SQL Connection to Sysmac NJ and IBM DB2 Quick Start Guide

Introduction:
The NJ series controllers have five CPU models with the ability to send data directly to a database: NJ501-1520, NJ501-1420, NJ501-1320, NJ501-4320, NJ101-1020, NJ101-9020. The connection steps are the same for all of the SQL databases. So this guide is good for all five of the SQL databases. The details are however – are just for IBM DB2 databases.

This Quick Start will show you how to connect to a database – it will not show you how to set up the database.

Why the need for database connection?
Assembly lines need an easy and fast way to log or get data about production equipment on the line.

Why collect data directly from the PLC?
Assembly lines last up to 10 years and their PLCs are designed to last for the life of the machinery. It is very difficult to maintain a SCADA software package for 10 years. The computer will not last that long and it is difficult to find someone to support a 10 year old version of a SCADA package.

Computers take a long time to boot – lost production time.

Computers need updates – IT has to service them – no guarantee that an update will not adversely affect the performance of the unit.

Which Data Bases:
NJ supports Oracle and MySQL (Oracle Corporation), SQL Server (Microsoft), DB2 (IBM for Linux, UNIX, and Windows operating systems) and Firebird.

Why SQL type data bases:
SQL databases accept many connections at once unlike databases like Microsoft Access which only allow one user at a time. Many PLC's can send data at once and many people can get data from the database at once. SQL databases are very popular.

Other Features:
The NJ can store the data to a spool file (1Mbyte in NJ memory) if connection to the data base is lost. The NJ can log commands and responses to files on the NJ SD card which are later used to debug the logging error.

Versions Required:
Sysmac Studio V1.07 for Microsoft SQL and Oracle; V1.09 or higher for MySQL, IBM DB2, or Firebird.

Example of How to Connect to IBM DB2 SQL

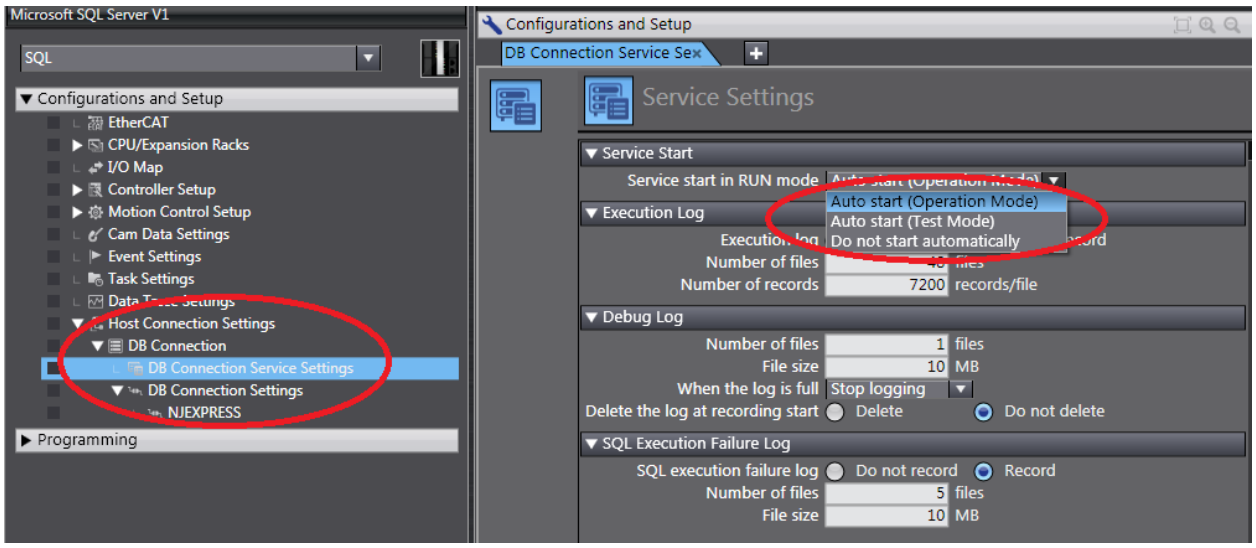
Setup:
SQL database is installed on laptop with IP address 192.168.250.50. NJ uses address 192.168.250.1

Introduction:
The SQL DB connection is setup in the "Configurations and Setup" in Sysmac Studio.
Show "Host Connection Setting" in the setup section of Sysmac Studio. This lets you test and setup your connection to the SQL Host.

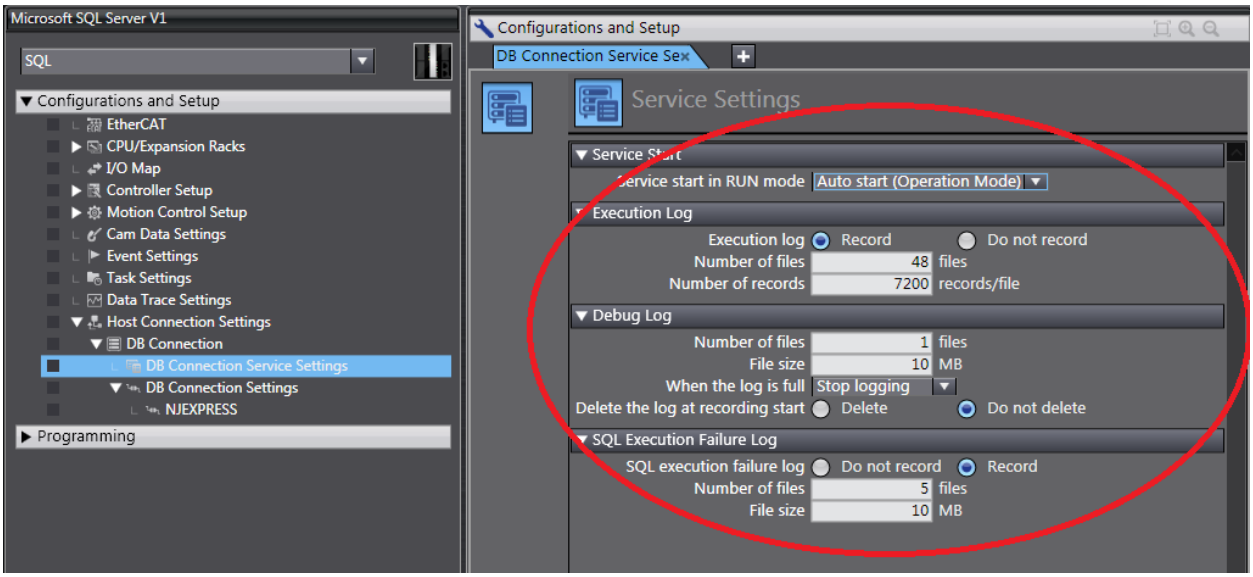
- DB Connection Service Settings – specify error files and enable service
- DB Connection Settings – set logon to SQL server

Under Service Start – pick "Auto Start" to make the SQL service start on power up.

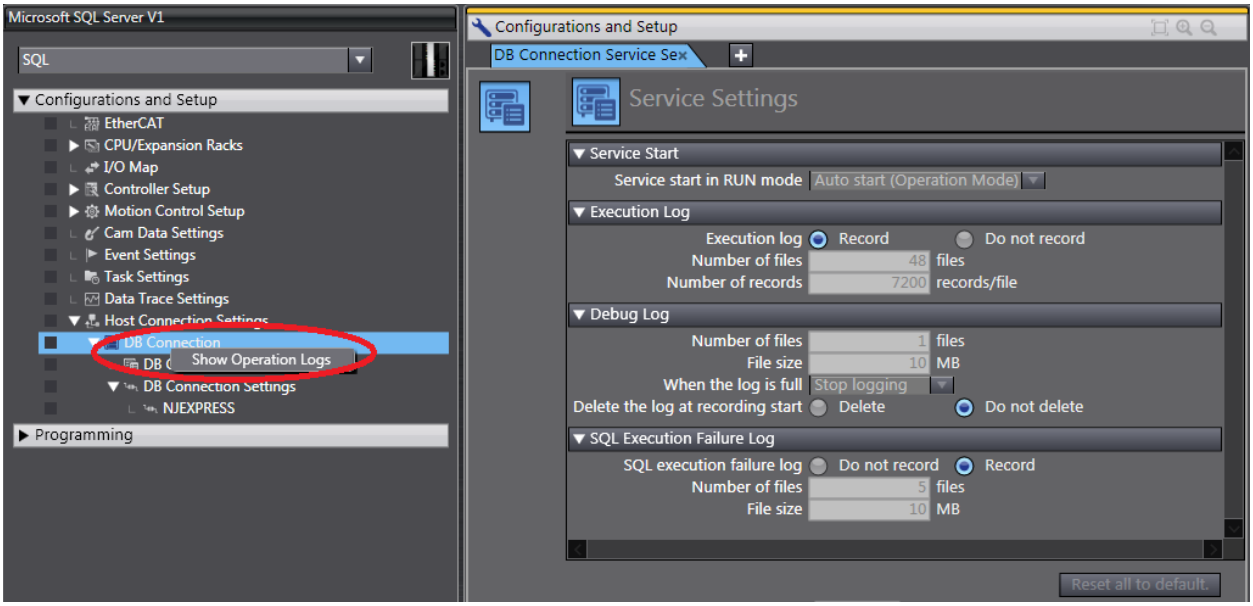
If you pick "Test Mode" (database not present) then the NJ will send all SQL commands to the SD memory card and all the program instructions will assume connection or data transfer was good – for debugging.



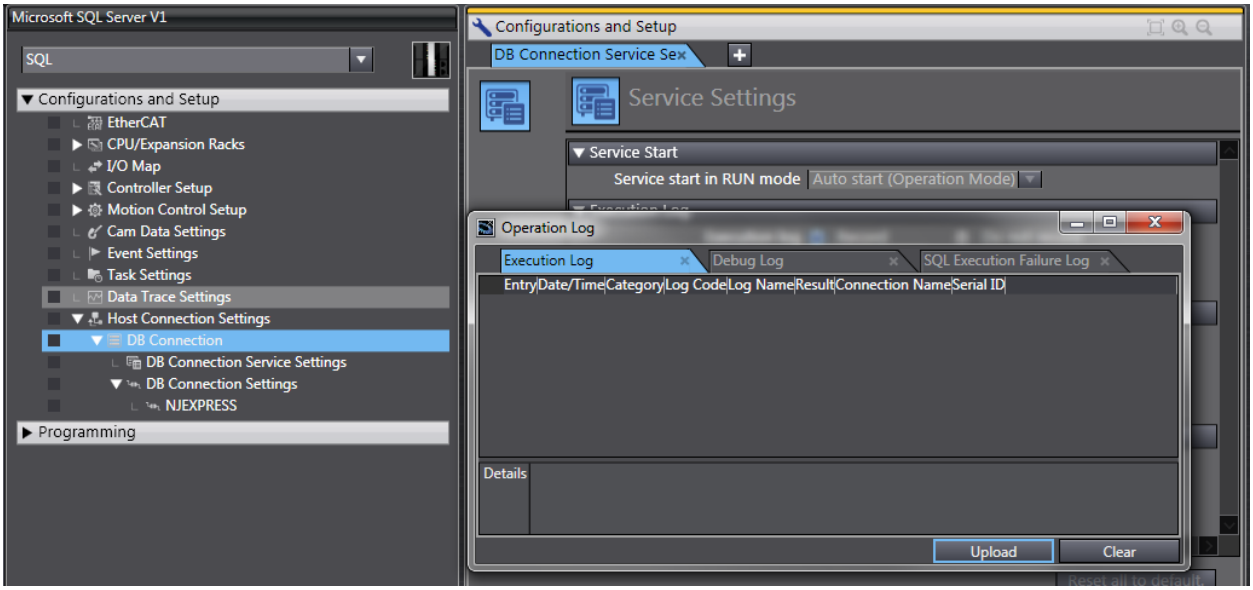
Execution Log, Debug Log, and SQL Execution Failure Log all go to the SD card.
The NJ SQL comes with an SD card.



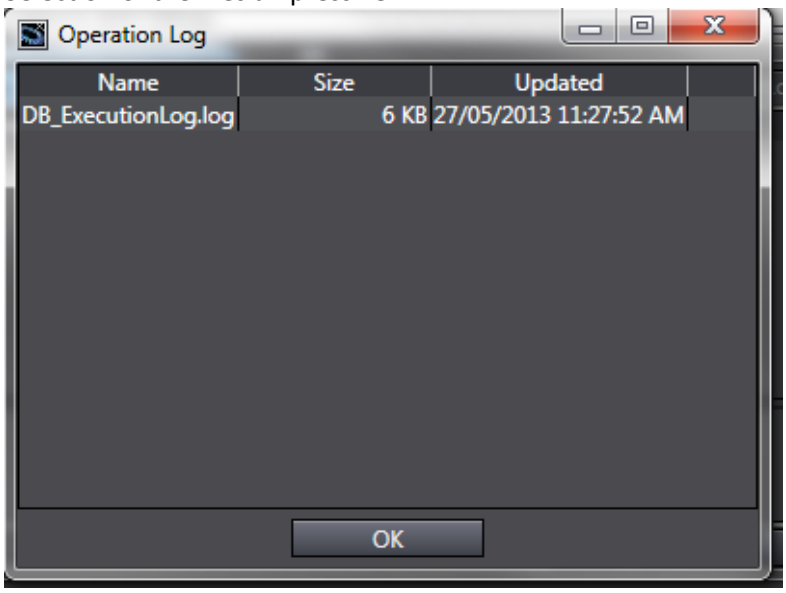
If you right click on “DB Connection” then you can see the Operation Logs – assuming you have at least tried to log on or save a record. You must be online to see the files.



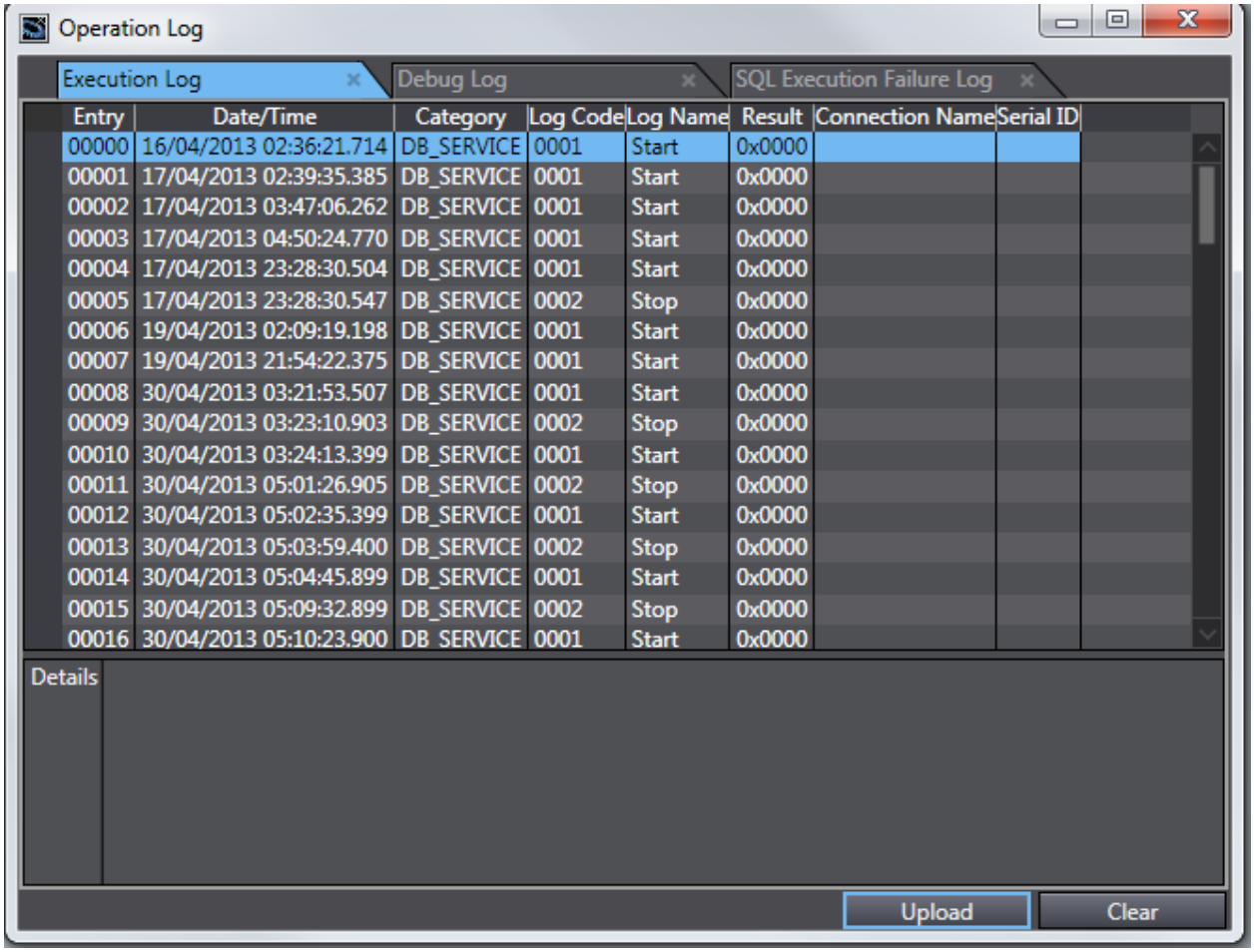
An “Operation Log” window will open. There are three tabs – one for each of the log types.
Pressing “Upload” at the bottom of the screen will bring up a list of log files that exist on the SD card.



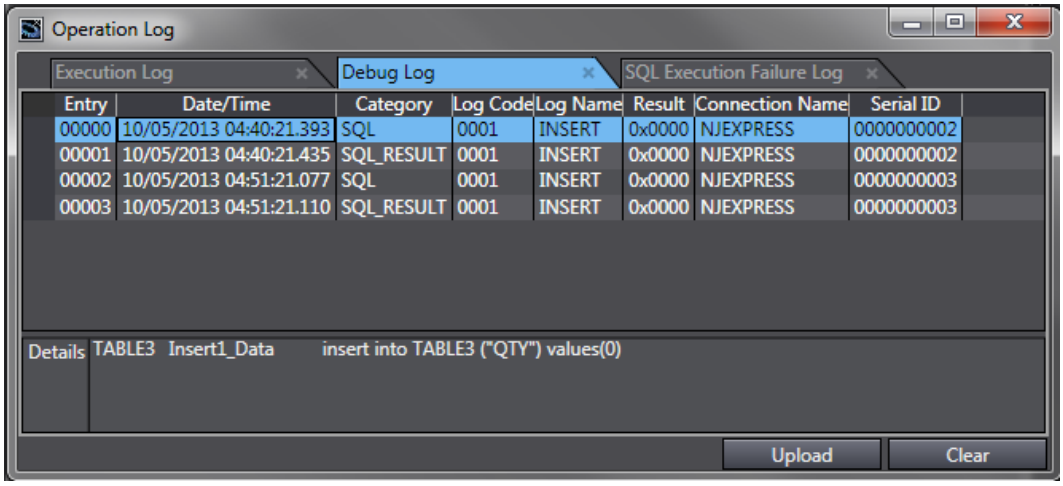
Select on of the files an press “OK”



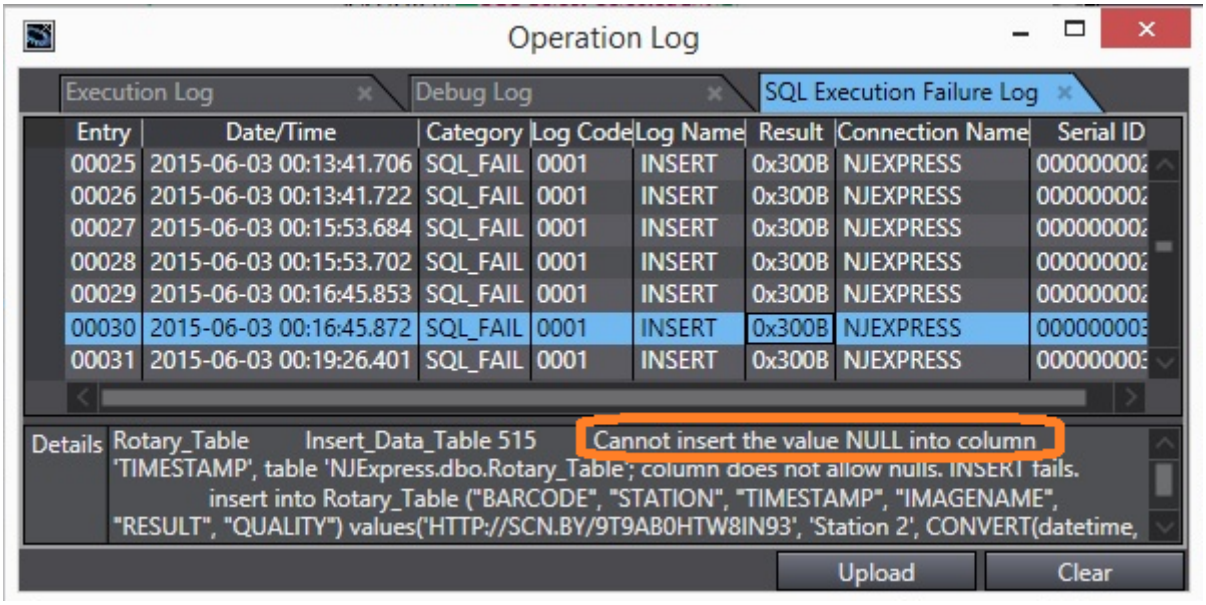
The Operation Log is good for seeing when services start and stop.



The Operation Log shows when the database commands occurred – good for the line programmer.



The SQL Execution Failure Log shows the “to” and “from” SQL commands – good for IT and high level NJ/SQL programmer. These logs show why a log did not happen – i.e., empty field on a field that cannot be empty.

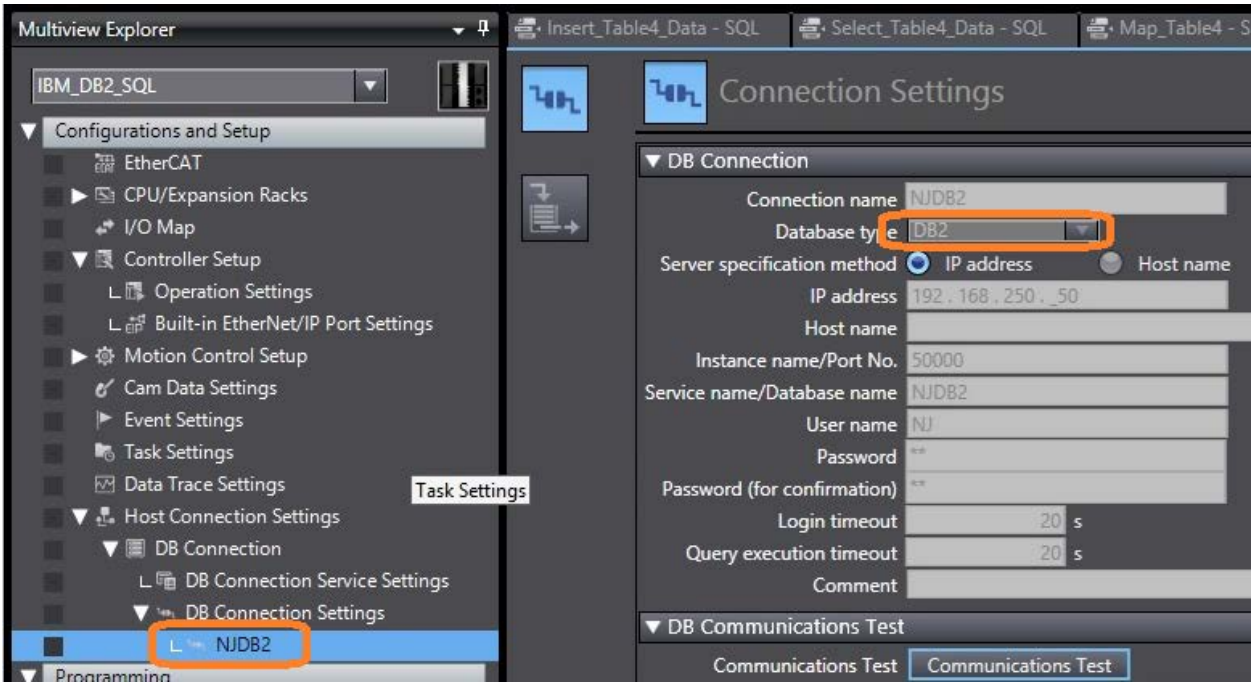


How to create the connection profile

See manual W527 section 2-2-2 for more detail.

Go to “DB Connection Settings” – Right Click – “Add” – “DB Connection Settings”. This will create a new connection setting with the “Connection Name” of “NJDB2”.

Database Type: Pick the database type that you want to connect to. In this case DB2.



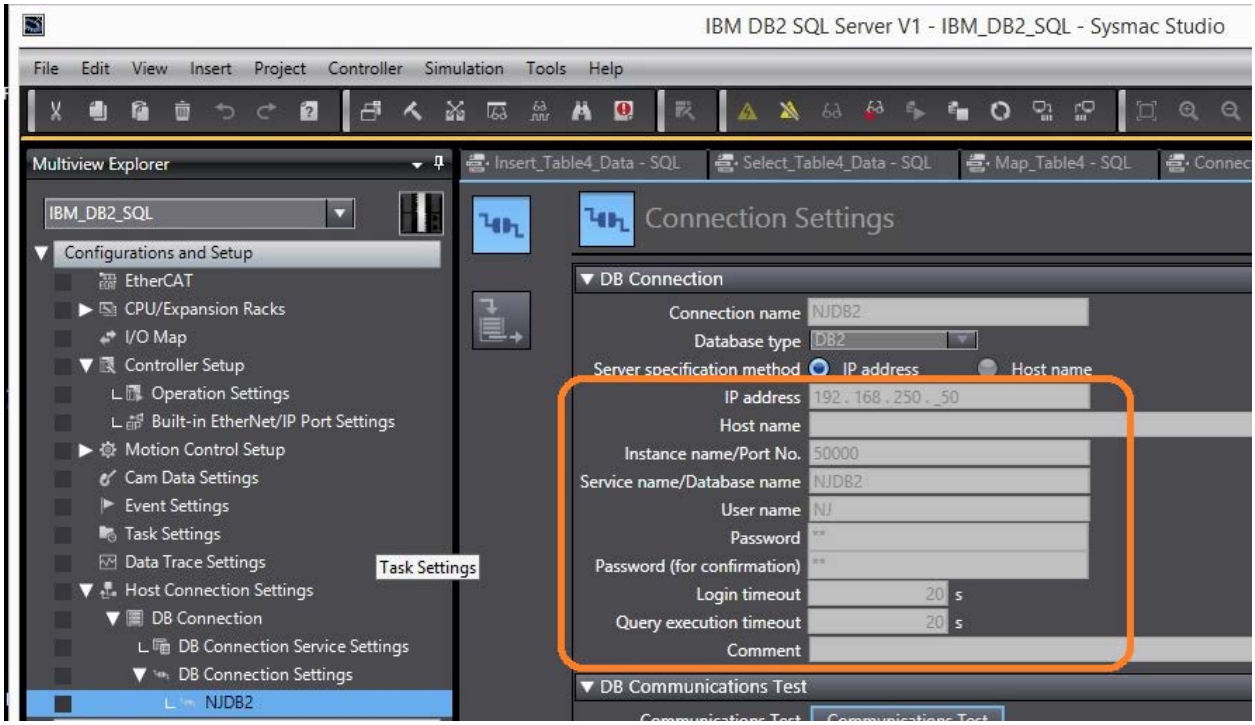
Server Specification Method: IP address or Host name of the computer the SQL server is on.

Instance Name/Port Number: An IT person will know this. You do not need to specify if it is the default.

Database	Default Port
Microsoft SQL	1433
Oracle	1521
IBM DB2	50,000 but cannot be omitted, must enter
MySQL	3306
Firebird by Firebird Foundation	3050

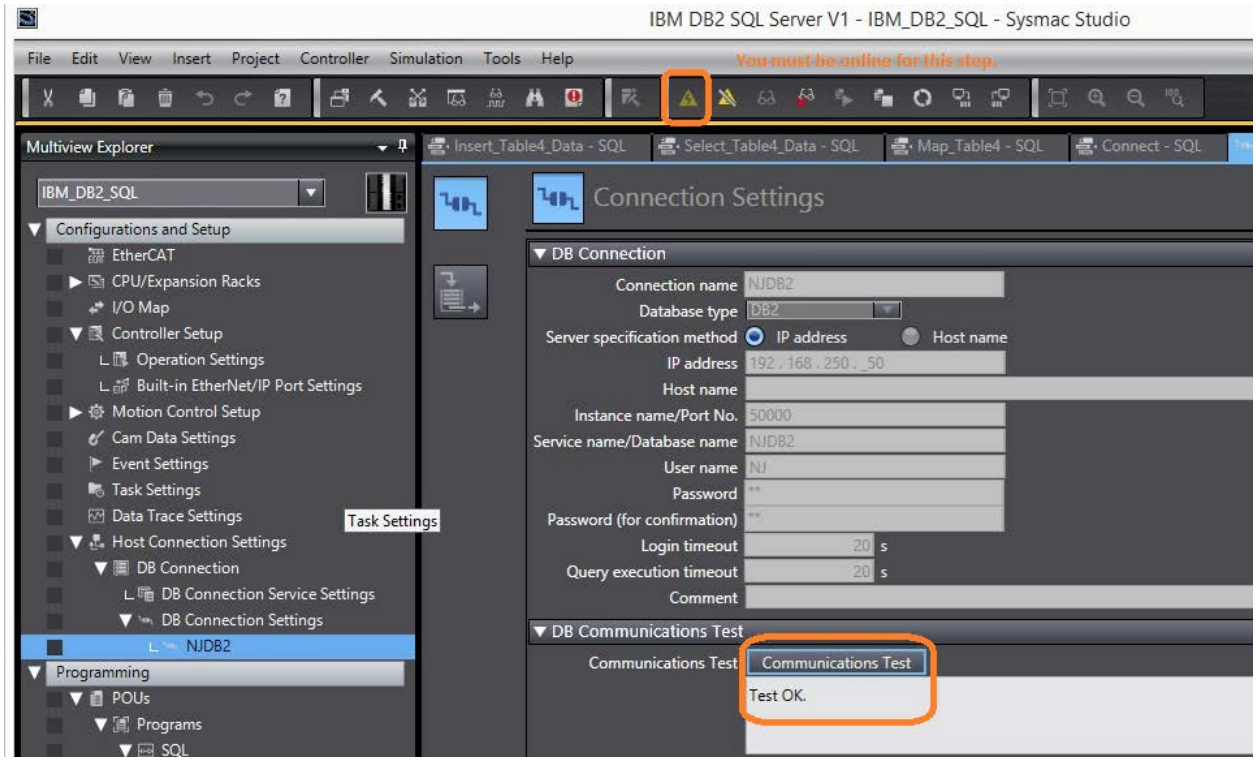
Service Name/Database Name: You must enter the database name here as specified by IT people. You can omit the name if the user has been set by default to the correct Service/Database within SQL for Oracle and Microsoft SQL only. All the others you must enter the Database name. See the appendices for more detail.

You must then enter the Login Name and Password as given by IT people.



You can now press the Communications Test Button.
"Test OK" will show if successful.

Note: When IBM SQL is on a laptop (personal computer) the biggest reason for a failed connection is that the Microsoft Firewall is blocking the connection.



Ladder Code to send data to SQL

You have created a connection setup log into the SQL data base and tested it.
Now we want to add ladder code to send data to/from the SQL server.
There are 3 basic parts to this step:

1) DB_Connect and DB_Close instructions to log in and log out of the SQL the database.
2) A DB_CreateMapping instruction to create a map between NJ Tags and SQL fields/Table.
3) DB_Insert/Select/Delete/Update instructions.
   - Insert: to append data to the table
   - Select: which allows you to query data from the table
   - Delete: delete a record.
   - UpDate: modify a record.

This is an example of how to write the connection program:

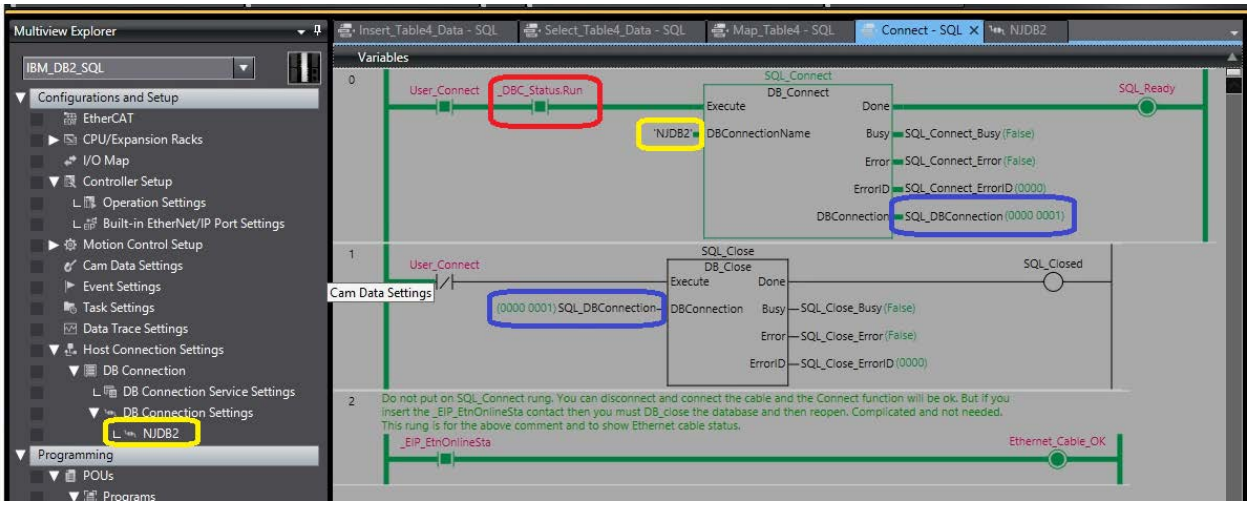
The _DBC_Status.Run bit lets you know the DB service has actually started up and is running.

'NJDB2' with single quotes is how you specify the DB Connection you want to use.

The "Done" bit lets you know if you successfully connected to the database/table.

The SQL_DBConnection variable is the reference variable to this database connection for all the other instructions including SQL_Close. I show it in blue for most of this document.

It is a good idea to close the database when the controller is about to shut down.



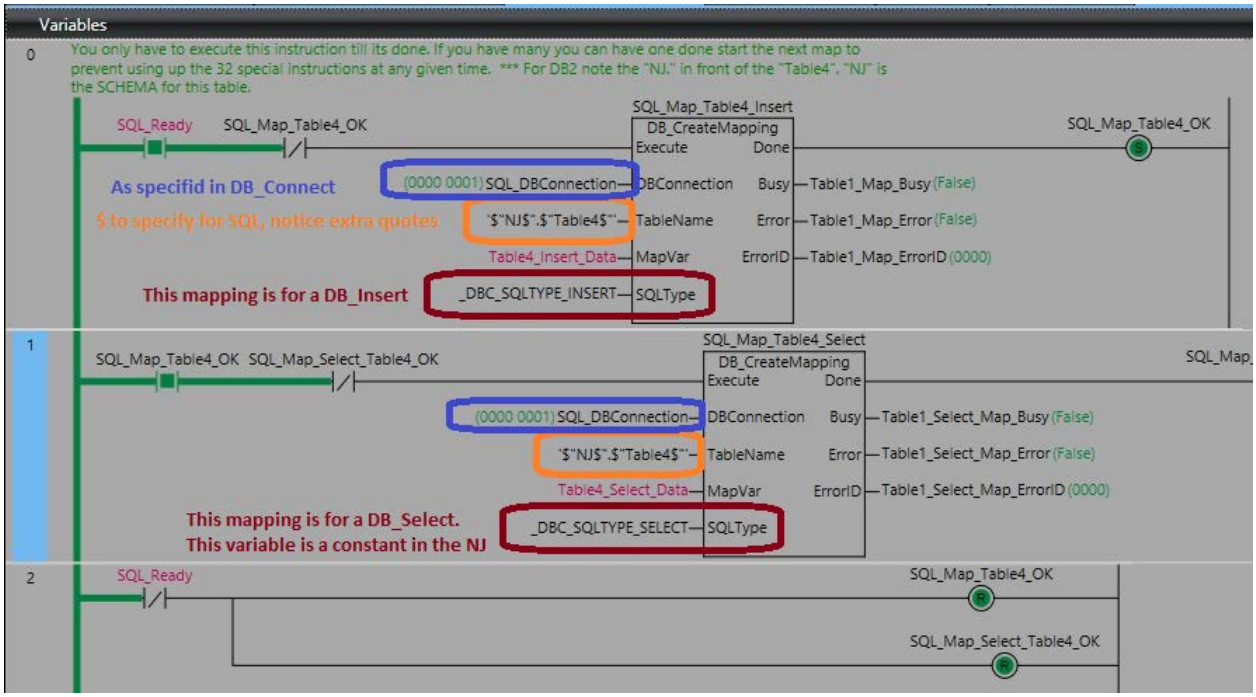
The next step is to map the NJ Tags to the Database Tables Fields

DBConnection: This came from the "DB_Connect Instruction" – unique number identifier for each connection.

TableName: This is the name of the Table you want to send data to/from in the SQL server.

SQLType: Enter one of the following contants DBC_SQLTYPE_INSERT, DBC_SQLTYPE_SELECT, DBC_SQLTYPE_DELETE, DBC_SQLTYPE_UPDATE.

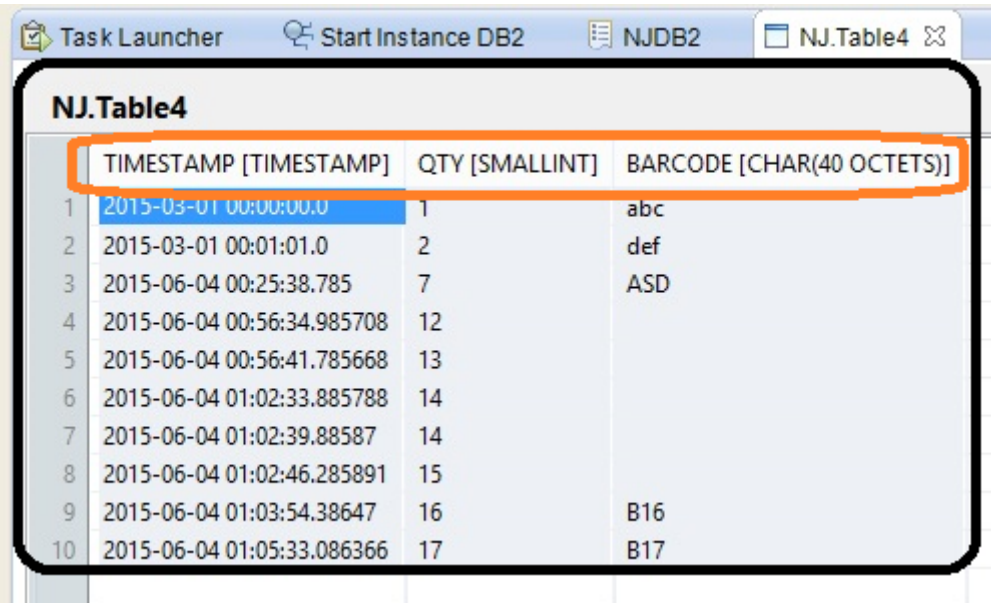
You must enter a unique variable name for "MapVar" even if it is for the same table – or only the last one will work. The MapVar must be of a structure type. Here is an example of an NJ Structure and the SQL table. In this case under Table4 of Database NJEXPRESS you will see Barcode, Qty, and Timestamp.



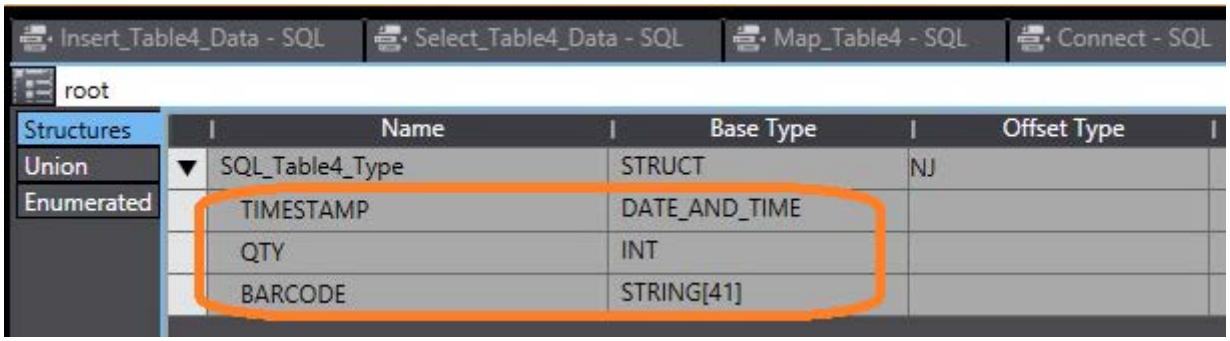
The SQL_Insert_Type is exactly the same. The member names must match exactly the field names in the SQL database.

When matching the DB field names to the NJ structure for the variables connected to the database you do not have to have all the field names – nor do they have to be in order. The variable types will not match exactly and the manual shows you how to match them up.

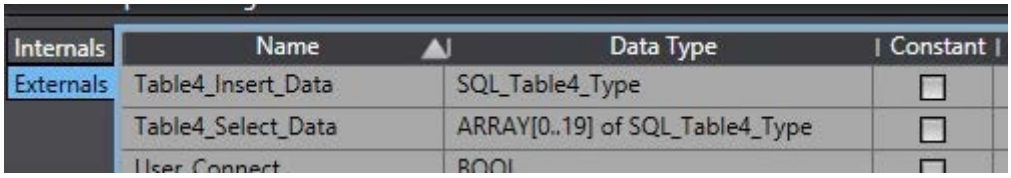
IBM DB2 Field names



Sysmac Studio Variables using Structures – to match the IBM DB2 field names.



You then create a variable for the DB_Insert and DB_Select Instructions – note that both are of the same structure but the DB_Select can be an array (DB_Insert variable cannot be an array). In this case the variables were made in the Global Variables area.



There is a complete list of data types for all databases in Manual W527 section 3-4.

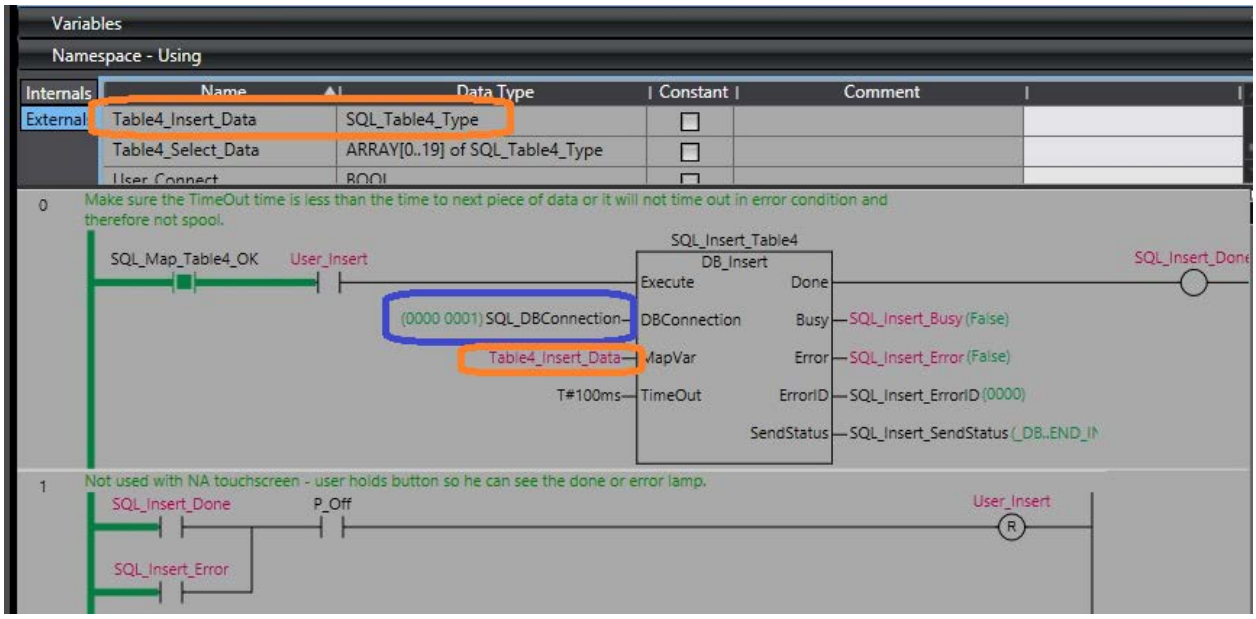
- DB2

Data type category	Data type in DB	Data type in NJ-series Controllers
Numbers	INT	DINT
	INTEGER	DINT
	BIGINT	LINT TIME
	SMALLINT	INT
Fixed-point numbers*1		*2
	DECIMAL(1)	BOOL
	DECIMAL(3)	SINT
	DECIMAL(5)	INT
	DECIMAL(10)	DINT
	DECIMAL(20)	LINT
	DECIMAL(3)	USINT
	DECIMAL(5)	UINT
	DECIMAL(10)	UDINT
	DECIMAL(20)	ULINT
	DECIMAL(20)	TIME
Real numbers	FLOAT	REAL LREAL
	REAL	REAL
	DOUBLE	LREAL
Date and time	DATE	DATE
	TIME	TIME_OF_DAY
	TIMESTAMP	DATE_AND_TIME
String	CHAR	STRING*3
	CHARACTER	STRING*3
	VARCHAR	STRING*3
	CHAR VARYING	STRING*3
	CHARACTER VARYING	STRING*3
	LONG VARCHAR	STRING*3
	CLOB	None
Binary string	BLOB	None
Others	GRAPHIC	None
	VARGRAPHIC	None
	LONG VARGRAPHIC	None
	DBCLOB	None
	DATALINK	None

To Insert Data into the SQL database:

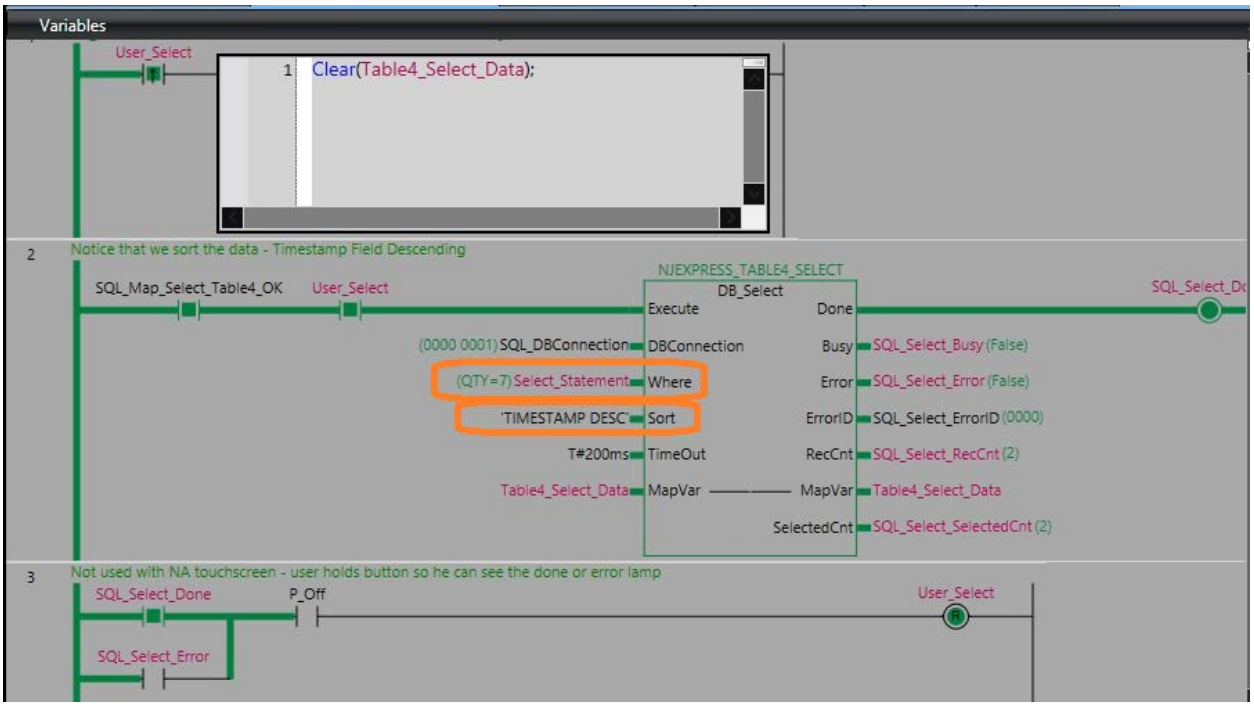
The DB_Insert instruction needs two reference inputs:

- DB_Connection comes from the DB_Connect instruction.
- MapVar is the same variable we used in the DB_CreateMapping instruction.
- With these two pieces of information the insert instruction know which database, table, and fields to add the data too.
- The “done” output does tell you if the data was successfully sent to the SQL database.

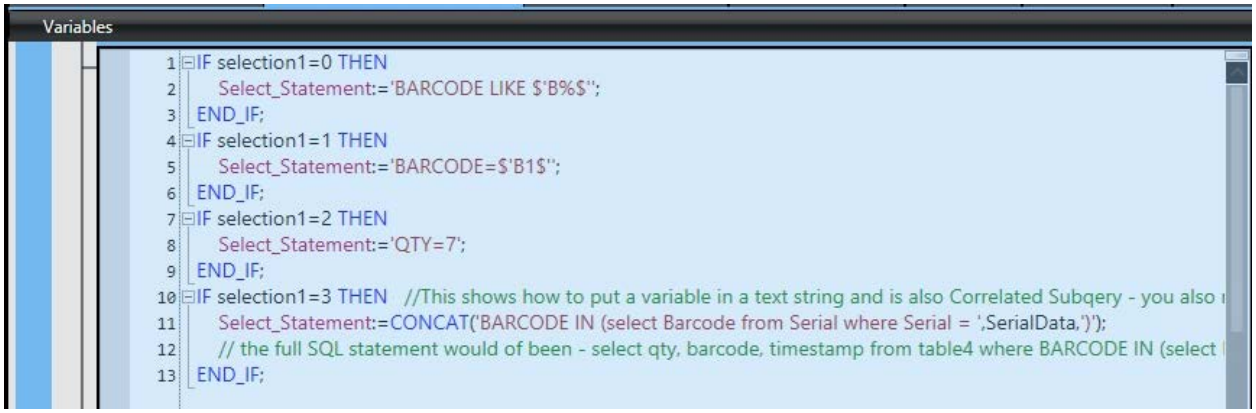


To Select Data from the database:
The DB_Select instruction does this for us. I works mostly the same as DB_Insert with two major differences. The MapVar can be an array. (Notice there is not "[0]" at the end of the variable name when it is an array. There is a "Where" input to filter which records you are looking for. (There is also a sort input).

There are two counters at the bottom right corner of the instruction to tell you how many records it found and how many it gave to you (if your array was to small it just gives you enough to fill the array.) Notes on how to use the "Where" are below.



The SQL Language uses ' ' in their syntax. To let Sysmac Studio the ' is for the database put a $'.
So the following first example means: **BARCODE LIKE 'B%'** to SQL. The % is a wildcard to SQL when the "LIKE" is included.



There are two instructions which will help you get the SQL connection status.

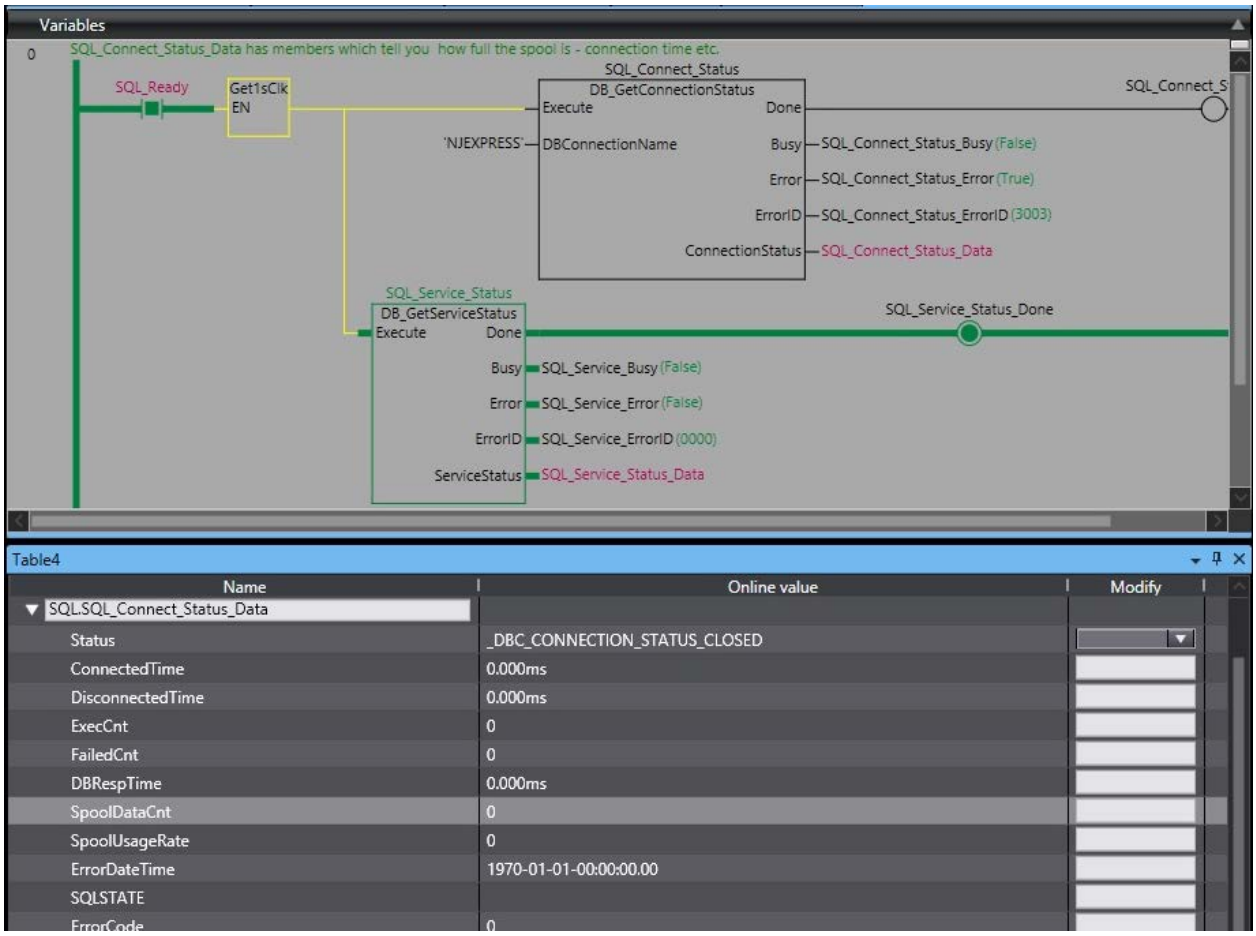


Table4

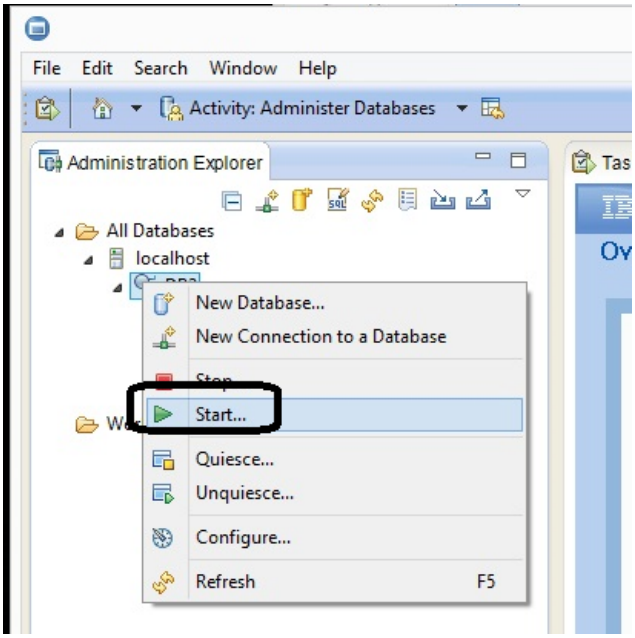
Name	Online value	Modify
SQL.SQL_Connect_Status_Data		
Status	_DBC_CONNECTION_STATUS_CLOSED	
ConnectedTime	0.000ms	
DisconnectedTime	0.000ms	
ExecCnt	0	
FailedCnt	0	
DBRespTime	0.000ms	
SpoolDataCnt	0	
SpoolUsageRate	0	
ErrorDateTime	1970-01-01-00:00:00.00	
SQLSTATE		
ErrorCode	0	

Appendix A: IBM DB2 SQL Connection Notes

This section shows you some information on how to set up and use the IBM DB2 SQL software.

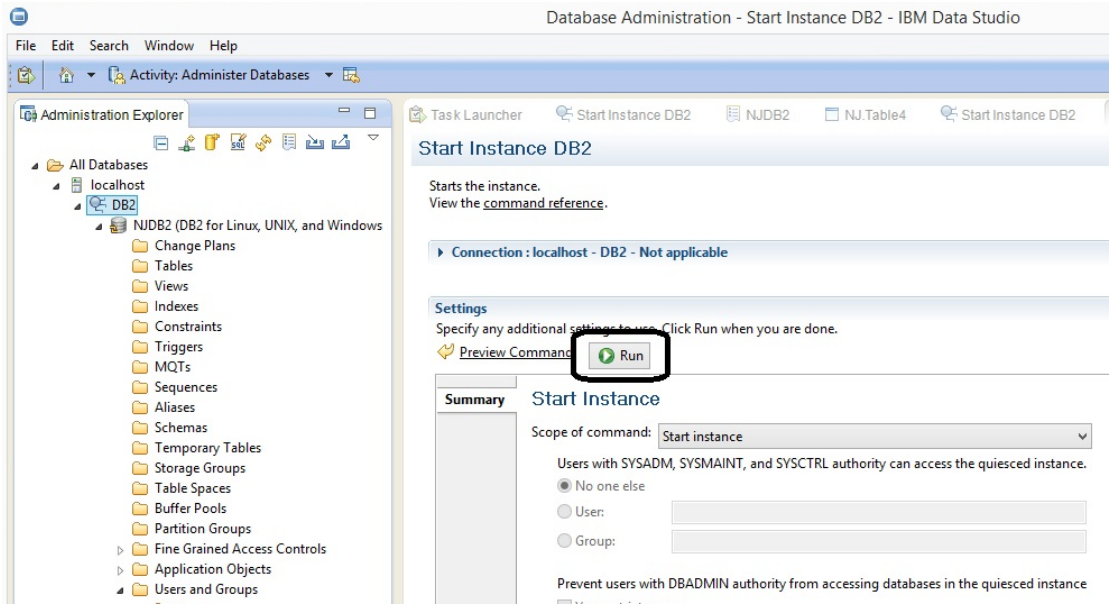
Open the IBM DB2 Software.

You may need to start the database.

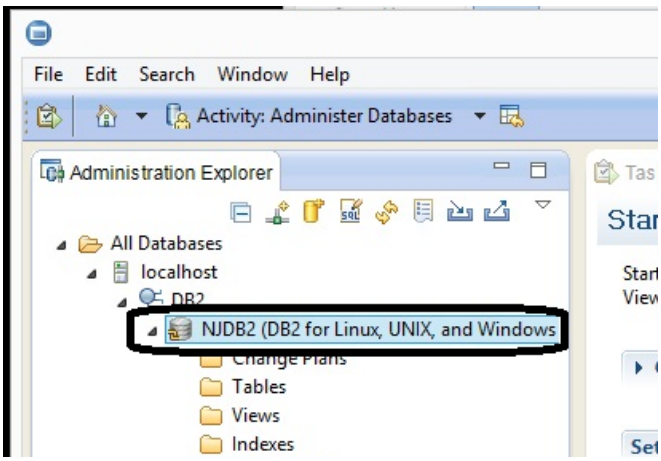


Enter your user name and password.

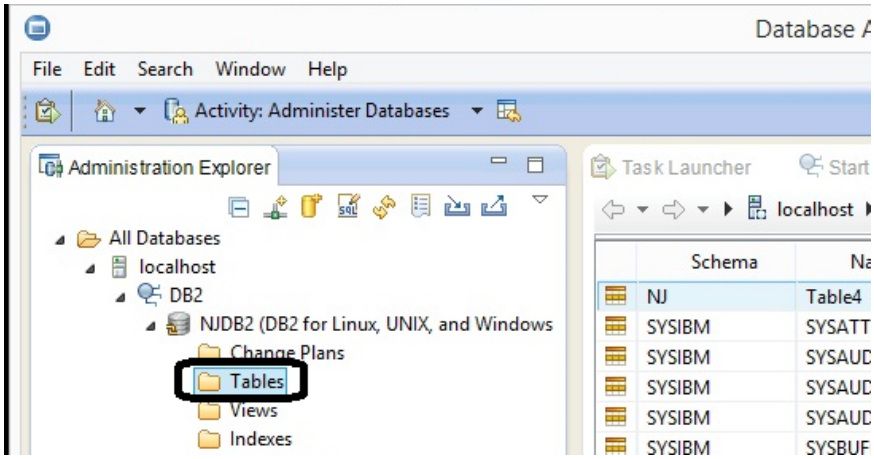
Now press the “Run” button



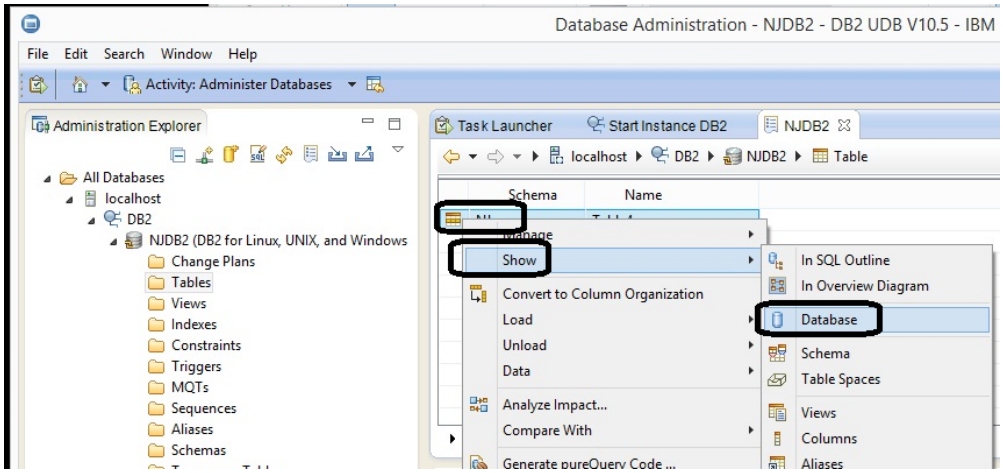
Open up the database you want to use, this is the database name for Sysmac Studio DB connection setting. “NJDB2”

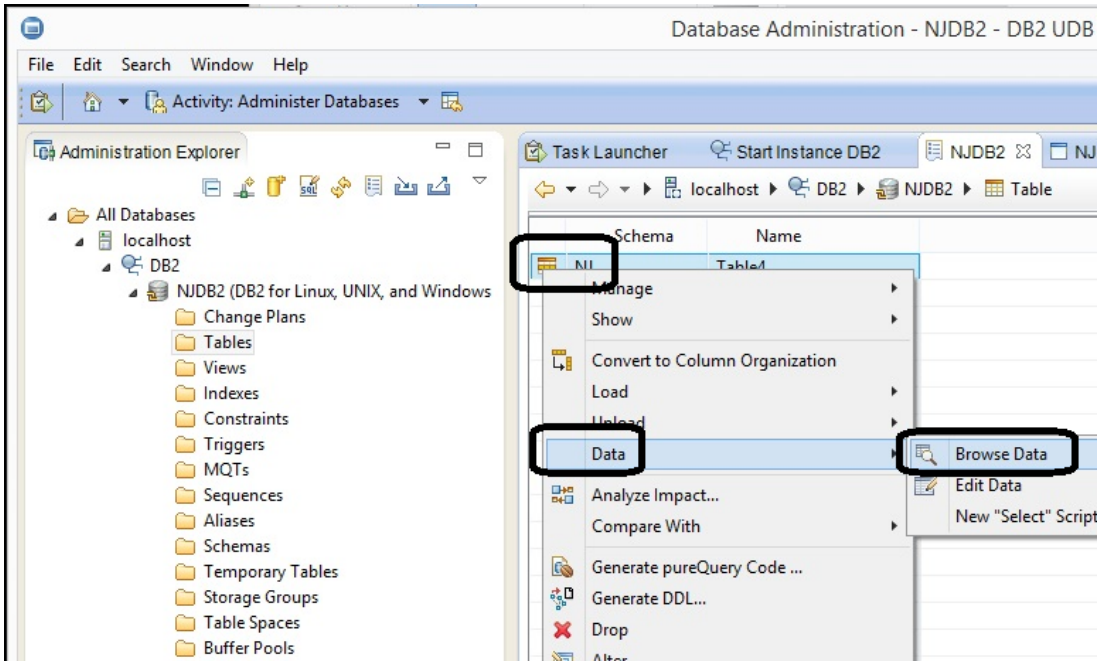


Go to the tables section.

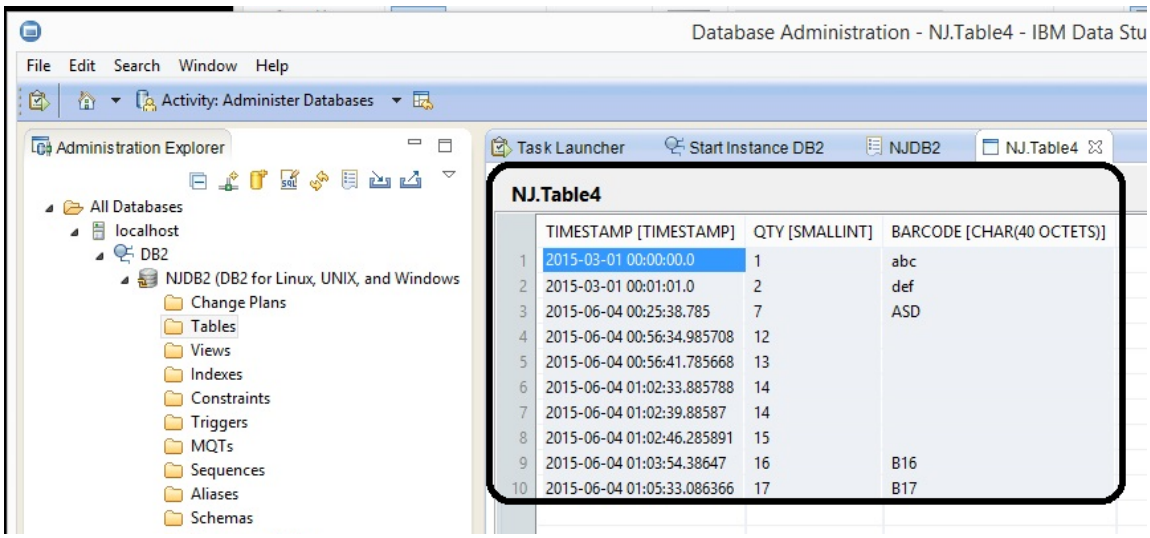


This is how we “show” the “NJ” database.





And here is the data in “NJ”

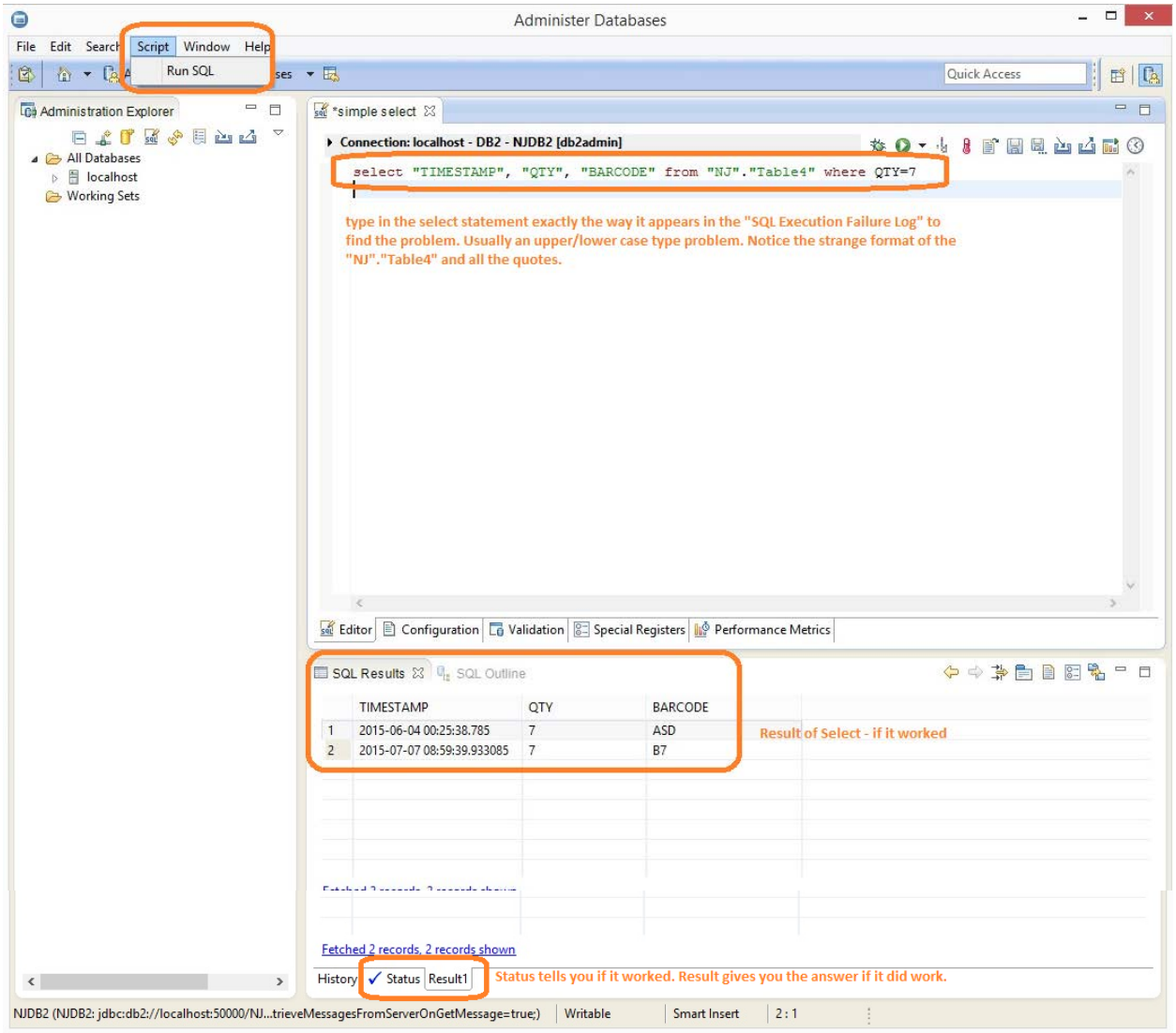


Appendix B: IBM DB2 Database Setup Notes

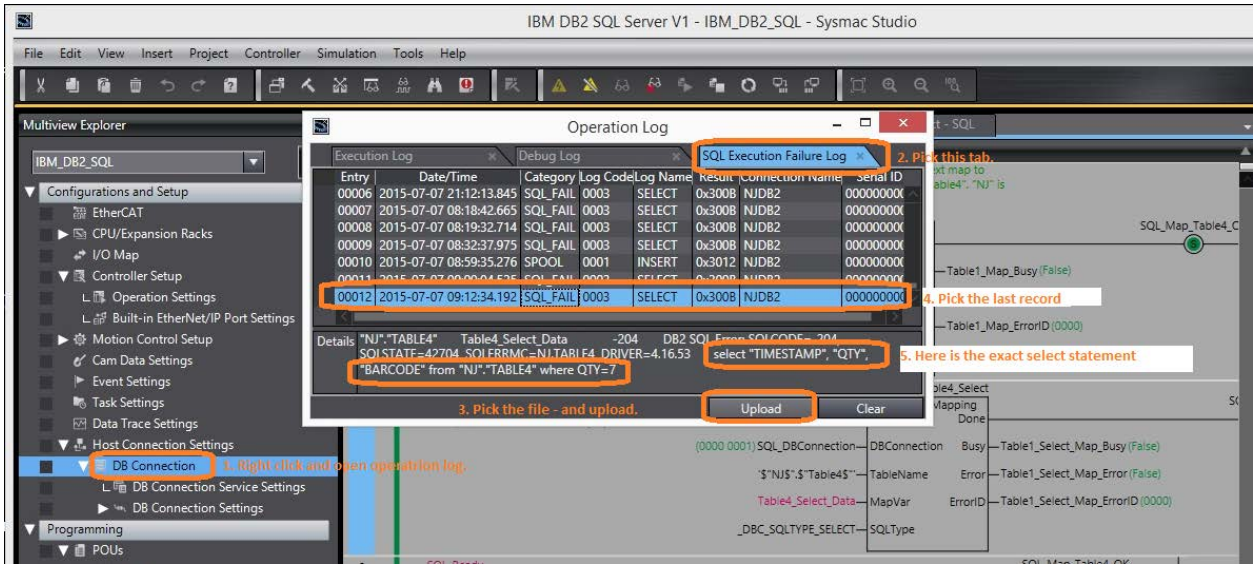
If you get an Error:SQLCODE=-204 using “Select”
Check the “Tablename” in the DB_CreateMapping Instruction. Upper/Lower case letters matter.
To test the error – In the IBM “Administer Database” Program

“Script” – “Run SQL” – type in – Select “TimeStamp” from “NJ”.”Table4” where QTY=7

Then press “F5” to run the script.



To get the exact string – do the following:



This completes the Quick Start for
SQL Connection to Sysmac NJ and IBM DB2

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