Connecting a PLC to a SQL Database

Level 4	1 – Fundamental – No previous experience necessary 2 – Basic – Basic knowledge recommended 3 – Advanced – Reasonable knowledge required 4 – Expert – Good experience recommended

Powering Business Worldwide

Services

For service and support, please contact your local sales organisation.

Contact details: Eaton.com/contacts
Service page: Eaton.com/aftersales

Original Application Note

Original document is the German version of this document.

Translation

All non-German language versions of this document are translations of the original application note.

1. Edition 2025, publication date 07/2025

DANGER!
DANGEROUS ELECTRICAL VOLTAGE!

Before commencing the installation

- Installation requires qualified electrician.
- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally retriggered.
- Verify isolation from the supply.
- Ground and short-circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (IL) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 part 100) may work on this device/ system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or to the potential equalizing. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 V supply. Only use power supply units complying with IEC 60364-4-41 or HD 384.4.41 S2 (VDE 0100 part 410).
- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the technical data, otherwise this may cause malfunction and dangerous operation.
- Emergency-Stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency switching off devices must not cause restart.
- Built-in devices for enclosures or cabinets must only be run and operated in an installed state, desk-top devices or portable devices only when the housing is closed.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency switching off devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, etc.).

Disclaimer

The information, recommendations, descriptions, and safety notations in this document are based on Eaton's experience and judgment and may not cover all contingencies. If further information is required, an Eaton sales office should be consulted. Sale of the product shown in this literature is subject to the terms and conditions outlined in the applicable Terms and Conditions for Sale of Eaton or other contractual agreement between Eaton and the purchaser. THERE ARE NO UNDERSTANDINGS, AGREEMENTS, WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OTHER THAN THOSE SPECIFICALLY SET OUT IN ANY EXISTING CONTRACT BETWEEN THE PARTIES. ANY SUCH CONTRACT STATES THE ENTIRE OBLIGATION OF EATON. THE CONTENTS OF THIS DOCUMENT SHALL NOT BECOME PART OF OR MODIFY ANY CONTRACT BETWEEN THE PARTIES. As far as applicable mandatory law allows so, in no event will Eaton be responsible to the purchaser or user in contract, in tort (including negligence), strict liability, or otherwise for any special, indirect, incidental, or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations, and descriptions contained herein. The information contained in this manual is subject to change without notice.

Content

1 What is SQL?

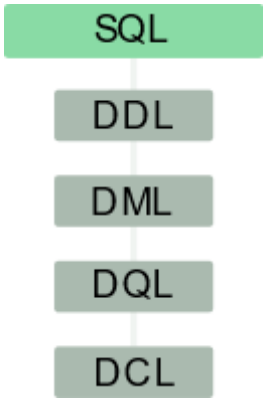
SQL (Structured Query Language) is a database-language to create relational database structures. It is designed to add, change or delete data in an easy way. SQL is standardized, but there are still some “SQL-dialects” and that’s why a 100% compatibility between different systems cannot be guaranteed. The most known free databases are MySQL and PostgreSQL. But also the MsSQL database from Microsoft is a widespread but commercial database.

Relational databases are characterized by the fact that elements of the real life can be mapped in a data-model. They consist of tables which saves their data in rows and columns. The columns are called attribute and the rows are also called tupel.

Attribut 1	Attribut 2	Attribut 3
Wert	Wert	Wert
Wert	Wert	Wert

SQL commands can be divided into four categories:

- DDL: Data Definition Language (Daten Definitions Sprache)
  - Create databases
  - e.g. "CREATE TABLE", "DROP INDEX", ...
- DML: Data Manipulation Language (Daten Manipulations Sprache)
  - Write, change and delete data inside the database
  - e.g. "INSERT INTO", "DELETE FROM", ...
- DQL: Data Query Language (Daten Abfrage Sprache) - Kein allgemeiner Standard
  - Retrieving data with conditions
  - e.g. SELECT FROM
- DCL: Data Control Language (Daten-Kontroll-Sprache)
  - Rights management and transaction control
  - e.g. "GRANT ON TO", "REVOKE", ...



There are some libraries available to realize a database connection from a PLC. These libraries can also be used on EATON PLCs. Only the CODESYS V3 version is considered below. Two libraries from the CODESYS Store (license needed) and a library from EATON (which was converted from old CODESYS V2 to V3) were tested. In addition, you can find a SQL4automation connector in the CODESYS Store which can also be used for a database connection. Further information on this can be found here: SQL4automation - Funktionen - SPS S7 | SQL4Automation

Eaton PLCs which support these SQL libraries:

Device/Database	**MsSQL**		**MySQL**
	CodeSys V3 library	Eaton library	CoDeSys V3 library
XV100	X	X	X
XV300	X	X	X
XC300	X	X	X

The following descriptions and tests were carried out with the CODESYS 3.5.16 BF4 and the devices XC303, XV303 and XV102 with runtime version 3.5.16.60.

2 MsSQL

The MsSQL library for connecting a PLC to an MsSQL database can be downloaded from the CODESYS store. It can be tested for 30minutes without functional restrictions. For an unlimited use you can purchase a license certificate in the CODESYS store.

There is also a user guide available that explains the most important steps from installing the server to connecting to the databse from the PLC via the function blocks. In this case the library version 1.4.0.5 was used.

For examples and libraries see: MsSQL - Files for Application Note (Part 1) & MsSQL - Files for Application Note (Part 2)

There is also a documentation for the MsSQL library from EATON. It refers to CODESYS V2, but it can be transfered 1:1 to CODESYS V3.

See: MsSQL - Files for Application Note (Part 1) & MsSQL - Files for Application Note (Part 2)

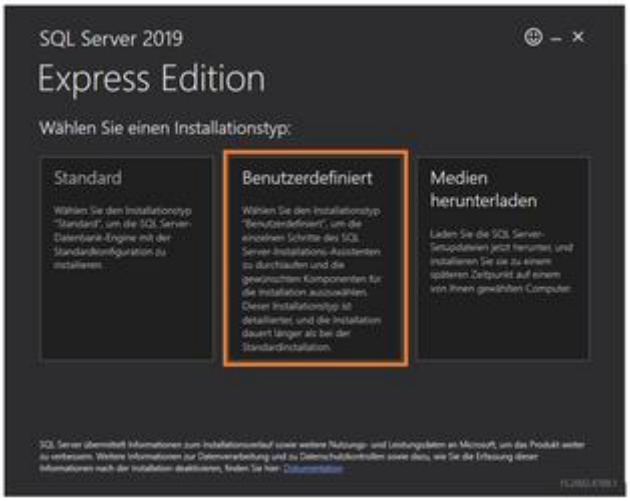
2.1 MsSQL-Server Installation

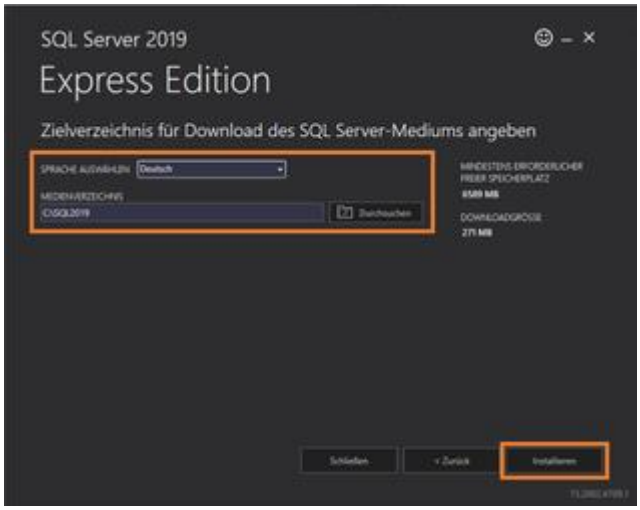
The Microsoft SQL-Server available in different version on the Microsoft website (free Express Edition oder chargeable Enterprise Edition). The main differences between these versions are the size of the databse, the number of possible users and the required memory. The most important steps when installing an MsSQL server are listed below. Therefor the SQL Server 2019 Express Edition was used.

Download-link: SQL Server Downloads | Microsoft

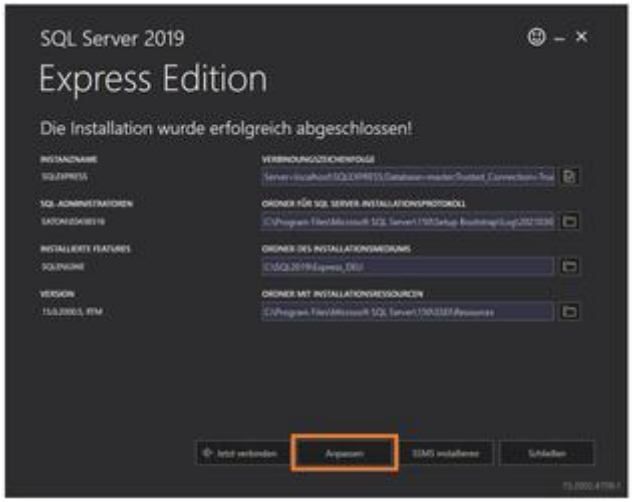
Installation-Exe see: MsSQL - Files for Application Note (Part 1) & MsSQL - Files for Application Note (Part 2)

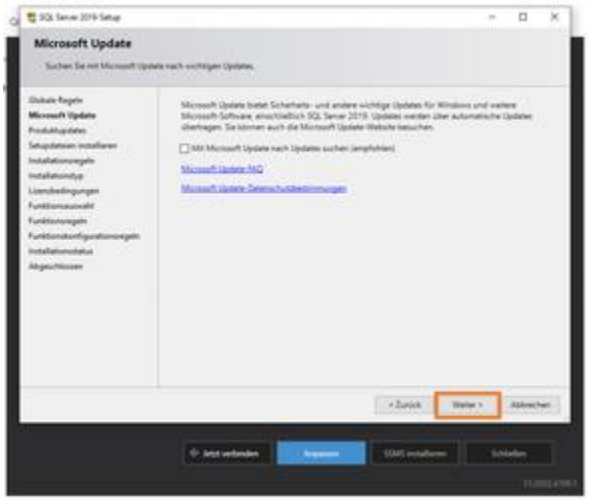
Choose user-defined Installation:

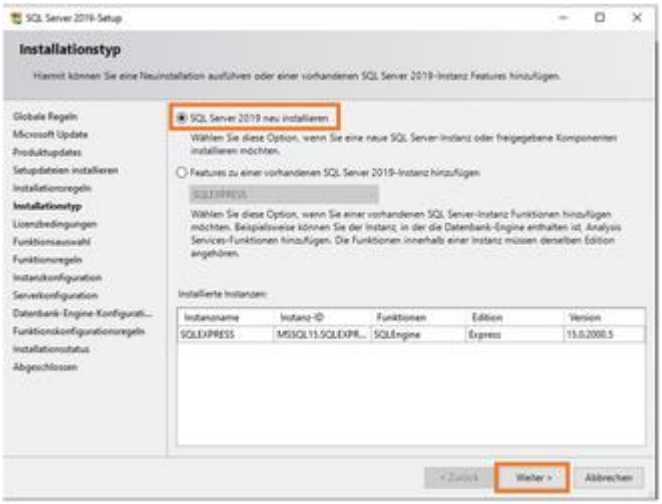


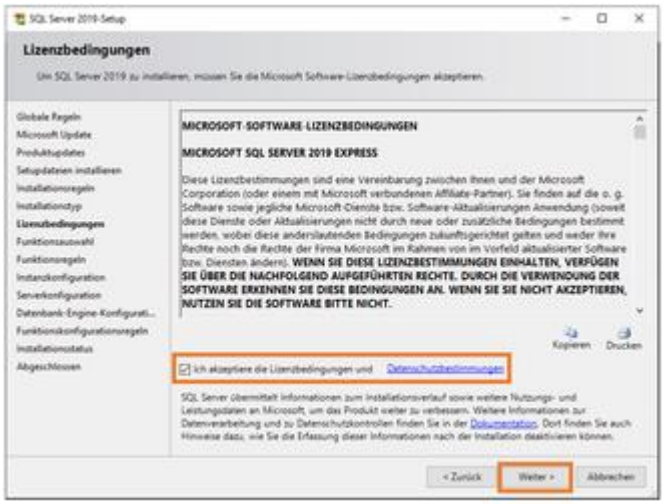


After successful installation of the installer, the installation and configuration of the SQL server takes place:

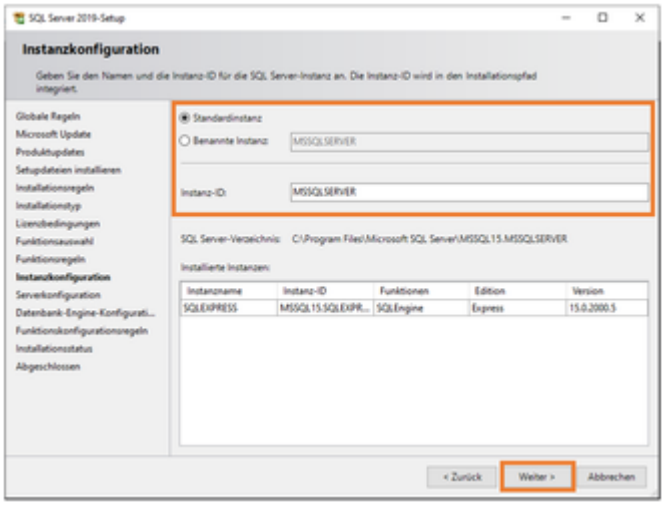


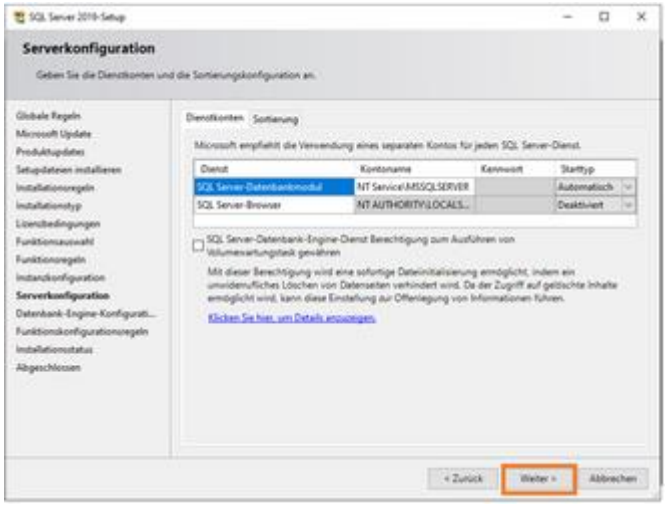

SQL Server 2019-Setup
Microsoft Update
Suchen Sie mit Microsoft Update nach wichtigen Updates.
Globale Regeln
Microsoft Update
Produktupdates
Setupdateien installieren
Installationsregeln
Installationstyp
Lizenzbedingungen
Funktionsauswahl
Funktionsregeln
Funktionskonfigurationsregeln
Installationsstatus
Abgeschlossen
Microsoft Update bietet Sicherheits- und andere wichtige Updates für Windows und weitere Microsoft-Software, einschließlich SQL Server 2019. Updates werden über automatische Updates übertragen. Sie können auch die Microsoft Update-Website besuchen.
Mit Microsoft Update nach Updates suchen (empfohlen)
Microsoft Update FAQ
Microsoft Update-Datenschutzbestimmungen
< Zurück
Weiter >
Abbrechen
Jetzt verbinden
Anpassen
SSMS installieren
Schließen


SQL Server 2019-Setup
Installationstyp
Hiermit können Sie eine Neuinstallation ausführen oder einer vorhandenen SQL Server 2019-Instanz Features hinzufügen.
Globale Regeln
Microsoft Update
Produktupdates
Setupdateien installieren
Installationsregeln
Installationstyp
Lizenzbedingungen
Funktionsauswahl
Funktionsregeln
Instanzkonfiguration
Serverkonfiguration
Datenbank-Engine-Konfigurati...
Funktionskonfigurationsregeln
Installationsstatus
Abgeschlossen
SQL Server 2019 neu installieren
Wählen Sie diese Option, wenn Sie eine neue SQL Server-Instanz oder freigegebene Komponenten installieren möchten.
Features zu einer vorhandenen SQL Server 2019-Instanz hinzufügen
SQLEXPRESS
Wählen Sie diese Option, wenn Sie einer vorhandenen SQL Server-Instanz Funktionen hinzufügen möchten. Beispielsweise können Sie der Instanz, in der die Datenbank-Engine enthalten ist, Analysis Services-Funktionen hinzufügen. Die Funktionen innerhalb einer Instanz müssen derselben Edition angehören.
Installierte Instanzen:
Instanzname | Instanz-ID | Funktionen | Edition | Version
SQLEXPRESS | MSSQL15.SQLEXPR... | SQLEngine | Express | 15.0.2000.5
< Zurück
Weiter >
Abbrechen

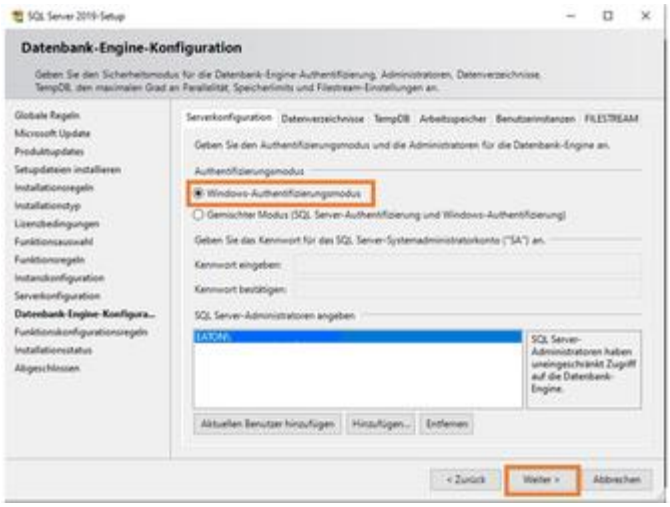

SQL Server 2019-Setup
Lizenzbedingungen
Um SQL Server 2019 zu installieren, müssen Sie die Microsoft Software-Lizenzbedingungen akzeptieren.
Globale Regeln
Microsoft Update
Produktupdates
Setupdateien installieren
Installationsregeln
Installationstyp
Lizenzbedingungen
Funktionsauswahl
Funktionsregeln
Instanzkonfiguration
Serverkonfiguration
Datenbank-Engine-Konfigurati...
Funktionskonfigurationsregeln
Installationsstatus
Abgeschlossen
MICROSOFT SOFTWARE LIZENZBEDINGUNGEN
MICROSOFT SQL SERVER 2019 EXPRESS
Diese Lizenzbestimmungen sind eine Vereinbarung zwischen Ihnen und der Microsoft Corporation (oder einem mit Microsoft verbundenen Affiliate-Partner). Sie finden auf die o. g. Software sowie jegliche Microsoft Dienste bzw. Software-Aktualisierungen Anwendung (soweit diese Dienste oder Aktualisierungen nicht durch neue oder zusätzliche Bedingungen bestimmt werden, wobei diese anderslautenden Bedingungen zukunftsgerichtet gelten und weder Ihre Rechte noch die Rechte der Firma Microsoft im Rahmen von im Vorfeld aktualisierter Software (bzw. Diensten ändern). WENN SIE DIESE LIZENZBESTIMMUNGEN EINHALTEN, VERFÜGEN SIE ÜBER DIE NACHFOLGEND AUFGEFÜHRTEN RECHTE. DURCH DIE VERWENDUNG DER SOFTWARE ERKENNEN SIE DIESE BEDINGUNGEN AN. WENN SIE SIE NICHT AKZEPTIEREN, NUTZEN SIE DIE SOFTWARE BITTE NICHT.
Kopieren
Drucken
Ich akzeptiere die Lizenzbedingungen und Datenschutzbestimmungen
SQL Server übermittelt Informationen zum Installationsverlauf sowie weitere Nutzungs- und Leistungsdaten an Microsoft, um das Produkt weiter zu verbessern. Weitere Informationen zur Datenverarbeitung und zu Datenschutzkontrollen finden Sie in der Dokumentation. Dort finden Sie auch Hinweise dazu, wie Sie die Erfassung dieser Informationen nach der Installation deaktivieren können.
< Zurück
Weiter >
Abbrechen

Renaming the SQL Server instance:

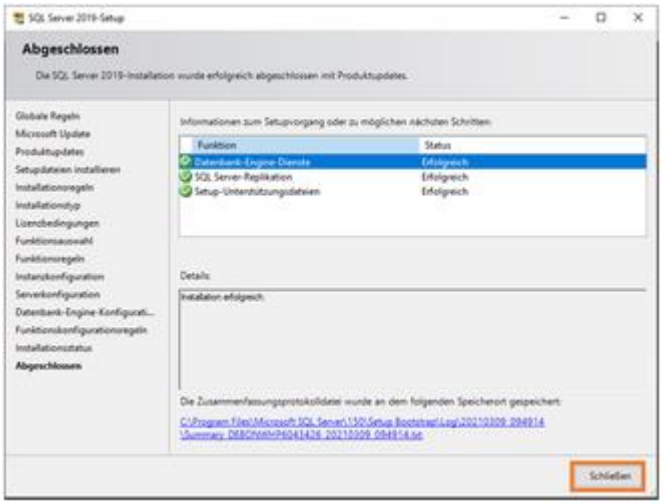




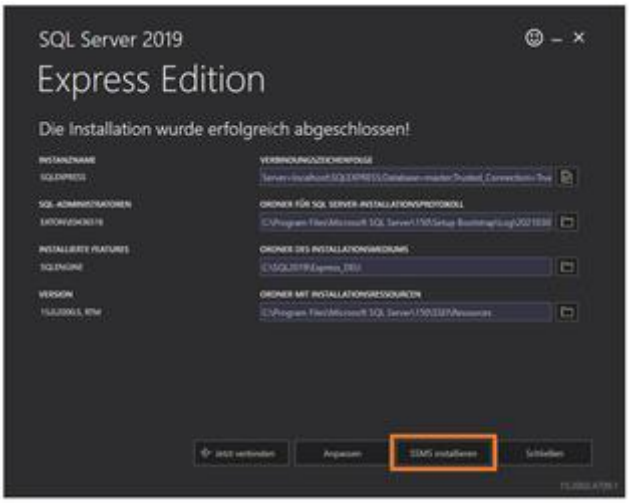
We select the Windows authentication mode as authentication mode. This means we can use the same username and password to log on to the SQL server as we use to log on to Windows.



After the successful installation of the SQL Server, the setup can be completed.

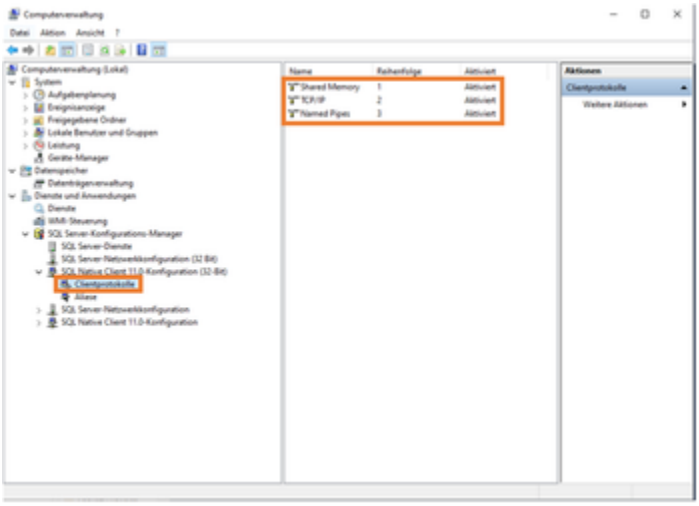


An important tool for using a SQL Server is the Microsoft SQL Server Management Studio (SSMS). With this tool you can establish a connection to the server and read/write data.



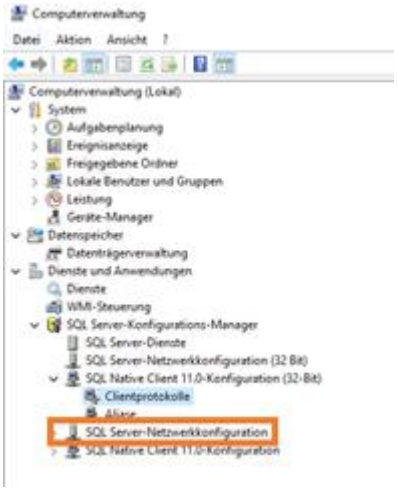
2.2 MsSQL-Server Configuration

In order to configure the server for external access (from the PLC), you will have to open the computer management and activate all three client protocols.

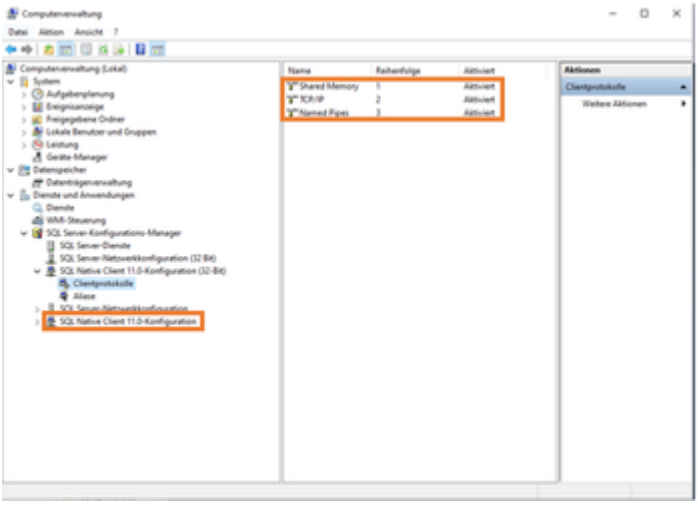


With a double-click on the TCP/IP protocol you can define further properties such as the default-port of the SQL server. By default, the port is set to 1433.

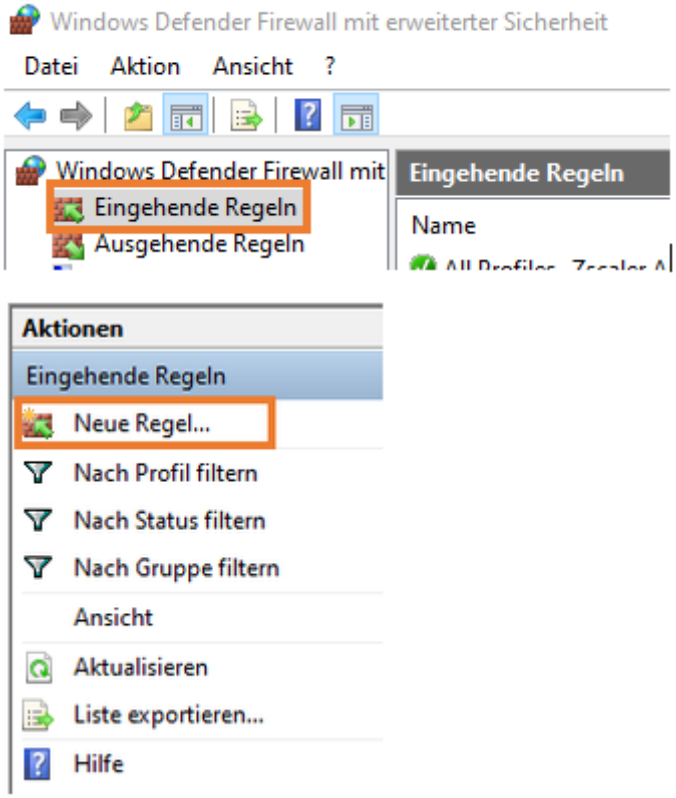
In the SQL Server network configuration, you can also define which IP addresses can get access to the SQL Server.



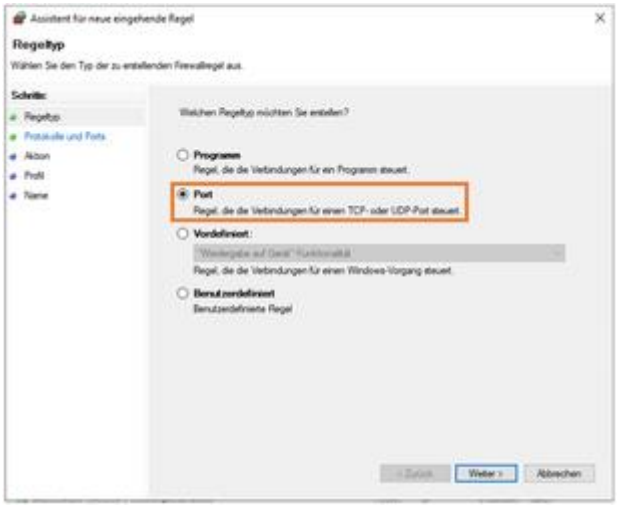
If you have installed a 64-bit SQL Server, you must also activate all three protocols in the SQL Native Client 11.0 configuration.



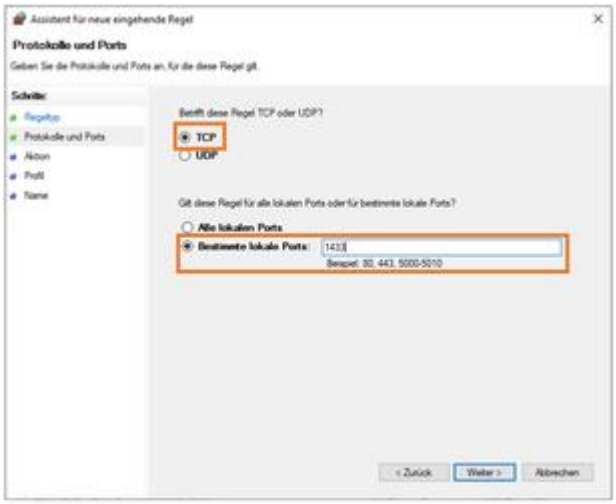
In addition, the port for the connection to the SQL server must be released in the firewall. A new "Incoming rule" is defined for this.



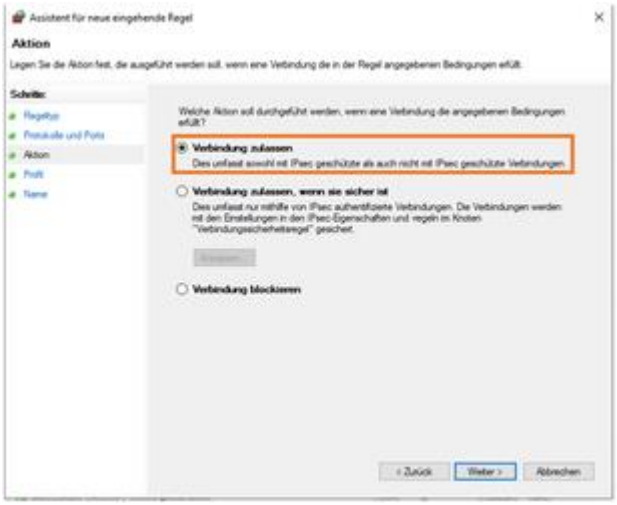
Rule-type: Port



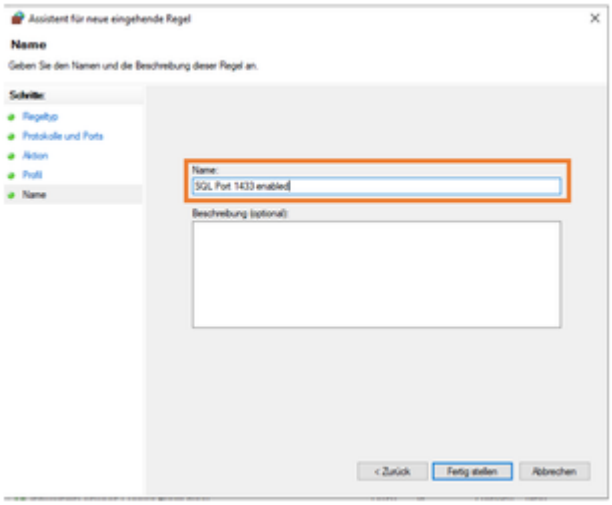
For TCP we choose port 1433 - default port for SQL server. If you have changed the default-port in previous settings, you will have to insert the correct port here.



Incoming connections via the configured port should be permitted.

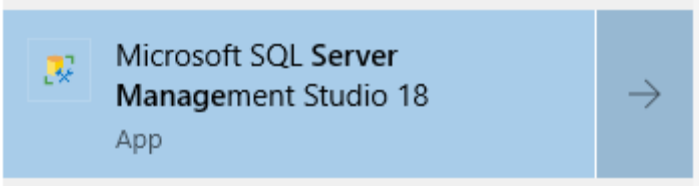


Finally you will have to define a name for the rule.

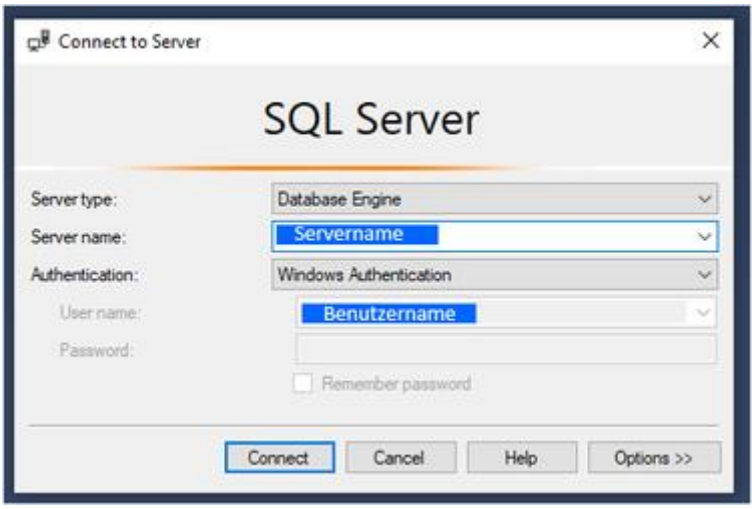


2.3 Establish a connection to the MsSQL-Server

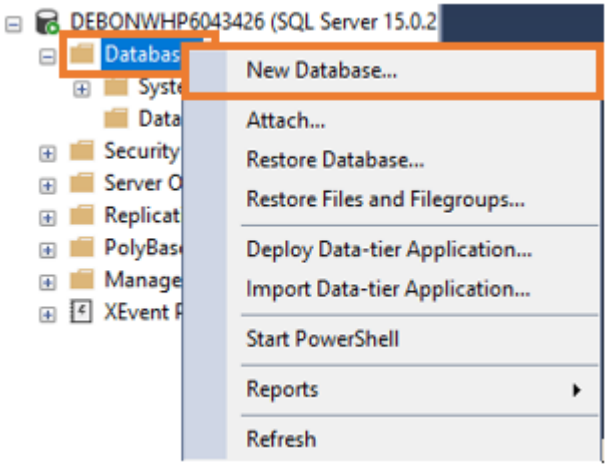
Start the SQL Server Management Studio to establish a first connection to the SQL server.

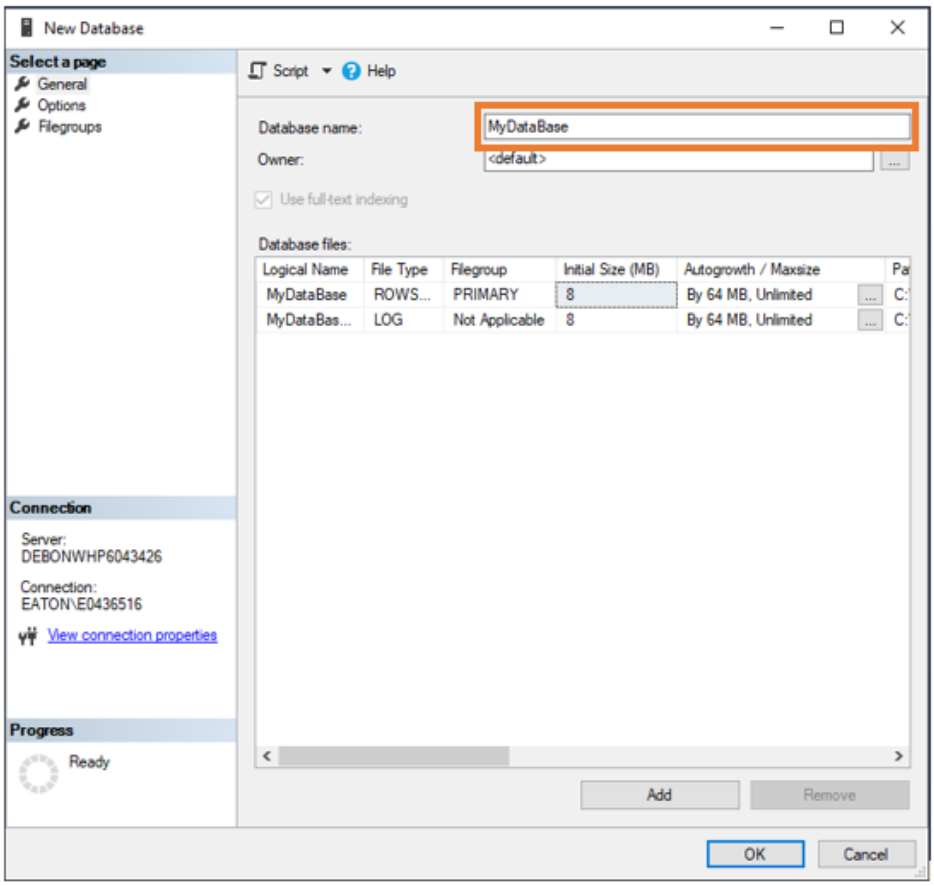


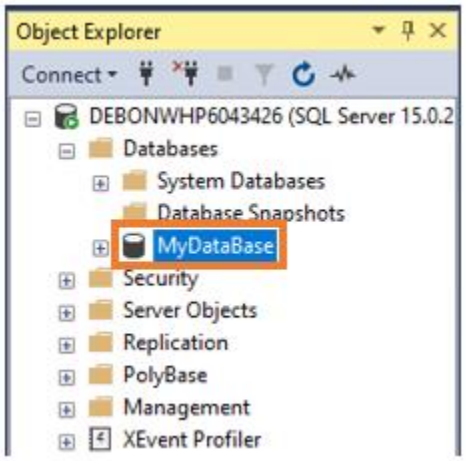
Put in the correct server and username and establish a connection.



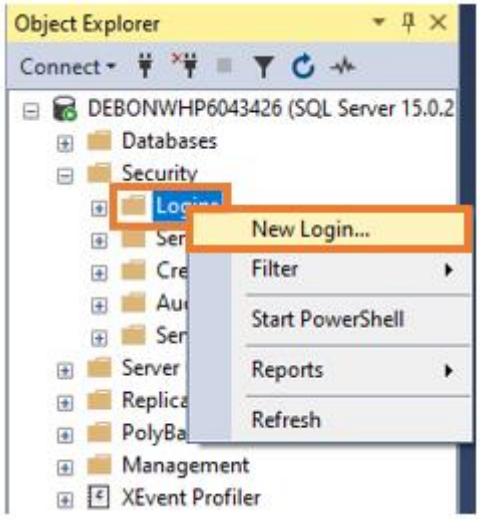
Add a new database:

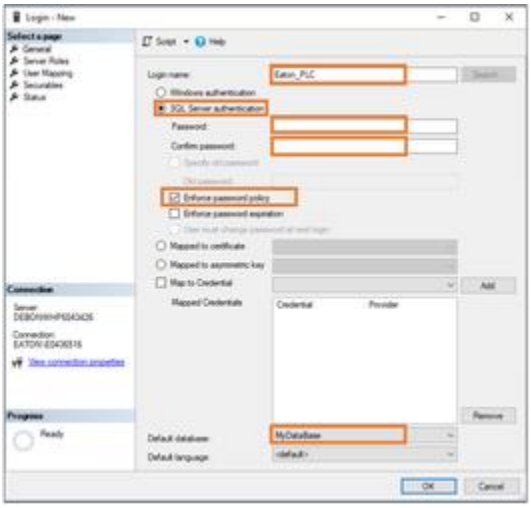


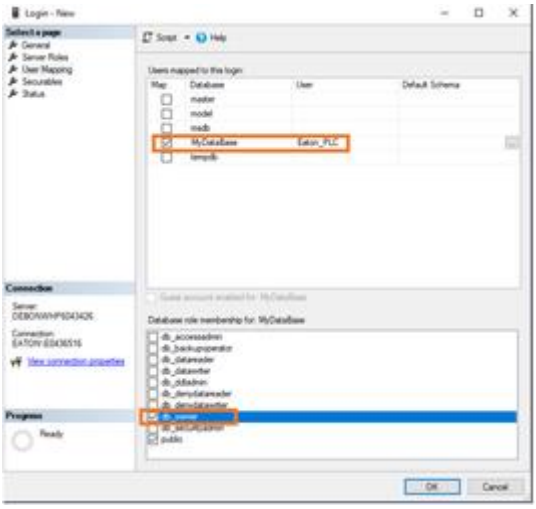




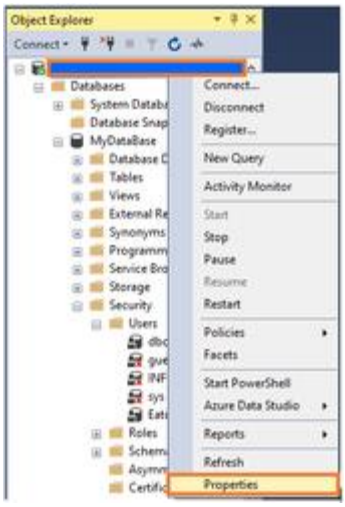
Create a new login which can be used for the connection from the PLC.

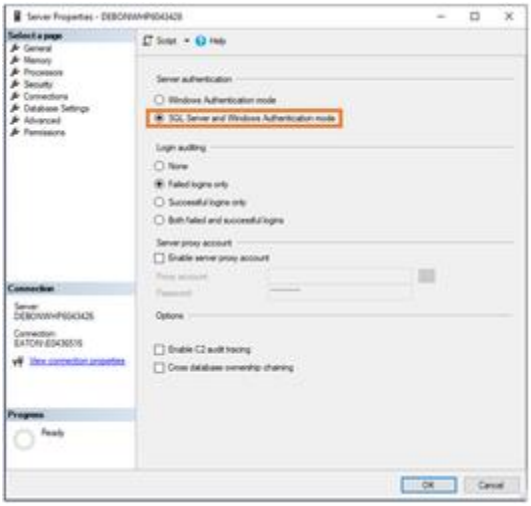






Change the server authentication to "SQL Server and Windows Authentication mode":





After successfully configuring the authentication, a connection can be established from the PLC to the SQL server. Therefor you can use the provided demo-projects.

3 MySQL

CODESYS offers a library in the store to establish a connection to a MySQL database. In this case version 1.1.0.0 was used. The library was created and supported by the company Pfänder. Currently only a communication to a MySQL server 5.x or lower is supported. The latest version is MySQL 8.x. and is the direct successor version of MySQL 5.x.

For this library there is also a documentation and a demo-application available.

See: MySQL - Files for Application Note.zip

3.1 MySQL-Server Installation

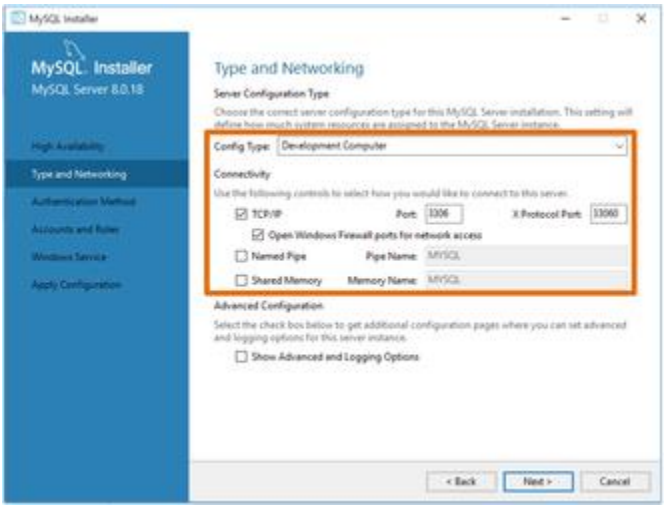
The Installationfiles can be downloaded here:

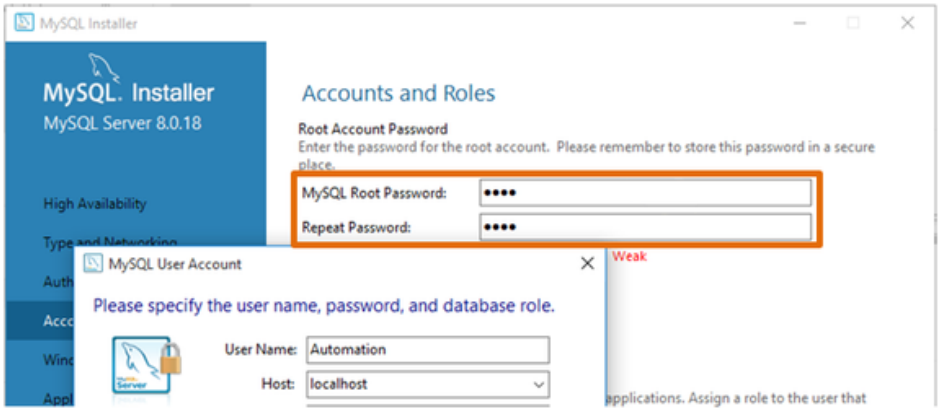
MySQL :: Download MySQL Installer (Archived Versions)

In case that no python is installed on your system, you will also have to install it:

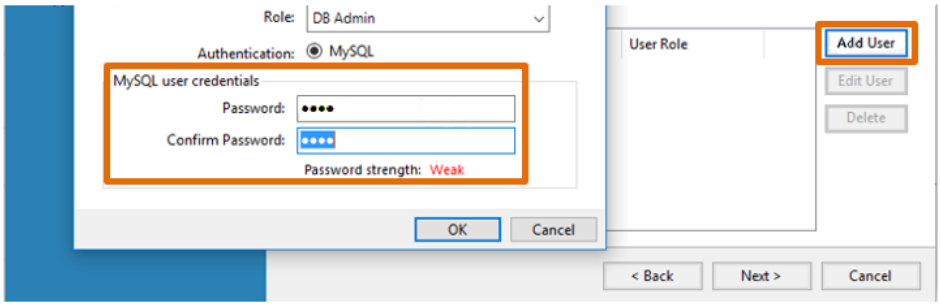
[MySQL :: Download MySQL for Visual Studio]

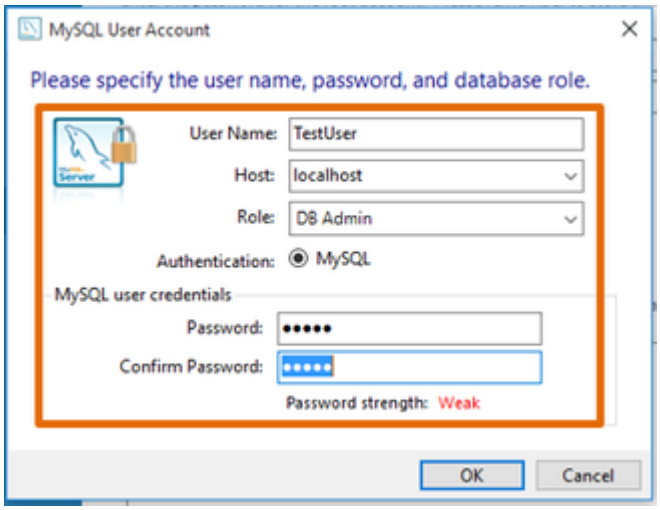
During the installation of a MySQL server, some network- and userdefined settings have to be done:

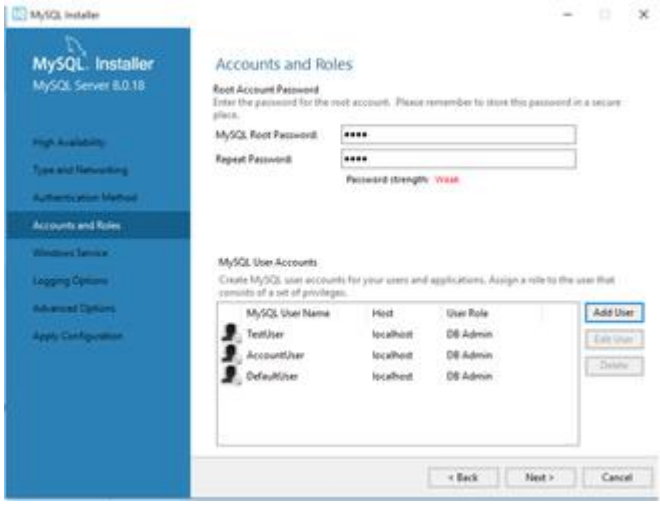




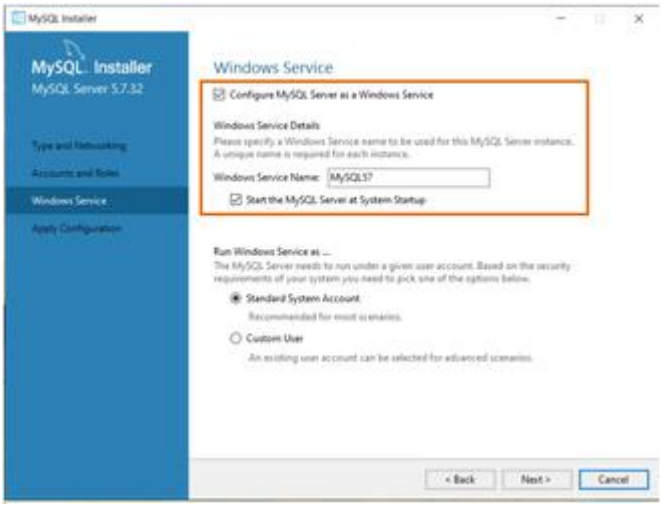
It is recommended to add an additional user, which can be used to login to the database from the PLC.

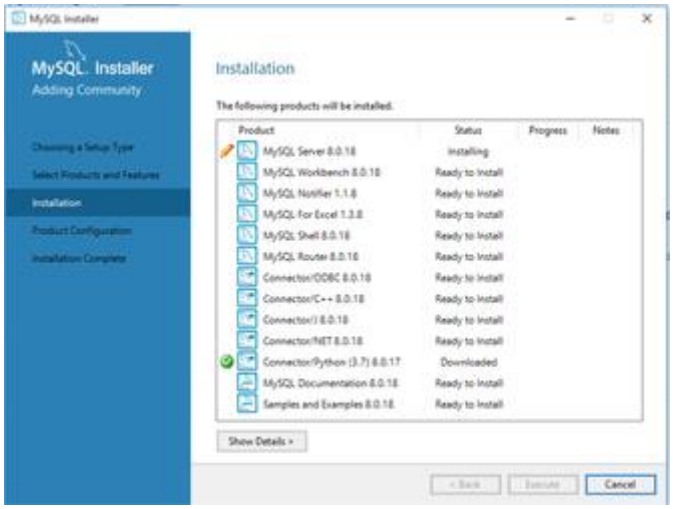




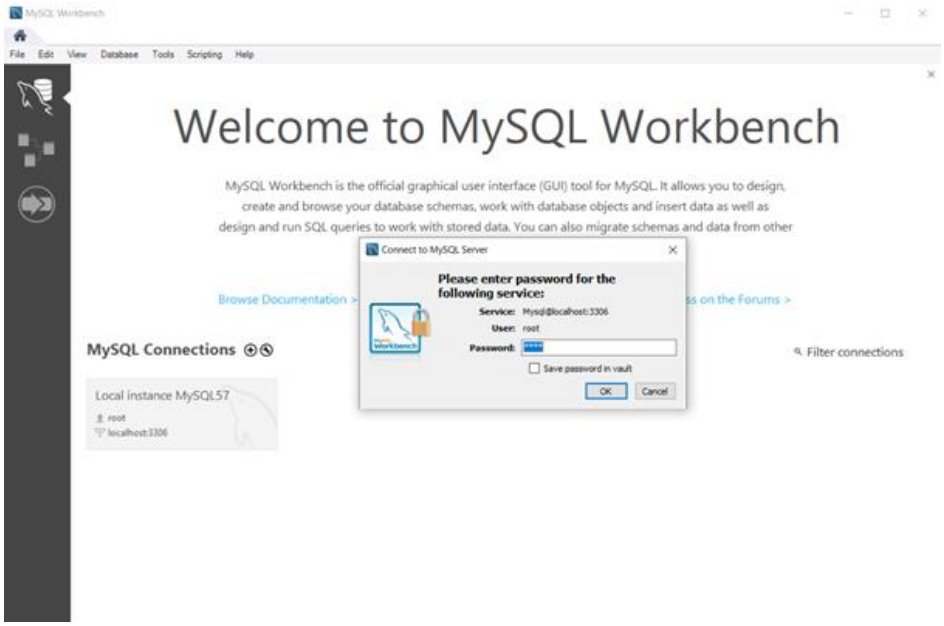


It is important that the MySQL Server is configured as Windows service, so it will be automatically started when the system is booted.

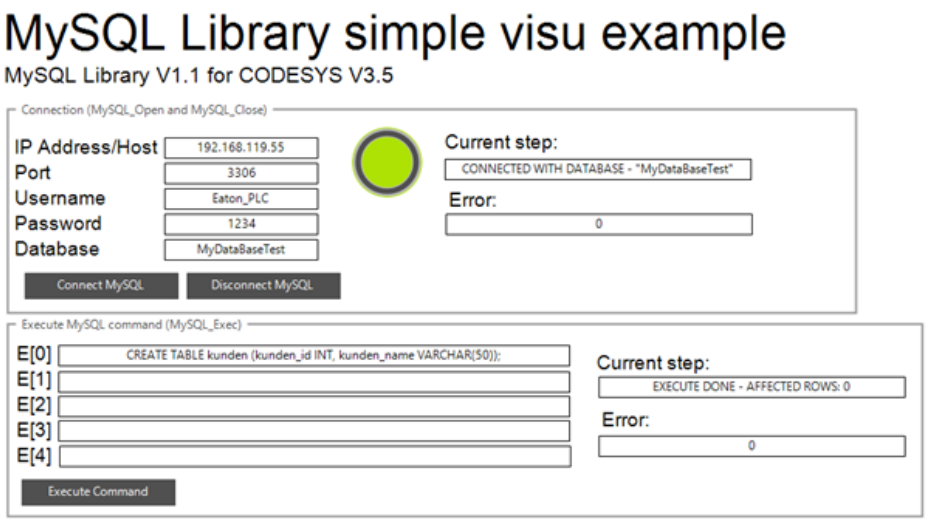




After the installation you can use the tool "MySQL Workbench" to test a connection to the database.



Or use the PLC:



4 SQL in AWS (Amazon Web Service)

A connection to databases in the RDS (Relational Database Service) from Amazon can be made with the function modules from the CODESYS Store. Functional tests with a MySQL and MsSQL database were successful.

4.1 MySQL:

- The database specified in the function-block corresponds to the SCHEMA on the server.
- If there is no SCHEMA defined, delete the name of the databse in the function-block and click "Connect MySQL" → After a successful connection a new SCHEMA can be created from the PLC (e.g. CREATE SCHEMA kunden)
- Now you can disconnect from the server and type in the name of your SCHEMA as database in the function-block→ Connect to the database and create a new table (e.g. CREATE TABLE kunden)
- The function-blocks only support MySQL version 5 or lower → must be taken into account when creating the database in AWS


4.2 MsSQL:

- For a connection to a MsSQL database in AWS a database must be already created
- The name of the database must be inserted into the database-box → Connect to the MsSQL database
- Now you can create a new table in the database (e.g. CREATE TABLE dbo.kunden)


Eaton is an intelligent power management company dedicated to improving the quality of life and protecting the environment for people everywhere. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power – today and well into the future.
By capitalizing on the global growth trends of electrification and digitalization, we're accelerating the planet's transition to renewable energy, helping to solve the world's most urgent power management challenges, and doing what's best for our stakeholders and all of society.

Founded in 1911, Eaton has been listed on the NYSE for nearly a century.
We reported revenues of $19.6 billion in 2021 and serve customers in more than 170 countries.

For more information, visit Eaton.com. Follow us on Twitter and LinkedIn.

Eaton Industries GmbH
Hein-Moeller-Str. 7- 11
D-53115 Bonn

07/2025 AP050018EN

Powering Business Worldwide