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SQL Synchronization and SQL Query to MS SQL Database

Introduction: This document discusses how to configure the SQL Sync and SQL Query feature in Easybuilder Pro and assist programmers in successfully connecting to **Microsoft SQL Server**. This document also explains how to install and configure Microsoft SQL Express step by step.

Equipment & Software:

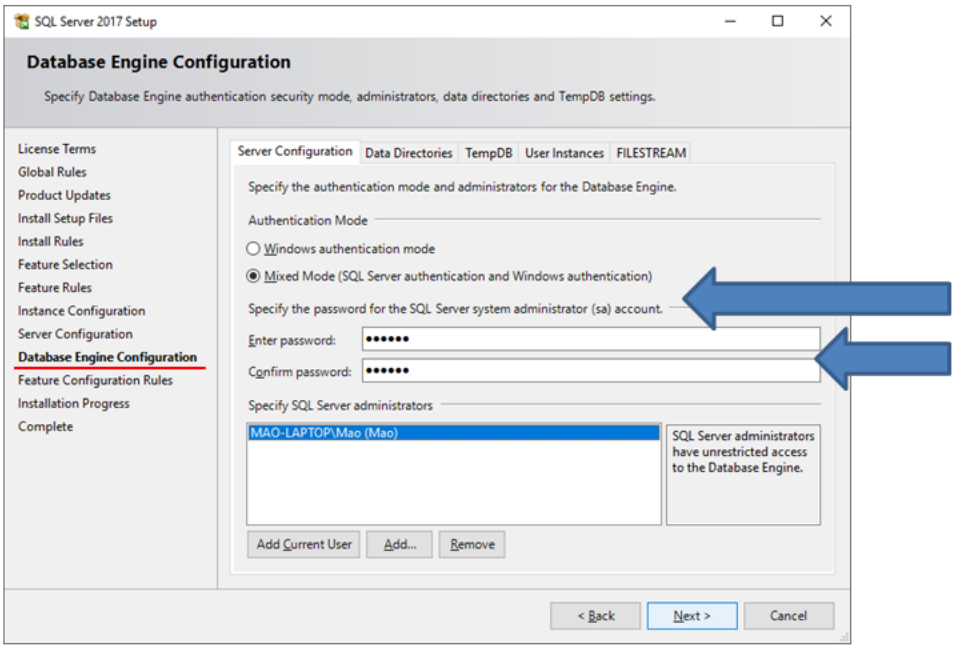
A) cMT3090 (cMT Series HMI)
B) Microsoft SQL Express 2017, which includes **SQL Server** and **SQL Server Management Studio**(SSMS).

Note: Easybuilder pro version 6.01.01 and greater supports MS SQL functionalities. In this document, Easybuilder pro V6.01.01.292 is used.

MS SQL Installation:

MS SQL Express 2017 (14.x), which is a free and limited version of SQL software, is installed and used in the following demonstration. Users can purchase and install other versions based on needs. Most of the steps during the installation can be kept on *Default*. However, the authentication mode must be set to "*Mix Mode*" to allow Weintek HMIs to access the MS SQL server.

In [Database Engine Configuration] » [Authentication Mode], choose "**Mix Mode**." Specify a password for the SQL Server system administrator (sa) account.



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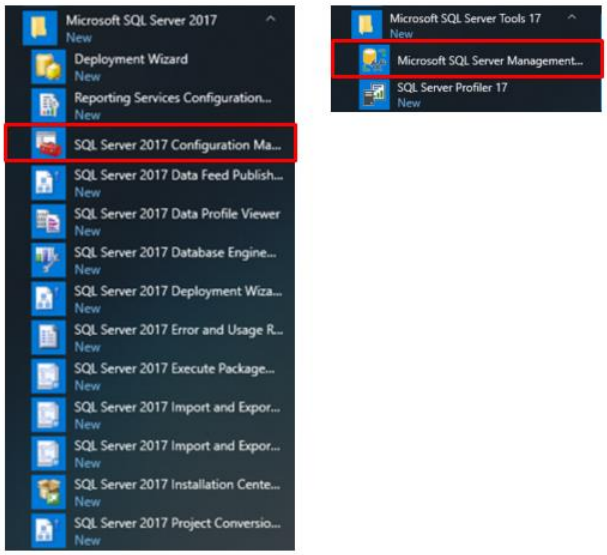
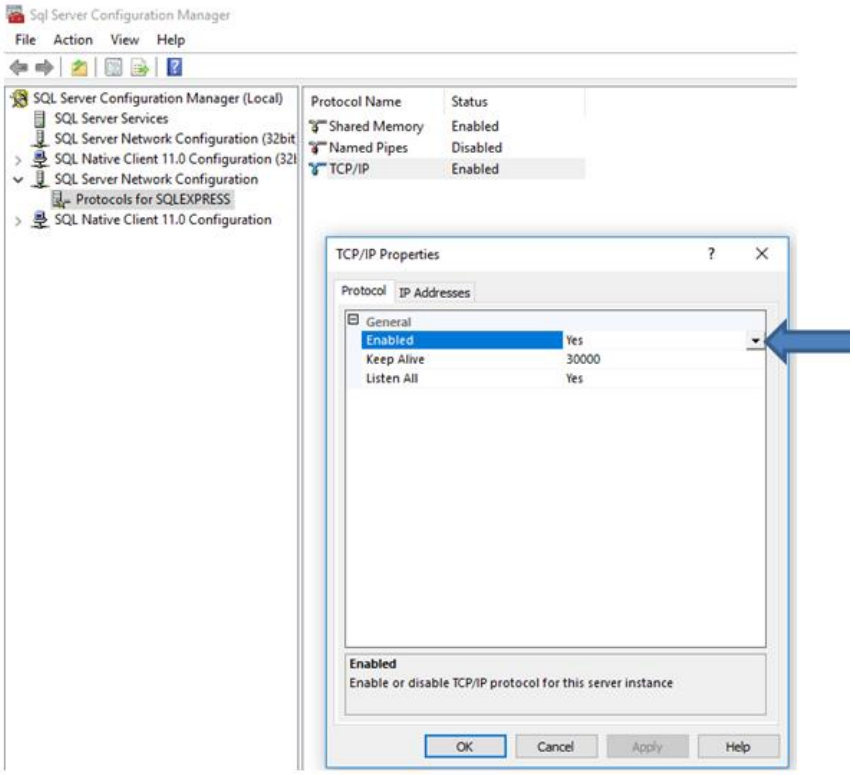
Chapter1. Configuration of MS SQL Server

After finishing the installation, the available utilities will be displayed as shown below. The following instructions show you how to configure **SQL Server Configuration Manager** and **SQL Server Management Studio.**

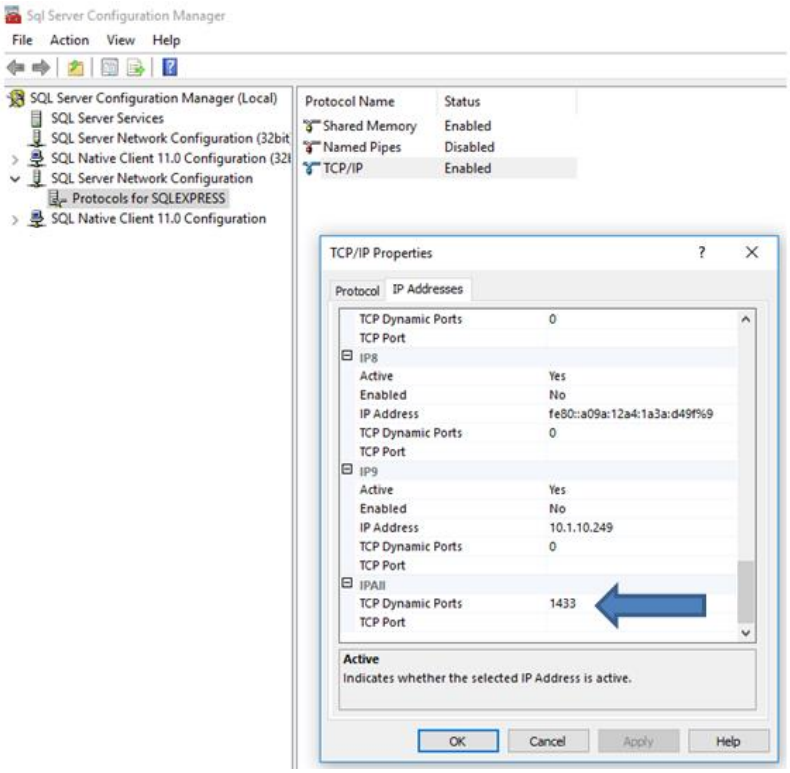


How to configure MS SQL Server

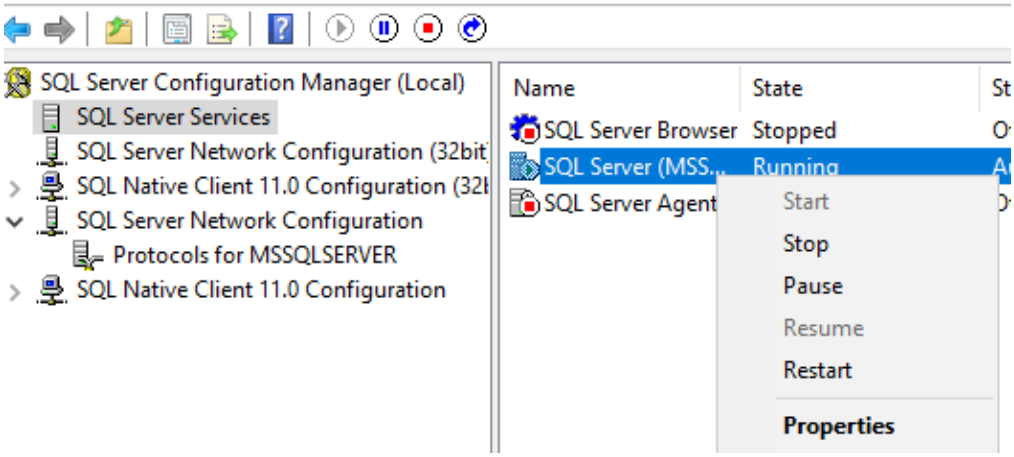
1. Launch **SQL Server Configuration Manager.**
2. Enable TCP/IP protocol in [TCP/IP Properties] because Weintek HMIs connect to the MS SQL server via TCP/IP protocol.
3. Expand [SQL Server Network Configuration].
4. Click on [Protocols for SQLEXPRESS].
5. Click on [TCP/IP].
6. Select [Yes].



7. Under the [IP Addresses] tab, the default port of MS SQL server is 1433. However, the port number can be changed depending on the project's requirements.

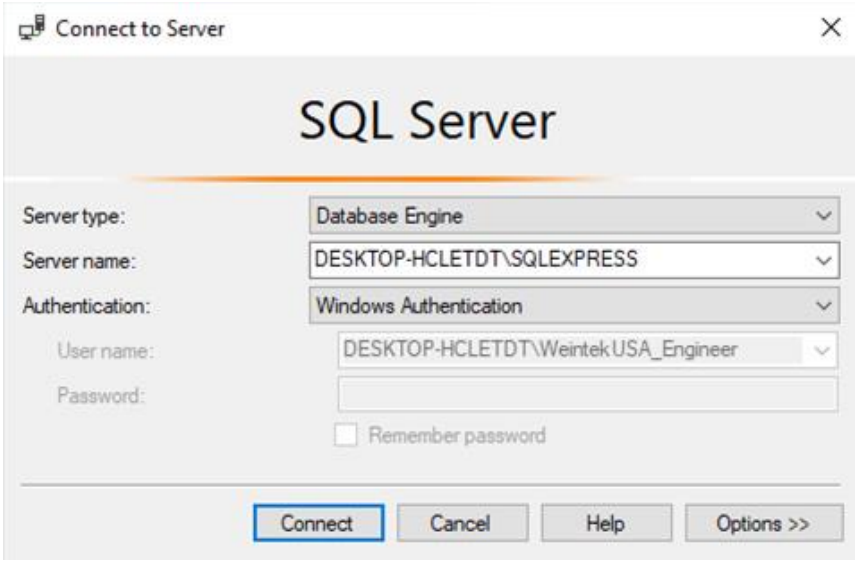


8. The changes will take effect after restarting the service, so you will need to restart the SQL server by the following steps.
   I. Click on [SQL Server Services].
   II. Right click on [SQL Server (MSS..].
   III. Select [Restart].

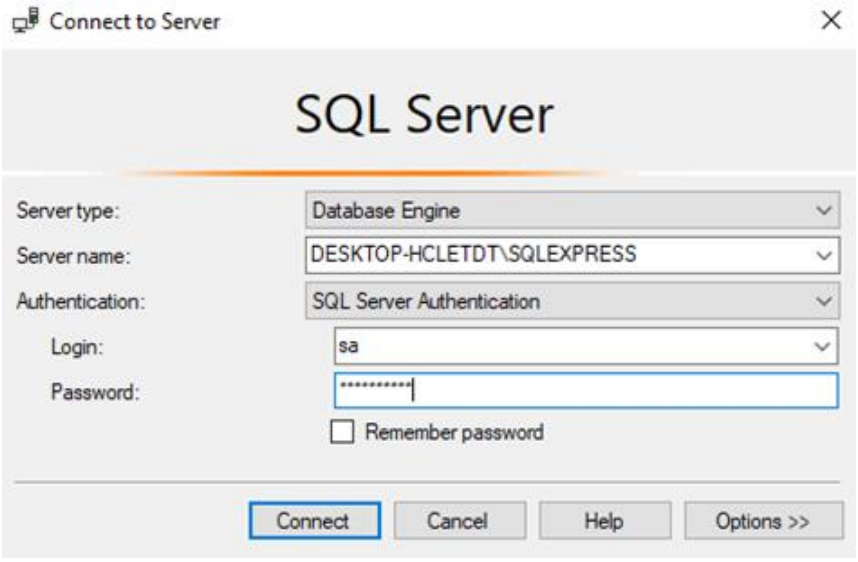


Chapter2. Configuration of SSMS (SQL Server Management Studio)

1. Launch **SQL Server Management Studio.**
2. To log in the SQL server via SSMS, you can use **Windows Authentication** or **SQL Server Authentication**.

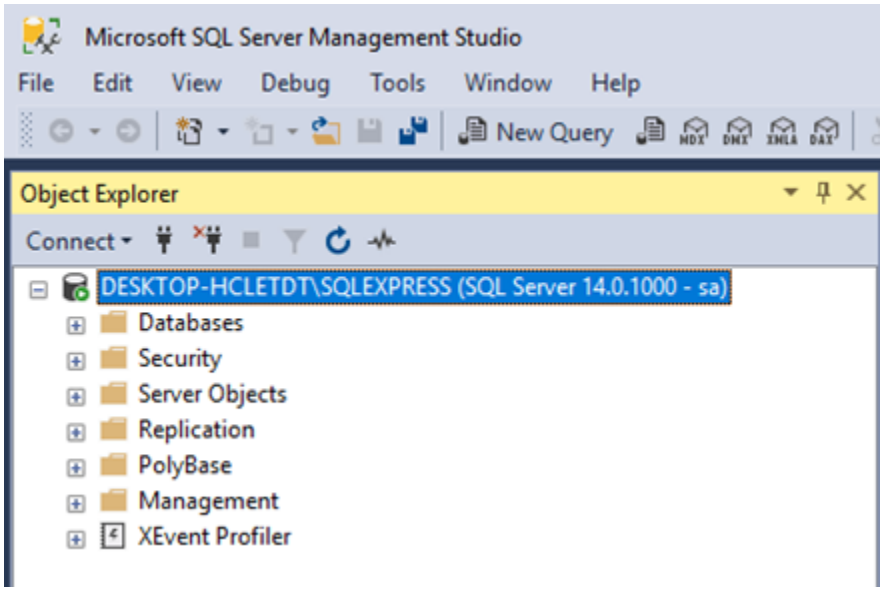


Windows Authentication

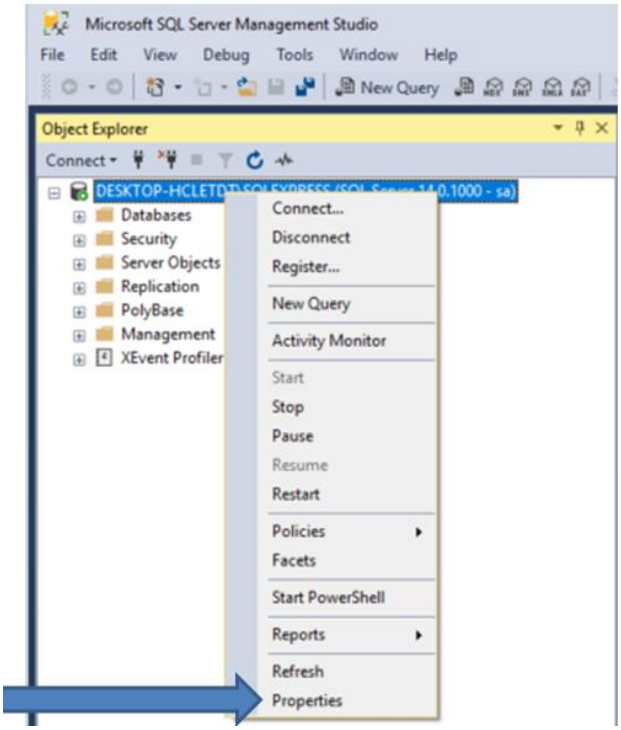


SQL Server Authentication

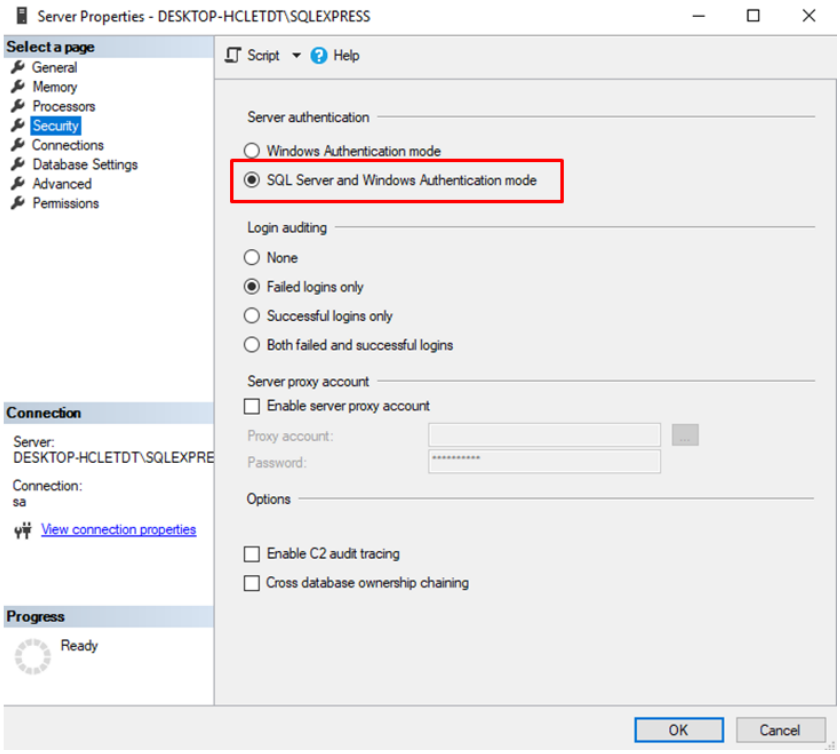
The user interface of SSMS will be displayed as shown.



Note: If you didn't choose "**Mix mode**" during installation, right click on **server** and select [Properties].

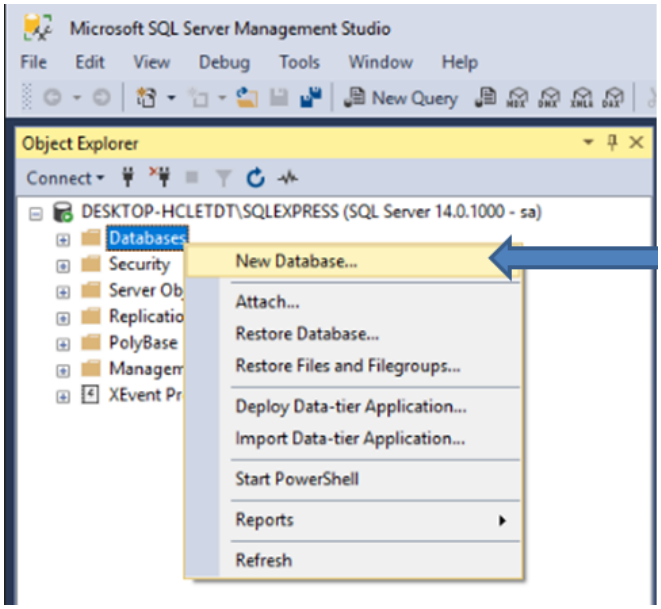


In the [Security] tab, select **SQL server and Windows Authentication mode** for server authentication.

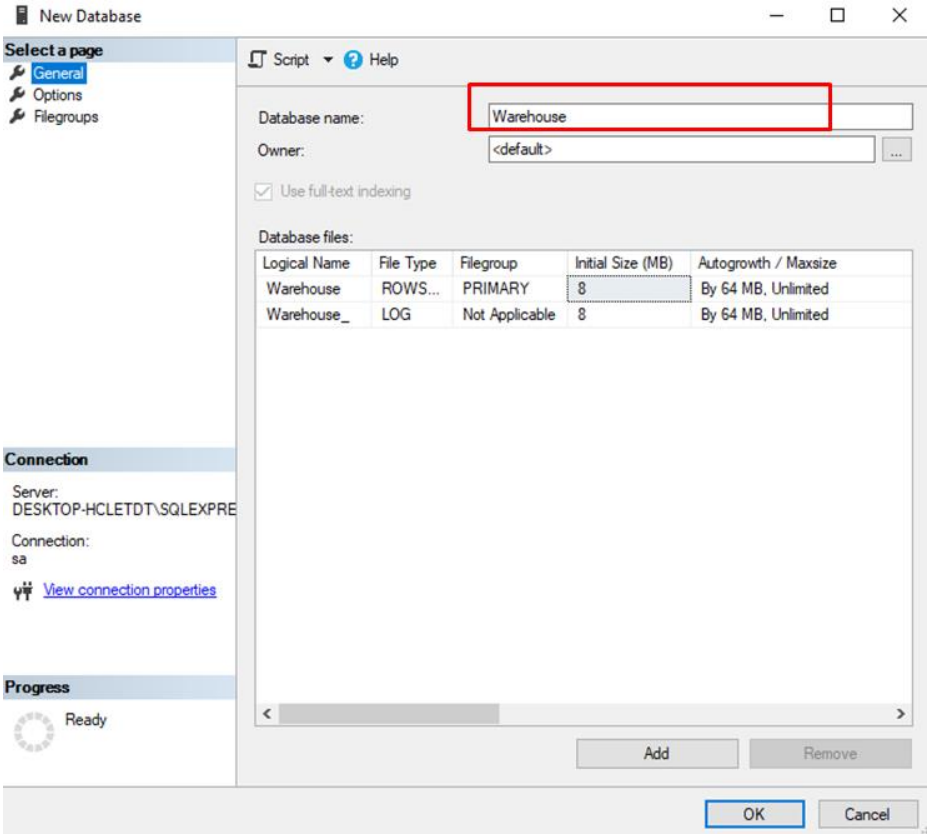


How to add a Database

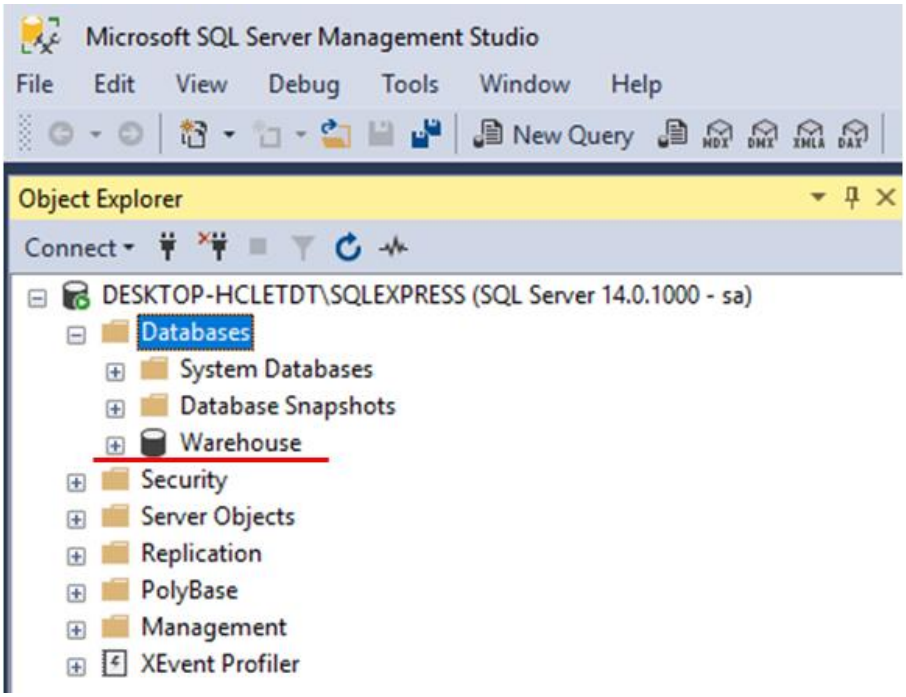
3. Right click on [Databases] and select [New Database…].



4. In the [General] tab, enter the desired name for this database. Click on [OK].

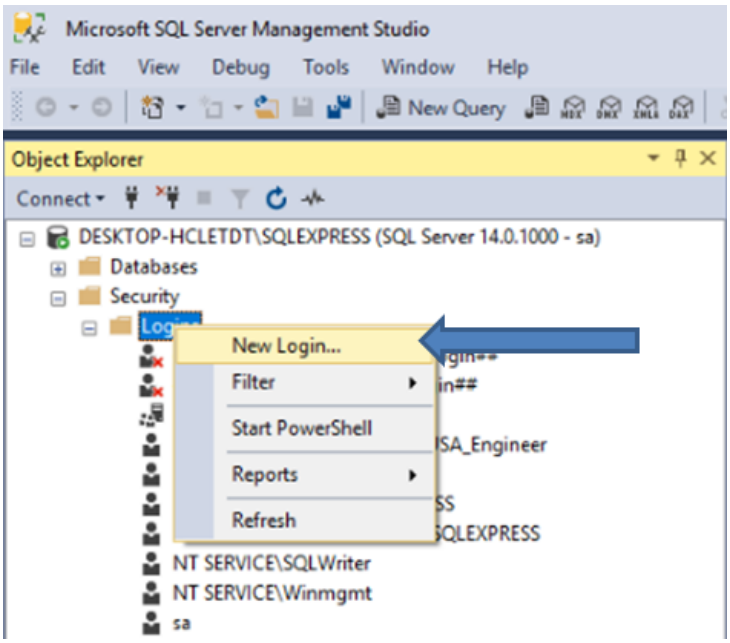


5. The new database will be listed under **Databases.**

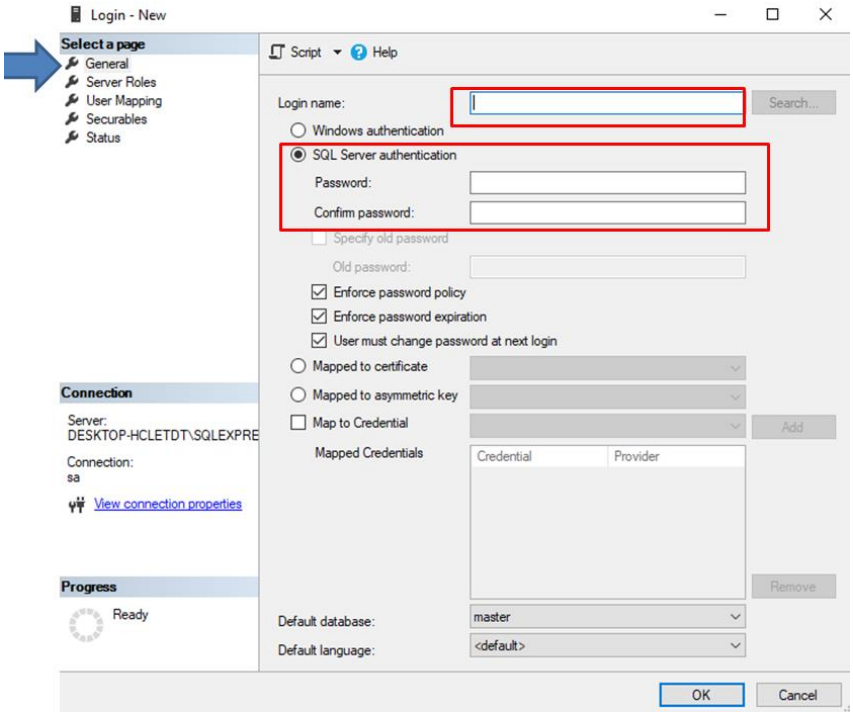


How to add user accounts

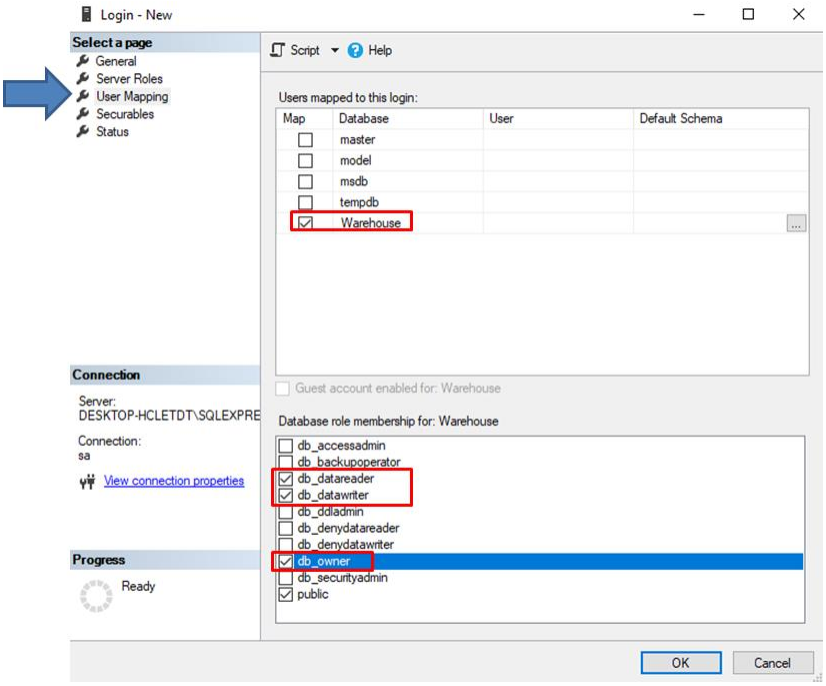
6. Go to [Security] » [Logins]. Right click [Logins] and select [New Login…].



7. In the [General] tab, create a new user. Specify a desired name and a password.

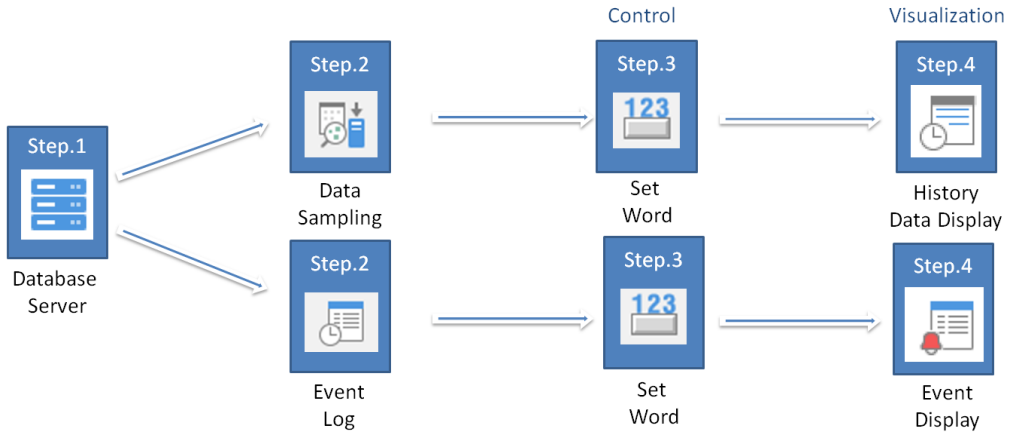


8. In the [User Mapping] tab, select database roles for this user. Check the following Database roles checkbox, including **db_datareader**, **db_datawritter**, and **db_owner**.



Chapter 3. Configuration of SQL Sync

This chapter demonstrates how to program the SQL Sync. feature in Easybuilder Pro. You can synchronize data logs and event logs to your SQL server.



Workflow

Adding a database server in EBpro

1. Launch Easybuilder pro. Go to [Data/History] tab » [Database Server]. Click on the [New] button to add a database server.
2. On the [General] tab, choose [MS SQL server] for server system. Enter the IP address, port number, and an authentication account of the SQL server. **Database name** depends on what database you want to use for data synchronization.

Note:

I. Weintek HMIs cannot use **Windows Authentication**.

II. Instead of entering the IP address, there are two more options to connect to your MS SQL server in EasyBuilder Pro v6.02.02 or greater.

- Use IP: Enter the IP address of the database
- Use domain name: Enter the **Microsoft PC Name**

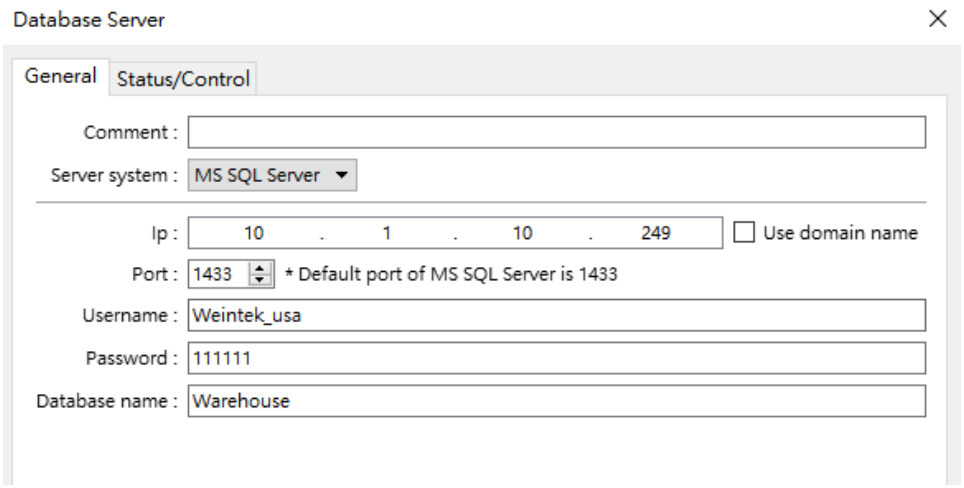
- Use server name: The server name stands for the **instance** name of the MS SQL server and can be in one of the following formats.

<Computer name>\<Instance name>

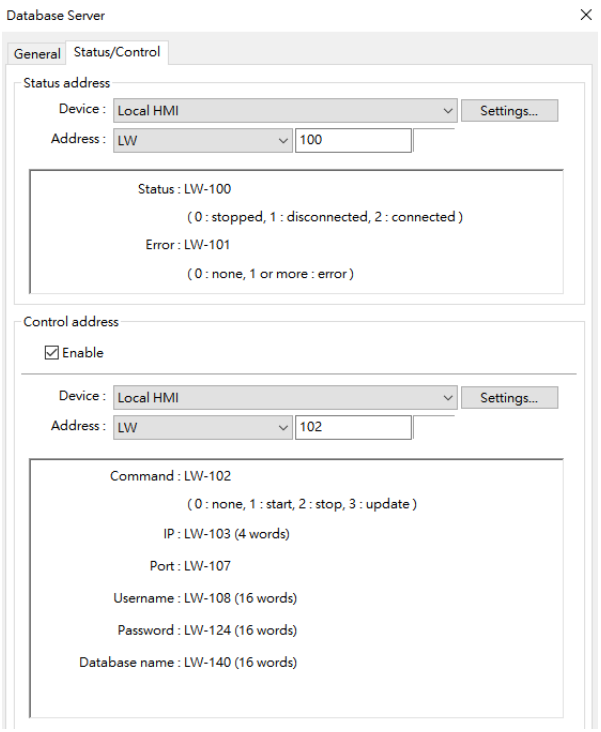
<Computer name> (connection to a default instance: MSSQLSERVER)

<IP address>\<Instance name>

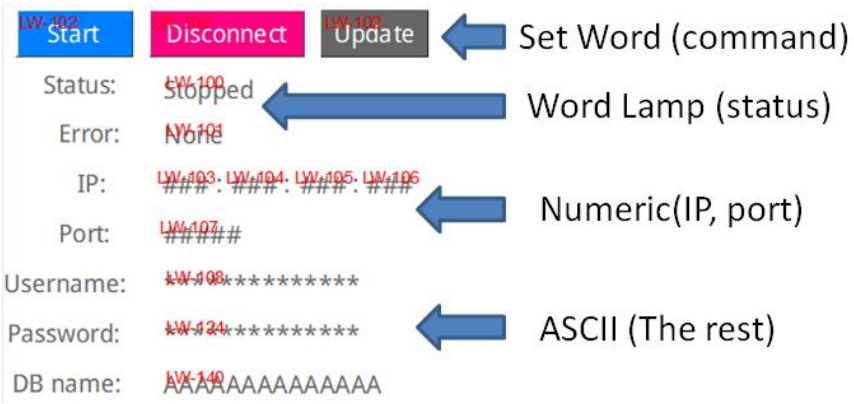
<IP address> (connection to a default: MSSQLSERVER)



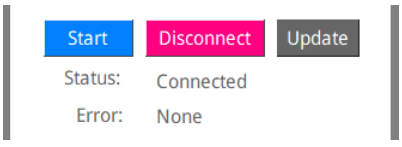
3. On the [Status/Control] tab, define the **Status address** to display the connection status on the HMI screen. You can define a **Control address** if enabled to change the following server parameters on the HMI screen during runtime.



4. Create the following objects on the editing area. These objects are used to monitor and control the MS SQL server connection.



Once the Weintek HMI succeeds in connecting to the MS SQL server, the "Connected" message will be displayed in the Status address.



Status: displays the connection status

Value	Description
0	Not attempting to connect to the server
1	Failed to connect to the server
2	Connected to the server

Error: displays the error code

Value	Description
0	No error
1	Unknown error
2	Failed to connect to database
3	Database blocks the unauthorized connection
4	Incorrect database name
5	Invalid domain name

Data Log Sync.

Follow these steps after you have created your data logs in **Data Sampling.**

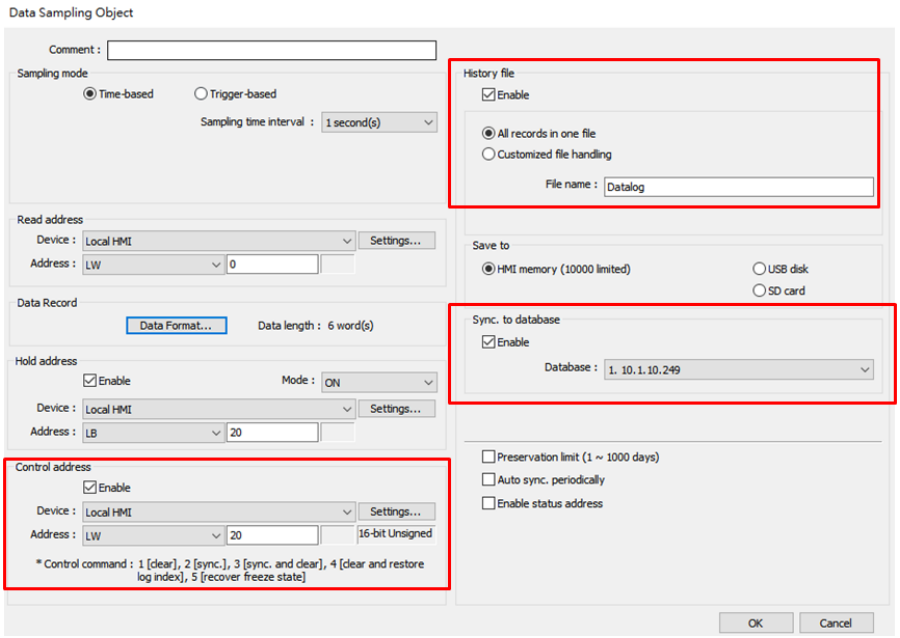
1. Go to the [Data/History] tab » [Data sampling]. Under **History file** select [Enable] and then select the [Sync to database] option. Once configured, select a database server to store your historical data.

   Note: SQL sync. doesn't support "Customized file handling." You must select "**All records in one file.**"

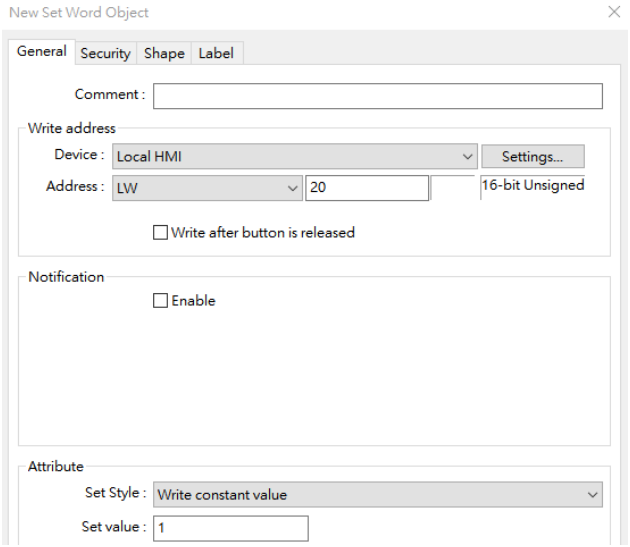
2. You can enable a **Control address** to trigger the following actions by issuing the corresponding commands. The HMI will perform auto synchronization at the specified time interval if **Auto sync. Periodically** is enabled.

Command Number	Description
1	This command will clear all logged records in the HMI flash memory.
2	This command will synchronize the historical data to the MySQL server.
3	This command will synchronize the historical data to the MySQL server and then clear all logged records in the HMI flash memory.

For more information about the **Control address**, please refer to the Easybuilder Pro user manual.

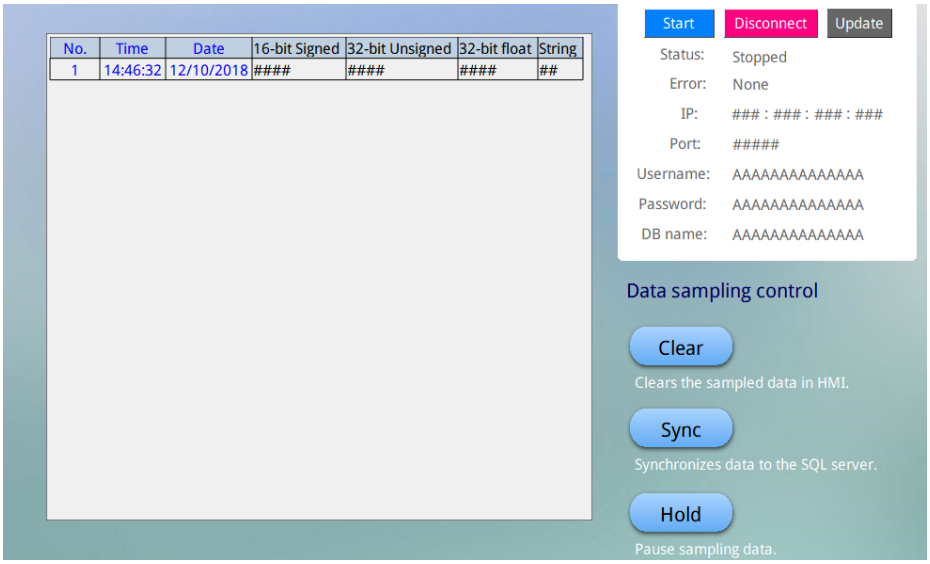


3. Create three **Set Word** objects on the editing area for the **Control address** of data sampling.
   I. Write constant value 1 to clear data.
   II. Write constant value 2 to sync data.
   III. Write constant value 3 to sync data and then remove duplicate data on the HMI.



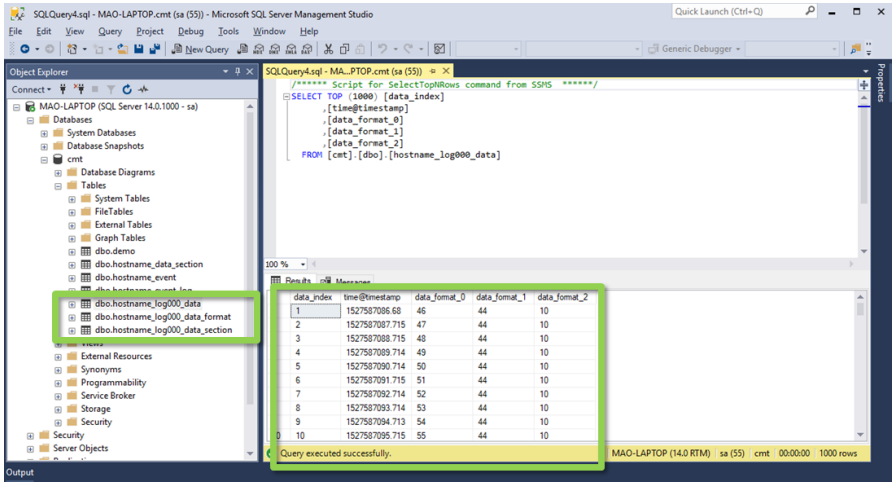
4. Go to the [Data/History] tab » [History Data Display]. Create this object on the editing area.

Screen Shot of the Final Project as shown below.



Testing - Click the [Sync] button, which is used to issue command #2 via a **Set Word** object. If the sync succeeds, the following three tables will be generated in your database.

Note: The HMI will transfer the original data logs to the MS SQL server. Please use SELECT statement to get a table that contains specific organized data.



Tables are automatically created by the HMI.

For example,

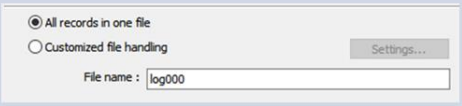
In Easybuilder Pro	In SQL Server Management Studio
Database name:Warehouse HMI name:hostname(simulation) Datalog name:log000 	

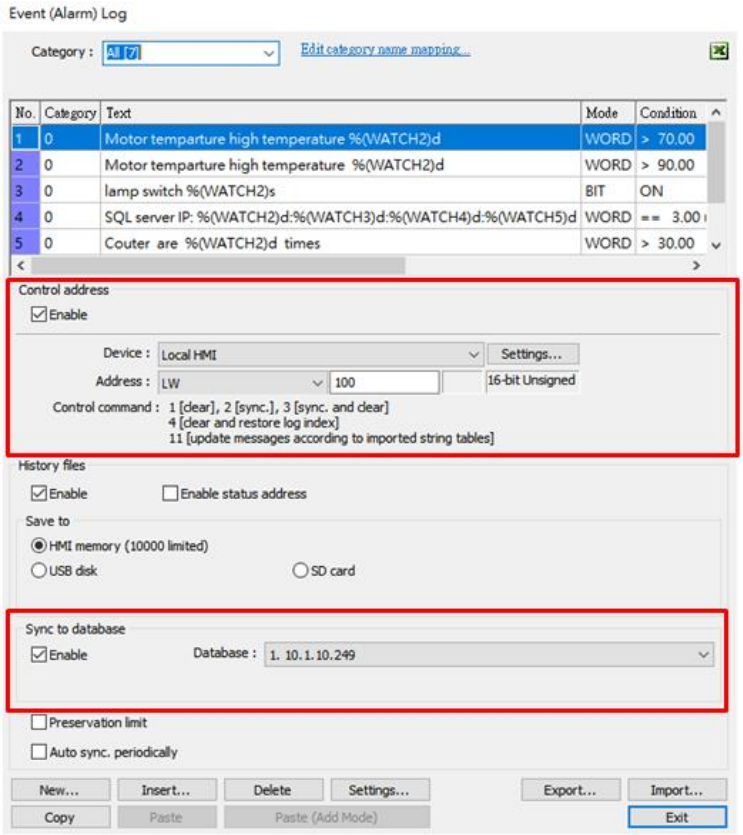
Table	Description
dbo.<HMI NAME>_<DATALOG NAME>_data	Saves data sampling
dbo.<HMI NAME>_<DATALOG NAME>_data_format	System folder
dbo.<HMI NAME>_<DATALOG NAME>_data_section	System folder

Datalog -Table naming

Event log Sync.

Configuring the SQL Sync for the Event Log is similar to the Data Sampling section. Follow these steps after you have created your event logs in **Event Log(Alarm).**

1. Go to the [Data/History] tab » [Event Log].
2. Under **History file** select [Enable] and then select the [Sync to database] option. Once configured, select a database server to store your historical data.
3. You can enable a **Control address** to trigger the following actions by issuing the corresponding commands. The HMI will perform auto synchronization at the specified time interval if **Auto sync. Periodically** is enabled.



Command Number	Description
1	This command will clear all logged records in the HMI flash memory.
2	This command will synchronize the historical data to the MySQL server.
3	This command will synchronize the historical data to the MySQL server and then clear all logged records in the HMI flash memory.

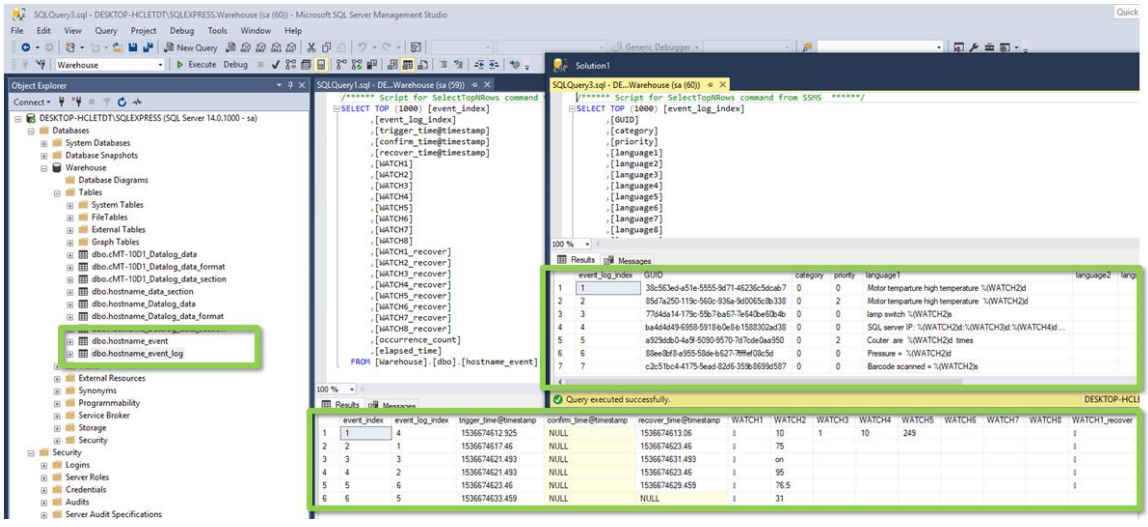
For more information about the **Control address**, please refer to the Easybuilder Pro user manual.

4. Create three **Set Word** objects on the editing area for the **Control address** of data sampling.
   I. Write constant value 1 to clear data.
   II. Write constant value 2 to sync data.
   III. Write constant value 3 to sync data and then remove duplicate data on the HMI.

5. Go to the [Data/History] tab » [Event Display]. Create this object on the editing area.

Testing - Click the [Sync] button, which is used to issue command #2 via a **Set Word** object. If the sync succeeds, the following three tables will be generated in your database.

Note: The HMI will transfer the original event logs to the MySQL server. Please use SELECT statement to get a table that contains specific organized data.



Tables are automatically created by the HMI.

For example,

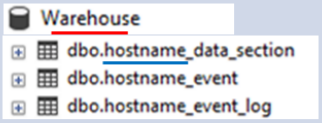
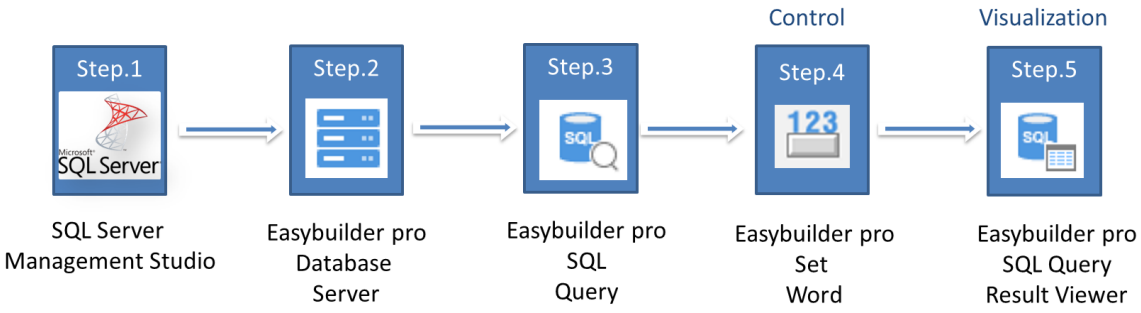
In Easybuilder Pro	In SQL Server Management Studio
Database name:Warehouse HMI name: hostname (simulation)	

Table	Description
dbo.<HMI NAME>_event	Saves event log
dbo.<HMI NAME>_event_log	Save event information
dbo.<HMI NAME>_data_section	System folder

Table naming of Event log

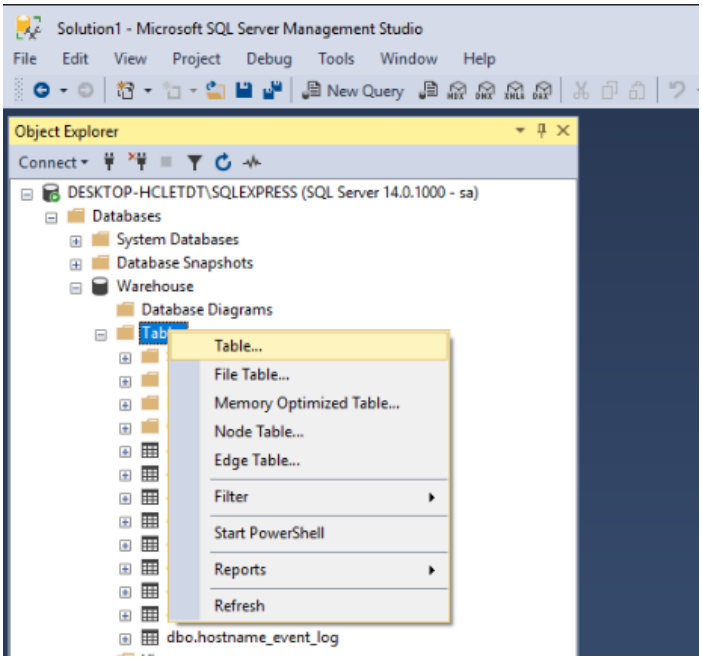
Chapter 4. Configuration of SQL Query

Weintek HMIs can perform CRUD operations (**C**reate, **R**ead, **U**pdate, **D**elete) to query the MS SQL server.

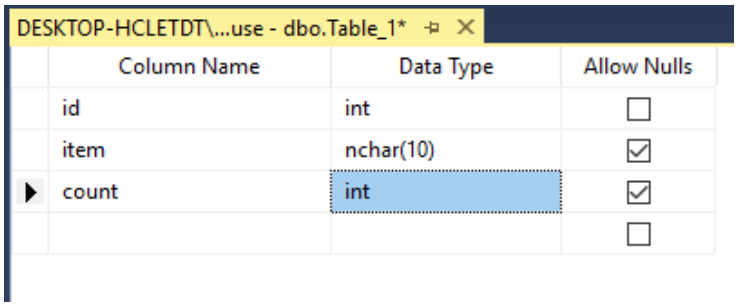


Creating a table in MS SQL server

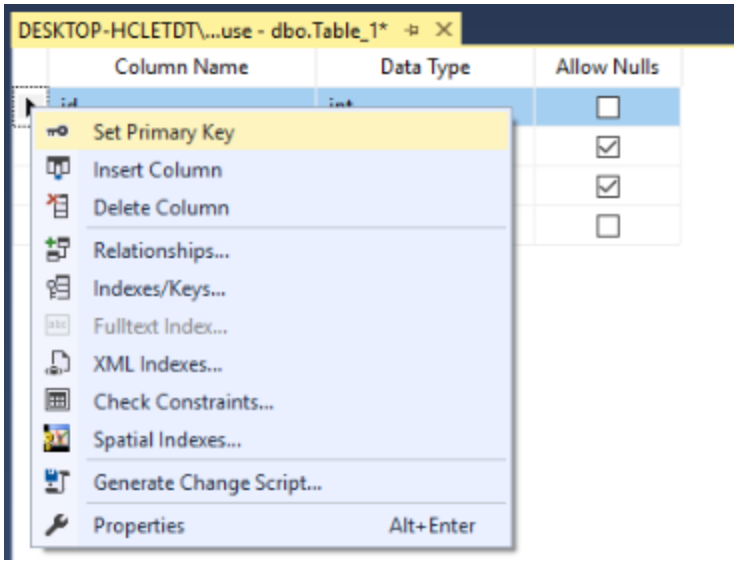
1. Launch SSMS. Then create a table in SSMS because the HMI won't create a table within the database server. Right click on [Tables] and select [Table].



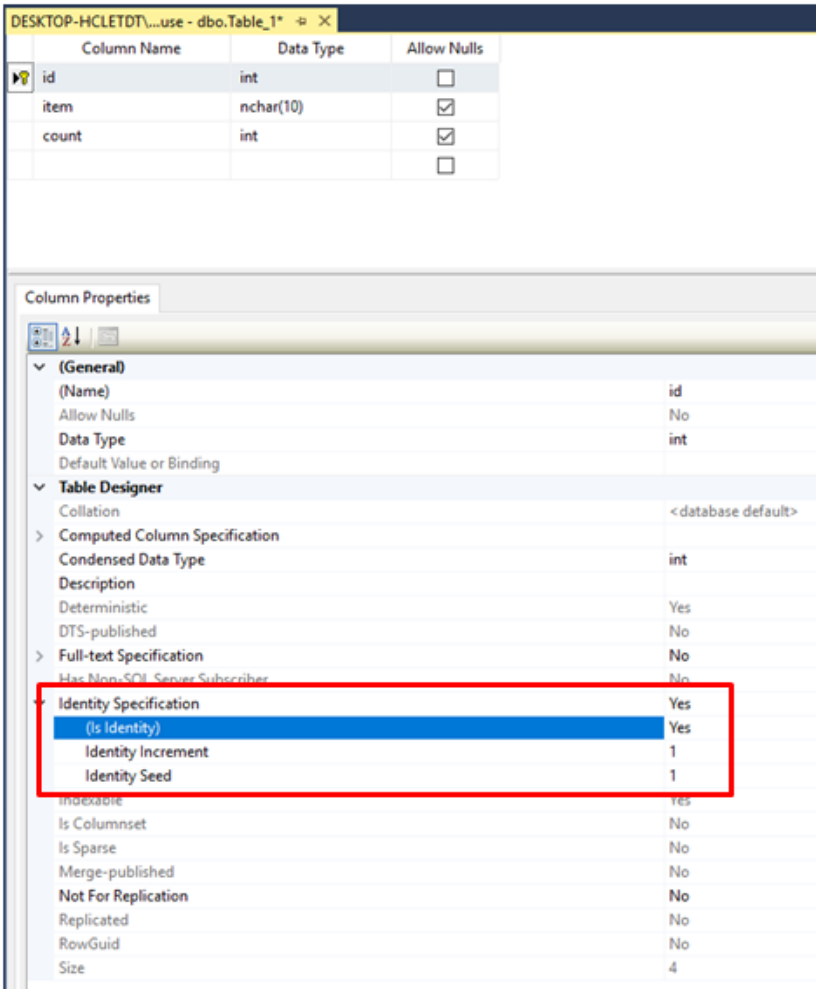
2. Fill out the column names and select data type for each column. Specify one column as **Primary Key**. A Primary Key is placed in the first column and cannot be set to Null. In this case, "id" will be the Primary Key.



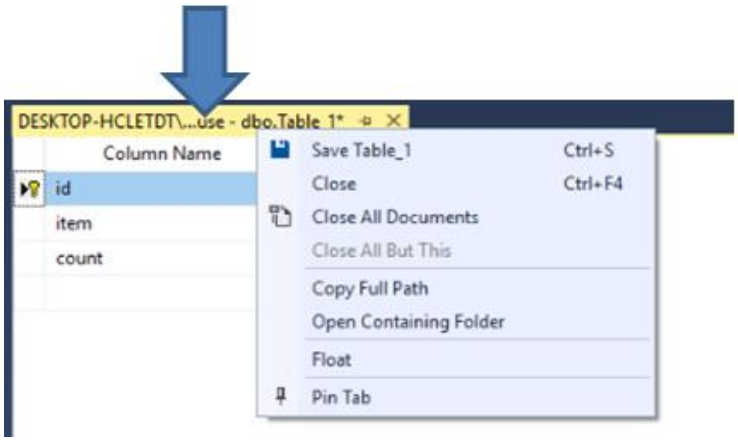
3. To set Primary Key, right click on [id] and select [Set Primary Key].



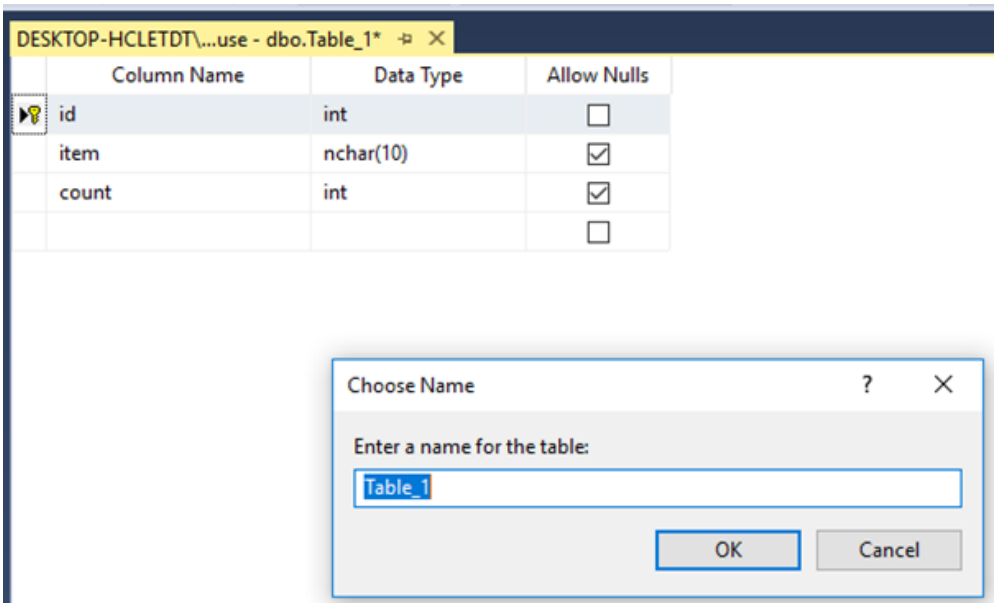
4. To enable AI (Auto Increment), click on [id]. Under the [Column Properties] tab, expand [Identity Specification] and change “No” to “Yes” for [Is Identity].



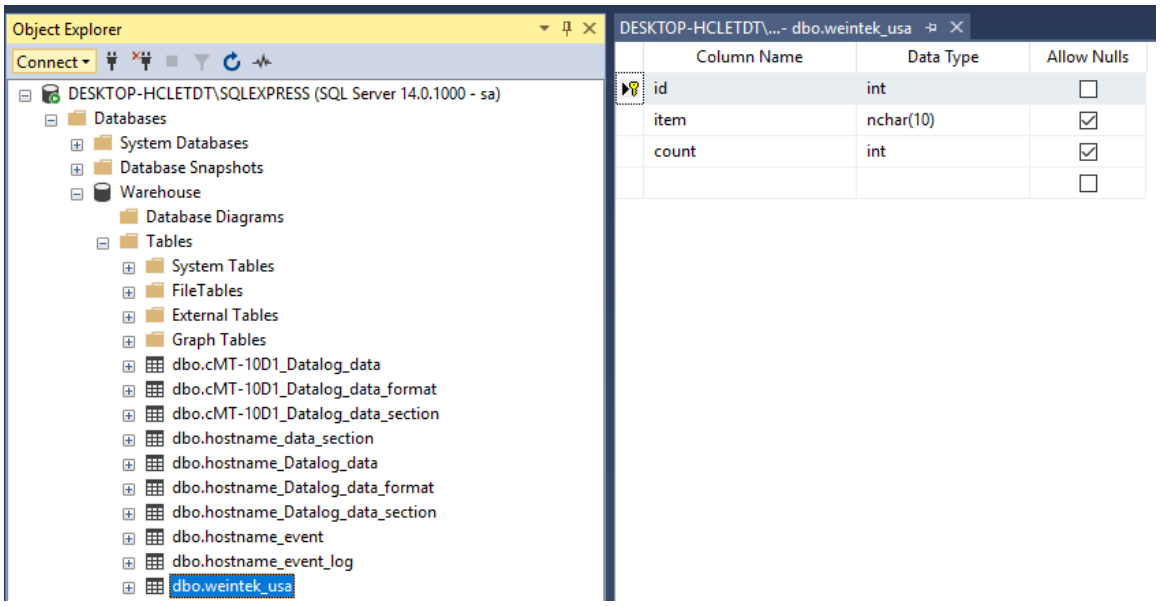
5. To save this table, Right click this tab and select [Save Table_1].



6. Enter a desired name for the table.



7. Right click on [Tables] and select [Refresh] to finish the procedure of adding the table.

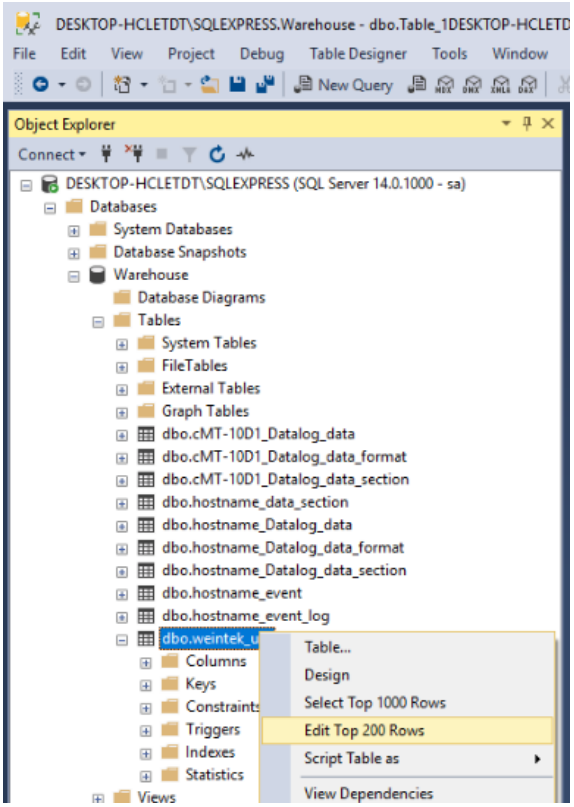


Note: If data type conversion cannot run properly, error code 5 will show in the specified error register. For example, when converting MySQL's INT into EB Pro's 16-bit unsigned, error code 5 will show if the value exceeds the limit of 16-bit unsigned data.

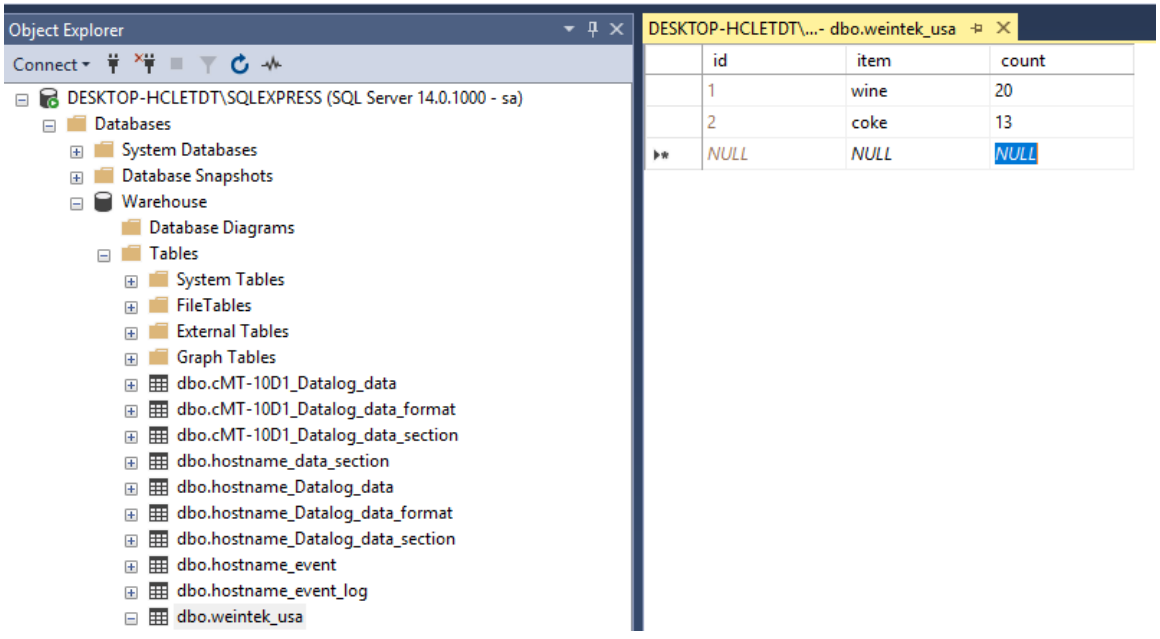
MS SQL data format	EasyBuilder Pro datatype
TINYINT SMALLINT INT BIGINT BIT	16/32-bit BCD 16/32-bit HEX 16/32-bit Binary 16/32-bit Signed 16/32-bit Unsigned
FLOAT REAL DECIMAL	32-bit Float
DATETIME NCHAR, NVARCHAR BINARY, VARBINARY TEXT	String

Supported data type

8. To insert data to the table, right click the table created earlier, and select [Edit Top 200 Rows].

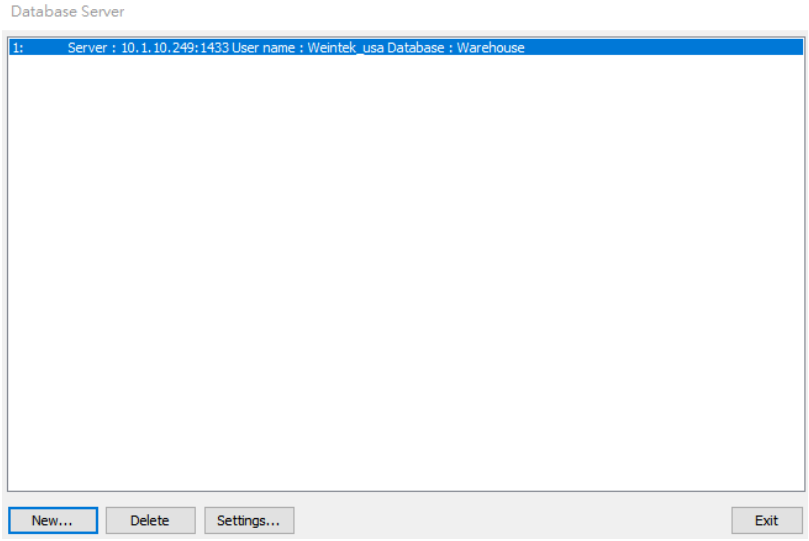


9. Enter the data into each cell.



Programming SQL Query in Easybuilder Pro

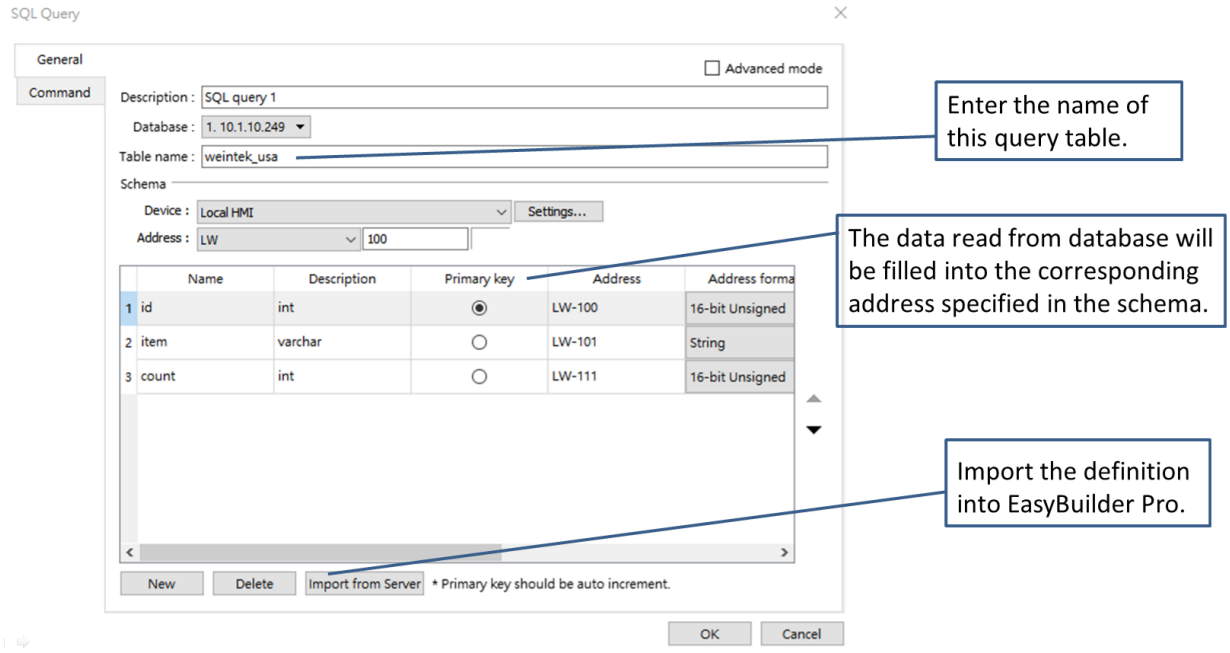
Launch Easybuilder pro. Go to the [Data/History] tab » [Database Server]. Click on the [New] button to add a database server. It is the same as the steps for adding a database for **SQL Sync.** section.



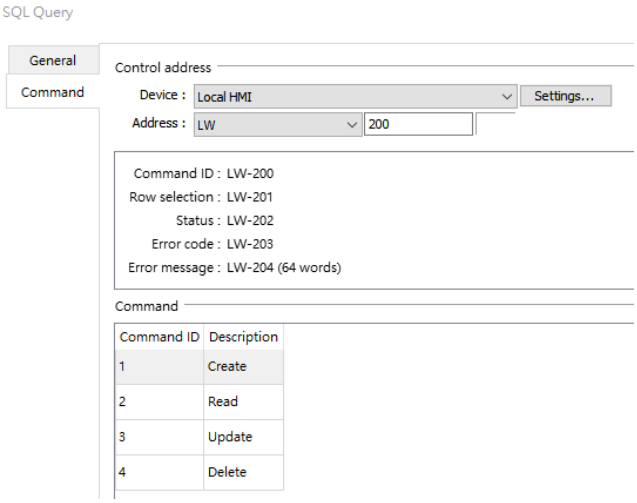
1. Go to the [Data/History] tab » [SQL Query]. Create a [SQL Query] object. There are two options for this object, **Simple mode** and **Advanced mode**.

SQL Query Using Basic Mode

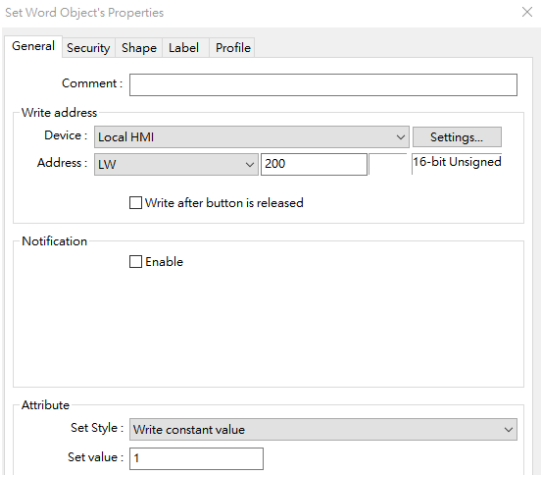
2. On the [General] tab, select a database server for querying. Enter a table name and define a register for **Schema**. Click on [New] to add the columns of the table. Another way is to click on the [Import from server] button to import column's information. You will need to select the correct data type for each column under [Address format] based on the data format in your MS SQL server.



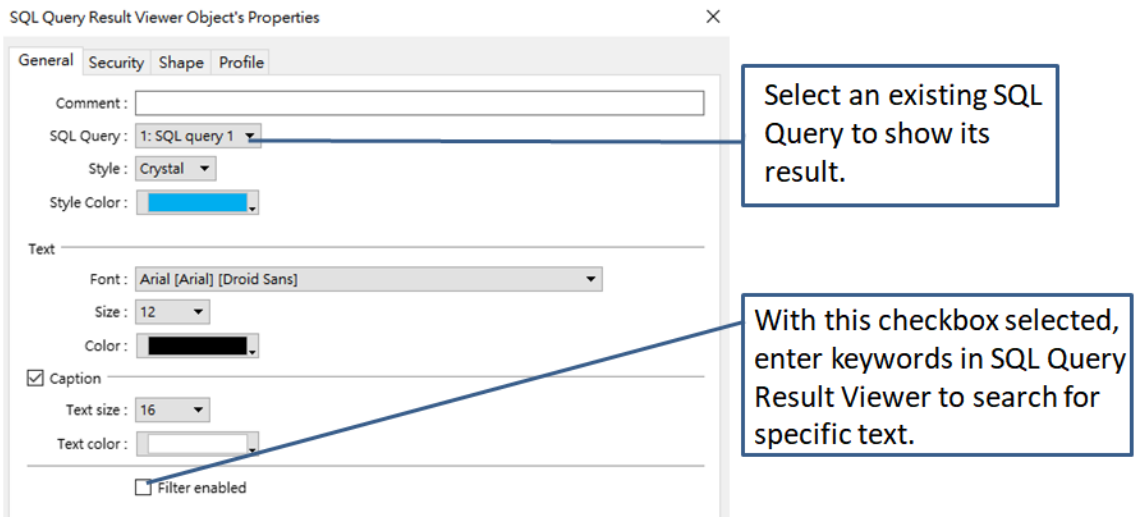
3. On the [Command] tab, define a register for **Control address**. Create the following objects related to the Control address on the editing area. Each SQL command is given a unique ID number.



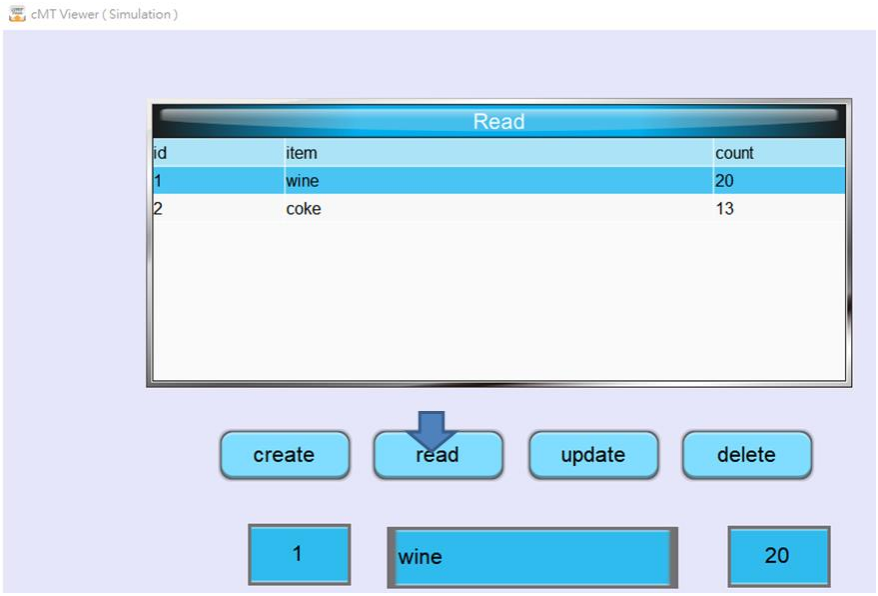
4. Create four **Set Word** objects on the editing area for the four commands, including Create (Command no.1), Read (Command no.2), Update (Command no.3), and Delete (Command no.4) as below.



5. Go to the [Data/History] tab » [SQL Query]. Create a [SQL Query Result Viewer] object on the editing area to show the result obtained from the MS SQL server.



Testing: When writing constant value 2 (Command no.2: Select all) via **Set Word** object to the control address of the SQL query. The data will be retrieved from the MS SQL server and displayed on **SQL Query Result Viewer** (Table) and **Schema** registers (Blue boxes).



Note: When you write the command ID to LW-200 (Command ID register) via a **Set Word** object to issue a SQL command, you must wait for the value to return to 0 before issuing the next command to the MS SQL server.

SQL Query Using Advanced Mode

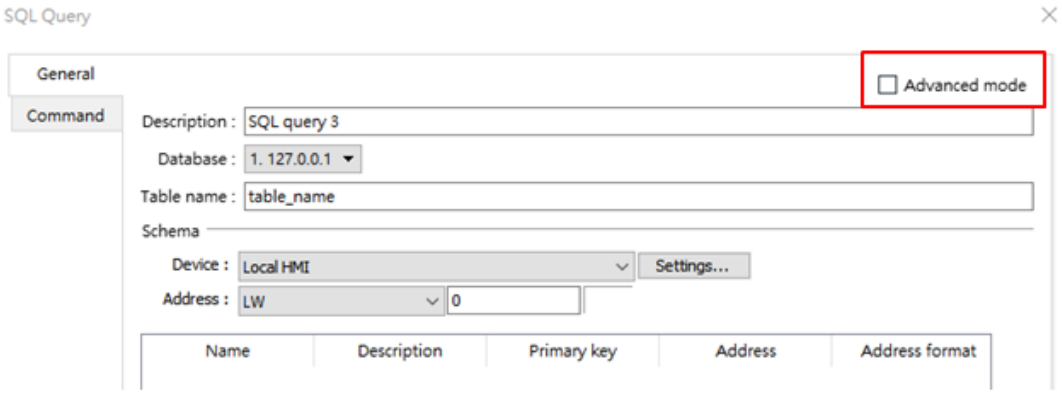
In the advanced mode of **SQL Query** object, you can write your own SQL statements to perform a specific query.

For example,

SELECT [default_name_1], [default_name_2], [default_name_3] FROM [table_name] where [default_name_2] =20;

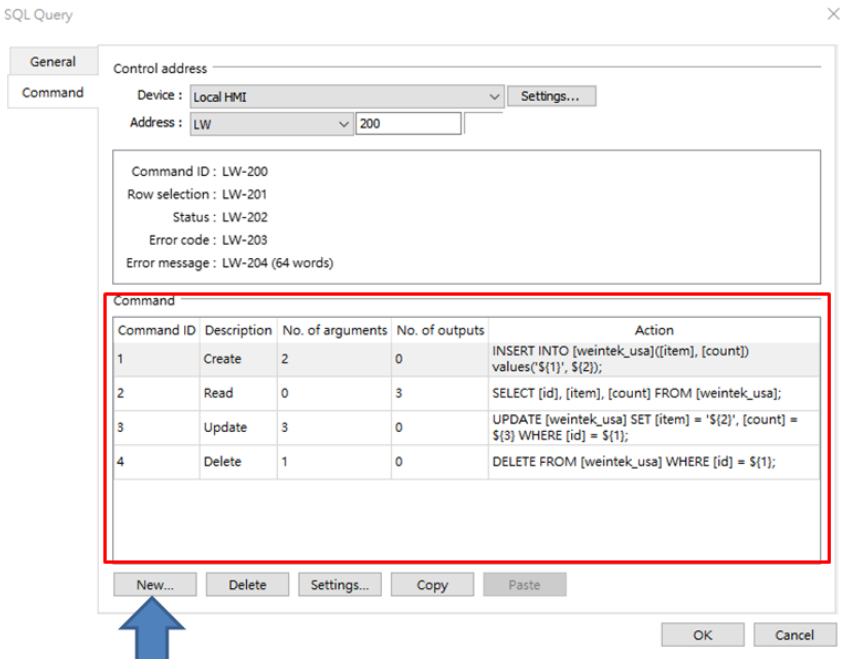
PK: default_name_1

1. Go to the [Data/History] tab » [SQL Query]. Create a [SQL Query] object. To write your own SQL Query commands, check the [Advanced mode] checkbox. Once you switch to advanced mode, it cannot be undone for that SQL Query object.



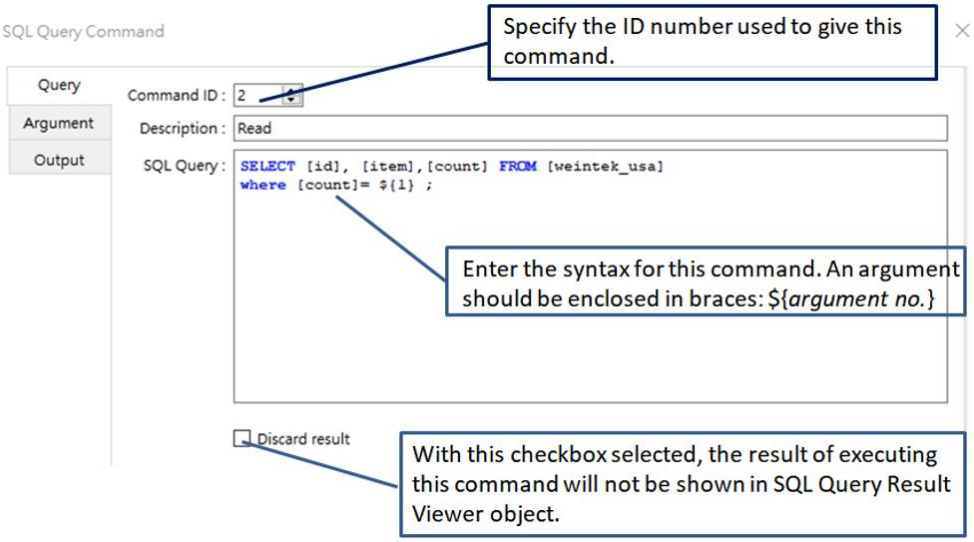
2. On the [General] tab, the user interface will be displayed as below after switching to advanced mode. Select a database server for querying.

3. On the [Command] tab, click on the [New] button to create a command or click the [Settings] button to modify a command.



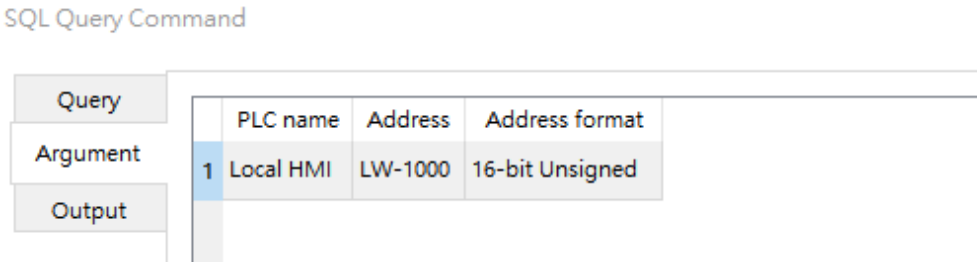
4. On the [Query] tab, the command window comes up as shown. There are three tabs to set up for a SQL command.

   Specify a unique command ID and write a SQL command with MS SQL syntax (T-SQL).

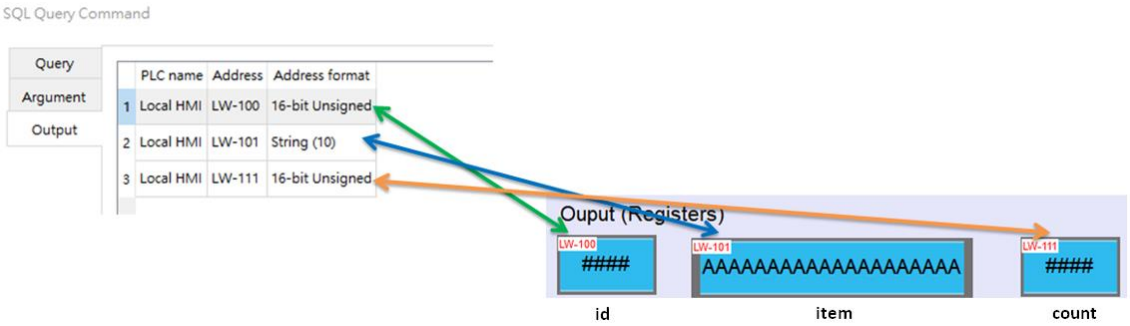


5. On the [Argument] tab, if arguments are used in the syntax of a command in the [Query] tab, the HMI will refer to the addresses specified in this tab corresponding to the argument number enclosed in ${*argument no.*}

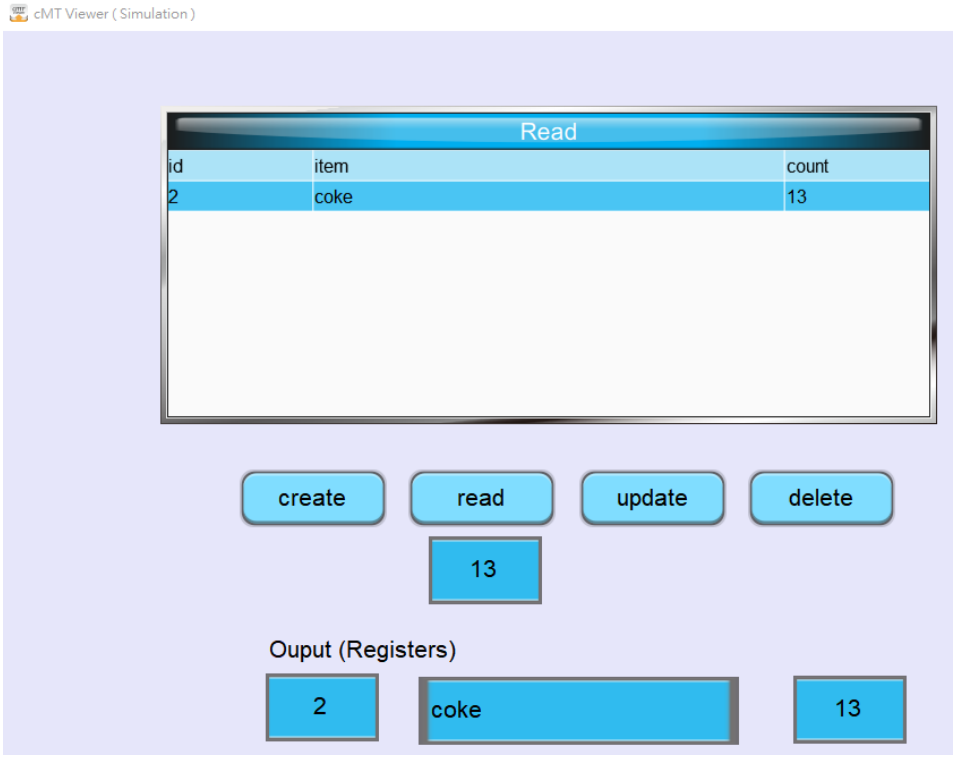
   SELECT [id], [item] FROM [weintek_usa] where [count] =**${1}**;



6. On the [Output] tab, when the HMI successfully reads data from the SQL server, the result will be transferred to the addresses specified in this tab. This tab will be hidden if **Discard result** option in [Query] tab is enabled.



Testing: Enter a value to the box below the [Read] button and then click on the [Read] button. [Read] means the HMI will issue the command ID no.2 (Select command) via the **Set Word** object to the control address of the SQL query. If the value exists in the SQL database, data will be displayed on the table and the specified **Output** registers.

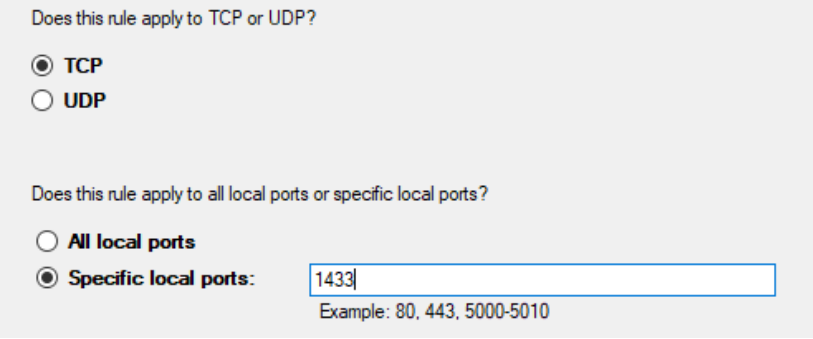


Appendix A

Troubleshooting: To make sure the HMI is able to establish the connection to the MS SQL server, the PC which runs the MS SQL server needs to allow traffic going to the defined TCP port to pass through. Anti-virus software might block traffic so that the HMI cannot connect to the MS SQL server.

Steps to configure Windows Firewall in Windows 10

1. In your Windows 10 PC, launch **Windows Defender Firewall with Advanced Security**.
2. Right click [Inbound Rules] and then select [New Rule…].
3. On the **Rule Type** menu, select [Port] and click the [Next] button.
4. On the **Protocol and Ports** menu, select [TCP] and add the port number of your MS SQL server into [Specific local ports] as below. Click the [Next] button.

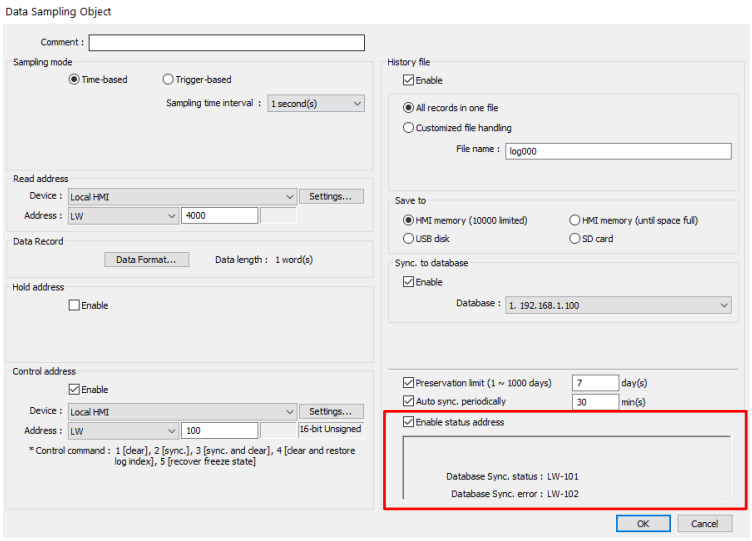


5. On the **Action** menu, select [Allow the connection] and click the [Next] button.
6. On the **Profile** menu, select the network types as you see fit your network.
   - Domain
   - Private
   - Public
7. On the **Name** menu, name the rule, add a description, and click the [Finish] button.

Appendix B

The **SQL Sync** and **SQL Query** features provide status registers to simplify troubleshooting during runtime.

SQL SYNC



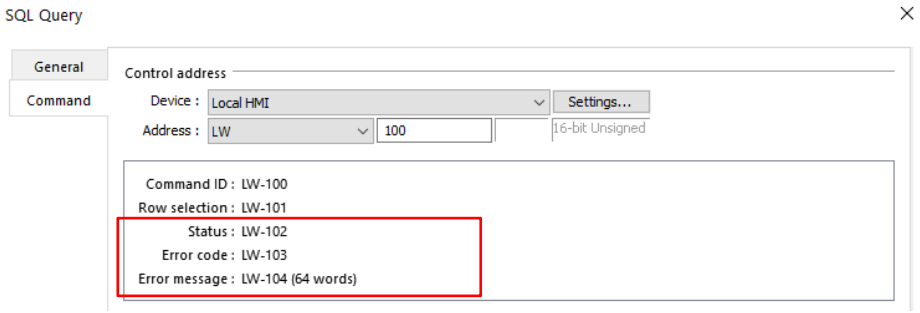
Database Sync. Status

Value	Description
0	Disconnected from the database server
1	Connecting with the database server
2	Connected with the database server
3	Storing records into the archive. When this is done, the value returns to 2.

Database Sync. Error

Error Code	Description
0	No error
1	Unknown error
2	Failed to connect with the database server
3	Access denied
4	Wrong database name
5	Inconsistent data format
6	Failed to open table
7	Failed to create table
8	Failed to write table

SQL Query



Status

Value	Description
0	Normal
1	Query result exceeds 1000 records (rows). Use LIMIT clause to reduce number of rows.

Error

Error Code	Description
0	No error
1	Unknown error
2	Invalid command
3	Database Server is not connected yet
4	Argument cannot be read
5	Cannot write and output
6	Incorrect number of arguments
7	Error in MySQL, please read error message
8	Unsupported datatype
9	The number of columns exceeds the limit
10	The number of rows exceeds the limit
11	Unable to read local database directory
12	Name of local database does not exist
13	Internal error

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