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Connecting BioPAT® MFCS to BioPAT® Trace | Multi Trace via OPC Unified Architecture (UA)

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Abstract

This application note provides step-by-step guidance for establishing a secure connection between BioPAT® MFCS and BioPAT® Trace | Multi Trace using OPC UA to allow supervisory control and data acquisition.

Since version 4.7, BioPAT® MFCS has provided a built-in OPC UA client that enables different types of OPC UA servers to be connected securely.

Introduction

BioPAT® MFCS is a Supervisory Control and Data Acquisition (SCADA) system. An OPC UA client was introduced in BioPAT® MFCS 4.7, allowing BioPAT® MFCS to connect to different OPC UA servers.

The BioPAT® Trace | Multi Trace is used for enzymatic, amperometric biosensor measuring for glucose | lactate and methanol | ethanol. Among its several practical features, it enables an OPC UA server to connect to other SCADA, DCS (Digital Control System), or historian systems.

OPC UA is an open standard communication protocol for industrial automation developed by the OPC Foundation. It is manufacturer-independent and can be used for different kinds of data exchange (machine to machine, machine to PC, PC to PC).

Materials

Sartorius Software

- BioPAT® MFCS Core Software
- BioPAT® MFCS OPC UA Server
- BioPAT® MFCS OPC UA Client

Sartorius Bioreactor System

BioPAT® Trace | Multi Trace

Methods

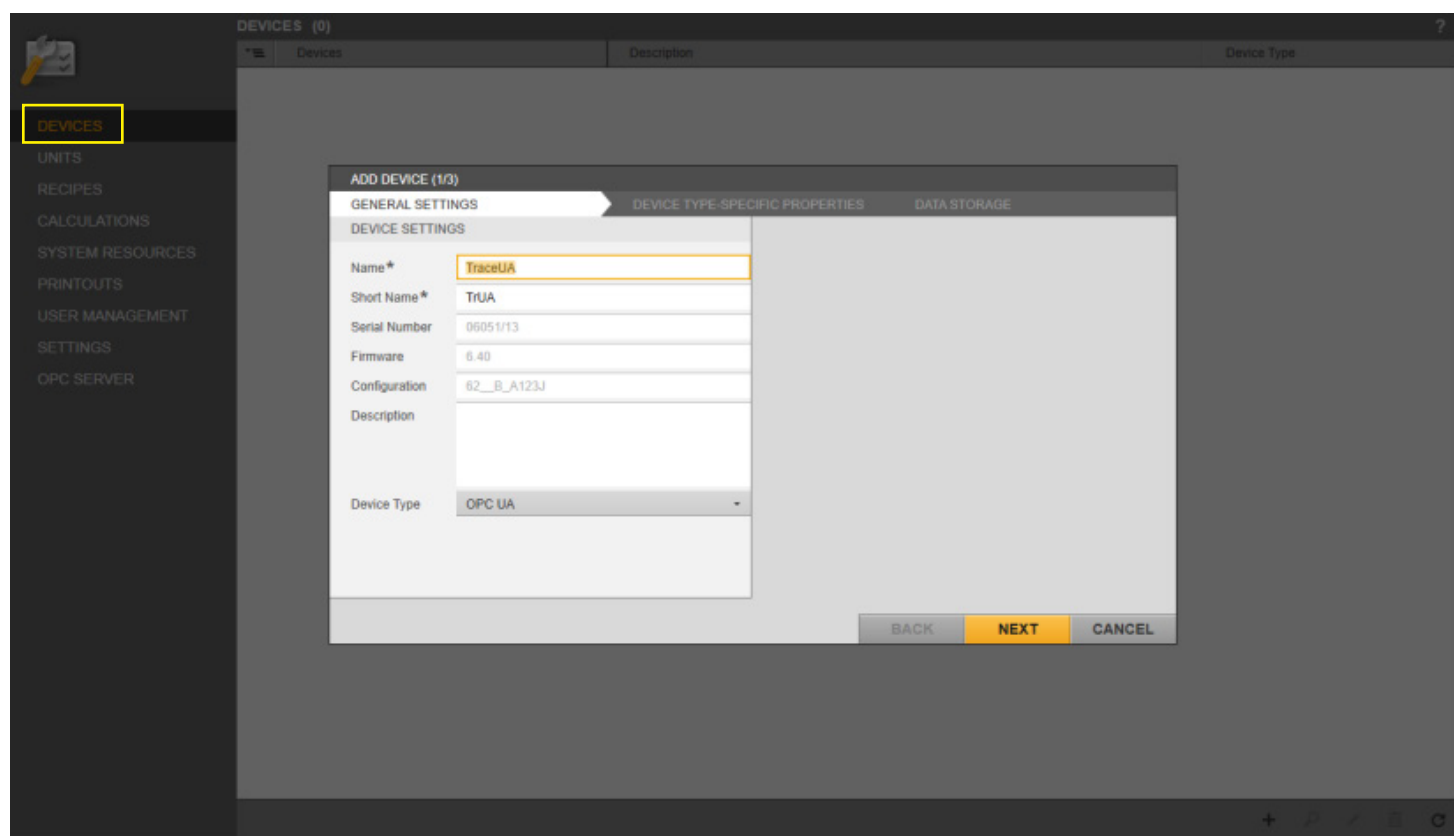
Connecting Trace to MFCS 4.7 (or higher) via OPC UA

1. Activate the OPC UA server in the trace device (using the same method described in the first paragraph of the existing application note).
2. Add the OPC device (as well as the Trace OPC UA server as a device) in BioPAT® MFCS.
3. Create the unit that has configured all the variables of the trace device.

Creating the OPC Device

BioPAT® MFCS client has three areas: administration, monitoring, and analysis. To create a new device, you need to switch to the administration area. On the left-hand side there is a list with navigable elements, including “Devices” and “Units.” In the “Devices” area, you can specify the device to be communicated with and its communication details. Under “Units,” you can define the process variables that are to be monitored or controlled in BioPAT® MFCS, or whose values are to be saved within a batch.

In the “Devices” area, a new device is added by clicking on the “+” button, which opens a wizard. The following images show the three pages of the wizard as they correspond to the default configuration of the Trace OPC UA server.



The screenshot displays the 'ADD DEVICE (1/3)' wizard in the BioPAT MFCS application. The left-hand navigation pane has 'DEVICES' selected. The main window is titled 'DEVICES (0)' and contains a table with columns 'Devices', 'Description', and 'Device Type'. Overlaid on this is the 'ADD DEVICE (1/3)' wizard, which has three tabs: 'GENERAL SETTINGS', 'DEVICE TYPE-SPECIFIC PROPERTIES', and 'DATA STORAGE'. The 'GENERAL SETTINGS' tab is active, showing the following fields:

- Name*: TraceUA
- Short Name*: TrUA
- Serial Number: 06051/13
- Firmware: 6.40
- Configuration: 62_B_A123J
- Description: (empty text area)
- Device Type: OPC UA (dropdown menu)

At the bottom right of the wizard are three buttons: 'BACK', 'NEXT' (highlighted in yellow), and 'CANCEL'.

Figure 1: First Configuration Page for Adding a Trace Device.

ADD DEVICE (2/3)

GENERAL SETTINGS

TIMING SETTINGS

Polling rate*

5000 ms

Max. retries*

3

Reconnect rate*

15 s

CONNECTION SETTINGS

OPC UA server address*

opc.tcp://192.168.120.231:4840

Security mode

None

Security policy

None

DEVICE TYPE-SPECIFIC PROPERTIES

AUTHENTICATION

Authentication mode

Anonymous

Username

Password

SECURITY CHECK OVERRIDES

☐

Accept expired certificates

☐

Disable hostname check

DATA STORAGE

Connection test successful

The connection test was successful!

ACKNOWLEDGE

BACK

NEXT

CANCEL

Figure 2: Second Configuration Page for Adding a Trace Device (Background) With the Result of a Successful Connection Test (Foreground).

ADD DEVICE (3/3)

GENERAL SETTINGS

STORAGE STRATEGY

Storage strategy*

Event-based

STORAGE SETTINGS

Deadband*

1 %

Backup Cycle*

60 min

DEVICE TYPE-SPECIFIC PROPERTIES

DATA STORAGE

BACK

SAVE

CANCEL

Figure 3: Third Configuration Page for Adding a Trace Device. The Dialog Is Closed by Clicking "SAVE" and the Creation of the Device Is Complete.

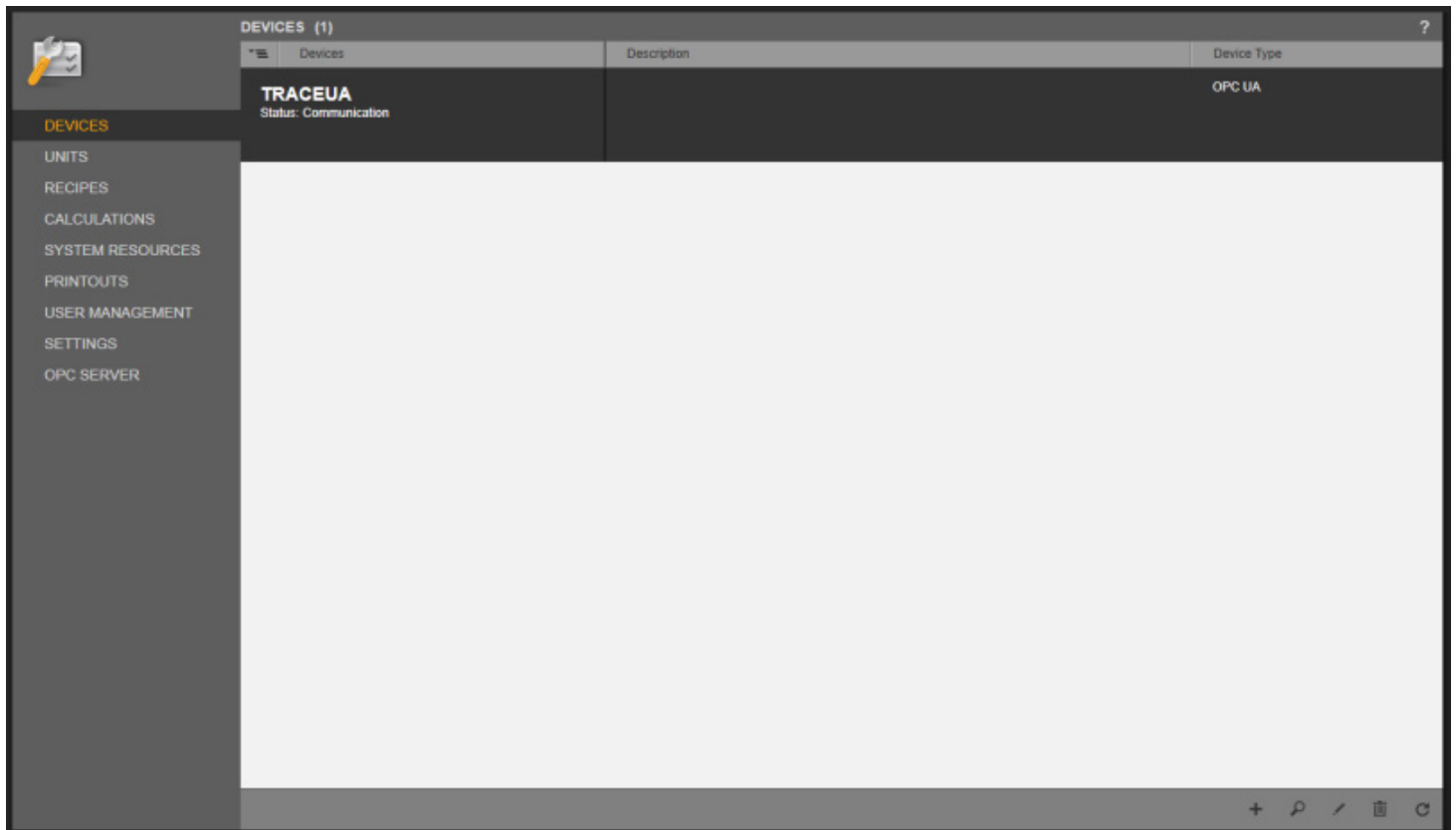


Figure 4: *The Trace Device Is Now Visible in the List of All Devices.*

These figures show the default settings. The IP address of the Trace OPC UA server in Figure 2 corresponds to the device-side default setting and may need to be adjusted. This figure also shows the result of a connection test that can be triggered via a button.

If the device cannot be connected successfully, the IP address of the OPC UA server and the functionality of the device itself should be checked. Another cause of a failed connection test could be missing certificates.

Creating the Trace Unit in BioPAT® MFCS

Once the OPC device has been created, a unit can be created containing the variables that are available via the address space of the OPC server. In BioPAT® MFCS, there is still no option to browse the address space of the relevant OPC server.

There are three options for defining the variables in the unit:

- 1. The individual variables can be created manually.
- 2. A unit can be imported together with all the associated devices.
- 3. Within the unit configuration, an XML file is imported with all the variables that the unit is to contain (individual variables can later be added or changed manually).

In this application note, we will follow the third approach: an appropriate XML for Trace (Trace_mon version 5.1.20) is specified and can be copied into BioPAT® MFCS.

In the “Units” area of the configuration, click the “+” in the lower righthand corner. This opens a dialog, which is shown in Figure 5.

To import variables within the unit configuration, click on the circled import button within the dialog screen.

ADD UNIT

UNIT SETTINGS

Name *

UTrace

Short Name *

UTr


Description

UNIT SPECIFICATION

Unit Type *

Undefined

Unit Picture



CONTROL MODULES (0/0)

+

Search in all columns

Name	Name on device	Engineering unit	Control Module Type	Devices	Measurement	Category
NO CONTROL MODULES AVAILABLE						
Click the "Plus" or "Import" button to add Control Modules or reset the filter						

SAVE

CANCEL

Figure 5: The Variables of the Unit Are Imported When You Open a Corresponding Wizard by Clicking on the Circled Button.

A wizard opens in which you can select the saved file. The pages of the wizard are shown in the following images with step-by-step explanation.

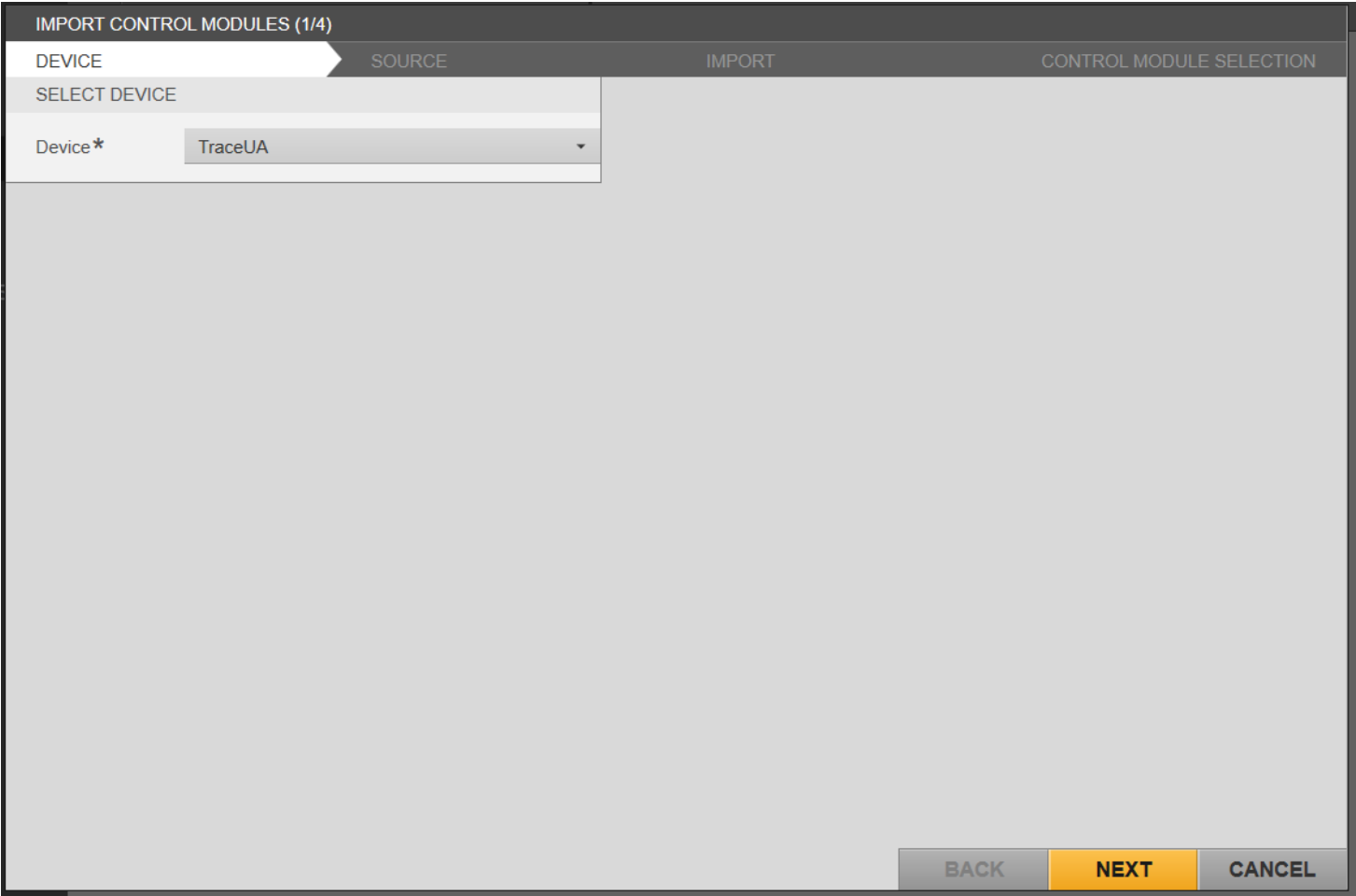


Figure 6: On the First Page of the Wizard, Select the Previously Created Device and Confirm by Clicking “NEXT.”

IMPORT CONTROL MODULES (2/4)

DEVICE	SOURCE	IMPORT	CONTROL MODULE SELECTION
SELECT SOURCE			
Configuration file	C:\Users\Sophie.Weggler\Desktop\limpo...		

BACK NEXT CANCEL

Figure 7: On the Second Page of the Wizard, Select the Xml File in Which the Variables Are Configured and Confirm by Clicking "Next."

IMPORT CONTROL MODULES (3/4)

DEVICE	SOURCE	IMPORT	CONTROL MODULE SELECTION
SELECT INSTRUMENT			
Instrument	TraceUA		

BACK NEXT CANCEL

Figure 8: On the Third Page of the Wizard, Confirm the Page of the Wizard Directly by Clicking "NEXT".

IMPORT CONTROL MODULES (4/4)

DEVICE
SOURCE
IMPORT
CONTROL MODULE SELECTION

SELECT CONTROL MODULE
☒
☐

Search in all columns

Name ▲	Name on device	Engineering unit	Control Module Type	Devices	Measurement	Category
Extern T 0	Extern T 0		Process Variable	TraceUA		
Extern T 1	Extern T 1		Process Variable	TraceUA		
Extern T 2	Extern T 2		Process Variable	TraceUA		
Extern T 3	Extern T 3		Process Variable	TraceUA		
MW A So 0	MW A So 0	g/l	Process Variable	TraceUA		
MW A So 1	MW A So 1	g/l	Process Variable	TraceUA		
MW A So 2	MW A So 2	g/l	Process Variable	TraceUA		
MW A So 3	MW A So 3	g/l	Process Variable	TraceUA		
MW B So 0	MW B So 0	g/l	Process Variable	TraceUA		
MW B So 1	MW B So 1	g/l	Process Variable	TraceUA		
MW B So 2	MW B So 2	g/l	Process Variable	TraceUA		
MW B So 3	MW B So 3	g/l	Process Variable	TraceUA		
Ref-Faktor A	Ref-Faktor A		Process Variable	TraceUA		
Ref-Faktor B	Ref-Faktor B		Process Variable	TraceUA		

BACK

OK

CANCEL

Figure 9: The Variables Configured in the File Are Listed on the Fourth Page of the Wizard. Click on the Circled Button to Select All Variables and Confirm by Clicking on "OK."

ADD UNIT

UNIT SETTINGS

Name *

UTrace

Short Name *

UTr


Description

UNIT SPECIFICATION

Unit Type *

Undefined

Unit Picture



CONTROL MODULES (24/24)

+

Search in all columns

Name ▲	Name on device	Engineering unit	Control Module Type	Devices	Measurement	Category
Extern T 0	Extern T 0		Process Variable	TraceUA		
Extern T 1	Extern T 1		Process Variable	TraceUA		
Extern T 2	Extern T 2		Process Variable	TraceUA		
Extern T 3	Extern T 3		Process Variable	TraceUA		
MW A So 0	MW A So 0	g/l	Process Variable	TraceUA		
MW A So 1	MW A So 1	g/l	Process Variable	TraceUA		
MW A So 2	MW A So 2	g/l	Process Variable	TraceUA		

SAVE

CANCEL

Figure 10: The Variables That Have Been Imported in the Newly Created Unit Can Now Be Viewed in the “ADD UNIT” Dialog. Save the Unit by Clicking the “SAVE” Button.

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Connecting the OPC UA Server directly to a Third Party System (Connection and Structure)

1. Activating the OPC UA Server in the Device

BioPAT® Trace | Multi Trace with software version 5.1.20 and higher has an OPC UA server. This OPC UA server function is initially switched off in the device. The OPC UA server in the BioPAT® Trace | Multi Trace can be switched on via the “Settings – Parameters” menu in Trace_mon by selecting OPC UA from the list of parameters and setting it to “On” (see Figure 11).

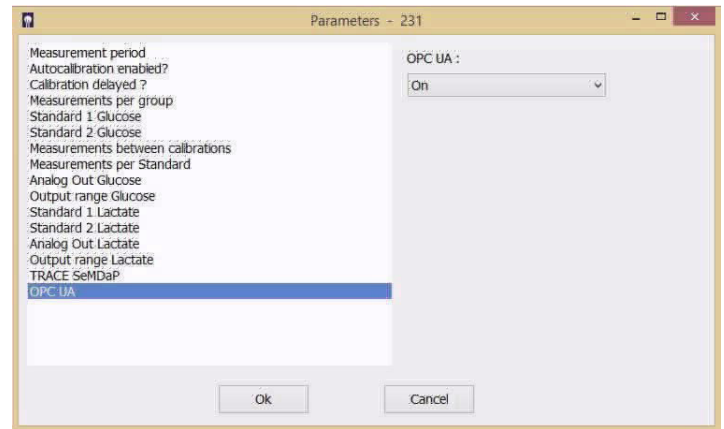


Figure 11: In the “Settings – Parameters” Menu, Select “Opc UA and Set It to “On.”

2. Client Program

An OPC UA client is required to read the data. The connection and the data structure displayed with the UAExpert client is explained below (see Figure 12). The data structure, however, is identical for all clients, as this is generated by the OPC UA server. With that said, the individual client programs differ in terms of how they are displayed and how the menus are arranged.

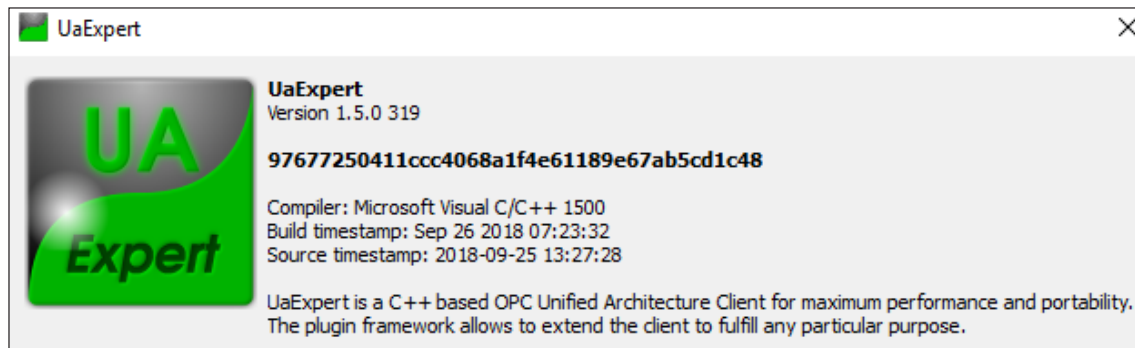


Figure 12: UAExpert Used With Version Number.

2.1. Adding the Server

An OPC UA server can be added via the “Server – Add” menu or by using the “+” symbol (circled in yellow in Figure 13).

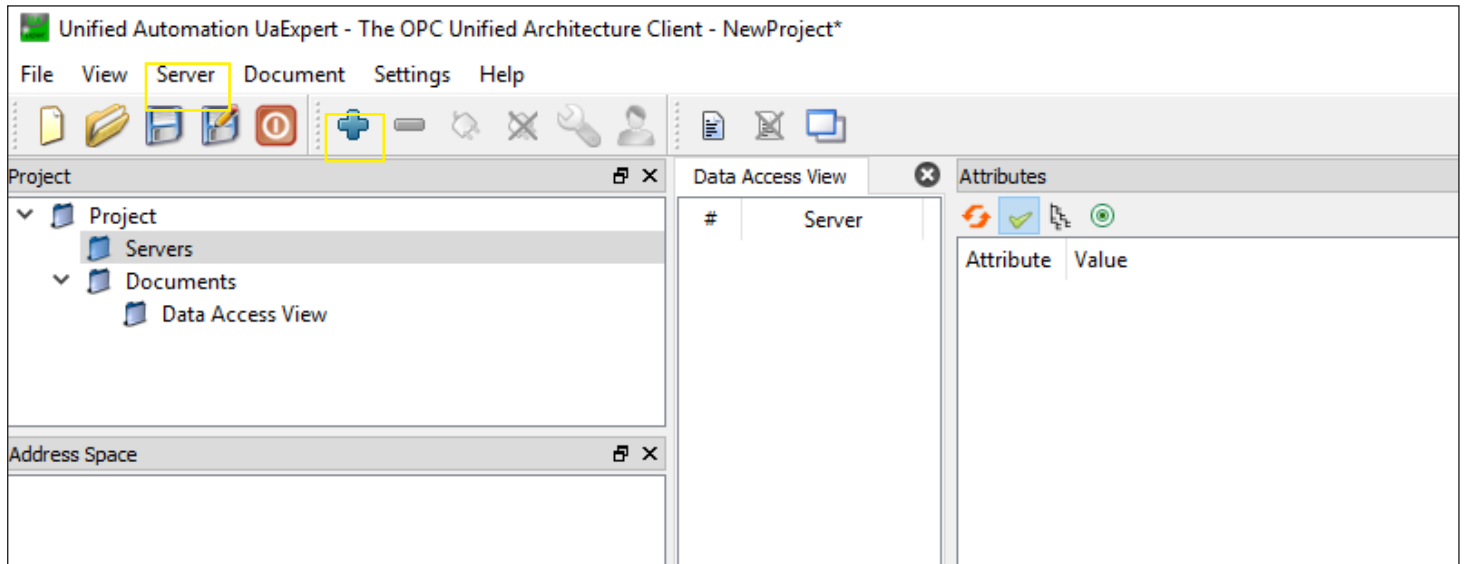


Figure 13: Adding the Server.

To add the server, a name must be assigned (“Configuration Name” in Figure 14) and an endpoint URL must be assigned (circled in yellow in Figure 14). The endpoint URL is comprised of “opc.tcp://,” the IP address of the device, and “:4840/.” The authentication settings should initially be set to “Anonymous.”

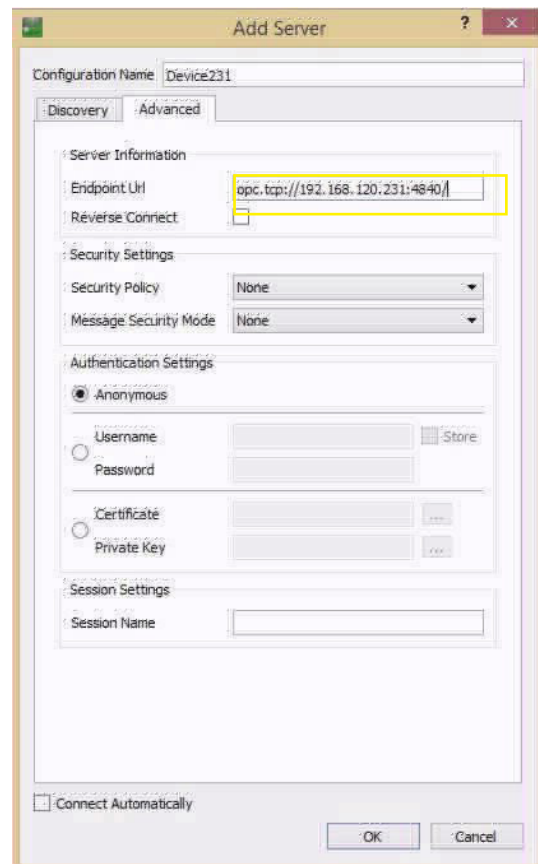


Figure 14: Connecting the Server.

Once the server has been connected, it will appear in the menu (circled in yellow in Figure 15).

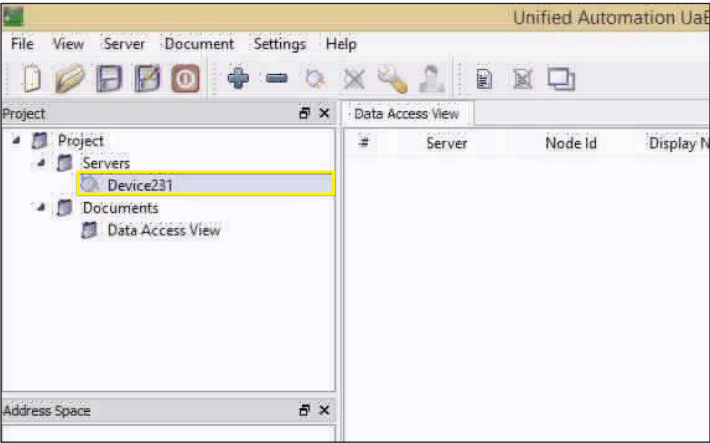


Figure 15: Displaying the Server.

For the client to display the data from the server, the relevant symbol or “Server – Connect” must be selected.

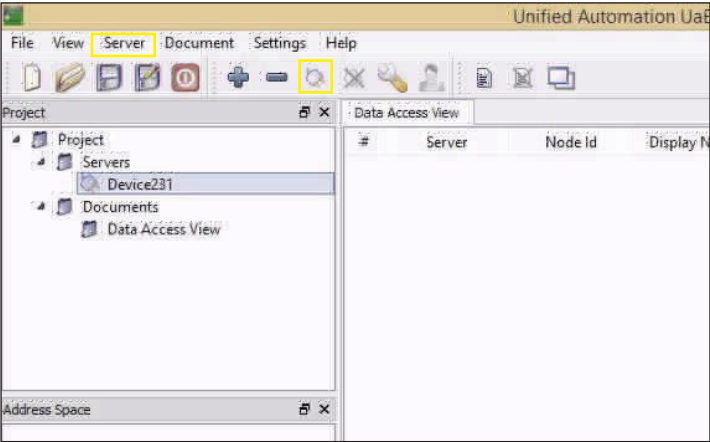


Figure 16: Connecting the Server.

Once the server has been connected, the structure of the measuring device is displayed under “Address Space” (Figure 17).

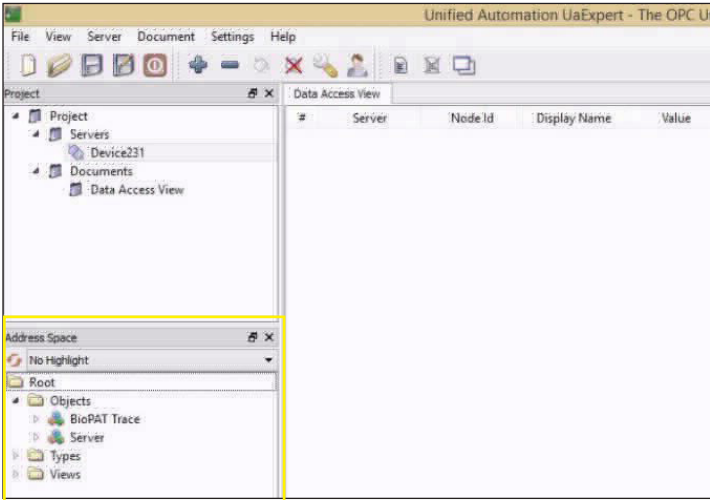


Figure 17: Displaying the Address Space.

2.2 Data Structure

The data structure is transmitted by the server and displayed in the “Address Space” (Figure 18).

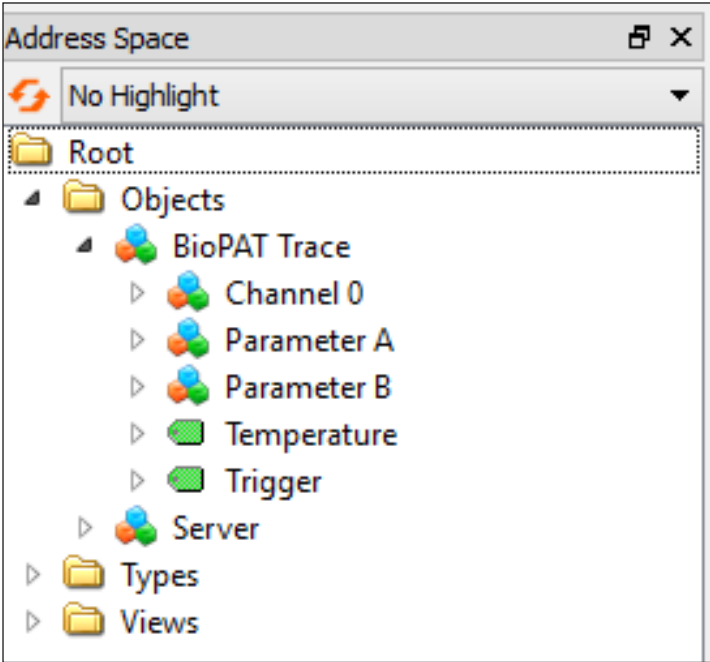


Figure 18: Data Structure.

Under the “BioPAT® Trace” folder, there are additional folders.

Temperature

The “Temperature” variable has the “Float” data type (floating point value). The device temperature at the sensor is transmitted using these variables (Node Id 1013).

Trigger

The “Trigger” variable has the “Int32” data type (integer variable, 32 bit, Node Id 2004). The device can be operated via the “Trigger” variable. The following settings are possible here:

- | | |
|---------------------------|------|
| 1. Measuring: | 4301 |
| 2. Readiness: | 4321 |
| 3. Calibration: | 4323 |
| 4. Reference Measurement: | 4324 |
| 5. Stop: | 8240 |

Measurement Parameters

General parameters for the measurement can be found in the folders “Parameter A” and “Parameter B” (Figure 19). These are, on the one hand, the slope of the calibration curves (“Slope A” and “Slope B”) and, on the other hand, the reference factor (“Ref-Factor A” and “Ref-Factor B”). These variables only change during calibration or when carrying out a reference measurement. Depending on the application selected, “Parameter A” relates to either glucose or methanol | ethanol. In the glucose | lactate application, “Parameter B” relates to lactate. In the methanol | ethanol application, “Parameter B” is not assigned.

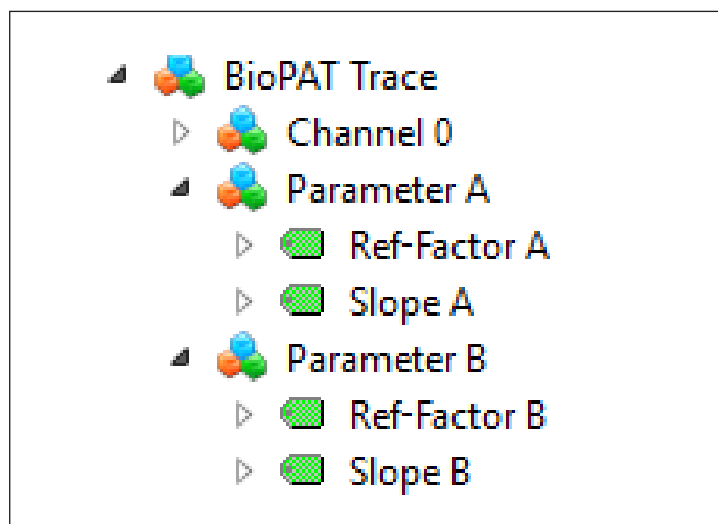


Figure 19: Measurement Parameters.

Measurement Channels

As Figure 20 shows, the four measurement folders (“Channel 0”, “Channel 1”, “Channel 2” and “Channel 3”) are further subdivided into three folders (“Measurement 0 A”, “Measurement 0 B” and “Controller 0”).

The variables of the measured values (MmA So 0 and MW B So 0) are contained there. These are the actual measured glucose (or ethanol/methanol) values and lactate. The data type of the measured values is “Float.”

Measurement channel 0 corresponds to the values of the first fermenter.

Measurement channels 1, 2, and 3 are only used for BioPAT® Multi Trace.

In terms of its data type, “Pump Rate 1” is a “Float” variable. The pump rate of the feeding pump is generated via this variable if the controller is activated.

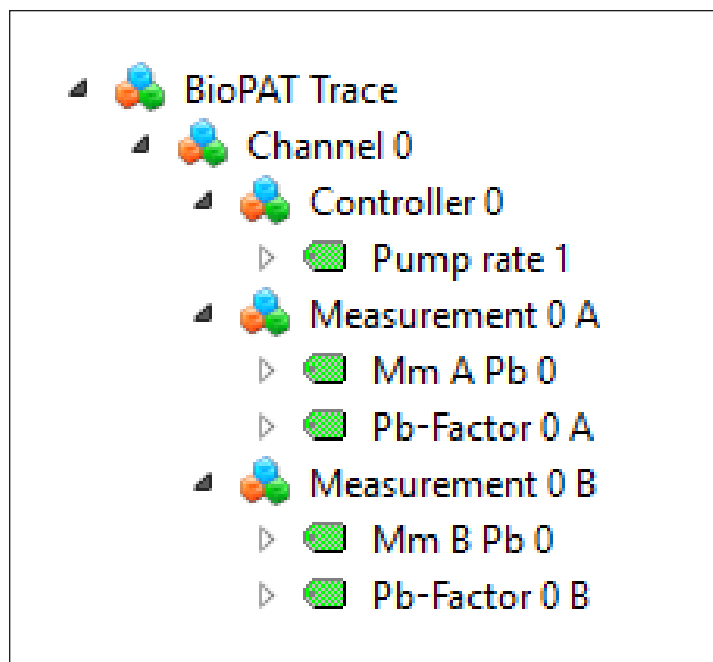


Figure 20: Measurement Channel.

2.3 Displaying the Variables

If you move a specific variable into the “Data Access View” by left clicking on it, the variable will be displayed there (Figure 21).

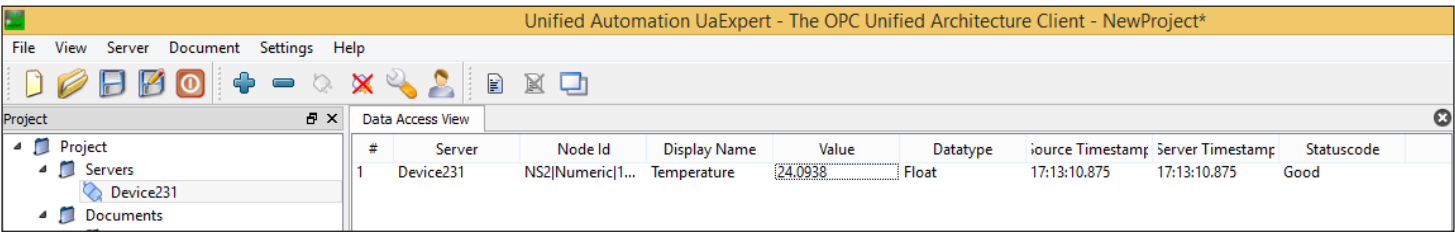


Figure 21: Displaying the Variables.

2.4 Overview of the Node Ids

The Node Ids that are assigned to the individual variables are shown in Figure 22. As a rule, the temperature and measured values from the two channels (MW A So 0 – MW A So 3 and MW B So 0 – MW B So 3) are transferred to the OPC UA client.

#	Server	Node Id	Display Name	Value	Datatype	Source Timestamp	Server Timestamp	Statuscode
1	Device231	NS2 Numeric 1013	Temperature	24.0596	Float	17:16:00.875	17:16:00.875	Good
2	Device231	NS2 Numeric 2004	Triqgger	2470	Int32	17:15:06.125	17:15:06.125	Good
3	Device231	NS2 Numeric 1001	Mm A Pb 0	1.#QNAN	Float	17:15:14.250	17:15:14.250	Good
4	Device231	NS2 Numeric 1002	Mm B Pb 0	1.#QNAN	Float	17:15:16.875	17:15:16.875	Good
5	Device231	NS2 Numeric 3111	Pb-Factor 0 A	9.31428e-039	Float	17:15:20.125	17:15:20.125	Good
6	Device231	NS2 Numeric 3121	Pb-Factor 0 B	3.44579e-042	Float	17:15:22.750	17:15:22.750	Good
7	Device231	NS2 Numeric 1015	Pump rate 1	1.#QNAN	Float	17:15:26.875	17:15:26.875	Good
8	Device231	NS2 Numeric 3012	Ref-Factor A	3.49484e-042	Float	17:15:40.125	17:15:40.125	Good
9	Device231	NS2 Numeric 3013	Slope A	3.52427e-042	Float	17:15:43.000	17:15:43.000	Good
10	Device231	NS2 Numeric 3022	Ref-Factor B	6.57657e+026	Float	17:15:58.250	17:15:58.250	Good
11	Device231	NS2 Numeric 3023	Slope B	2.50877e+021	Float	17:16:00.875	17:16:00.875	Good

Figure 22: Overview of the Node Ids.

Discussion

OPC UA is a modern approach to connect analytical instruments to local automation or to SCADA systems. Here we show how BioPAT® Trace | Multi Trace can be connected to BioPAT® MFCS and to Third Party Systems.

Conclusion

This application note outlines how to successfully connect BioPAT® Trace | Multi Trace with BioPAT® MFCS via OPC UA and can be conveniently used for supervisory control and data acquisition.

The OPC UA server functionality of BioPAT® Trace | Multi Trace offers a flexible and standardized way of integrating a BioPAT® Trace | Multi Trace into a preexisting infrastructure without the need for implementing any special communication protocols.

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