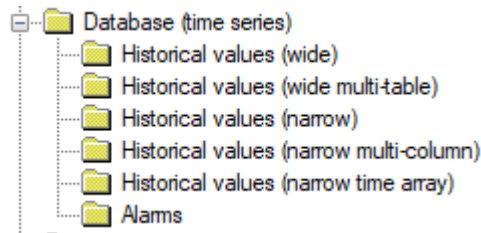# Database (time series) Connectors

Overview

For database tables containing timestamped records, XLReporter provides specialized connectors that provide all the functionality usually found in a historian such as aggregating and tag browsing **without** the user needing to formulate SQL statements.

In **Data Connectors**, expand the **Database (time series**:

As a pre-requisite for this connector, there needs to be a column (s) representing the data and time.

Normally, time series data is recorded in a wide format where each column represents the process data or in a narrow format where the process data is recorded in a single column.

Historical values (wide)

This connector is used for wide tables/views which has a column representing a timestamp and the remaining columns representing process data. The following is an example of a wide table:

DateAndTime	Flow	Pressure	Speed	Temp
1/1/2023 0:00	6.8	28.5	64.2	78.3
1/1/2023 0:01	7.2	28.8	64.8	78.4
1/1/2023 0:02	7.4	29.1	65.2	78.3
...	...	...	...	...
1/1/2023 23:59	4.6	26.8	26.8	78.2

In the above, the data has been collected periodically every minute. Support is also provided for collections on events in which case the timestamp of each row will represent the time when the event occurred e.g., for each machine cycle. When the connector is created, a browser is automatically provided for tag selection.

For reporting purposes, a specified time can provide raw values and aggregates.

Connector

To configure the connector, from the **Project Explorer** select **Data, Connectors**.
- Click **Add**
- Select **Database (time series)**, **Historical values (wide)**
- Click **OK**

Primary Database

This defines the database where the report data is located. A browse button […] is provided for the selection. If there are issues connecting to the database, please refer to the **Database Connectors** document for the specific database.

Table

With a database selected, select the **Table** containing the values. In the above example the *Activities* table was selected.

Date/Time Column

From the columns of the Table selected the column representing the date and time. If both the data and time are in the same column, check **Date includes Time**.

Settings

The **Settings** button opens the **Settings** dialog.

Typically, these settings are defaulted based on the **Primary Server**.

- **Client Wait Time**

   If the connector is used for a large volume of data or the database is slow to respond it is possible that the connection times out. In these cases, increase this value.

- **Date/Time Storage**

   This indicates the format of the timestamps in the database, for example, set to *Local Date and Time* indicates the timestamp in the database is expressed in local time.
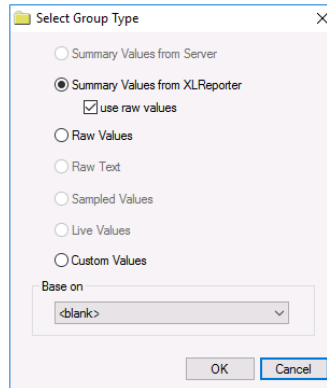
When records are retrieved from the database using the timestamp, the request can be formatted as **YYYY-MM-DD** which removes any ambiguity of the calendar components. It is rare that this default needs to be unchecked.

Data Group

The following describes the historical data group settings specific to this connector. For information on common features such as the Columns and Time Period Tabs, please refer to **Historical Data Groups** documentation.
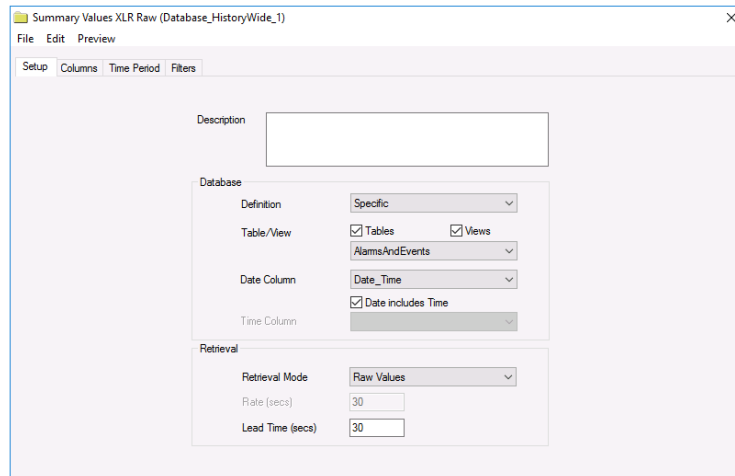
Group Type

The following group types are available for this connector:

- **Summary Values from XLReporter**

  Summary values are calculated by XLReporter. Select **use raw values** to base calculations on raw values otherwise they will be based on sampled values from the Server.

- **Raw Values**

  Numeric values from the Server

- **Custom Values**

  Custom values queried from any table/view in the historian database using the **Database Group**.

Group Settings

Setup Tab

Database

The **Database** settings indicate the table and column(s) for the timestamp. If **Definition** is set to *Connector*, the settings from the connector are used. If set to *Specific*, any appropriate table in the database can be selected.

Retrieval

The **Retrieval** settings is only enabled for summary values.

- **Retrieval Mode**

  This setting defines how data is retrieved from the historian. Only *Raw Values* are available.

- **Lead Time**

  The amount of time (in seconds) to retrieve data before the start time.

Filters Tab

If the **Perform by Server** option is checked, any filter configured in this tab is put into the *WHERE* clause of the query sent to retrieve data for the group. Otherwise, the configured filtering is performed by the reporting engine after the values are returned. It is recommended to leave this setting checked as the performance is much better.

Verify the Data Connector

From the **XLReporter Project Explorer** select**, Tools, Connector Groups**

Select the *Historical Values (wide)* connector and then select **Add.**
- Set the **Type** *Raw Values* and click **OK**.

On the **Columns** tab of the group, select the tag **Name**(s).

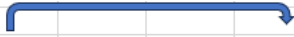Select **Preview,** pick a *Start* date and click **Refresh.**

Historical values (narrow)

This connector is used for narrow tables/views that has at least a column representing a timestamp, a column representing the tag name/tag index and a column representing process data. The following is an example of a narrow table using a tag name column:

DateAndTime	TagName	Val
1/1/2023 0:00	Flow	6.8
1/1/2023 0:00	Pressure	28.5
1/1/2023 0:00	Speed	64.2
1/1/2023 0:00	Temperature	78.3
1/1/2023 0:01	Flow	7.2
1/1/2023 0:01	Pressure	28.8
1/1/2023 0:01	Speed	64.8
1/1/2023 0:01	Temperature	78.4
...	...	
1/1/2023 23:59	Flow	4.6
1/1/2023 23:59	Pressure	26.8
1/1/2023 23:59	Speed	65.3
1/1/2023 23:59	Temperature	78.2

In the case where the table contains a tag index, instead of a tag name, a <u>second</u> table is used to establish the tag index/tag name relationship. The data above would be stored as follows:

DateAndTime	TagIndex	Val		TagIndex	TagName
1/1/2023 0:00	1	6.8		1	Flow
1/1/2023 0:00	2	28.5		2	Pressure
1/1/2023 0:00	3	64.2		3	Speed
1/1/2023 0:00	4	78.3		4	Temperature
1/1/2023 0:01	1	7.2			
1/1/2023 0:01	2	28.8			
1/1/2023 0:01	3	64.8			
1/1/2023 0:01	4	78.4			
...	...				
1/1/2023 23:59	1	4.6			
1/1/2023 23:59	2	26.8			
1/1/2023 23:59	3	65.3			
1/1/2023 23:59	4	78.2			

In both the cases above, the data has been collected periodically every minute. Support is also provided for collections on events in which case the timestamp of the row will represent the time when the event occurred e.g., cycle end. A tag catalog is automatically created for tag selection.

For reporting purposes, a specified time can provide raw values and aggregates.

Connector

To configure the connector, from the **Project Explorer** select **Data, Connectors**.

- Click **Add**
- Select **Database (time series)**, **Historical values (narrow)**
- Click **OK**

Primary Database

This defines a connection to the database where the report data is located. A browse button […] is provided to define. If there are issues connecting to the database, please refer to the section in the Database Connectors document on the specific database.

Table

The table or view that contains the data. Note, only one table or view may be selected so if the data is in multiple tables a view will be required in the database to join tables together into a single entity.

Rows

The column that contains the timestamp for each record. If the date and time are in the same columns, check **Date includes Time**.

Columns

This setting depends on whether the narrow **Table** contains a tag name or tag index column.

- **Tag Name**

  Set the **Columns** to the name of the column representing the tag name and uncheck *Tags in a Separate Table*

- **Tag Index**

  Set the **Columns** to the name of the column representing the tag index and check *Tags in a Separate Table*. Click the button to open the **Tag Table Settings**.

  Select the **Table** and the **Columns** that provide the relationship between the tag **Name** and **Index**.

Values

The column that contains the values e.g., *Value*.
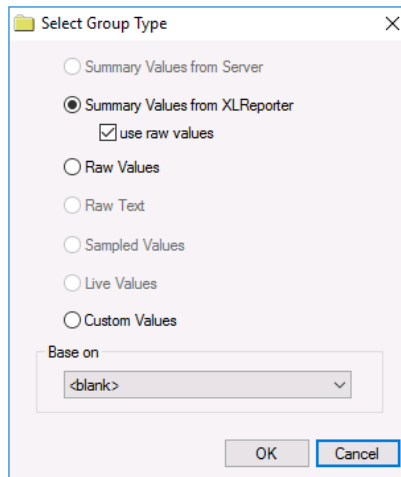
Settings

See the **Historical Values (wide)** section for more information.

Data Group

The following describes the historical data group settings specific to this connector. For information on common features such as the **Columns** and **Time Period** tabs, please refer to **Historical Data Groups** documentation.

Group Type

The following group types are available for this connector:

- **Summary Values from XLReporter**

    Summary values are calculated by XLReporter. Select **use raw values** to base calculations on raw values otherwise they will be based on sampled values from the Server.

- **Raw Values**

    Numeric values from the Server

    Using the narrow table presented at the start of this section, a **Raw Values** retrieval for every tag would produce:

DateAndTime	Flow	Pressure	Speed	Temp
1/1/2020 00:00	6.8	28.5	64.2	78.3
1/1/2020 00:01	7.2	28.8	64.8	78.4
1/1/2020 00:02	7.4	29.1	65.2	78.3
…	…	…	…	…
1/1/2020 23:59	4.6	26.8	65.3	78.2

- **Custom Values**

    Custom values queried from any table/view in the historian database using the **Database Group**.

Group Settings

Setup Tab

Retrieval

The **Retrieval** settings is only enabled for summary values.

- **Retrieval Mode**

  This setting defines how data is retrieved from the historian. Only *Raw Values* are available.

- **Lead Time**

  The amount of time (in seconds) to retrieve data before the start time.

Filters Tab

Server Filtering

To exclude values that do not match the criteria are not considered, set **Server Filtering** to the column used for **Value** in connector and the condition accordingly.

Verify the Data Connector

From the **XLReporter Project Explorer** select**, Tools, Connector Groups**

Select the *Historical Values (narrow)* connector and then select **Add.**

- Set the **Type** *Raw Values* and click **OK**.

On the **Columns** tab of the group, select the tag **Name**(s).

Select **Preview,** pick a *Start* date and click **Refresh.**

Historical values (wide multi-table)

When multiple tables in a database each contain a timestamp column, this connector can be used to "combine" the tables to appear as a single table. This has the benefit that

- Tag browsing spans over every table allowing a report to contain data from each.
- The retrieved values are in one table.
- Filters affect the entire selection.

Note that the minimum sample rate for the data in these tables is 1 minute.

As an illustration, consider a database containing 3 identical tables which differ only by the production line populating the table:

Using the connector, comparison between the production lines is greatly simplified because the user selects the tags from a single browser:
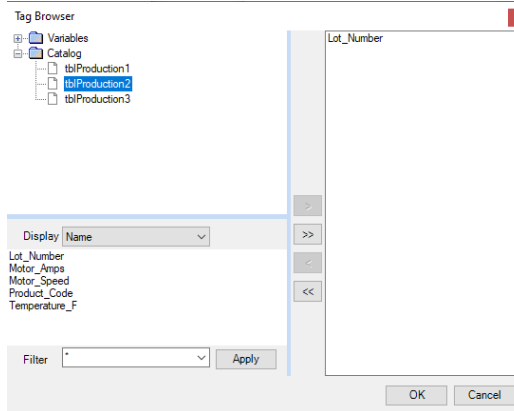
Connector

To configure the connector, from the **Project Explorer** select **Data, Connectors**.
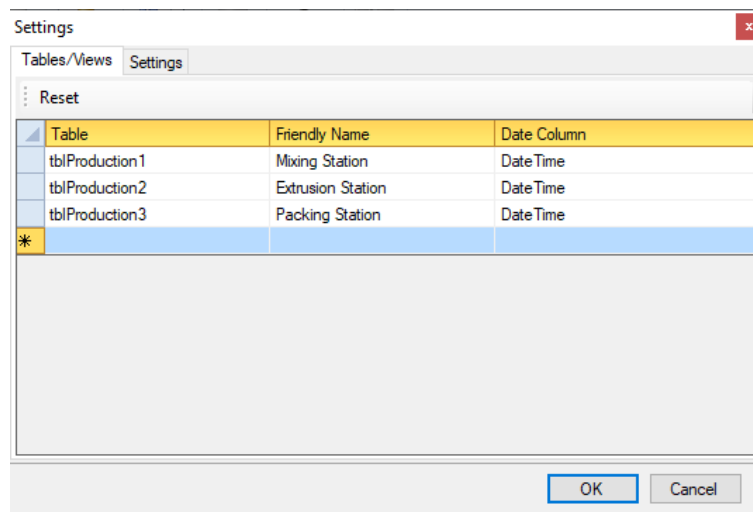
- Click **Add**
- Select **Database (time series)**, **Historical values (wide)**
- Click **OK**

Primary Database

This defines a connection to the database where the report data is located. A browse button […] is provided to define. If there are issues connecting to the database, please refer to the section in the Database Connectors document on the specific database.

Settings

Tables/Views Tab

The **Tables/Views** tab displays a list of tables and views from the database which should be considered for the connector. The initial list is generated automatically after the connection to the database is established by listing every table and view in the database that has a column with a DateTime type.

Each row consists of the following settings:

- **Table**
  The name of the table or view in the database.

- **Friendly Name**
  The name that the table or view will be displayed as when items are browsed for the connector.

  By default, this is the same name as the table or view in the database but can be changed to something more descriptive and user friendly.

- **Date Column**
  The name of the column in the table or view that contains the timestamp to use when requesting data.

  Note that the specified column must either be a valid date/time type reference or a *CAST* statement so that it is treated as a timestamp (e.g., *CAST(mycolumn AS datetime)*.

Additional tables and views can be added to the list. Tables and views can be deleted from the list by selecting the row indicator column on the left and pressing the Delete key.

When the connector is saved the first time, catalogs are created for every table/view listed here. If the connector is modified and tables/views are added or removed from the list, the subsequent catalog is added or removed from the project but catalogs for existing tables and views are not modified in any way. This means that if a column is added to an existing table or view, it must be added to the catalog manually.

The **Reset** option resets the list of tables and views by running the same detection as it did when the connection to the database was first established. Please note that this will delete every existing catalog for the connector in the project. These catalogs will get regenerated when the connector is saved but any modifications made to any catalog will be lost.
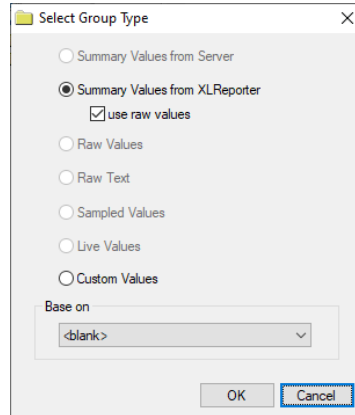
Settings Tab

The **Settings** tab provides the settings used to query data from the database. For more information see **Settings** in the **Historical values (wide)** section of this document.

Data Group

The following describes the historical data group settings specific to this connector. For information on common features such as the Columns and Time Period Tabs, please refer to **Historical Data Groups** documentation.

Group Types

The following group types are available for this connector:

- **Summary Values from XLReporter**

  Summary values are calculated by XLReporter. Select **use raw values** to base calculations on raw values otherwise they will be based on sampled values from the Server.

- **Custom Values**

  Custom values queried from any table/view in the historian database using the **Database Group**.

Group Settings

Setup Tab

Retrieval

The **Retrieval** settings is only enabled for summary values.

- **Retrieval Mode**

  This setting defines how data is retrieved from the historian. Only *Raw Values* are available.

- **Lead Time**

  The amount of time (in seconds) to retrieve data before the start time.

Columns Tab

Item Browsing

When browsing for items in the groups a group can have items from multiple tables in the database defined for the connector.

Verify the Data Connector

From the **XLReporter Project Explorer** select**, Tools, Connector Groups**

Select the *Historical Values (wide multi-table)* connector and then select **Add.**

- Set the **Type** *Summary Values from XLReporter*, check **use raw values** and click **OK**.
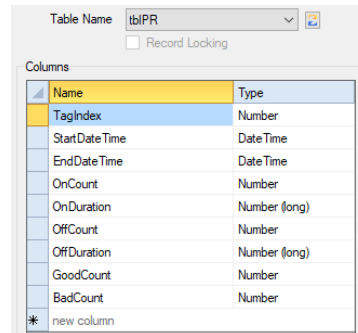
On the **Columns** tab of the group, select the tag **Name**(s).

Select **Preview,** pick a *Start* date and click **Refresh.**
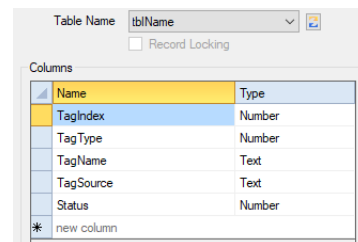
Historical Values (narrow multi-column)

The Historical Values (narrow) connector handles database tables where each tag is logged as a separate row in the table, that connector only accommodates one value column in the table. In some cases, there may be multiple value columns in the table from which data should be reported for every tag.

For this case, the **Historical Values (narrow multi-column)** connector is provided. As an illustration, consider the following table:

This table consists of a timestamp column, a tag index column and multiple data columns pertaining to the tag.

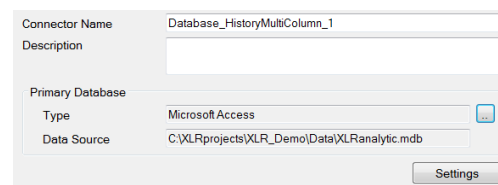The table *tblName* gives the association between *TagName* and *TagIndex* for browsing purposes.

Connector

To configure the connector, from the **Project Explorer** select **Data, Connectors**.

- Click **Add**
- Select **Database (time series)**, **Historical values (narrow multi-column)**
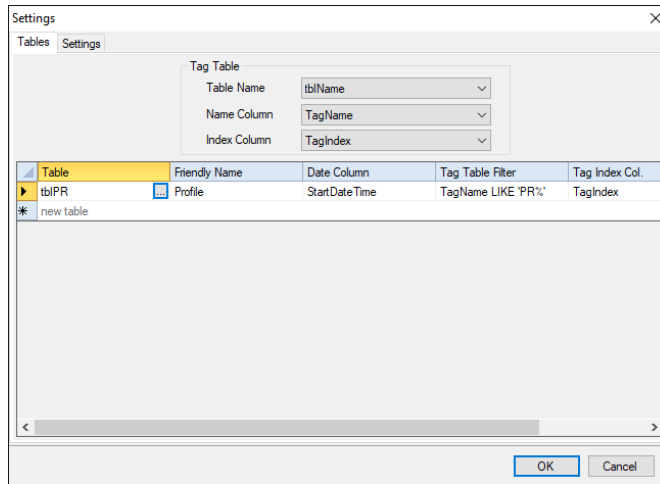- Click **OK**

Primary Database

This defines a connection to the database where the report data is located. A browse button […] is provided to define. If there are issues connecting to the database, please refer to the section in the Database Connectors document on the specific database.

Settings

Tables Tab

The **Tables** tab displays the settings to define the **Tag Table** and the list of data tables for the connector.

The **Tag Table** settings define the table where the tag names can be queried from for browsing purposes. The following settings are required:

- **Table Name**
  The name of the tag table in the database.

- **Name Column**
  The column in the tag table with the tag names to display for the user.

- **Index Column**
  The column in the tag table with the index used to link the tag table to the data table(s) in the database.

The list beneath the **Tag Table** section defines each table in the database that can be queried to retrieve data. To define a data table, click the browse pushbutton […] under the **Table** column.
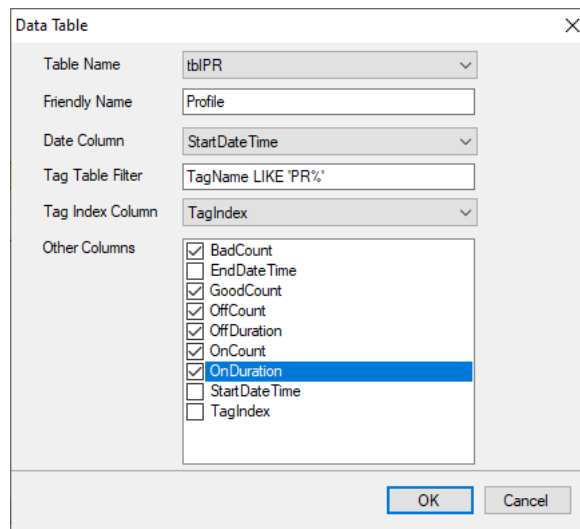
The following elements are required:

- **Table Name**
  The name of the data table in the database.

- **Friendly Name**
  A friendly name for the table. This will appear in the browser for the user to select from.

- **Date Column**
  The column in the data table that contains the timestamp to filter records on.

- **Tag Table Filter**

  A filter for the tag table to extract the tag names relevant for this data table. For example, if all the tags in the tag table for this data table start with "PR", this should be defined as:
  TagName LIKE 'PR%'
  If no filter is required, this can be left blank.

- **Tag Index Column**

  The column in the data table used to link to the tag table.

- **Other Columns**

  The columns in the data table that provide the data. Check all that apply. Every column in the selected **Table Name** is listed.
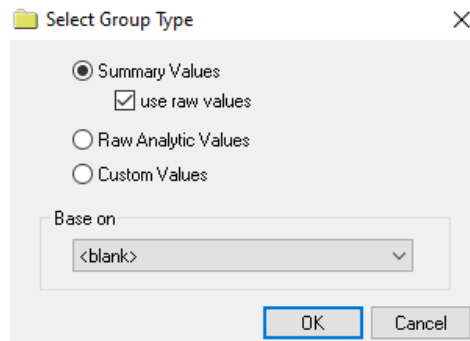
Settings Tab

The **Settings** tab provides the settings used to query data from the database. For more information see **Settings** in the **Historical values (wide)** section of this document.

Data Group

The following describes the historical data group settings specific to this connector. For information on common features such as the Columns and Time Period Tabs, please refer to **Historical Data Groups** documentation.

Group Types

The following group types are available for this connector:

- **Summary Values**

  Summary values are calculated by XLReporter. Select **use raw values** to base calculations on raw values otherwise they will be based on sampled values from the Server.

- **Raw Analytic Values**

  Numeric values from the Server

- **Custom Values**

  Custom values queried from any table/view in the historian database using the **Database Group**.

Group Settings
   Setup Tab

The tables defined in the schema will be listed in the **Type** dropdown list in the order that they are configured.

Verify the Data Connector

From the **XLReporter Project Explorer** select**, Tools, Connector Groups**

Select the *Historical Values (narrow multi-column)* connector and then select **Add.**
- Set the **Type** *Raw Analytic Values* and click **OK**.

On the **Columns** tab of the group, select the tag **Name**(s).

Select **Preview,** pick a *Start* date and click **Refresh.**

Historical Values (narrow time array)

The Historical Values (narrow time array) requires two tables: a tag table that contains the tag names that are logged and a data table where each row contains data logged at a preset rate and stored in columns. Below is a sample of both tables:

Tag Table

The table contains the relationship between the friendly name of the tag and a unique index which is used in the **Data Table**.

TagIndex	TagName
1	Flow
2	Pressure
3	Speed
4	Temperature

Data Table

The table contains the data logged for each tag. The logging is performed across a row until every column is filled and then a new record is created and the process repeats.

| DateAndTime	Index	v0	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11
1/1/2023 0:00	1	1	2	3	4	5	6	7	8	9	10	11	12
1/1/2023 0:00	2	1.1	2.1	3.1	4.1	5.1	6.1	7.1	8.1	9.1	10.1	11.1	12.1
1/1/2023 0:00	3	1.2	2.2	3.2	4.2	5.2	6.2	7.2	8.2	9.2	10.2	11.2	12.2
1/1/2023 0:00	4	1.3	2.3	3.3	4.3	5.3	6.3	7.3	8.3	9.3	10.3	11.3	12.3
1/1/2023 1:00	1	1.4	2.4	3.4	4.4	5.4	6.4	7.4	8.4	9.4	10.4	11.4	12.4
1/1/2023 1:00	2	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5
1/1/2023 1:00	3	1.6	2.6	3.6	4.6	5.6	6.6	7.6	8.6	9.6	10.6	11.6	12.6
1/1/2023 1:00	4	1.7	2.7	3.7	4.7	5.7	6.7	7.7	8.7	9.7	10.7	11.7	12.7
1/1/2023 2:00	1	1.8	2.8	3.8	4.8	5.8	6.8	7.8	8.8	9.8	10.8	11.8	12.8
1/1/2023 2:00	2	1.9	2.9	3.9	4.9	5.9	6.9	7.9	8.9	9.9	10.9	11.9	12.9
1/1/2023 2:00	3	2	3	4	5	6	7	8	9	10	11	12	13
1/1/2023 2:00	4	2.1	3.1	4.1	5.1	6.1	7.1	8.1	9.1	10.1	11.1	12.1	13.1
1/1/2023 3:00	1	2.2	3.2	4.2	5.2	6.2	7.2	8.2	9.2	10.2	11.2	12.2	13.2
1/1/2023 3:00	2	2.3	3.3	4.3	5.3	6.3	7.3	8.3	9.3	10.3	11.3	12.3	13.3
1/1/2023 3:00	3	2.4	3.4	4.4	5.4	6.4	7.4	8.4	9.4	10.4	11.4	12.4	13.4
1/1/2023 3:00	4	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5
1/1/2023 4:00	1	2.6	3.6	4.6	5.6	6.6	7.6	8.6	9.6	10.6	11.6	12.6	13.6

The table requires

- A timestamp column e.g., **DateAndTime**.
- An index column which refers back to the **Tag Table**
- A set of data columns which contain a zero based numeric sequence e.g., v0, v1, v2 and so on. Support for zero padding of the numeric is supported e.g., v00, v01, v02 and so on.

Connector

To configure the connector, from the **Project Explorer** select **Data, Connectors**.

- Click **Add**
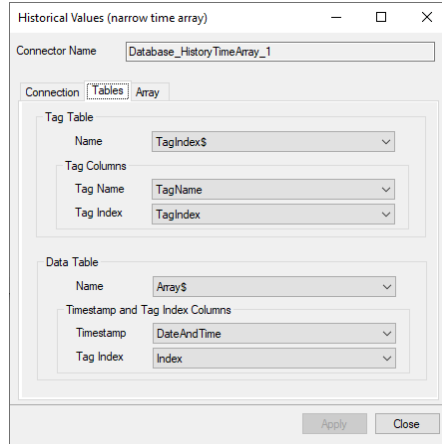- Select **Database (time series)**, **Historical values (narrow time array)**
- Click **OK**
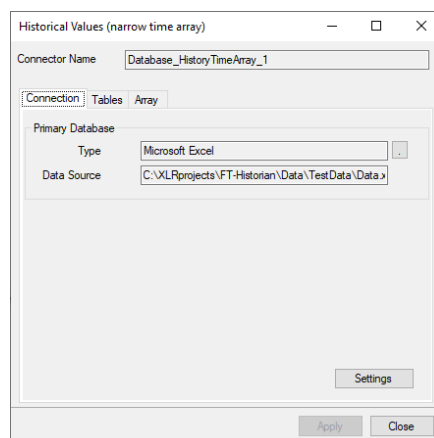
The connector contains 3 tabs: **Connection**, **Tables** and **Array**

Connection tab

On this tab the **Primary Database** specifies where the tables are located. A browse button […] is provided to define. If there are issues connecting to the database, please refer to the section in the Database Connectors document on the specific database.

Tables tab

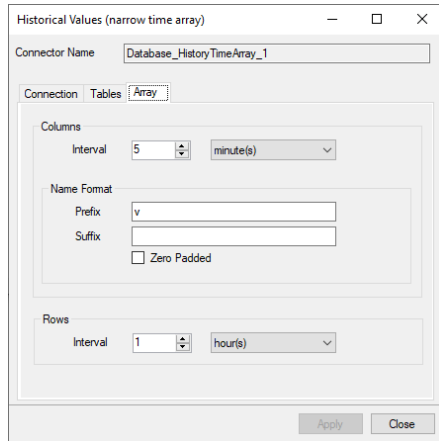On this tab, information about the tag and data tables is provided.

Under **Tag Table** the table **Name** and the columns representing the **Tag Name** and **Tag Index** are specified.

Under **Data Table** the table **Name** and the columns representing the **Timestamp** and **Tag Index** are specified.

Array tab

On this tab, information on the data columns and how the data is arranged in the **Data** table is specified.

Under **Rows** is the frequency of when a new record is added to the table e.g., 1 hour.

Under **Columns**, the interval indicates the logging frequency of each tag. Considering the row and column frequencies together, the number of data columns is expected e.g., new row every hour with a logging frequency of 5 minutes results in 12 columns.
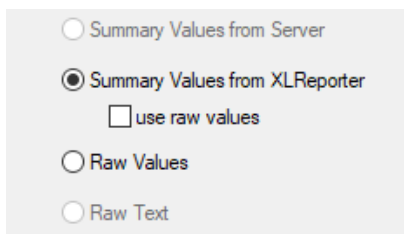
The column names are a zero-based numeric sequence that can contain a **Prefix**, **Suffix** and **zero pad**. By default, the column naming is 0, 1, 2, and so on.

Data Group

The following describes the historical data group settings specific to this connector. For information on common features such as the Columns and Time Period Tabs, please refer to **Historical Data Groups** documentation.

Group Types

The following group types are available for this connector:

- **Summary Values**

  Summary values are calculated by XLReporter. Select **use raw values** to base calculations on raw values otherwise they will be based on sampled values from the Server.

- **Raw Values**

  Numeric values from the Server

Group Settings

All the group settings are described elsewhere in this document.

Verify the Data Connector

From the **XLReporter Project Explorer** select**, Tools, Connector Groups**

Select the *Historical Values (narrow time array)* connector and then select **Add.**

- Set the **Type** *Raw Values* and click **OK**.

On the **Columns** tab of the group, select the tag **Name**(s).

Select **Preview,** pick a *Start* date and click **Refresh.**

Alarms

This connector is used to get time series alarms from a table/view in a database. The table/view must have a column for the timestamp or separate columns for the date and time stamps.

The settings of this connector are identical to the History Values (wide) connector. For details, see the History value (wide) section of this document.

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