+F9 to force all functions to recalculate.
- Right-click any part of a function array and then click **Recalculate (Resize) Function**. This command will write the entire array and automatically size the array to fit the returned data.

Worksheet sharing

To share PI System data with others, you can share worksheets created with PI DataLink. To determine the best way to share your worksheets, consider the following:

- You can send a PI DataLink workbook to another Microsoft Excel user. The user must have PI DataLink installed and an active connection to the same PI Data Archive server and PI AF server in order to recalculate functions and see dynamically updated PI point and PI AF attribute values.
- Those who do not have PI DataLink installed can still see the last data saved in the worksheet provided the Excel **Workbook Calculation** option is set to **Manual** before they open the worksheet in Excel. See Set Workbook Calculation option to manual.
- You can also save a worksheet as a web page or PDF file to share a static version of the worksheet.

- You can values from function arrays to new locations on a worksheet using the **Paste Special** command. Although the worksheet data can no longer be recalculated once copied, this method allows you to distribute a customized snapshot of data to anyone who has a copy of Excel. See Common function array tasks.
- If you have Microsoft SharePoint Server in your computing environment, you can publish a PI DataLink worksheet to a SharePoint site and use PI DataLink Server (DLS)to display and recalculate data from PI DataLink functions.

Set Workbook Calculation option to manual

To let those without PI DataLink view the last data saved in the workbook, set the Excel **Workbook Calculation** option to **Manual** before you save a workbook.

Procedure

1. Click the **File** tab and select **Options**. (In Excel 2007, click the **Microsoft Office Button**, and then click **Excel Options**.)
2. In the Excel Options window, click **Formulas**.
3. Under **Calculation options**, set **Workbook Calculation** to **Manual**, and then click **OK**.

Advanced topics

Topics in this discussion provide more in-depth information useful for work with PI DataLink functions.

Topics in this section

- PI time
- Expressions
- Manual function entry
- Functions to write data

PI time

You can use a special syntax, called PI time, to specify inputs for time stamps and time intervals. PI time uses specific abbreviations, which you combine to create time expressions.

Topics in this section

- PI time abbreviations
- PI time expressions
- Time-stamp specification
- Time-interval specification

PI time abbreviations

When specifying PI time, you can use specific abbreviations that represent time units and reference times.

Time-unit abbreviations

Abbreviation	Full version	Plural version	Corresponding time unit
`s`	`second`	`seconds`	Second
`m`	`minute`	`minutes`	Minute
`h`	`hour`	`hours`	Hour
`d`	`day`	`days`	Day
`mo`	`month`	`months`	Month
`y`	`year`	`years`	Year
`w`	`week`	`weeks`	Week

To specify time units, you can specify the abbreviation, the full version, or the plural version of the time unit, such as `s`, `second`, or `seconds`. You must include a valid value with any time unit.

If specifying seconds, minutes, or hours, you can specify a fractional value, such as `1.25h`. You cannot specify fractional values for other time units.

Reference-time abbreviations

Abbreviation	Full version	Corresponding reference time
*		Current time
t	today	00:00:00 (midnight) of the current day
y	yesterday	00:00:00 (midnight) of the previous day
sun[1]	sunday	00:00:00 (midnight) on the most recent Sunday
jun[2]	june	00:00:00 (midnight) on the current day in June of the current year
dec *DD*	december *DD*	00:00:00 (midnight) on the *DD*th day of December in the current year
YYYY		00:00:00 (midnight) on the current day and month in year *YYYY*
M-*D* or *M*/*D*		00:00:00 (midnight) on the *D*th day of month *M* in the current year
DD		00:00:00 (midnight) on the *DD*th day of the current month

[1]: Use the first three letters as an abbreviation for any day of the week: `sun`, `mon`, `tue`, `wed`, `thu`, `fri`, or `sat`.

[2]: Use the first three letters as an abbreviation for any month of the year: `jan`, `feb`, `mar`, `apr`, `may`, `jun`, `jul`, `aug`, `sep`, `oct`, `nov`, or `dec`.

PI time expressions

PI time expressions can include fixed times, reference-time abbreviations, and time offsets. A time offset indicates the offset direction (either + or -) and the offset amount (a time-unit abbreviation with a value).

For example, PI time expressions can have the following structure:

Structure	Example
Fixed time only	`24-aug-2012 09:50:00`
Reference-time abbreviation only	`t`
Time offset only	`+3h`
Reference-time abbreviation with a time offset	`t+3h`

Include at most one time offset in an expression; including multiple time offsets can lead to unpredictable results.

Time-stamp specification

To specify inputs for time stamps, you can enter time expressions that contain:

- Fixed times

  A fixed time always represents the same time, regardless of the current time.

Input	Meaning
`23-aug-12 15:00:00`	3:00 p.m. on August 23, 2012
`25-sep-12`	00:00:00 (midnight) on September 25, 2012

- Reference-time abbreviations

  A reference-time abbreviation represents a time relative to the current time.

Input	Meaning
`*`	Current time (now)
`3-1` or `3/1`	00:00:00 (midnight) on March 1 of the current year
`2011`	00:00:00 (midnight) on the current month and day in the year 2011
`25`	00:00:00 (midnight) on the 25th of the current month
`t`	00:00:00 (midnight) on the current date (today)
`y`	00:00:00 (midnight) on the previous date (yesterday)
`tue`	00:00:00 (midnight) on the most recent Tuesday

- Reference-time abbreviations with a time offset

  When included with a reference-time abbreviation, a time offset adds or subtracts from the specified time.

Input	Meaning
`*-1h`	One hour ago
`t+8h`	08:00:00 (8:00 a.m.) today
`y-8h`	16:00:00 (4:00 p.m.) the day before yesterday
`mon+14.5h`	14:30:00 (2:30 p.m.) last Monday
`sat-1m`	23:59:00 (11:59 p.m.) last Friday

- Time offsets

  Entered alone, time offsets specify a time relative to an implied reference time. The implied reference time might be the current clock time or another time, depending on where you enter the expression.

Input	Meaning
`-1d`	One day before the reference time
`+6h`	Six hours after the reference time

Time-interval specification

Time-interval inputs define intervals for collecting or calculating values during a time period. For example, you might specify a 60-minute interval to compute an hourly average over a 12-hour period. To specify time-interval inputs, enter a valid value and time unit:

- Positive values define intervals that begin at the earlier time in the period and that finish at or before the later time in the period.

Start time	`2:00:00`
End time	`3:15:00`

Time interval	`30m`
Returned intervals	2:00:00 to 2:30:00 2:30:00 to 3:00:00

- Negative values define intervals that finish at the later time in the period and that begin at or after the earlier time in the period.

Start time	`2:00:00`
End time	`3:15:00`
Time interval	`-30m`
Returned intervals	2:15:00 to 2:45:00 2:45:00 to 3:15:00

Expressions

In PI DataLink, expressions are performance equations that you can use in functions to incorporate mathematical operations and calculations based on PI System data items. For example, you might use an expression in a PI DataLink function to calculate values as they are retrieved from PI Data Archive.

Note:
PI DataLink restricts data items that you can include in expressions. See Restrictions on data items in expressions.

Some PI DataLink functions accept either a data item or an expression as input. These functions have **Data item** and **Expression** options at the top of the task pane. Some PI DataLink functions also have a **Filter Expression** field. Specify a filter expression to limit the values that a function returns.

PI DataLink functions that can use expressions include:

- Archive Value function
- Compressed Data function
- Sampled Data function
- Timed Data function
- Calculated Data function
- Time Filtered function

Subsequent sections describe basic information about expressions. PI DataLink supports all the syntax, operators, and functions that PI Data Archive supports.

For a full description of performance equations and examples, see the PI Server topic "Performance Equations syntax and functions reference" in Live Library (https://livelibrary.osisoft.com).

Topics in this section

- Use expressions in PI DataLink functions
- Expression syntax

- Expressions in Excel cells
- Cell references in expressions
- Restrictions on data items in expressions
- Expression examples
- Filter expressions

Use expressions in PI DataLink functions

Use expressions in PI DataLink functions to incorporate mathematical operations and calculations based on PI System data items. Functions that accept either a data item or an expression have **Data item** and **Expression** options at the top of the task pane.

Before you start

Open the function task pane.

Procedure

1. Click the **Expression** option at the top of the function task pane.

   The **Data item(s)** field becomes an **Expression(s)** field. The availability of other fields might change.

2. Enter the expression directly in the **Expression(s)** field, or enter a reference to a cell that contains a complete expression.

   You must use a cell reference in the following cases:

   - To enter multiple expressions for a function

     In the **Expression(s)** field, enter a range of cells that contain complete expressions.

   - To enter an expression that includes an Excel function or Excel calculation operator, such as the ampersand used to reference another cell

     Enter these expressions in a cell as an Excel formula.



Tip:
Expressions entered with cell references are easier to view and edit. Make future worksheet maintenance easier by using cell references to enter expressions.

Expression syntax

Follow these guidelines when writing expressions:

- Enclose any PI point or PI AF attribute names in single quotes.

  ```
  'sinusoid'>1
  ```

- Enclose any time expression in single quotes.

  ```
  't'
  ```

  ```
  '11-Apr-17'
  ```

- Enclose any string values or digital states in double quotes.

  ```
  'stringtag'="ACME"
  ```

Expressions in Excel cells

When entering an expression in an Excel cell, use the appropriate method:

- **Excel string**

  Enter a single quote followed by the expression. This results in two single quotes in succession for expressions that begin with a PI point or PI AF attribute name.

  ```
  'abs('sinusoid')>1
  ```

  ```
  ''sinusoid'>1
  ```

  The single quote forces Excel to interpret the expression as a string.

  Use this method only if the expression contains no Excel functions or calculation operators (including those used for cell references in expressions).

- **Excel formula**

  Enter an equal sign followed by the expression within double quotes.

  ```
  =" abs('sinusoid') > 1"
  ```

  ```
  =" 'sinusoid' > 1"
  ```

  Use this method if the expression contains an Excel function or calculation operator, such as the ampersand used for cell references in expressions.

  This method can be used for any expression.

Cell references in expressions

To include a cell reference within an expression, you must specify the expression in an Excel cell. (When entered in task-pane fields, cell references must specify the entry for the entire field.)

In the Excel cell, enter the expression as an Excel formula following this approach:

- Split the expression into the strings before and after the cell references.
- Concatenate all the strings with the ampersand (&) calculation operator. At calculation, Excel combines the strings before and after the ampersand to create a single string.

Examples

- **Cell reference for single value**

  Suppose you want an expression that returns true when the PI point specified in cell B6 is greater than 0:

  ```
  'Point in B6' > 0
  ```

  In the cell where you want to store the expression, enter:

  ```
  ="'" & B6 & "' > 0"
  ```

  Excel resolves the formula based on the value of the cell B6, such as the point `sinusoid`. In a PI DataLink function, you can reference this cell in any expression field that requires a Boolean expression.

'sinusoid'>0

- **Cell references for multiple inputs to performance-equation function**

  Suppose you want an expression that uses the **TimeGT** performance-equation function with inputs from an Excel worksheet.

6	Point	sinusoid
7	Start Time	t
8	End Time	*
9	Minimum	40

  This function finds the total time that a PI point is above a particular value. In the worksheet, cell B6 contains the point, B7 the start time, B8 the end time, and B9 the value. The start and end times are entered as PI time expressions. The equivalent expression is:

  `TimeGT('Point in B6','Time in B7','Time in B8',Value in B9)`

  In the cell where you want to store the expression, enter:

  `= "TimeGT('" & B6 & "','" & B7 & "','" & B8 & "'," & B9 & ")"`

  Excel resolves the formula based on the value of the cells.

TimeGT('sinusoid','t','*',40)

- **Excel-function and cell-reference inputs to performance equation function**

  Suppose you want to use the same performance-equation function but the time inputs use a non-PI time format.

14	Point	sinusoid
15	Start Time	4/16/2017 12:00:00 AM
16	End Time	4/17/2017 12:00:00 AM
17	Minimum	40

  In this case, the time is entered as a string in a specific format. You can use the Excel TEXT function to convert the time strings into a date. The equivalent expression is:

  `TimeGT('Point in B14','TEXT(B15,"DD-MMM-YYYY HH:MM:SS")','TEXT(B16,"DD-MMM-YYYY HH:MM:SS")',Value in B17)`

  In the cell where you want to store the expression, enter:

  `="TimeGT('" & B14 & "','" & TEXT(B15,"DD-MMM-YYYY HH:MM:SS") & "','" & TEXT(B16,"DD-MMM-YYYY HH:MM:SS") & "'," & B17 & ")"`

  Excel resolves the formula based on the value of the cells.

TimeGT('sinusoid','16-Apr-2017 00:00:00','17-Apr-2017 00:00:00',40)

Restrictions on data items in expressions

PI DataLink permits the following data items in expressions:

- PI points
- PI AF attributes that store data references to PI points
- PI AF attributes that store constant values

Furthermore, a PI DataLink function can only return data from a single PI Data Archive server. Therefore, any PI points in an expression, including those referred to by PI AF attributes, must be stored on the same PI Data Archive server. Similarly, PI points in a filter expression must be stored on the same PI Data Archive server as any PI points specified by the **Data item** or **Expression** fields.

Expression examples

The following examples show expressions that evaluate data items and manipulate or do calculations on the values of data items:

- **Arithmetic operation on PI points**

  ```
  ('sinusoid')^3 + 'cdf144'/10
  ```

  Returns the sum of the value of the PI point `sinusoid` cubed and the value of the PI point `cdf144` divided by 10.

- **Boolean evaluation of PI point**

  ```
  abs('mytag') >= 14.65
  ```

  Returns `true` (non-zero) if the absolute value of the PI point `mytag` is at least 14.65.

- **Boolean evaluation of PI AF attribute**

  ```
  '\\Server\Database\Element|Manufacturer' = "ACME"
  ```

  Returns `true` if the value of the PI AF attribute `Manufacturer` is `ACME`.

- **Complex Boolean evaluation of simultaneous condition of two PI points**

  ```
  'sinusoid' < 45 and sqr('vdf1002') > 2
  ```

  Returns `true` if the value of the PI point `sinusoid` is less than 45 and the square root of the value of the PI point `vdf1002` is greater than 2.

- **Evaluation of digital-state point**

  ```
  StateNo('BA:Phase.1')
  ```

  Returns the digital state number (also known as the digital state code) of the digital point `BA.Phase.1` rather than returning the digital state value of the point.

Filter expressions

Use a filter expression in a PI DataLink function to filter recorded values with a Boolean performance equation. PI DataLink removes data for which the expression evaluates as `false`.

PI DataLink applies the filter expression to the raw data retrieved (and not values that result from the calculation itself). For example, adding the simple filter expression `'sinusoid' < 70` to the Calculated Data function would remove all values equal to or greater than 70 from the calculation.

Filter expressions can contain any valid Boolean performance equation; however, data items in filter expressions must reference a PI point. You can build complex expressions. For example, you might use filter expressions to remove atypical peaks in recorded values.

If available, select the **Mark as filtered** check box to insert the label `Filtered` in place of a value or block of values that the function filtered from the output based on the filter expression.

Manual function entry

Though you can use the PI DataLink interface to build any PI DataLink function, experienced users might prefer to enter functions directly in the Excel formula bar.

The following topics apply to PI DataLink functions entered directly into the formula bar.

Topics in this section

- Define functions manually
- Guidelines for entering arguments manually
- Output codes

Define functions manually

If you do not want to use the function task pane, you can define PI DataLink functions manually.

Procedure

1. Select an appropriate range in the worksheet for the output array based on the number of expected values.
2. Enter the PI DataLink function and its arguments into the Excel formula bar.
3. Press Ctrl+Shift+Enter to place the PI DataLink function into the selected output cells.

   Refer to the Microsoft Excel online help for more information on array formulas.

Guidelines for entering arguments manually

The following table lists types of data you might enter as arguments to PI DataLink functions, and provides guidelines for entering them:

Data entered as argument	Guideline
Standard functions	You can include various functions in arguments that accept expressions. For a list of functions, see the PI Server topic "Built-in performance equation functions" in Live Library (https://livelibrary.osisoft.com).
Strings	Surround string arguments with double quotes. For example, to retrieve the snapshot time and value for the PI point `sinusoid` from the PI Data Archive server named `casaba`, select a 1 x 2 output array and enter: `=PICurrVal("sinusoid", 1, "casaba")`
Expressions	Surround expression arguments with double quotes. Within the expression, surround PI point or PI AF attribute names with single quotes and surround string values or digital states with two double quotes. For example, to enter an expression that returns a value of `true` when the PI point `cdm158` equals `Manual`, type: `"'cdm158'=""Manual"""`

Cell references	You can use cell references for any PI DataLink function arguments. For example, suppose the worksheet cells have the following values:
	• A1: `"sinusoid"`
	• A2: `1`
	• A3: `"casaba"`
	Then, entering the following function in the formula bar:
	`=PICurrVal(A1, A2, A3)`
	is equivalent to entering:
	`=PICurrVal("sinusoid", 1, "casaba")`

Root path	Surround an entry with double quotes. For example, to retrieve the current value for the PI AF attributes specified in cells B3 through B5 and stored in the PI AF server `DLAFPI`, database `MyTest`, and element `Reactor`, enter:
	`=PICurrVal(B3:B5,0,"\\DLAFPI\MyTest\Reactor")`
	To specify no root path, such as if the data item is a PI point on the default PI Data Archive server, enter two double quotes:
	`""`
	See Data items for information about valid entries.

Output codes	Determines what appended data the function returns and how the function orients output. See Output codes.

Output codes

PI DataLink function syntax contains an integer **`OutCode`** argument. This argument takes an output code that determines which appended data the function returns and the orientation of output cells.

PI DataLink task panes generate output code values automatically. However, if you enter a function manually in the Excel formula bar, you need to calculate and include an appropriate output code value.

An output code is an integer representation of binary bits. In PI DataLink, bit meaning depends on the function:

Bit meaning for Current Value and Archive Value functions

Bit	Purpose
1st	Show time stamp in column to left of value
2nd	Show time stamp in row above value

Bit meaning for other PI DataLink functions

Bit	Purpose
1st	Show time stamps
2nd	Orient data in rows rather than columns
3rd	Show percent good
4th	Hide count
5th	Show extended status
6th	Show annotations
7th[1]	Show start time
8th[1]	Show end time
9th[1]	Show min/max time
[1] Requires that the 1st bit be enabled also	

With the **`OutCode`** argument set to `0`, a function returns the value in a column orientation with no appended data. To compute the **`OutCode`** argument, use the following formula:

$$\text{OutCode} = \sum_{i} 2^{x_i - 1}$$

where x is the set of enabled bits

For example, with an **`OutCode`** argument of `0`, the `PISampDat()` function returns the sampled values in the designated output cell. With an **`OutCode`** argument of `1`, the function returns time stamps in column one and sampled values in column two of an *n* x 2 array. With an **`OutCode`** argument of `3`, the function returns time stamps in row one and the sampled values in row two of a 2 x *n* array. (In these results, *n* is the number of sampled values.)

Note:
Functions support different bits and therefore **`OutCode`** argument values. Those valid for one function are not necessarily valid for another function. See the Function reference for the bits that each function supports in its **`OutCode`** specification.

Example

Suppose you want the Calculated Data function to display percent good, start time, and min/max time. To display the start time and min/max time, you must enable the show-time-stamps bit. To calculate the **OutCode** argument:

Enabled bits = {Show time stamps, Show percent good, Show start time, Show min/max time}

x = { 1, 3, 7, 9 }

$$\text{OutCode} = \sum_i 2^{x_i - 1}$$

$$= 2^{1-1} + 2^{3-1} + 2^{7-1} + 2^{9-1}$$

$$= 2^0 + 2^2 + 2^6 + 2^8$$

$$= 1 + 4 + 64 + 256$$

$$= 325$$

In the Excel formula bar, enter:

```
=PIAdvCalcDat("sinusoid","y","t","1h","minimum","time-weighted", 50, 1,
325,"MyDataServer")
```

Note:
If an **OutCode** argument specifies the display of multiple columns or rows but the worksheet does not show them, right-click the function array and choose **Recalculate/ Resize** to rewrite the function array.

Functions to write data

Unlike standard PI DataLink functions, which retrieve data from PI Data Archive or PI AF, the `PIPutVal()` and `PIPutValX()` functions write values from a worksheet to PI Data Archive or PI AF. The `PIPutVal()` and `PIPutValX()` functions can replace existing values at particular time stamps with new user-supplied values. You must run the `PIPutVal()` or `PIPutValX()` function from a macro-enabled workbook.

You can use the example workbooks distributed with PI DataLink to write data to PI Data Archive or PI AF. See Write data to PI Data Archive or PI AF.

See also

PIPutVal() and PIPutValX()

Write data to PI Data Archive or PI AF

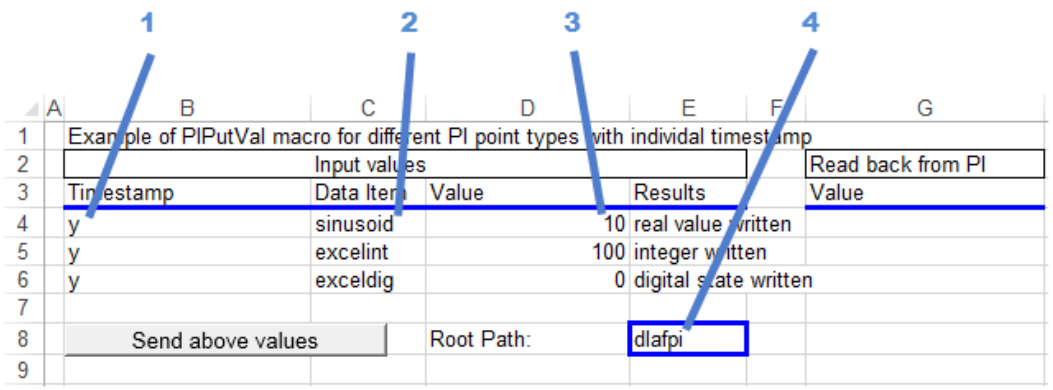
Use the example workbooks distributed with PI DataLink to write data to PI Data Archive or PI AF with the `PIPutVal()` and `PIPutValX()` functions.

Tip:
For an example of how you can write Visual Basic for Applications (VBA) code to use these functions, open the Visual Basic editor for the example workbook and examine the `PutVal_code` module.

Procedure

1. Open the example workbook from the `../PIPC/Excel` directory:
   - `piexam32.xls`, distributed with PI DataLink for 32-bit Excel
   - `piexam64.xls`, distributed with PI DataLink for 64-bit Excel

   The sample workbooks contain one worksheet, `PutVal`. This worksheet has two sections. The first section uses the `PIPutVal` function to enter values for multiple data items, each with a different time stamp. The second section uses the `PIPutValX` function to enter values for multiple data items with the same time stamp.
2. In the appropriate cells of the `PutVal` worksheet, enter the time stamp, data item, and value that you want to write, as well as the root path that specifies the server for the entered data items.

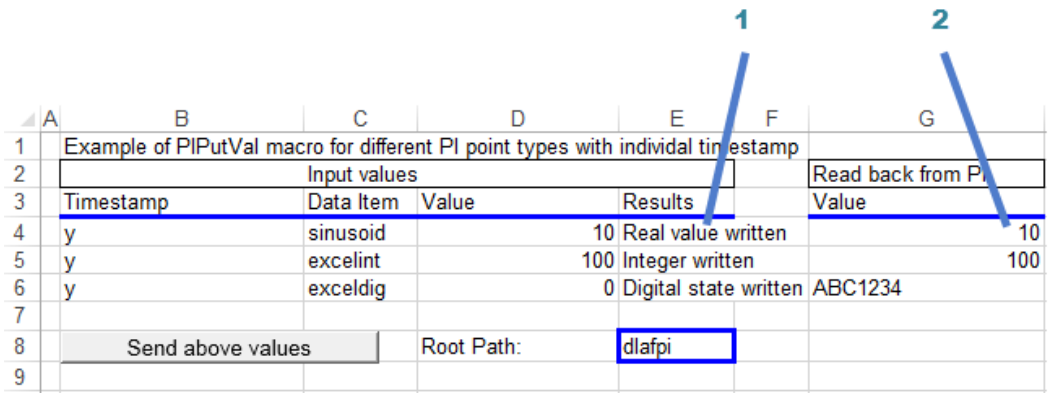


1. Time stamp
2. Data item
3. Value to write
4. Root path

Worksheet with values entered to write to server

3. Click the **Send above values** button to start the macro.

   The macro uses either the `PIPutVal()` or `PIPutValX()` function to write the specified values and record the responses, and then uses the `PIArcVal` function to return the values stored on the server.



1. Response from `PIPutVal` function
2. Value retrieved with `PIArcVal` function

Worksheet after macro runs

Tag functions

A PI point is a stream of real-time data from a defined source. Point attributes, including **Tag** (that is, the PI point name) and point source, describe a PI point.

Use PI DataLink tag functions to find points that correspond to PI point IDs or other point attributes. You can find tag functions on the **PI DataLink** tab in the **Tag Functions** group.

Note:
You must activate the PI DataLink (Legacy) add-in to use these functions (see Microsoft Excel add-in configuration).

See also

Overview of PI DataLink functions

Properties function

Trends

Topics in this section

- Point ID to Tag function
- Attribute Mask to Tag function
- Search for PI points

Point ID to Tag function

The Point ID to Tag function returns the name of the PI point that corresponds to a specific point ID.

Input	Description
PI Data Archive	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.
Point ID(s)	One or more point IDs for which you want the function to return point names. Required.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.

See also

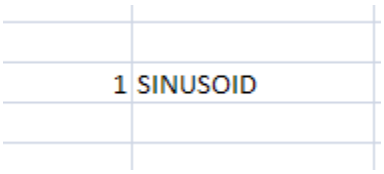
PIPointIDToTag()

Point ID to Tag example

To see the name of the PI point that corresponds to a point ID, set the following inputs for the Point ID to Tag function:

Input	Value
Point ID	A5 (a cell that contains a point ID)

The function returns the following array:



In this case, 1 is the point ID and SINUSOID is the returned point name.

Attribute Mask to Tag function

The Attribute Mask to Tag function returns the names of PI points that match one or more specified point attribute values.

Input	Description
PI Data Archive	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.
Tagname(s)	PI point attribute value for which the function finds the corresponding point name. You must enter a value in at least one input. Use the wildcard character (*) to find all matches or matches limited to specified characters. For example, enter S* in **Point source** to find any point with a point source of S or a point source that begins with S.
Descriptor	
Point source	
Point type	
Point class	
Engineering units	
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
Column	Click this option to return values in a column.
Row	Click this option to return values in a row.

See also

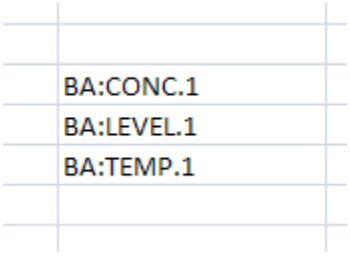
PIAttributeMaskToTag ()

Attribute Mask to Tag example

To see the PI points of type `Float32` and that have a name that starts with `BA`, set the following inputs for the Attribute Mask to Tag function:

Input	Value
Tagname	`BA*`
Point type	`Float32`

The function returns the following array:



Note that you can use wildcards. The entered strings must match attribute values in PI Data Archive.

Search for PI points

For tag-information functions, use the Tag Search window to query PI Data Archive for the IDs or names of PI points to insert in the task pane.

Procedure

1. On the task pane, click  next to the **Point ID(s)** or **Tagname(s)** field.
2. In the Tag Search window, click the appropriate tab for your search:
   - **Basic Search**

     Use to create a mask from specified PI point attributes and search for points that have matching attribute values.
   - **Advanced Search**

     Use to build a query for a complex search that involves more point attributes than the basic search.
   - **Alias Search**

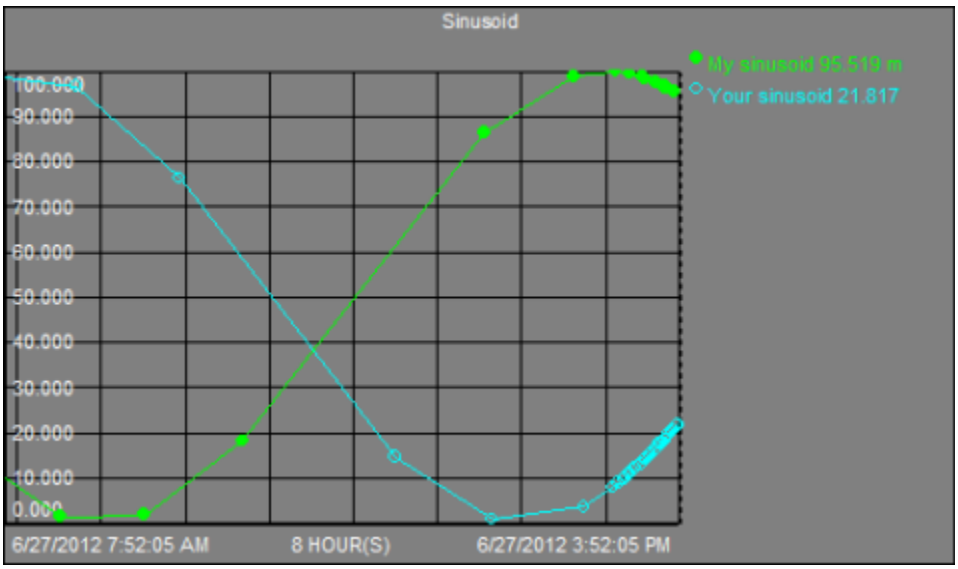
     Use to select points by their descriptive aliases in the PI Module Database.
3. Enter the search criteria.

   Use * or ? as wildcard characters, as appropriate. For example, set the **Tag Mask** field to `Tem*` to return all point names that start with `Tem`, but set the field to `Tem?` to return only points that start with `Tem` and end with another single character. All search fields are case insensitive.
4. If desired, click **Favorites** to access previous searches.

5. Click **Search** to find points that match the specified criteria.
6. Select the desired point in the results pane, and click **OK** to insert the value in the task pane.

Trends

The PI DataLink version for 32-bit Microsoft Office includes an ActiveX trend object. You can insert a trend into a worksheet to visually depict changes in recorded values over time. Trends can depict data in the worksheet or from selected PI points.



Note:
You must activate the PI DataLink (Legacy) add-in to insert or edit trends (see Microsoft Excel add-in configuration).

Topics in this section

- Create a trend
- Trend right-click menu

Create a trend

A trend includes one or more traces, which visually depict a set of values. Use the Trend Add-in Wizard to insert and configure trends.

Procedure

1. In a worksheet, click the cell where you want to place the top left corner of the trend.

   When selecting the cell, remember that by default a trend requires approximately 14 by 8 standard cells.

2. On the **PI DataLink** tab, in the **Tag Functions** group, click **Insert Trend** to open the Trend Add-in Wizard.

3. Define one or more traces to include in the trend. You can:

   - Create a trace of values in the worksheet.
   - Create a trace of PI point values retrieved from PI Data Archive.

4. Adjust the appearance of the traces in the trend. You can:
   - Select the check box in the **Markers** column to include markers that indicate the location of archived data points.

     Note:
     Traces are drawn in different colors. By default a trend also includes color-blind markers to differentiate traces on monochrome screens. Color-blind markers are evenly spaced along a trace and do not indicate archived data points.
   - Select a trace and then use the arrow buttons to move the trace up or down in the legend.
   - Select a trace and then click **X** to remove the trace.
   - Click **X All** to remove all the traces.
   - Select a trace and then click **Rename** to rename the trace.
5. Click **Next**.
6. If any of the traces in the trend contains PI point values retrieved from a PI Data Archive server, specify the time period to retrieve values:
   a. Specify the start of the period in the **Start Time** field and the end of the period in the **End Time** field. You can:
      - Select a time string from the list.
      - Type a time value in the field.
      - Click  to change the field to a data-reference field, and then click the worksheet cell that contains a time string or type the address of that worksheet cell

      See PI time for a discussion of valid time strings.
   b. Select the **Enable Updates** check box to refresh the trend with new PI Data Archive data if the time range changes or extends to the present.
7. Click **Next**.
8. Specify the title and placement of the trend:
   a. In the **Trend title** field, type a title for the trend.
   b. Clear the **Show Value Attributes** check box if you do not want value attributes to appear on trend traces.

      The icons appear when the data contains recorded values that have the Questionable, Substituted, or Annotated bits set.
   c. If desired, specify a different location for the trend. You can select:
      - **New worksheet** to place the trend at the top left corner of a blank worksheet.
      - **Existing worksheet** to place the trend in the current worksheet beginning in the specified cell.

        If you change the cell, make sure the new cell does not contain data.
9. Click **Finish**.

Create a trace of values in the worksheet

When creating a trend with the Trend Add-in Wizard, you can define a trace for the trend from values in a worksheet.

Procedure

1. In the Trend Add-in Wizard, click **Data on worksheet**.
2. Click the **Cell Range containing data** field, and then select the worksheet cells that contain the values.
3. Specify options appropriate to the specified cell range:
   - Select the **First element is trace name** check box to use the value of an adjacent cell as the name of the trace. (If the cell range is a column, then the name of the trace is in the cell above the first value; if the cell range is a row, then the name of the trace is in the cell to the left of the first value.)
   - Select the **Include all cells in array** check box to include all the cells in a function array in the cell range. If you select this check box, the **Cell Range containing data** field only needs to specify one cell in a function array.
   - Select the **Stepped** check box to plot a stepped trend instead of a continuous trace. You might select this check box for PI points that store discrete values.
4. Click **Add** to insert the trace in the trend.

Create a trace of PI point values retrieved from PI Data Archive

When creating a trend with the Trend Add-in Wizard, you can define a trace for the trend from values retrieved from PI Data Archive.

Procedure

1. In the Trend Add-in Wizard, click **Data from PI**.
2. In the **Tag name** field, specify the PI point name you want to retrieve values for. You can:
   - Type the name of the point.
   - Click the field and then select the worksheet cells that contain names of points.
   - Click  to open the Tag Search window, which you can use to search for points (see Search for PI points).
3. In the **Server name** field, specify the PI Data Archive server that stores values for the point. You can:
   - Select the server from the list.
   - Click  to change the field to a data reference field, and then click the worksheet cell that contains a server or type the address of that worksheet cell.
4. Click **Add** to insert the trace in the trend.

Trend right-click menu

Use the trend right-click menu to update, edit, or manage a trend inserted in a worksheet. Right-click a trend to open a menu with several commands:

- **Change Scale**

  Open the Change Scale window to change the y-axis scale or the x-axis time range.

- **Revert**

  Undo any changes and revert to the original trend settings defined in the Trend Add-in Wizard.

- **Scroll Bar**

  Enable a scroll bar at the bottom of the trend to scroll the display through adjacent time periods.

- **Format**

  Open the PI Trend Control Properties window to edit the appearance of individual traces or the trend as a whole. You can change the color or line thickness of a trace, or add legend items to the trend.

- **Define Trend**

  Open the trace definition page of the trend wizard to update or change the traces.

- **Define Trend Time Range**

  Open the time range definition page of the trend wizard to update the time range.

- **Delete Trend**

  Remove the trend from the worksheet.

  Note:
  You cannot restore a deleted trend; you can only recreate.

- **Export Data**

  Open the Export Data window to paste the values in the trend into rows or columns of the worksheet. You can also export trace names as headings.

- **Move/Resize**

  Open the Move/Resize window to move the upper left corner of the trend to a specified cell. Enter a cell range to resize the trend.

- **Copy/Paste**

  Open the Copy/Paste window to paste a copy of the trend to a specified cell.

PI Module Database objects

The topics in this section describe the tools that PI DataLink provides to access PI Module Database objects. You can find these tools on the **PI DataLink** tab in the **Module Database** group. See the PI Data Archive documentation for more information about module databases and configuration.

Note:
You must activate the PI DataLink (Legacy) add-in to use these tools (see Microsoft Excel add-in configuration).

Topics in this section

- PI Module Database and worksheets
- Insert PI Module Database objects into your worksheet
- Module database functions

PI Module Database and worksheets

The PI Module Database is a hierarchical tree structure based on the contents of PI Data Archive. The PI Module Database provides an entirely different way to build the infrastructure of a worksheet. If the module database on your PI Data Archive is configured and includes objects that represent the PI points you want to use, your worksheets can be easier to build and provide more flexibility and potential for re-use.

The PI Module Database is typically configured by your system or PI administrator, and stores aliases and properties that refer to PI points and their attributes, respectively. The hierarchical structure of these objects provides a relational context between points.

For example, you may have five PI points that represent the levels of five individual, identical tanks. Each point has a different name (**Tag** attribute) and represents a different physical object, but their usage and monitoring requirements are the same.

By retrieving objects from the module database, you can create a single worksheet built on the aliases and properties that represent all five tanks. Module database functions resolve these objects into point names and other attribute values. Parallel module paths for each tank provide a different context for the alias references.

With this type of structure, you can use the same worksheet to alternate between views of multiple assets. For instance, when you select the name of any of the five tanks in a worksheet cell, the alias mapping to the matching PI point allows PI DataLink functions to retrieve values for the appropriate tank.

Insert PI Module Database objects into your worksheet

Use the Module Browse window to browse PI aliases, properties, and module paths in the PI Module Database. You can select these items and copy them directly into a worksheet.

Note:
Aliases and properties corresponding to PI points must be configured in your PI Module Database to use the Module Database functions in PI DataLink.

Procedure

1. Select a cell, and then on the **PI DataLink** tab click **Module Browse** to open the Module Browse window.
2. Select the type of object you are looking for:
   - **Alias**
   - **Property**
   - **Module**
3. From the **PI Data Archive** list, select the connected PI Data Archive server that contains the module database you want to browse.
4. From the **Query date** list, specify the effective date and time of the module database hierarchy that you want to see.
5. Browse the tree hierarchy to find the desired item.
6. Select an item or a parent collection object that you want to copy to the worksheet:
   - Select an item to copy it to the worksheet.
   - Select a parent object (either **Aliases** or **Properties**) in a module to copy all the aliases or properties of that module to the worksheet.
7. Select the **Copy module path** check box to copy the full module path of the alias or property to the adjacent worksheet cell.

   The module path provides the context for the selected object.

   Note:
   If the **Copy PI Data Archive name** setting (see Manage PI DataLink settings from Excel) is enabled, PI DataLink also copies the corresponding PI Data Archive server name.
8. Click **OK** to copy the selected items to the worksheet and close the window.

Module database functions

Use PI DataLink module database functions to find the PI points that correspond to aliases and properties in a module database tree. These functions use the module path. You can enter a module path as a function argument or reference it from a worksheet cell. You can find module database functions on the **PI DataLink** tab in the **Module Database** group.

Note:
The function cannot resolve an alias or property object into a PI point without a module path. The path provides a context that maps the alias to a specific PI point.

See also

Overview of PI DataLink functions

Topics in this section

- Alias to Tag function

- Property to Value function

Alias to Tag function

The Alias to Tag function returns the name of the PI point that corresponds to a specified PI alias.

Input	Description
PI Data Archive	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.
Alias(s)	An alias in PI Module Database. Required.
Module path	The module path from the PI Module Database where the specified alias can be found. If you specify **Alias** by browsing the Module Database, then PI DataLink enters **Module path** automatically. Required.
Query date	An effective date of the alias. PI DataLink returns the point that corresponds to the specified alias on this date. Required.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.
No server	Choose to return only the PI point name.
Server at right	Choose to display the PI Data Archive server that stores the point in the cell to the right of the point name.
Server at bottom	Choose to display the PI Data Archive server that stores the point in the cell below the point name.

See also

PIAliasToTag()

Property to Value function

The Property To Value function returns the value or values corresponding to a specified PI property.

PI DataLink can return values for Boolean, Date, Double, Integer, Long, Null, Single, and String property types, or for Double, Integer, Long, and Single array property types.

Input	Description
PI Data Archive	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.
Property(s)	A PI property in PI Module Database. Required.
Module path	The module path from the PI Module Database where the specified property can be found. If you specify **Property** by browsing the Module Database, then PI DataLink enters **Module Path** automatically. Required.
Query date	An effective date of the PI property. PI DataLink returns the value of the specified property on this date. Required.
Output cell	The worksheet cell where the function writes the resulting function array. If you select a cell before you open the function task pane, PI DataLink inserts the selected cell into the **Output cell** field. Specify the top-left corner of the function array. PI DataLink expands the range downward and to the right of the output cell, as necessary to return specified data. PI DataLink might overwrite adjacent cells. If you specify a multi-cell array in the **Output cell** field and the specified array is larger than the resulting function array, PI DataLink pastes the function formula in the unneeded cells of the specified array.
Column	Click this option to return values in a column.
Row	Click this option to return values in a row.

See also

PIPropertyToValue()

Notifications

PI DataLink includes the PI DataLink Notifications add-in. Use this add-in to retrieve notifications from PI Notifications 2012 and earlier. To retrieve notifications created with PI Server 2016 R2 and later, use the Explore Events function. See Explore Events function.

The PI Notifications Client feature must be installed on the computer to activate the PI DataLink Notifications add-in (see Microsoft Excel add-in configuration). When activated, this add-in inserts the Notification Search function on the **PI DataLink** tab. Use the Notification Search function to retrieve PI System notifications that you subscribe to and to insert those notifications into worksheets.



Note:
You must have an account on at least one PI AF server with PI Notifications and be subscribed to at least one notification rule to receive notifications.

For software version requirements, see the OSIsoft Tech Support page PI DataLink System Requirements (https://techsupport.osisoft.com/Products/PI-Visualization/PI-DataLink/System-Requirements). For further information on PI Notifications, see the *PI Notifications User Guide*.

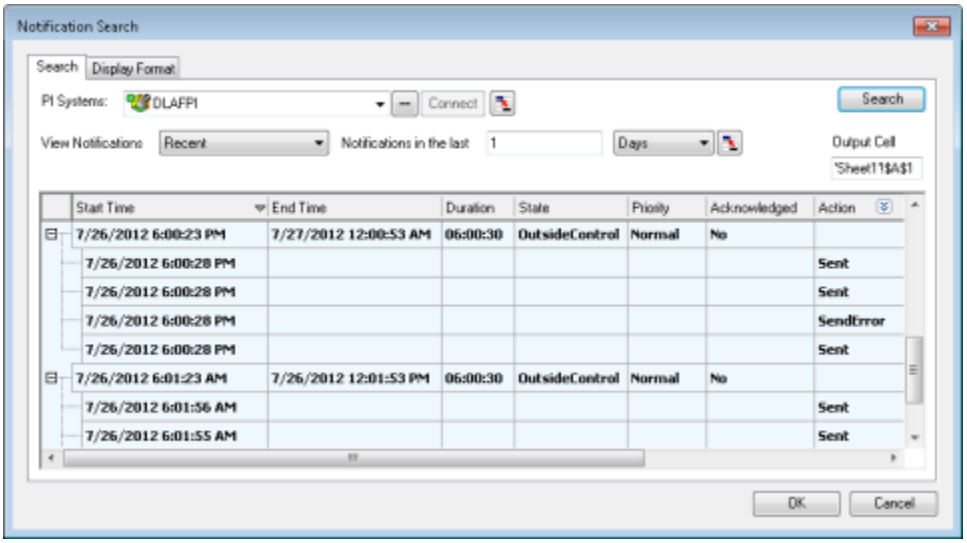
To access the Notification Search function, click the desired output cell in the worksheet, and then on the **PI DataLink** tab (in the **Notifications** group), click **Notification Search** to open the Notification Search window.

Topics in this section

- Search and insert notifications
- Inserted notifications
- Notification display settings

Search and insert notifications

Use the Notification Search window to search for notifications that you subscribed to from a particular PI AF server and then insert them into your worksheet. The PI AF server contains a database of structural elements and notification events that help you work with data in your PI Data Archive server.



Procedure

1. On the **PI DataLink** tab, in the **Notifications** group, click **Notification Search** to open the Notification Search window.
2. On the **Search** tab, select the PI AF server you will search for notifications:
   - From the **PI Systems** list, select a PI AF server and click **Connect** to connect to that server.

     If necessary, click **Show List** ... to open the AF Servers window, where you can add a PI AF server to the list. See Add a PI AF server to the Notification Search function.
   - Click and then click a worksheet cell that contains the name of a PI AF server.

     Click the button again to show the **PI Systems** list.
3. From the **View Notifications** list, select the option to filter returned notifications:
   - Select **Active** to return all currently-active notifications.
   - Select **Timerange** and enter **Start Time** and **End Time** values to return notifications that occurred over a specific time range.
   - Select **Recent** and enter a value and a time interval to return the most recent notifications over a specific time period.
4. In the **Output Cell** field, specify the worksheet cell where you want to insert the notifications.
5. Click **Search** to retrieve the notifications that match the specified criteria into the results area at the bottom of the tab.
6. Examine the retrieved notifications. You can:
   - Adjust display of retrieved notifications
   - Manage retrieved notifications
7. Click **OK** to insert the displayed notifications into the worksheet and close the window.

PI DataLink inserts the notification query into the worksheet as a function array at the designated location. Like other PI DataLink functions, the Notification Search function updates data when the worksheet recalculates. See Triggered recalculation.

Add a PI AF server to the Notification Search function

Your PI System might have multiple PI AF servers, each of which might have PI Notifications installed and be a source of relevant notifications. For example, you might subscribe to notifications from PI AF servers that run in different facilities or that represent different business units.

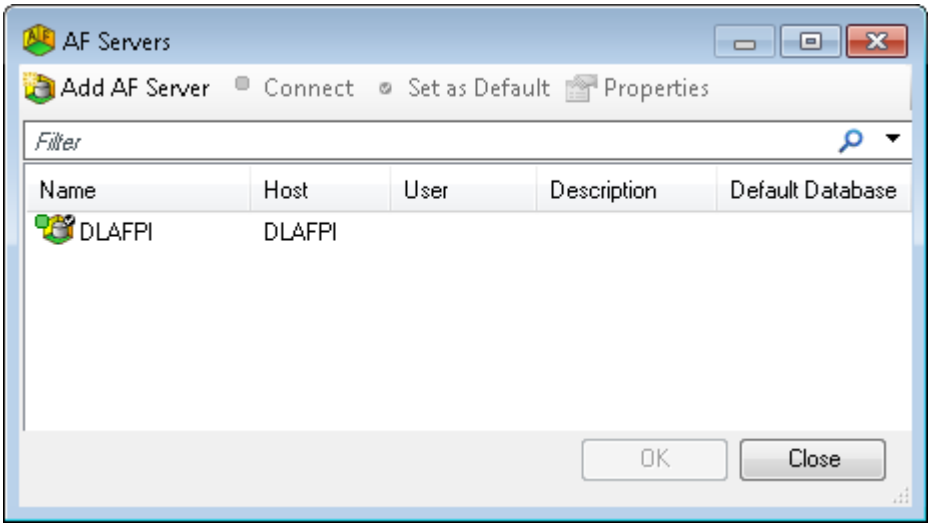
Before you can view the notifications from a particular PI AF server in Excel, you must add that PI AF server to the **PI Systems** list that the Notification Search function maintains.

Before you start

Subscribe to the notifications in PI System Explorer.

Procedure

1. On the **Search** tab of the Notification Search window, click **Show List** ... next to the **PI Systems** list to open the AF Servers window.



2. Click **Add AF Server** to open the AF Server Properties window.
3. Enter the relevant network information to locate the PI AF server and to authenticate your computer to that server:
   a. In the **Name** field, enter the name that will identify the PI AF server in the Notification Search function.
   b. Click **Configure Active Directory** to configure access to Active Directory to acquire login information.
4. Click **OK** to save the properties and add to list of PI AF servers.
5. Click **OK** to close the AF Servers window.

   The PI AF server appears in the PI Systems list. For more information about PI AF servers, see the PI AF documentation.

Adjust display of retrieved notifications

On the Notification Search window, the results area at the bottom of the **Search** tab shows the notifications that match the specified search criteria. You can adjust the display of these notifications.

Procedure

- Click column headings to sort notifications by a particular attribute.
- Right-click the results to show and hide columns:
  - Click **Expand All** or **Collapse All** to expand or collapse a notification grouping.
  - Click **Show Contact Events** to toggle the display of contact events for each notification.

Manage retrieved notifications

On the Notification Search window, the results area at the bottom of the **Search** tab shows the notifications that match the specified search criteria. Before you insert retrieved notifications into your worksheet, you can assess, manage, and respond to these notifications.

Procedure

- Right-click a notification and choose a command:
  - **Acknowledge Instance**

    Acknowledge that action has been taken regarding the notification, and that no further escalation is needed. If desired, enter a comment, and click **OK**.
  - **Acknowledge Subscription**

    Acknowledge receipt of a notification you are subscribed to. If desired, enter a comment and click **OK**.
  - **Add Comment**

    Comment on a notification.
  - **View Notification Rule Summary**

    Display the properties of the notification rule that triggered a selected notification.

Inserted notifications

PI DataLink functions can reference notifications data in worksheet cells. For example, you might use the **`Start Time`** value from a retrieved notification to retrieve sampled data that indicates the progress of a batch process.

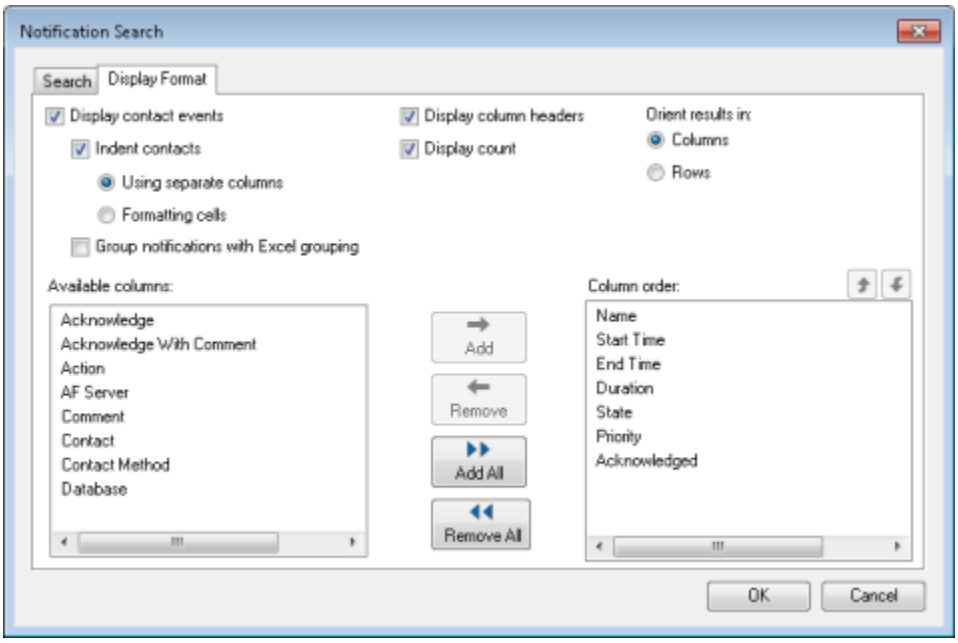
Notification Count:	22						
Start Time	Contact Event Time	End Time	Duration	State	Priority	Action	Acknowledge
10-Dec-07 01:02:42		10-Dec-07 05:04:42	04:02:00	high	Normal		
	10-Dec-07 01:02:42					Instance acknowledged automatically	
	10-Dec-07 01:02:42					Sent	
09-Dec-07 23:50:11		10-Dec-07 01:02:42	01:12:31	low	Normal		
	09-Dec-07 23:50:11					Instance acknowledged automatically	
	09-Dec-07 23:50:11					Sent	
09-Dec-07 13:02:42		09-Dec-07 17:04:41	04:01:59	high	Normal		
	09-Dec-07 13:02:42					Instance acknowledged automatically	

If your notifications are set to display acknowledgments, these columns include links to PI Notifications web pages where you can acknowledge or comment on a notification.

For more information on notifications, subscriptions, and acknowledgments, see the *PI Notifications User Guide*.

Notification display settings

Use the **Display Format** tab on the Notification Search window to specify the appearance of notifications inserted into worksheet cells. You can select the columns displayed and change their organization and formatting.



Columns

- Select columns from the **Available columns** list and click **Add** to move them to the **Column order** list, which specifies the data inserted into the worksheet.

  Note:
  Include the **Acknowledge** column to add a link in the worksheet to acknowledge receipt of a notification, and include the **Acknowledge With Comment** column to add a link in the worksheet to make a comment on a notification.

- Click **Add All** to move all columns to the **Column order** list.
- Select columns from the **Column order** list and click the arrow buttons above the list to change column order.
- Select columns from the **Column order** list and click **Remove** to remove the selected columns from the list.
- Click **Clear** to remove all columns from the **Column order** list.

Contact events

- Select the **Display contact events** check box to include contact events related to each notification, such as sending to each recipient, comments and acknowledgments.
- Select the **Indent contacts** check box to indent contact events in the worksheet. This can help you identify them.
  - Select **Using separate columns** to add a second column for contact events.
  - Select **Formatting cells** to indent contact events in the same column as notification events.
- Select the **Group notifications with Excel grouping** check box to use Excel's grouping functionality to nest contact events beneath individual parent notifications that spawned them.



Note:
PI DataLink Server (DLS) does not support Excel grouping.

Display and orientation

- Select the **Display column headers** check box to add headers to the notifications data.
- Select the **Display count** check box to add a row or column that contains the count of notifications before the notifications data.
- Under **Orient results in**, select **Columns** to display notifications data in columns or select **Rows** to display notifications data in rows.

Function reference

You can generate PI DataLink functions from PI DataLink task panes (see Overview of PI DataLink functions). The resulting function array depends on the inputs. You can also enter these same functions directly in the Excel formula bar (see Manual function entry).

This section contains a reference to supported PI DataLink functions. Each topic describes the function syntax and arguments; most topics also include an example. Subsequent sections group functions by type.

Topics in this section

- Single-value functions
- Multiple-value functions
- Calculation functions
- Tag functions
- Module Database functions
- Input functions
- Deprecated functions

Single-value functions

Single-value functions retrieve the value of a data item at a specific time. They return exactly one value per data item.

Topics in this section

- PICurrVal()
- PIArcVal()
- PIExpVal()
- PITagAtt()

PICurrVal()

Returns the most recent value of a historical PI point or PI AF attribute. For a future PI point, the value returned depends on the time stamps of recorded values relative to the current time:

- If all recorded values have time stamps before the current time, the function returns the last recorded value.
- If recorded values have time stamps that straddle the current time, the function returns an interpolated value.
- If all recorded values have time stamps after the current time, the function returns no data.

This function supports bulk calls.

Syntax

```
PICurrVal(DataItem, OutCode, RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns a value. Specify a range of cells that contain PI point names or PI AF attribute names to return a value for each.
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1 and 2.
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PICurrVal("let439",1,"holden")
```

Returns the current value and corresponding time stamp for the PI point `let439` from the PI Data Archive server named `holden` and places the time stamp in the column to the left of the value.

See also

Current Value function

Define functions manually

Guidelines for entering arguments manually

Retrieval of large amounts of data

Interpolated values

PIArcVal()

Returns the value of a PI point or PI AF attribute at a specified time stamp. This function supports bulk calls.

Syntax

```
PIArcVal(DataItem, TimeStamp, OutCode, RootPath, Mode)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns a value. Specify a range of cells that contain PI point names or PI AF attribute names to return a value for each.
TimeStamp	String	The time stamp for which the function returns values. See Time inputs.

Argument	Type	Description
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1 and 2.
RootPath	String	The path to the data item. See Data items.
Mode	String	The method the function uses to retrieve values: • previous • previous only • interpolated • auto • next • next only • exact time

Examples

```
=PIArcVal("cdep158","11-dec-92 19:20",0, "casaba","interpolated")
```

Returns the interpolated value of the PI point `cdep158` at 7:20 p.m. on December 11, 1992 from the PI Data Archive server named `casaba`.

See also

Archive Value function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

Retrieval of large amounts of data

PIExpVal()

Returns the computed value of a performance equation at a specified time stamp.

Syntax

```
PIExpVal(Expression, TimeStamp, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each.
TimeStamp	String	The time stamp for which the function returns values. See Time inputs.

Argument	Type	Description
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1 and 2.
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PIExpVal("sqr('sinusoid')","y",0,"thevax")
```

Calculates the square root of the value of the PI point `sinusoid` from the PI Data Archive server named `thevax` at midnight yesterday.

See also

Archive Value function

Define functions manually

Guidelines for entering arguments manually

PITagAtt()

Returns a property value associated with a specified data item.

Syntax

```
PITagAtt(DataItem, Property, RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns a value. Specify a range of cells that contain PI point names or PI AF attribute names to return a value for each.
Property	String	The PI point attribute or PI AF attribute property for which the function returns the value.
RootPath	String	The path to the data item. See Data items.

Examples

```
=PITagAtt(d1,"uom","")
```

Returns the engineering units for the PI point specified in cell D1 from the default PI Data Archive server.

See also

Properties function

Multiple-value functions

Multiple-value functions associate a PI point or PI AF attribute with a time period over which there can be one or many corresponding values.

Topics in this section

- PINCompDat()
- PINCompFilDat()
- PICompDat()
- PICompFilDat()
- PISampDat()
- PISampFilDat()
- PIExpDat()
- PITimeDat()
- PITimeExpDat()

PINCompDat()

Returns a specific number of PI point values or PI AF attribute values beginning at a certain time.

Syntax

```
PINCompDat(DataItem, STime, NumVals, OutCode, RootPath, Mode)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns values. Specify a range of cells that contain PI point names or PI AF attribute names to return values for each.
STime	String	The start of the time period for which the function returns values. See Time inputs.
NumVals	Integer	The number of values that the function returns, beginning at **STime** (specify a negative number to retrieve values backward in time).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1, 2, 5, and 6.
RootPath	String	The path to the data item. See Data items.

Argument	Type	Description
Mode	String	The method that the function uses to determine which values to retrieve near the start time (boundary type): • `inside` • `outside` • `interpolated` • `auto`

Examples

```
=PINCompDat("sinusoid","1:00:00",10,1,"","inside")
```

Returns ten values and the corresponding time stamps from the default PI Data Archive server for the PI point `sinusoid` starting from 1:00 a.m. this morning, using boundary type `inside`.

See also

Compressed Data function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PINCompFilDat()

Returns a specific number of filtered PI point values or filtered PI AF attribute values beginning at a certain time.

Syntax

```
PINCompFilDat(DataItem, STime, NumVals, FiltExp, FiltCode, OutCode, RootPath,
Mode)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns a value. Specify a range of cells that contain PI point names or PI AF attribute names to return a value for each.
STime	String	The start of the time period for which the function returns values. See Time inputs.
NumVals	Integer	The number of values that the function returns, beginning at **STime** (specify a negative number to retrieve values backward in time).
FiltExp	String	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.

Argument	Type	Description
FiltCode	Integer	A code that indicates whether to label filtered values: • `1` Insert the label `Filtered` in place of a value or block of values that the function filtered from the output based on **FiltExp**. • `0` Do not label filtered values.
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1, 2, 5, and 6.
RootPath	String	The path to the data item. See Data items.
Mode	String	The method that the function uses to determine which values to retrieve near the start time (boundary type): • `inside` • `outside` • `interpolated` • `auto`

Examples

```
=PINCompFilDat("sinusoid","2:00:00",10,"'cdep158'>38",1,1,"","inside")
```

Returns ten values and the corresponding time stamps from the default PI Data Archive server for the PI point `sinusoid` starting from 2:00 a.m. this morning, when the point `cdep158` is greater than 38, using boundary type `inside`.

The output contains the label `Filtered` between any values where the filter condition was false.

See also

Compressed Data function

Filter expressions

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PICompDat()

Returns PI point values or PI AF attribute values stored during a specified time period.

Syntax

```
PICompDat(DataItem, STime, ETime, OutCode, RootPath, Mode)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns values. Specify a range of cells that contain PI point names or PI AF attribute names to return values for each.
STime	String	The start of the time period for which the function returns values. See Time inputs.
ETime	String	The end of the time period for which the function returns values. See Time inputs.
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1, 2, 4, 5, and 6.
RootPath	String	The path to the data item. See Data items.
Mode	String	The method that the function uses to determine which values to retrieve near the start time (boundary type): • `inside` • `outside` • `interpolated` • `auto`

Examples

```
=PICompDat("sinusoid","1:00:00","3:00:00",1,"","inside")
```

Returns values and corresponding time stamps from the default PI Data Archive server for the PI point `sinusoid` from 1:00a.m. to 3:00 a.m. this morning using boundary type `inside`.

See also

Compressed Data function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PICompFilDat()

Returns filtered PI point values or filtered PI AF attribute values stored during a specified time period.

Syntax

```
PICompFilDat(DataItem, STime, ETime, FiltExp, FiltCode, OutCode, RootPath, Mode)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns values. Specify a range of cells that contain PI point names or PI AF attribute names to return values for each.
STime	String	The start of the time period for which the function returns values. See Time inputs.
ETime	String	The end of the time period for which the function returns values. See Time inputs.
FiltExp	String	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
FiltCode	Integer	A code that indicates whether to label filtered values: • `1` Insert the label `Filtered` in place of a value or block of values that the function filtered from the output based on **FiltExp**. • `0` Do not label filtered values.
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1, 2, 4, 5, and 6.
RootPath	String	The path to the data item. See Data items.
Mode	String	The method that the function uses to determine which values to retrieve near **STime** or **ETime** (boundary type): • `inside` • `outside` • `interpolated` • `auto`

Examples

```
=PICompFilDat("sinusoid","2:00:00","10:00:00","'cdep158'>38",1,1,"","inside")
```

Returns values and the corresponding time stamps for the PI point `sinusoid` from the default PI Data Archive server, starting at 2:00 a.m. and ending at 10:00a.m., when the PI point `cdep158` is greater than 38, using boundary type `inside`.

The output contains the label `Filtered` between any values where the filter condition was false.

See also

Compressed Data function

Filter expressions

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PISampDat()

Returns evenly-spaced, interpolated values for a PI point or PI AF attribute stored over a specified time period.

Syntax

```
PISampDat(DataItem, STime, ETime, Interval, OutCode, RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns values. Specify a range of cells that contain PI point names or PI AF attribute names to return values for each.
STime	String	The start of the time period for which the function returns values. See Time inputs.
ETime	String	The end of the time period for which the function returns values. See Time inputs.
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1 and 2.
RootPath	String	The path to the data item. See Data items.

Examples

```
=PISampDat("sinusoid","y","t","3h",1,"")
```

Returns sampled data and the corresponding time stamps for the PI point `sinusoid` from the default PI Data Archive server, beginning at midnight yesterday and ending at midnight today, reporting values in 3-hour intervals.

See also

Sampled Data function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PISampFilDat()

Returns evenly-spaced, interpolated and filtered values for a PI point or PI AF attribute stored over a specified time period.

Syntax

```
PISampFilDat(DataItem, STime, ETime, Interval, FiltExp, FiltCode, OutCode,
RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns values. Specify a range of cells that contain PI point names or PI AF attribute names to return values for each.
STime	String	The start of the time period for which the function returns values. See Time inputs.
ETime	String	The end of the time period for which the function returns values. See Time inputs.
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.
FiltExp	String	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
FiltCode	Integer	A code that indicates whether to label filtered values: • `1` Insert the label `Filtered` in place of a value or block of values that the function filtered from the output based on **FiltExp**. • `0` Do not label filtered values.
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1 and 2.
RootPath	String	The path to the data item. See Data items.

Examples

```
=PISampFilDat("sinusoid","11-Jan-1997","+3h","1h",A1,1,1,"")
```

Returns sampled data for the PI point `sinusoid` from the default PI Data Archive server. The function retrieves values at midnight 11-Jan-97, 1:00 a.m. on 11-Jan-97, 2:00 a.m. on 11-Jan-97, and 3:00 a.m. on 11-Jan-97. If the condition in cell A1 is not satisfied at any of those times, the

function returns the label `Filtered` at that time. The function shows time stamps in the first column and values in the second column.

See also

Sampled Data function

Filter expressions

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PIExpDat()

Returns evenly-spaced, computed values of a performance equation over a specified time period.

Syntax

```
PIExpDat(Expression, STime, ETime, Interval, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each.
STime	String	The start of the time period for which the function calculates a value. See Time inputs.
ETime	String	The end of the time period for which the function calculates a value. See Time inputs.
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 1 and 2.
RootPath	String	The path to the data item. See Data items.

Examples

```
=PIExpDat("sqr('sinusoid')","y","t","1h",1,"thevax")
```

Calculates the square root of the value of the PI point `sinusoid` retrieved from the PI Data Archive server named `thevax` at one-hour intervals, starting from midnight yesterday to midnight today.

The function displays the time stamp for each value in the column to the left of the calculated value.

See also

Sampled Data function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PITimeDat()

Returns actual or interpolated sample values of a PI point or PI AF attribute at specified time stamps.

Syntax

```
PITimeDat(DataItem, TimeStamps, RootPath, Mode)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function returns values. Specify a range of cells that contain PI point names or PI AF attribute names to return values for each.
TimeStamps	Reference	A reference to one or more worksheet cells that contain time stamps for which the function returns values. See Time inputs.
RootPath	String	The path to the data item. See Data items.
Mode	String	The method the function uses to retrieve data: • `interpolated` • `exact time`

Returns

Values at the specified time stamps, presented in the same orientation as the time stamp reference. If the time stamp reference is a row, the function presents values in a row. If the time stamp reference is a column, the function presents values in a column. The orientation of the output array must match the orientation of the time stamp reference.

Examples

```
=PITimeDat("sinusoid",b1:b12,"","interpolated")
```

Retrieves interpolated values at the time stamps located in cells B1 through B12 for the PI point `sinusoid` on the default PI Data Archive server.

This function requires a twelve-cell horizontal output array, such as C1:C12 or B14:B25.

See also

Timed Data function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PITimeExpDat()

Returns values of a performance equation calculated at specified time stamps.

Syntax

```
PITimeExpDat(Expression, TimeStamps, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each.
TimeStamps	Reference	A reference to one or more worksheet cells that contain time stamps for which the function returns values. See Time inputs.
RootPath	String	The path to the data item. See Data items.

Returns

Values at the specified time stamps, presented in the same orientation as the time stamp reference. If the time stamp reference is a row, the function presents values in a row. If the time stamp reference is a column, the function presents values in a column. The orientation of the output array must match the orientation of the time stamp reference.

Examples

```
=PITimeExpDat("sqr('sinusoid')",b1:b12,"")
```

Calculates the square root of the value of the PI point `sinusoid` retrieved from the default PI Data Archive server at the times specified in cells B1 through B12.

This function requires a twelve-cell horizontal output array, such as C1:C12 or B14:B25.

See also

Timed Data function

Define functions manually

Guidelines for entering arguments manually

Calculation functions

Calculation functions compute values from PI point values, PI AF attributes, or performance equation evaluations during a specific time period.

Topics in this section

- PIAdvCalcVal()
- PIAdvCalcFilVal()
- PIAdvCalcExpVal()
- PIAdvCalcExpFilVal()
- PIAdvCalcDat()
- PIAdvCalcFilDat()
- PIAdvCalcExpDat()
- PIAdvCalcExpFilDat()
- PITimeFilter()
- PITimeFilterVal()

PIAdvCalcVal()

Returns a value calculated from PI point or PI AF attribute values during a specified time period. This function supports bulk calls.

Syntax

```
PIAdvCalcVal(DataItem, STime, ETime, Mode, CalcBasis, MinPctGood, CFactor,
OutCode, RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function calculates a value. Specify a range of cells that contain PI point names or PI AF attribute names to calculate a value for each.
STime	String	The start of the time period for which the function calculates a value. See Time inputs.
ETime	String	The end of the time period for which the function calculates a value. See Time inputs.
Mode	String	The type of calculation that the function performs: • `total` • `minimum` • `maximum` • `stdev` • `range` • `count` • `average (time-weighted)` • `average (event-weighted)`
CalcBasis	String	The calculation method: • `time-weighted` • `event-weighted`

Argument	Type	Description
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, and 9 (if **Mode** is set to `minimum`, `maximum`, or `range`).
RootPath	String	The path to the data item. See Data items.

Examples

```
=PIAdvCalcVal("sinusoid","y","t","total","time-weighted",50,1,4,"")
```

Returns a time-weighted total of the PI point `sinusoid` calculated from the values on the default PI Data Archive server from yesterday to today.

The function multiplies the result by 1, and only returns a result if at least 50 percent of the data is good. The function returns the percent good to the right of the calculated total.

See also

Calculated Data function

Define functions manually

Guidelines for entering arguments manually

Retrieval of large amounts of data

PIAdvCalcFilVal()

Returns a value calculated from filtered PI point or PI AF attribute values during a specified time period.

Syntax

```
PIAdvCalcFilVal(DataItem, STime, ETime, FiltExp, Mode, CalcBasis, SampMode,
SampFreq, MinPctGood, CFactor, OutCode, RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function calculates a value. Specify a range of cells that contain PI point names or PI AF attribute names to calculate a value for each.
STime	String	The start of the time period for which the function calculates a value. See Time inputs.
ETime	String	The end of the time period for which the function calculates a value. See Time inputs.

Argument	Type	Description
FiltExp	String	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
Mode	String	The type of calculation that the function performs: • total • minimum • maximum • stdev • range • count • average (time-weighted) • average (event-weighted)
CalcBasis	String	The calculation method: • time-weighted • event-weighted
SampMode	String	The sampling method the function uses to determine when to evaluate **FiltExp**: • compressed • interpolated
SampFreq	String	The frequency that the function evaluates **FiltExp** if **SampMode** is set to interpolated. Enter a value and time unit. For example, set to 10m (10 minutes) to return an interpolated value for every 10-minute interval. See Time-interval specification
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter 1 if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, and 9 (if **Mode** is set to minimum, maximum, or range).
RootPath	String	The path to the data item. See Data items.

Examples

```
=PIAdvCalcFilVal("sinusoid","y","t","'cdm158'=""Manual""","total","time-
weighted","compressed","10m",50,1,4,"")
```

Returns the time-weighted total for the PI point sinusoid calculated from the values on the default PI Data Archive server, summing values from yesterday to today during the time periods when the PI point cdm158 is set to Manual.

The function multiplies the result by 1. Because the sampling mode is compressed, the function ignores the sampling frequency and samples the filter expression at the compressed

events of the point `sinusoid`. The function only returns a result if at least 50 percent of the data is good. The function returns the percent good to the right of the calculated total.

See also

Calculated Data function

Filter expressions

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PIAdvCalcExpVal()

Returns a value calculated from a performance equation during a specified time period.

Syntax

```
PIAdvCalcExpVal(Expression, STime, ETime, Mode, CalcBasis, SampMode, SampFreq,
MinPctGood, CFactor, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each.
STime	String	The start of the time period for which the function calculates a value. See Time inputs.
ETime	String	The end of the time period for which the function calculates a value. See Time inputs.
Mode	String	The type of calculation that the function performs: • `total` • `minimum` • `maximum` • `stdev` • `range` • `count` • `average (time-weighted)` • `average (event-weighted)`
CalcBasis	String	The calculation method: • `time-weighted` • `event-weighted`
SampMode	String	The sampling method the function uses to determine when to evaluate **Expression**: • `compressed` • `interpolated`

Argument	Type	Description
SampFreq	String	The frequency that the function evaluates **Expression** if **SampMode** is set to `interpolated`. Enter a value and time unit. For example, set to `10m` (10 minutes) to return an interpolated value for every 10-minute interval. See Time-interval specification
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, and 9 (if **Mode** is set to `minimum`, `maximum`, or `range`).
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PIAdvCalcExpVal("'sinusoid'+'cdt158'","y","t","total","time-
weighted","compressed","10m",50,1,4,"")
```

Returns the time-weighted total for the expression `'sinusoid'+'cdt158'` calculated from the values on the default PI Data Archive server, using values from yesterday to today.

The function multiplies the result by 1. Because the sampling mode is `compressed`, the function ignores the sampling frequency and samples the filter expression at the combined compressed events of `sinusoid` and `cdt158`. The function only returns a result if at least 50 percent of the data is good. The function returns the percent good to the right of the calculated total.

See also

Calculated Data function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PIAdvCalcExpFilVal()

Returns a filtered, calculated PI point value based on a performance equation.

Syntax

```
PIAdvCalcExpFilVal(Expression, STime, ETime, FiltExp, Mode, CalcBasis, SampMode,
SampFreq, MinPctGood, CFactor, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each.
STime	String	The start of the time period for which the function calculates a value. See Time inputs.
ETime	String	The end of the time period for which the function calculates a value. See Time inputs.
FiltExp	String	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
Mode	String	The type of calculation that the function performs: • `total` • `minimum` • `maximum` • `stdev` • `range` • `count` • `average (time-weighted)` • `average (event-weighted)`
CalcBasis	String	The calculation method: • `time-weighted` • `event-weighted`
SampMode	String	The sampling method the function uses to determine when to evaluate **Expression** and **FiltExp**: • `compressed` • `interpolated`
SampFreq	String	The frequency that the function evaluates **Expression** and **FiltExp** if **SampMode** is set to `interpolated`. Enter a value and time unit. For example, set to `10m` (10 minutes) to return an interpolated value for every 10-minute interval. See Time-interval specification.
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, and 9 (if **Mode** is set to `minimum`, `maximum`, or `range`).

Argument	Type	Description
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PIAdvCalcExpFilVal("'sinusoid'+'sinusoidu'","y","t","'cdm158'=""Manual""","total
","time-weighted","compressed","10m",50,1,4,"")
```

Returns the time-weighted total for the expression `'sinusoid'+'sinusoidu'` calculated from the values on the default PI Data Archive server when the PI point `cdm158` is set to `Manual` using values from yesterday to today.

The function multiplies the result by 1. Because the sampling mode is `compressed`, the function ignores the sampling frequency and samples the filter expression at the combined compressed events of `sinusoid` and `sinusoidu`. The function only returns a result if at least 50 percent of the data is good. The function returns the percent good to the right of the calculated total.

See also

Calculated Data function

Filter expressions

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PIAdvCalcDat()

Returns evenly spaced values calculated from PI point or PI AF attribute values during a specified time period.

Syntax

```
PIAdvCalcDat(DataItem, STime, ETime, Interval, Mode, CalcBasis, MinPctGood,
CFactor, OutCode, RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function calculates values. Specify a range of cells that contain PI point names or PI AF attribute names to calculate values for each.
STime	String	The start of the time period for which the function calculates values. See Time inputs.
ETime	String	The end of the time period for which the function calculates values. See Time inputs.

Argument	Type	Description
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.
Mode	String	The type of calculation that the function performs: • `total` • `minimum` • `maximum` • `stdev` • `range` • `count` • `average (time-weighted)` • `average (event-weighted)`
CalcBasis	String	The calculation method: • `time-weighted` • `event-weighted`
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, 7, 8, and 9 (if **Mode** is set to `minimum`, `maximum`, or `range`).
RootPath	String	The path to the data item. See Data items.

Examples

```
=PIAdvCalcDat("sinusoid","y","t","3h","total","time-weighted",50, 1,4,"")
```

Returns the time-weighted total for the PI point `sinusoid` calculated from the values on the default PI Data Archive server for three-hour intervals from midnight yesterday to midnight today.

The function multiplies the result by 1, and only returns a result if at least 50 percent of the data is good. The function returns the percent good to the right of each calculated total.

See also

Calculated Data function

Define functions manually

Guidelines for entering arguments manually

PIAdvCalcFilDat()

Returns evenly spaced values calculated from filtered PI point or PI AF attribute values during a specified time period.

Syntax

```
PIAdvCalcFilDat(DataItem, STime, ETime, Interval, FiltExp, Mode, CalcBasis,
SampMode, SampFreq, MinPctGood, CFactor, OutCode, RootPath)
```

Arguments

Argument	Type	Description
DataItem	String	The PI point name or PI AF attribute name for which the function calculates values. Specify a range of cells that contain PI point names or PI AF attribute names to calculate values for each.
STime	String	The start of the time period for which the function calculates values. See Time inputs.
ETime	String	The end of the time period for which the function calculates values. See Time inputs.
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.
FiltExp	String	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
Mode	String	The type of calculation that the function performs: • `total` • `minimum` • `maximum` • `stdev` • `range` • `count` • `average (time-weighted)` • `average (event-weighted)`
CalcBasis	String	The calculation method: • `time-weighted` • `event-weighted`
SampMode	String	The sampling method the function uses to determine when to evaluate **FiltExp**: • `compressed` • `interpolated`

Argument	Type	Description
SampFreq	String	The frequency that the function evaluates **FiltExp** if **SampMode** is set to `interpolated`. Enter a value and time unit. For example, set to `10m` (10 minutes) to return an interpolated value for every 10-minute interval. See Time-interval specification
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, 7, 8, and 9 (if **Mode** is set to `minimum`, `maximum`, or `range`).
RootPath	String	The path to the data item. See Data items.

Examples

```
=PIAdvCalcFilDat("sinusoid","y","t","3h","'cdm158'=""Manual""","total","time-
weighted","compressed","10m",50,1,4,"")
```

Returns the time-weighted total for the PI point `sinusoid`, calculated from the values on the default PI Data Archive server for three-hour intervals from midnight yesterday to midnight today when PI point `cdm158` is set to `Manual`.

The function multiplies the result by 1. Because the sampling mode is `compressed`, the function ignores the sampling frequency and samples the filter expression at the compressed events of `sinusoid`. The function only returns a result if at least 50 percent of the data is good. The function returns the percent good to the right of the calculated total.

See also

Calculated Data function

Filter expressions

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PIAdvCalcExpDat()

Returns evenly spaced values calculated from a performance equation during a specified time period.

Syntax

```
PIAdvCalcExpDat(Expression, STime, ETime, Interval, Mode, CalcBasis,SampMode,
SampFreq, MinPctGood, CFactor, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each.
STime	String	The start of the time period for which the function calculates values. See Time inputs.
ETime	String	The end of the time period for which the function calculates values. See Time inputs.
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.
Mode	String	The type of calculation that the function performs: • `total` • `minimum` • `maximum` • `stdev` • `range` • `count` • `average (time-weighted)` • `average (event-weighted)`
CalcBasis	String	The calculation method: • `time-weighted` • `event-weighted`
SampMode	String	The sampling method the function uses to determine when to evaluate **Expression**: • `compressed` • `interpolated`
SampFreq	String	The frequency that the function evaluates **Expression** if **SampMode** is set to `interpolated`. Enter a value and time unit. For example, set to `10m` (10 minutes) to return an interpolated value for every 10-minute interval. See Time-interval specification
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).

Argument	Type	Description
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, 7, 8, and 9 (if **Mode** is set to `minimum`, `maximum`, or `range`).
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PIAdvCalcExpDat("'sinusoid'+'cdt158'","y","t","3h","total","time-
weighted","compressed","10m",50,1,4,"")
```

Computes the expression `'sinusoid'+'cdt158'` at any time stamp between midnight yesterday and midnight today with a recorded value stored on the default PI Data Archive server, and then calculates the time-weighted total of the computed values in three-hour intervals.

The function multiplies each calculated total by 1 and returns a value when the percent of good values is at least 50 percent during the three-hour interval. The function returns the percent good to the right of the calculated total. Note that because the sampling mode is `compressed`, the function ignores the sampling frequency, and samples values whenever `sinusoid` or `cdt158` has a recorded value stored.

See also

Calculated Data function

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PIAdvCalcExpFilDat()

Returns evenly spaced values calculated from a filtered performance equation during a specified time period.

Syntax

```
PIAdvCalcExpFilDat(Expression, STime, ETime, Interval, FiltExp, Mode, CalcBasis,
SampMode, SampFreq, MinPctGood, CFactor, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	One or more performance equations that the function computes a value for. See Expressions. To specify multiple expressions, enter a range of cells that contain complete expressions. The function returns values for each.
STime	String	The start of the time period for which the function calculates values. See Time inputs.

Argument	Type	Description
ETime	String	The end of the time period for which the function calculates values. See Time inputs.
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.
FiltExp	String	A Boolean performance equation that the function uses to filter values. When the expression evaluates to false, the function excludes corresponding values. See Filter expressions.
Mode	String	The type of calculation that the function performs: • `total` • `minimum` • `maximum` • `stdev` • `range` • `count` • `average (time-weighted)` • `average (event-weighted)`
CalcBasis	String	The calculation method: • `time-weighted` • `event-weighted`
SampMode	String	The sampling method the function uses to determine when to evaluate **Expression** and **FiltExp**: • `compressed` • `interpolated`
SampFreq	String	The frequency that the function evaluates **Expression** and **FiltExp** if **SampMode** is set to `interpolated`. Enter a value and time unit. For example, set to `10m` (10 minutes) to return an interpolated value for every 10-minute interval. See Time-interval specification.
MinPctGood	Number	The minimum percentage of good data required during the time period to calculate and return a value.
CFactor	Number	A factor that the function applies to the returned value. Enter `1` if a conversion factor is not needed. For time-weighted total calculations, specify a factor that converts recorded rate values to the server default time unit (units per day).
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, 7, 8, and 9 (if **Mode** is set to `minimum`, `maximum`, or `range`).
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PIAdvCalcExpFilDat("'sinusoid'+'cdt158'","y","t","3h","'cdm158'=""Manual""","tot
al","time-weighted","compressed","10m",50,1,4,"")
```

Calculates a time-weighted total for the expression `'sinusoid'+'cdt158'` when `'cdm158' = "Manual"` at three-hour intervals from yesterday to today from the default PI Data Archive server.

The function multiplies each calculated total by 1 and returns a value when the percent of good values is at least 50 percent during the three-hour interval. The function returns the percent good to the right of the calculated total. Note that because the sampling mode is `compressed`, the function ignores the sampling frequency, and samples values whenever `sinusoid` or `cdt158` has a recorded value or the value of `cdm158` changes to or from `Manual`.

See also

Calculated Data function

Filter expressions

Define functions manually

Guidelines for entering arguments manually

Interpolated values

PITimeFilter()

Returns the amount of time that a performance equation evaluates to `true` during evenly spaced intervals in a specified time period.

Syntax

```
PITimeFilter(Expression, STime, ETime, Interval, TimeUnit, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	A Boolean performance equation that the function evaluates. See Expressions. Reference a range of cells that contain expressions to return values for each.
STime	String	The start of the time period for which the function calculates values. See Time inputs.
ETime	String	The end of the time period for which the function calculates values. See Time inputs.
Interval	String	The interval between returned values. Enter a value and time unit that specifies the length of the interval. For example, enter `15m` (15 minutes) to return a value for every 15-minute interval during the time period. See Time-interval specification.

Argument	Type	Description
TimeUnit	String	Time unit of the calculated result: • seconds • minutes • hours • days
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2, 3, 7, and 8.
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PITimeFilter($A$1,"y","t","1h","seconds",65,"thevax")
```

Returns the number of seconds that the expression in cell A1 is true on the PI Data Archive server named `thevax` during one-hour intervals, starting from midnight yesterday to midnight today.

The function shows the time stamp of the start of each calculation interval to the left of the value.

See also

Time Filtered function

Define functions manually

Guidelines for entering arguments manually

PITimeFilterVal()

Returns the amount of time that a performance equation evaluates to `true` during a specified time period.

Syntax

```
PITimeFilterVal(Expression, STime, ETime, TimeUnit, OutCode, RootPath)
```

Arguments

Argument	Type	Description
Expression	String	A Boolean performance equation that the function evaluates. See Expressions. Reference a range of cells that contain expressions to return values for each.
STime	String	The start of the time period for which the function calculates a value. See Time inputs.
ETime	String	The end of the time period for which the function calculates a value. See Time inputs.

Argument	Type	Description
TimeUnit	String	Time unit of the calculated result: • seconds • minutes • hours • days
OutCode	Integer	An output code that determines what appended data the function returns and how the function orients output. See Output codes for information on how to compute the code. This function supports bits 2 and 3.
RootPath	String	The path to the data item referenced by the expression. See Data items.

Examples

```
=PITimeFilterVal($A$1,"y","t","seconds",0,"thevax")
```

Returns the number of seconds that the expression in cell A1 is true on the PI Data Archive server named `thevax` from midnight yesterday to midnight today.

See also

Time Filtered function

Define functions manually

Guidelines for entering arguments manually

Tag functions

Tag functions help you work with PI points.

Topics in this section

- PIPointIDToTag()
- PIAttributeMaskToTag ()

PIPointIDToTag()

Returns the name of the PI point that corresponds to a specific PI point ID.

Syntax

```
PIPointIDToTag(PointID, Server)
```

Arguments

Argument	Type	Description
PointID	String	A PI point ID, which is a unique internal ID that is not reused when a point is deleted.

Argument	Type	Description
Server	String	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.

Examples

```
=PIPointIDToTag("123","thevax")
```

Searches the PI Data Archive server named `thevax` for point ID 123, and returns that point's name (the **Tag** attribute).

See also

Point ID to Tag function

PIAttributeMaskToTag ()

Returns the names of PI points that match one or more specified PI point attribute values.

Syntax

```
PIAttributeMaskToTag(TagName, Descriptor, PointSource, PointType, PointClass,
EngUnits, OutCode, Server)
```

Arguments

Argument	Type	Description
TagName	String	Name of returned points.[1]
Descriptor	String	Descriptor of returned points.[1]
PointSource	String	Point source of returned points.[1]
PointType	String	Point type of returned points.[1]
PointClass	String	Point class of returned points.[1]
EngUnits	String	Engineering units of returned points.[1]
OutCode	Integer	An output code that determines how the function orients output: • `0` Write values in a column. • `2` Write values in a row.
Server	String	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.

[1] Use wildcard character (*) to find all matches or matches limited to specified characters.

Examples

```
=PIAttributeMaskToTag("sin*","*","*","*","*","*",0,"thevax")
```

Returns the names of points that start with `sin` from the PI Data Archive server named `thevax`.

See also

Attribute Mask to Tag function

Module Database functions

Topics in this section

- PIAliasToTag()
- PIPropertyToValue()

PIAliasToTag()

Returns the name of the PI point that corresponds to a specified PI alias.

Syntax

```
PIAliasToTag(Alias, ModulePath, QueryDate, OutCode, Server)
```

Arguments

Argument	Type	Description
Alias	String	The module database alias that corresponds to the PI point to return.
ModulePath	String	The full module path to the alias
QueryDate	Integer	An effective date of the alias. The function returns the name of the point that corresponds to the specified alias on this date.
OutCode	Integer	An output code that determines whether to append the server name to the result: • 0 Returns only point name. • 1 Returns the PI Data Archive server that stores the point in the cell to the right of the point name. • 2 Returns the PI Data Archive server that stores the point in the cell below the point name.
Server	String	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.

Examples

```
=PIAliasToTag("Temperature","\Unit1\Reactor1","*",0,"thevax")
```

Returns the name of the PI point that corresponds to the `Temperature` alias of module `Reactor1`, which is a submodule of `Unit1`. `Unit1` is at the root of the module database for a PI Data Archive server named `thevax`. The module database is queried at the current time.

See also

Alias to Tag function

PIPropertyToValue()

Returns the value or values corresponding to a specified PI property.

Syntax

```
PIPropertyToValue(Property, ModulePath, QueryDate, Server, OutCode)
```

Arguments

Argument	Type	Description
Property	String	The module database property that corresponds to the PI point for which the function retrieves values.
ModulePath	String	The full module path to the property.
QueryDate	Integer	An effective date of the PI property value. The function returns the values that correspond to the specified property on this date.
Server	String	The PI Data Archive server that the function returns data from. If you do not select a server or leave the field blank, the function searches the default PI Data Archive server.
OutCode	Integer	An output code that determines how to orient the result: • `0` Returns values in a column. • `2` Returns values in a row.

Examples

```
=PIPropertyToValue("Implementer","\Unit1\Reactor1","*","thevax")
```

Returns the value corresponding to the `Implementer` property of module `Reactor1` which is a submodule of `Unit1`. `Unit1` is at the root of the module database for a PI Data Archive server named `thevax`. The module database is queried at the current time.

See also

Property to Value function

Input functions

Input functions write values to PI Data Archive or PI AF.

PIPutVal() and PIPutValX()

Writes a value to the PI Data Archive server or PI AF server and returns a string that indicates the status.

Note:

- Only use the `PIPutVal` and `PIPutValX` functions within Visual Basic for Applications (VBA). Do not enter these functions in the Excel formula bar. See Functions to write data.
- In the current version of PI DataLink, there is no difference between the `PIPutVal` function and the `PIPutValX` function. In PI DataLink versions earlier than PI DataLink 2013, the `PIPutVal` function only supported three traditional PI point types: real, integer, and digital. In those versions of PI DataLink, the `PIPutValX` function added support for string points and subsecond time stamps.

Syntax

```
PIPutVal(DataItem, Value, TimeStamp, RootPath, OutCell)
```

```
PIPutValX(DataItem, Value, TimeStamp, RootPath, OutCell)
```

Arguments

Argument	Type	Description
`DataItem`	String	The name of the PI point or PI AF attribute to which the function writes a value.
`Value`	Reference	A reference to the cell that contains the value to be written, either a string or a number.
`TimeStamp`	String	The time stamp for the value. See Time inputs.
`RootPath`	String	The path to the data item. See Data items.
`OutCell`	Reference	A reference to the cell where PI DataLink writes the string that macro function returns. The returned string varies: • If the write succeeds: ◦ The `PIPutVal` function returns *xxx* `Written` where *xxx* is either `Real Value`, `Integer`, `Digital State`, or `Value`, depending on the value type written. ◦ The `PIPutValX` function returns `Value Written`. • If the write fails, the function returns an error code such as `[-5] Tag not found`.

Notes

The `PIPutVal` and `PIPutValX` functions cannot write to PI AF attributes that are configuration attributes. These functions can only write to a PI AF attribute for which the **Configuration Item** check box is not selected. You can check the status of the check box on the **Attributes** tab in PI System Explorer.

The `PIPutVal` and `PIPutValX` functions support all PI Data Archive data types. The functions interpret time stamps using client-machine time-zone information for PI Data Archive unless the **PI Data Archive time zone** setting is enabled.

The functions do not verify the user-specified range for a point before writing the value. The range is defined as *zero* to *zero + span*, where *zero* and *span* are point attributes specified during point creation. The function returns a `Value Written` string even if `Over Range` or `Under Range` is stored in PI Data Archive.

Deprecated functions

Several functions have been replaced by more powerful functions. To support older worksheets that use these replaced functions, PI DataLink supports the old, deprecated functions, but OSIsoft recommends that you use the corresponding new functions.

Old function	New function
PICalcVal	**PIAdvCalcVal**
PICalcDat	**PIAdvCalcDat**
PIExTimeVal	**PIArcVal** (with **Mode** set to `exact time`)

Troubleshooting

Consult the topics in this section if you experience difficulty using PI DataLink. If these topics do not address or solve the problem, contact Technical Support (see the OSIsoft Tech Support Contact Us page (https://techsupport.osisoft.com/Contact-Us/)).

Topics in this section

- Log files
- PI DataLink tab not available
- Array and cell limits
- Data retrieval limits
- Data item not supported by function
- Duplicate event exists
- Security
- PI Data Archive connection issues
- Eliminate timeout exception error
- Data does not update

Log files

PI DataLink does not generate a generic log file. You can use error messages in worksheets to diagnose issues. However, some specific processes do generate log files:

- Installation

  The `../pipc/dat` directory contains the installation log files, `SetupPIDataLink_x64.log` and `SetupPIDataLink_x86.log`.

- PI Data Archive server connectivity

  Examine the PI Data Archive log file in PI SMT for PI Data Archive server connectivity issues.

PI DataLink tab not available

If the **PI DataLink** tab does not appear after you install PI DataLink, you might need to manually configure the add-in for Excel (see Microsoft Excel add-in configuration), or reduce security settings for add-ins (see Security).

Some user-written VBA scripts in Excel worksheets (or add-ins) reset the main Excel ribbon. In such cases, the **PI DataLink** tab might disappear even though the PI DataLink add-in is still loaded, and embedded PI DataLink functions may work even though the **PI DataLink** tab itself is not available. Restarting Excel usually fixes this problem.

Array and cell limits

PI DataLink is subject to an Excel limitation on the number of elements in a calculation array. A single PI DataLink function can return no more than 1,048,576 values per retrieval.

The Excel SDK used by PI DataLink limits strings to 255 characters in length. Input strings for PI DataLink expressions in a referenced cell may not exceed this 255-character limit.

Similarly, PI DataLink might truncate string output, such as PI point names, to 255 characters.

Data retrieval limits

Error code `-11091` indicates that a single query initiated by a PI DataLink function attempted to retrieve more recorded values from PI Data Archive than allowed by the **`ArcMaxCollect`** tuning parameter.

Because this limit applies to recorded values retrieved from PI Data Archive, even functions that return small numbers of values can exceed the limit posed by this tuning parameter. For example, the value of the PI point `sinusoid` constantly varies between 0 and 100. You might create a function that returns sampled values of `sinusoid` every 30 seconds over a year with a filter to exclude values less than 95. This function might return a relatively small number of values, but will retrieve many more recorded values from the archives to process the query.

If you receive this error, consider modifying your search criteria to reduce the data retrieved. For example, you might reduce the time period over which the function retrieves data.

Data item not supported by function

The returned message `Data item not supported by function` can indicate:

- A PI AF attribute uses a custom data reference that does not allow calculations. To use in PI DataLink, change the custom-data-reference code to permit use of data-access methods. This is disabled by default.
- The Calculated Data function attempted a summary calculation on a PI AF attribute of type PI Point Array.

Duplicate event exists

The returned message `Duplicate event exists: specify index for` *`EventName`* indicates that the parent event in this worksheet row contains more than one child event named *`EventName`*. To resolve, change the specification of the Compare Events function to use an indexed version of the event for the attribute displayed in this column.

When a parent event has child events with duplicate names, PI DataLink automatically adds an index to the child event name in the Add Attributes window. If other events at the same level do not have duplicate names, they will not have the index. For more details, see Add child-event attributes as columns in the Compare Events task pane.

Security

Excel security features for add-ins, ActiveX controls, and macros control the types of components that can run inside Excel. The security settings either disable, enable with prompting, or completely enable these types of objects.

Excel security settings may conflict with certain PI DataLink features:

- PI DataLink is an Excel add-in. Security settings that disable add-ins prevent PI DataLink from loading in Excel.
- Trends use a signed ActiveX control marked safe for initialization and require that ActiveX controls be enabled.
- Worksheets that contain a `PIPutVal()` or `PIPutValX ()` function use macros and require that macros be enabled (see PIPutVal() and PIPutValX()).

If you regularly apply Excel security to worksheets, or encounter problems using these PI DataLink features, you may need to reduce or eliminate Excel security settings depending on how you plan to use PI DataLink.

For further information on Excel security, consult Microsoft Excel online help and online resources.

PI Data Archive connection issues

This version of PI DataLink uses tighter security settings for connecting to PI Data Archive. The new settings reduce exposure to security weaknesses associated with PI password authentication. For more information, see the OSIsoft Tech Support alert, AL00206 - Security Alert: PI Authentication Weakness (https://techsupport.osisoft.com/Troubleshooting/Alerts/AL00206).

The new security settings can result in errors if PI DataLink uses:

- PI user names and passwords to connect to PI Data Archive
- Default user to connect to PI Data Archive

Specifically, these settings might generate the following error:

```
Cannot connect to the PI Data Archive. Windows authentication trial
failed because insufficient privilege to access the PI Data Archive.
Trust authentication trial failed because insufficient privilege to
access the PI Data Archive.
```

To resolve these errors, you can:

- Configure PI mappings for users who connect to PI Data Archive.

  OSIsoft recommends this approach (available in PI Data Archive version 3.4.380 and later). This is the most secure connection method. For information on creating PI mappings, see the PI Server topic "Mapping management" in Live Library (https://livelibrary.osisoft.com). To use PI mappings, you must also enable the Windows Security authentication protocol on each computer that runs PI DataLink.
- Configure PI trusts for users who connect to PI Data Archive.

This is the next-best approach. To use PI trusts, you must also enable the PI Trust authentication protocol on each computer that runs PI DataLink.

- Configure each computer to allow an explicit login prompt when a PI mapping or PI trust is not available.

  OSIsoft does not recommend this approach. Explicit logins are not secure. With this approach, you must enter your user name and password the first time you connect to each PI Data Archive during a particular Microsoft Excel session.

For more information, see the PI Server topic "Manage authentication" in Live Library (https://livelibrary.osisoft.com).

Note:
Entering an incorrect password at a login prompt can result in the same error message.

Topics in this section

- Enable an authentication protocol
- Configure a computer to allow explicit login prompts
- Enter login credentials from Connection Manager

Enable an authentication protocol

To connect to PI Data Archive with a defined PI mapping or PI trust, use PI SDK Utility to enable the corresponding protocol on your computer. You must configure each computer where you connect to PI Data Archive with a PI mapping or PI trust.

Procedure

1. Click **Start** > **All Programs** > **PI System** > **PISDKUtility** to open PI SDK Utility.
2. Under **PI-SDK**, click **Connections** to show available PI Data Archive servers and update the utility menus.
3. Click **Connections** > **Options** to open the Connection Options window.
4. Under **Specify Authentication Procedure**, use the arrow keys to move and sort the enabled protocols listed under **Protocol order**. List the needed protocols:
   - To use PI mappings, **Windows Security** must be listed. This should be the first protocol in the **Protocol order** list.
   - To use PI trusts, **PI Trust** must be listed.
5. Click **OK**.

Configure a computer to allow explicit login prompts

To connect to PI Data Archive by logging in as a PI user, use PI SDK Utility to configure your computer to allow explicit login prompts. You must configure each computer where you want to connect to PI Data Archive by logging in as a PI user.

Caution:
OSIsoft recommends that you select an alternative, more secure method to connect to PI Data Archive.

Procedure

1. Click **Start** > **All Programs** > **PI System** > **PISDKUtility** to open PI SDK Utility.
2. Click **Connections** > **Options** to open the Connection Options window.
3. Select the **Allow login prompt (if all configured protocols fail)** check box.
4. Click **OK**.

After you finish

Enter your user name and password to access PI Data Archive each new Excel session. You can access the connection prompt by searching PI Data Archive with the Search tool or by connecting manually from Connection Manager. See Enter login credentials from Connection Manager.

Enter login credentials from Connection Manager

If you connect to PI Data Archive by logging in as a PI user, then you must enter your user name and password for each PI Data Archive you connect to during each Excel session.

Before you start

Configure a computer to allow explicit login prompts.

Procedure

1. On the **PI DataLink** tab, in the **Resources** group, click **Settings** to open the Settings window.
2. Click **Connection Manager** to open the Servers window.
3. In the list of servers, right-click the PI Data Archive server that you want to connect to, and then click **Connect As** to open the Connect to PI Data Archive window.
4. From the **Authentication** list, select **PI User Authentication**.

   If the window does not show the **Authentication** list, then you must configure the computer to allow explicit login prompts.
5. Enter you user name and password, and then click **OK**.

Eliminate timeout exception error

Searches of PI Data Archive servers with large point databases might reach the data timeout before PI Data Archive returns all results. You will receive the following error:

```
OSIsoft.PI.Net.PITimeoutException: [-10722] PINET: Timeout on PI RPC or
System Call.
```

To eliminate the error, use Connection Manager to increase the data timeout value.

Procedure

1. On the **PI DataLink** tab, in the **Resources** group, click **Settings** to open the Settings window.
2. Click **Connection Manager** to open the Servers window.

3. Right-click the PI Data Archive server that returned the error, and then click **Properties** to open the PI Data Archive Properties window.
4. Increase the value of the **Data Timeout** field, and then click **OK**.

Data does not update

PI DataLink caches configuration data for PI points and non-time-based data from PI AF (that is, data other than PI point data references and events). As a result, data inserted into worksheets may not update to show values based on changed configuration or non-time-based data, even when you recalculate the function. Before calculating a function, PI DataLink checks when the cache was last cleared; if the cache has not been cleared within the last six hours, PI DataLink automatically clears the cache. To clear the cache and obtain updated data sooner, do one of the following:

- Click **Clear Cache** on the Settings window. See Manage PI DataLink settings from Excel.
- Close and reopen Microsoft Excel.

Technical support and other resources

For technical assistance, contact OSIsoft Technical Support at +1 510-297-5828 or through the OSIsoft Tech Support Contact Us page (https://techsupport.osisoft.com/Contact-Us/). The website offers additional contact options for customers outside of the United States.

When you contact OSIsoft Technical Support, be prepared to provide this information:

- Product name, version, and build numbers
- Details about your computer platform (CPU type, operating system, and version number)
- Time that the difficulty started
- Log files at that time
- Details of any environment changes prior to the start of the issue
- Summary of the issue, including any relevant log files during the time the issue occurred

To ask questions of others who use OSIsoft software, join the OSIsoft user community, PI Square (https://pisquare.osisoft.com). Members of the community can request advice and share ideas about the PI System. The PI Developers Club space within PI Square offers resources to help you with the programming and integration of OSIsoft products.