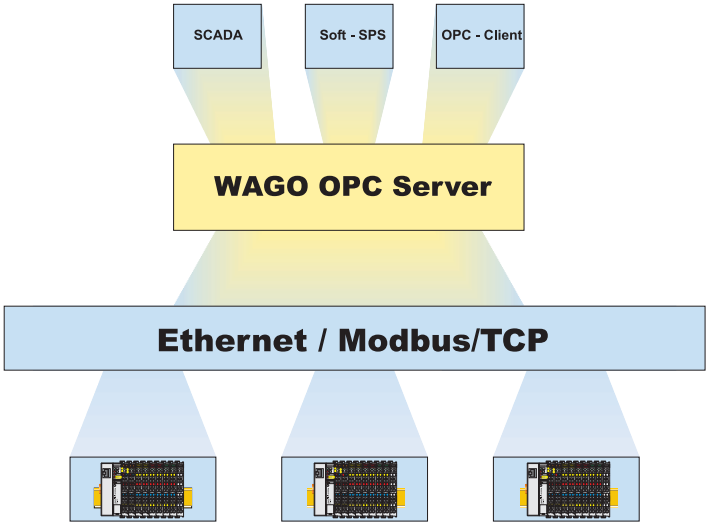
WAGO I/O SYSTEM 759

Modbus/TCP OPC Server



Manual

Technical description

Version 1.1.0

WAGO®
INNOVATIVE CONNECTIONS

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Every conceivable measure has been taken to ensure the correctness and completeness of this documentation. However, as errors can never be fully excluded we would appreciate any information or ideas at any time.

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We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally trademark or patent protected.

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1 Important Comments

To ensure fast installation and start-up of the units described in this manual, we strongly recommend that the following information and explanations are carefully read and abided by.

1.1 Legal Principles

1.1.1 Copyright

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1.1.2 Personnel Qualification

The use of the product detailed in this manual is exclusively geared to specialists having qualifications in PLC programming, electrical specialists or persons instructed by electrical specialists who are also familiar with the valid standards. WAGO Kontakttechnik GmbH declines all liability resulting from improper action and damage to WAGO products and third party products due to non-observance of the information contained in this manual.

1.1.3 Intended Use

For each individual application, the components supplied are to work with a dedicated hardware and software configuration. Modifications are only permitted within the framework of the possibilities documented in the manuals. All other changes to the hardware and/or software and the non-conforming use of the components entail the exclusion of liability on part of WAGO Kontakttechnik GmbH.

Please direct any requirements pertaining to a modified and/or new hardware or software configuration directly to WAGO Kontakttechnik GmbH.

1.2 Symbols

Danger
Always abide by this information to protect persons from injury.

Warning
Always abide by this information to prevent damage to the device.

Attention
Marginal conditions must always be observed to ensure smooth operation.

ESD (Electrostatic Discharge)
Warning of damage to the components by electrostatic discharge. Observe the precautionary measure for handling components at risk.

Note
Routines or advice for efficient use of the device and software optimization.

More information
References on additional literature, manuals, data sheets and INTERNET pages

1.3 Font Conventions

Italic	Names of path and files are marked italic i.e.: *C:\programs\WAGO-IO-CHECK*
Italic	Menu items are marked as bold italic i.e.: ***Save***
\	A backslash between two names marks a sequence of menu items i.e.: ***File\New***
END	Press buttons are marked as bold with small capitals i.e.: **ENTER**
< >	Keys are marked bold within angle brackets i.e.: **<F5>**
`Courier`	Program code is printed with the font `Courier`. i.e.: `END_VAR`

1.4 Number Notation

Number Code	Example	Note
Decimal	100	normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	Within ', Nibble separated with dots

1.5 Scope of Validity

Item no.	Description
759-311	Modbus/TCP OPC server, single license
759-311/000-100	Modbus/TCP OPC server, 10 licenses
759-311/000-200	Modbus/TCP OPC server, 25 licenses
759-311/000-300	Modbus/TCP OPC server, unlimited licenses

1.6 Abbreviations

AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
I/O	Input/Output

2 Modbus/TCP OPC Server

2.1 General

The OPC standard defines an open industrial interface which can be used by PC-based software components to transfer data. The interface is based on the OLE (Object Linking and Embedding), COM (Component Object Model), and DCOM (Distributed COM) Windows technologies. This makes OPC an ideal basis for the connection of industrial applications or MS-Office programs with field devices such as the WAGO-I/O-SYSTEM in factory automation application.

The WAGO Modbus/TCP OPC server allows easy and convenient access to Modbus/TCP Ethernet devices. Simple configuration of the OPC server shortens the time needed for training and start-up.

2.2 Technical data

759-311 WAGO OPC-Server MODBUS/TCP	
OPC specifications	Data Access V1.0A Data Access V2.04
Operating systems	Windows NT 4.0 (SP5 and higher) Windows 2000 Windows 95 (with DCOM95 V1.3 und Windows Socket 2.0 Update) Windows 98 (with DCOM98 V1.3) Windows ME
Supported protocols	Modbus/TCP and Modbus via UDP
Configuration-tool	included

2.3 Installation

For the operation of the WAGO OPC server Modbus/TCP the following components must be installed depending on the used operating system on your computer:

2.3.1 Windows 95

If the following components are not yet installed on your computer, install these before you start the setup for the WAGO OPC server Modbus/TCP.

2.3.1.1 Distributed COM (DCOM95)

- Start the program "redist\dcom\DCOM95.exe".
- Follow the instructions of the installation program.
- Restart your computer, if requested.

2.3.1.2 Windows Socket 2.0

Step 1:

- Ensure that Windows Sockets 1.x is installed.
- Ensure that you use the TCP/IP protocol.
- Start the program "redist\WinSock2\W95ws2setup.exe".
- Follow the instructions of the installation program.
- Restart your computer, if requested.

Step 2:

- Start the program "redist\WinSock2\y2kvdhcp.exe".
- Follow the instructions of the installation program.
- Restart your computer, if requested.

The necessary installation programs are on the CD ROM in the directory "[LW]:\Redist". (replace [LW] by the identifier of your CD ROM drive.)

2.3.2 Windows 98

The support for Distributed COM (DCOM98) is component of Windows 98. Microsoft Corporation provides an update to the version 1.3 in the internet. The distribution of this update is not permitted in accordance with the license conditions (EULA) of Microsoft Corporation. You will find the current DCOM98 version on the Microsoft homepage at:

http://www.microsoft.com/com/resources/downloads.asp

It is recommended to install this update in order to improve the stability of the OPC server!

2.3.3 Windows ME

The support for Distributed COM (DCOM) is component of Windows ME. Please install following program to configure DCOM:

"DCOMCNFG for Windows 95 and Windows 98"

- Start the program "redist\dcom\dcm95cfg.exe".
- Follow the instructions of the installation program.
- Restart your computer, if requested.

3 Modbus/TCP Konfigurator

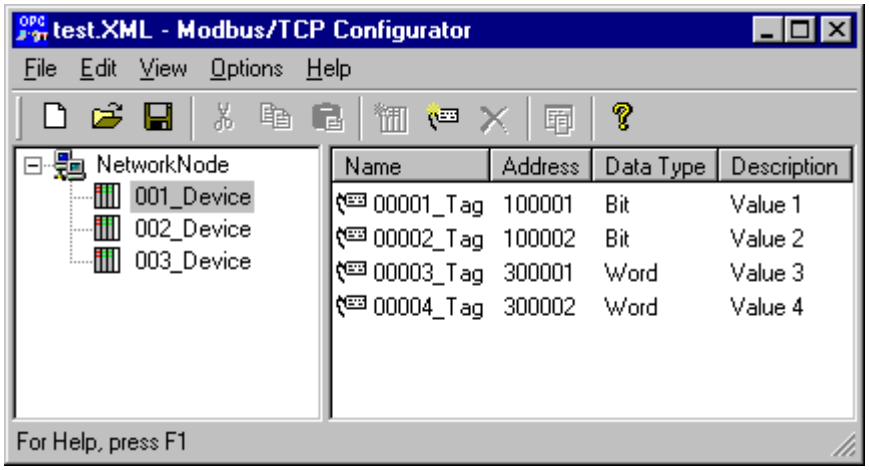
3.1 Functionality

The Modbus/TCP Configurator is part of the WAGO Modbus/TCP OPC Server delivery.

The configurator has a surface for generating or changing the OPC Server's configuration information. This information is stored in an XML file. The only connection between the OPC Server application and the configurator application is this configuration file.

The OPC Server reads the configuration information from the XML file during starting.

The physical structure of the system (existing devices) and the process values which can be reached with OPC are configured.



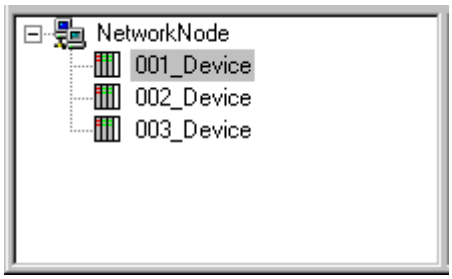
The configurator is structured in the same way as the Windows Explorer. The window of the configuration application consists of two parts. The left part contains the Modbus/TCP devices of the system in tree topology . In the right part, the process values (tags) possible with OPC which belong to the device currently selected in the device tree are listed.

You can reach all functions of the configurator via the main menu and its submenus. Via the respective menus, devices and process values can be entered in the configuration, deleted from it or modified. The content of the "Edit" menu is also offered as a popup menu if you click the right mouse button.

The properties of the devices and process values can be entered or changed by means of dialogs.

3.2 Device Tree

The device tree consists of a network object as the root and the corresponding devices represented in terraced form. It contains all devices to be addressed via the Modbus/TCP OPC Server.



The network object has no parameters and is automatically generated with the menu command "File - New". The name of the network object is "network" by default and cannot be changed.

A Modbus/TCP device corresponds to a WAGO Modbus/TCP Coupler (750-342 or 750-842). The parameters of a device are accessed via a dialog which is called either by double-clicking on the device or by the Context menu "Properties". If you have selected the device, pressing the Return key will also start the Device dialog.

The devices are organized according to their device names. The individual devices with the corresponding process values in the tree structure can be copied or deleted. If new devices are added with "Edit - Insert Device", device names are assigned automatically. These names must be unique within the network.

3.3 List of Values

The process values of a selected Modbus/TCP device possible with OPC are represented in the list of values. Each row in the list stands for a process value which can be reached with OPC.

Name	Address	Data Type	Description
00001_Tag	100001	Bit	Value 1
00002_Tag	100002	Bit	Value 2
00003_Tag	300001	Word	Value 3
00004_Tag	300002	Word	Value 4

In the list of values, the value name, the Modbus/TCP address, the data type and a description of the value are shown. The values belong to the device selected in the device tree. They are listed with their names in ascending alphabetical order.

Value names must be unique per device.

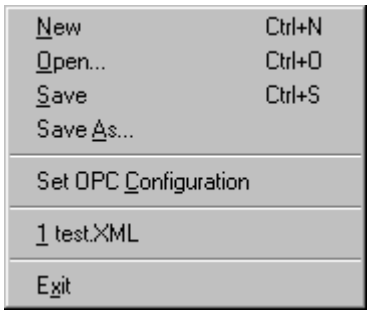
Entries in the list of values can be added manually, copied or deleted.

By a double-click or via the context menu "Properties", the Value Dialog is displayed. Fast editing of names directly in the list is possible as well.

Organizing the list according to selected columns (in alphabetically ascending or descending order) is supported. Individual columns can also be moved.

3.4 The Menu Bar

3.4.1 The File Menu



3.4.1.1 New

With the command "New", a new configuration is created. All existing configuration data will be deleted.

3.4.1.2 Open

By selecting this command, you will open a mask by means of which you can select and load existing configuration files. The configuration files are stored with the file extension .xml.

3.4.1.3 Save

By selecting this command, you can save changes in the configuration file.

3.4.1.4 Save as...

If you select this command, you can save a new configuration or an existing configuration with a new name. The default file extension is .xml.

3.4.1.5 Set OPC Configuration

If you select this command, you can define the actual loaded file as the OPC configuration file.

3.4.1.6 Quit

By selecting this command, you will quit the Modbus/TCP Configurator. If you have performed changes in the file which have not been saved yet, the system will ask you whether you want to save them.

3.4.2 The Edit Menu

3.4.2.1 Cut

If you select this command, you will delete the selected part of the configuration (device or process value) and store it in the clipboard.

3.4.2.2 Copy

By choosing this command, you will copy the selected part of the configuration to the clipboard.

3.4.2.3 Paste

By choosing this command, you will transfer the copied part of the configuration from the clipboard to the selected position.

3.4.2.4 Insert Device

If this command is selected, a new device is added to the network. The Device dialog is automatically started with the default data of the new device. Adding the device is not possible if the network object has not been selected.

3.4.2.5 Insert Value

If this command is selected, a new value is added for the device chosen in the device tree and the Value dialog for this value is opened. This menu item is only available if a device has been selected.

3.4.2.6 Delete

By selecting this command, the selected part of the configuration (a device with all process values or an individual process value) will be deleted.

3.4.2.7 Properties

If this command is selected, the properties of a selected configuration part will be displayed.

3.4.3 The View Menu

3.4.3.1 Toolbar

If you select this command, the toolbar of the configurator will be displayed.

3.4.3.2 Status Bar

If you select this command, the status bar of the configurator will be displayed.

3.4.3.3 Split

A selection of this command enables you to change the arrangement of the configurator window areas by means of the keyboard.

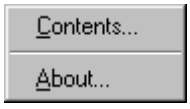
3.4.4 The Options Menu

3.4.4.1 Language

If you select this command, a submenu is displayed in which you can switch between the different languages for the Modbus/TCP Configurator (German and English).

Please note that this switchover only becomes effective after a configurator restart.

3.4.5 The Help Menu



3.4.5.1 Contents

If you select this command, the online help of the Modbus/TCP Configurator is started.

3.4.5.2 Info

By selecting this command, the manufacturer information about the Modbus/TCP Configurator is displayed.

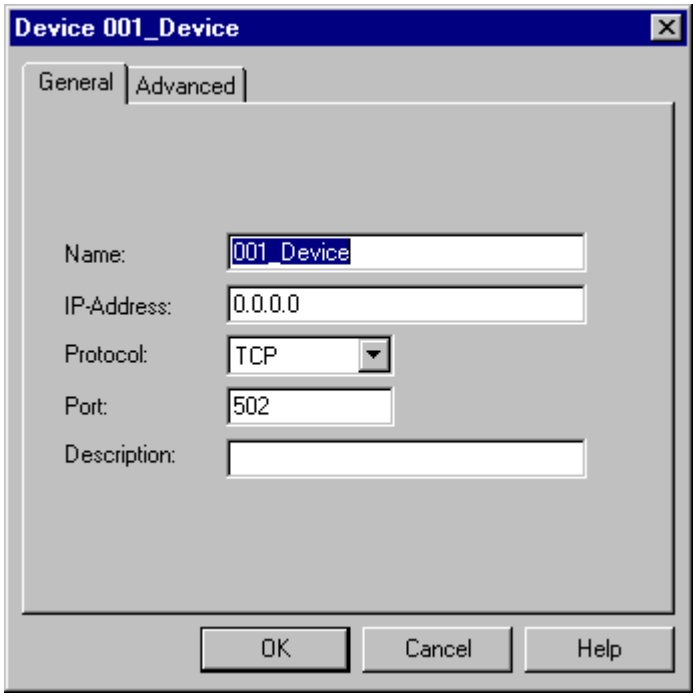
3.5 Input-Dialogs

3.5.1 Device Dialog

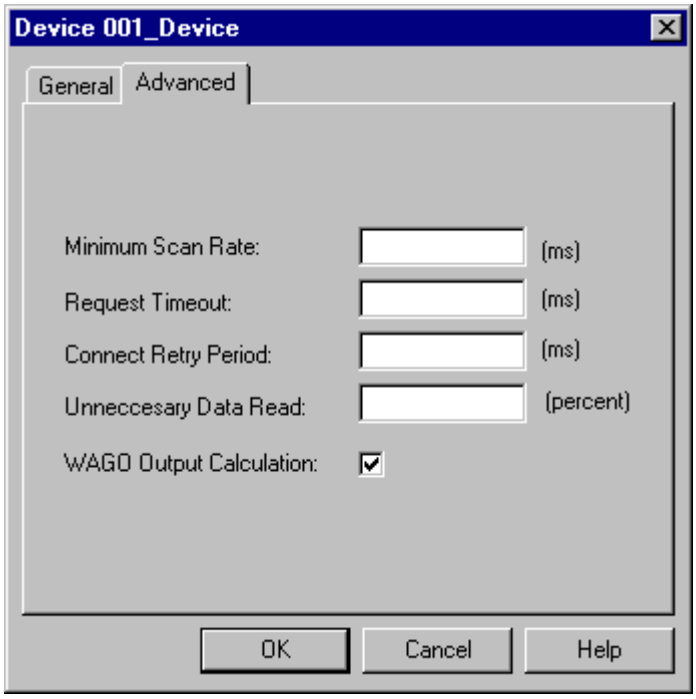
If an entry is highlighted in the device tree and the Properties menu is selected, Return is pressed or the entry is double-clicked, the modal Device dialog is opened.

The dialog consists of 2 pages: "General" and "Extended".

The "General" page contains the following properties:



The "Advanced" page contains the following properties:



3.5.1.1 Readable Name of the Device

The name must be unique among the devices. If a new device is generated, a unique default name is determined automatically.
The default name is composed as follows: <serial number>_device.

Since the characters '/' and '#' are used in the namespace of the OPC Servers, they may not be used in the device name.

3.5.1.2 IP Address or DNS Device Name

The IP address or a DNS name of the Modbus/TCP device must be indicated in any case.

3.5.1.3 Protocol Type

The protocols TCP and UDP are supported.

3.5.1.4 Port Address

The port number by which the OPC Server accesses the Modbus/TCP device.

Default: 502

3.5.1.5 Description

Description of the device

3.5.1.6 Minimum Scan Rate in Milliseconds

The minimum scan rate defines the time interval for the duration of which a value is regarded as current by the OPC Server. If there is a read request for a value within this interval, the value is not read by the device. The value within the cache of the OPC Server is supplied to the OPC Client as the current value.

With this parameter, the load on the Modbus/TCP devices and on the Ethernet can be controlled. The higher this value, the lower the load.

The default setting is 50 milliseconds.

3.5.1.7 Request Timeout in Milliseconds

The request timeout is the maximum time permitted for a complete I/O operation (transmission of the request + reception of the response) with the device. If an I/O operation takes longer than the request timeout, it is aborted after the timeout.

Default setting is 10 seconds. This ensures that the OPC Server waits at most 10 seconds till the I/O operation is finished.

3.5.1.8 Connect Retry Period in Milliseconds

The connect retry period determines the time period within the attempt of establishing a connection with the device is repeated. The IP connection with a device is established when the OPC Server is started. If this attempt is not successful, the OPC Server tries to establish a connection cyclically after the connect retry period is over.

The default setting contains no information. Thus, the OPC Server uses a connect retry period of 3 minutes.

3.5.1.9 Unneccesary Data Read in Percent

The maximum ammount of unneccesary read data within one read operation. This number defines the percentage of unneccesary data within the total read data.

The default setting is 100 percent. The OPC Server creates a Modbus/TCP telegramm for each Modbus/TCP I/O area (DI, DO, AI, AO). With one telegram a maximum area of 125 addresses could be read.

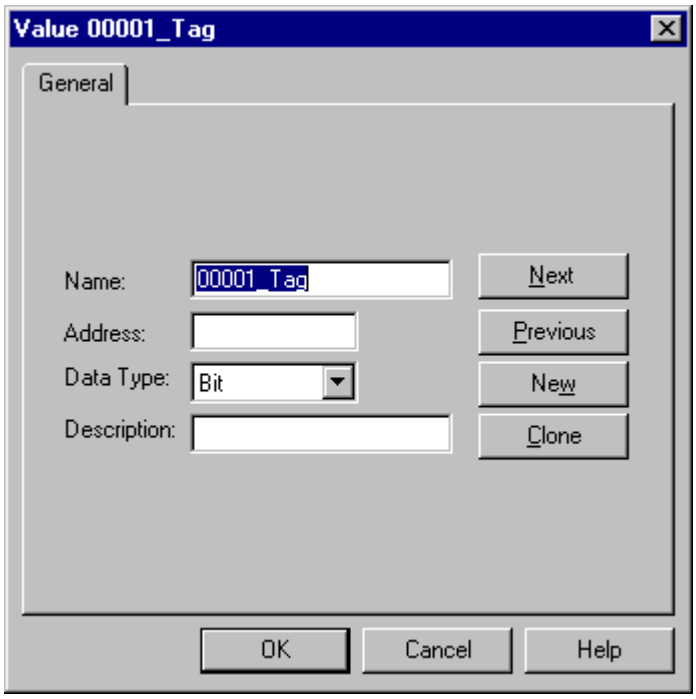
3.5.1.10 WAGO Output Calculation

The output addresses of tag, will be adapted to the output address area of WAGO couplers (over 0x200). To an output address less than 0x200 the configurator adds 0x200.

3.5.2 Value Dialog

If an entry is selected in the list of values and the Properties menu is selected or the entry is double-clicked, the modal Process Value dialog is opened.

The following properties are configured for a value:



In a separate area of the Process Value dialog, you will find the following buttons: Next, Previous, New and Clone.

By means of these buttons, the list of values can be walked through when the dialog is open. Changes of a value's parameters are performed by clicking these buttons. When the Cancel button of the dialog is clicked, only the alteration process for the value currently displayed in the dialog is aborted.

3.5.2.1 Name of the Process Value

The name must be unique among the process values. If a process value is generated, a unique default name is determined automatically. This default name is composed as follows: <serial number>_value.

Since the characters '/' and '#' are used in the namespace of the OPC Servers, they may not be used in the process value name.

3.5.2.2 Modbus/TCP Address

The address can be entered as a 6-digit decimal (dddddd) or a 5-digit hexadecimal value (0xhhhhh). The first digit of the address determines the Modbus/TCP table (0, 1, 3 or 4); the other 4 or 5 digits determine the value address starting with 1. For the exception status of a device, "ES" must be entered here.

Modbus/TCP Commands:

The Modbus/TCP table of a value is determined by the first digit of the value address.
The table selected for a process value determines the Modbus/TCP command by means of which the value is read or written.

	Table	Read Command	Write Command
Output Register	4	FC 3	FC 16
Input Register	3	FC 4	
Output Coil	0	FC 1	FC 15
Input Coil	1	FC 2	
Exception Status	7	FC 7	

For the "Exception Status" table, the address is set to 0 and cannot be changed since there is only one exception status per device.

3.5.2.3 Data Type

The following data types can be selected: Bit, Byte, Word, DWord, Char, Short, Long and Real.

For values from the Modbus/TCP tables 0 or 1, the data type is always bit.
The exception status always has the data type byte.
The values from tables 3 and 4 have a data type which is not bit.

Modbus/TCP Data Types:

The following table describes mapping of the OPC data types to the Modbus data.

Data Type	OPC Data Type	Tables	Description
bit	VT_BOOL	Coil	
8-bit unsigned integer	VT_UI1	register, exception status	bits 7-0 of the register = bits 7-0 of the UI1
8-bit integer	VT_I1	register	bits 7-0 of the register = bits 7-0 of the I1
16-bit unsigned integer	VT_UI2	register	bits 15-0 of the register = bits 15-0 of the UI2
16-bit integer	VT_I2	register	bits 15-0 of the register = bits 15-0 of the I2
32-bit unsigned integer	VT_UI4	register	Bits 15-0 of the first register = bits 15-0 of the UI4 bits 15-0 of the second register = bits 31-16 of the UI4
32-bit integer	VT_I4	register	Bits 15-0 of the first register = bits 15-0 of the I4 bits 15-0 of the second register = bits 31-16 of the I4
32-bit real	VT_R4	register	32-bit Intel floating-point number bits 15-0 of the first register = bits 15-0 of the R4 bits 15-0 of the second register = bits 31-16 of the R4

3.5.2.4 Description of the Process Value

Description of the value.

3.6 Connection State

The connection state is shown in the ´Connection State´ device property with the item ID <devicename>#50000.

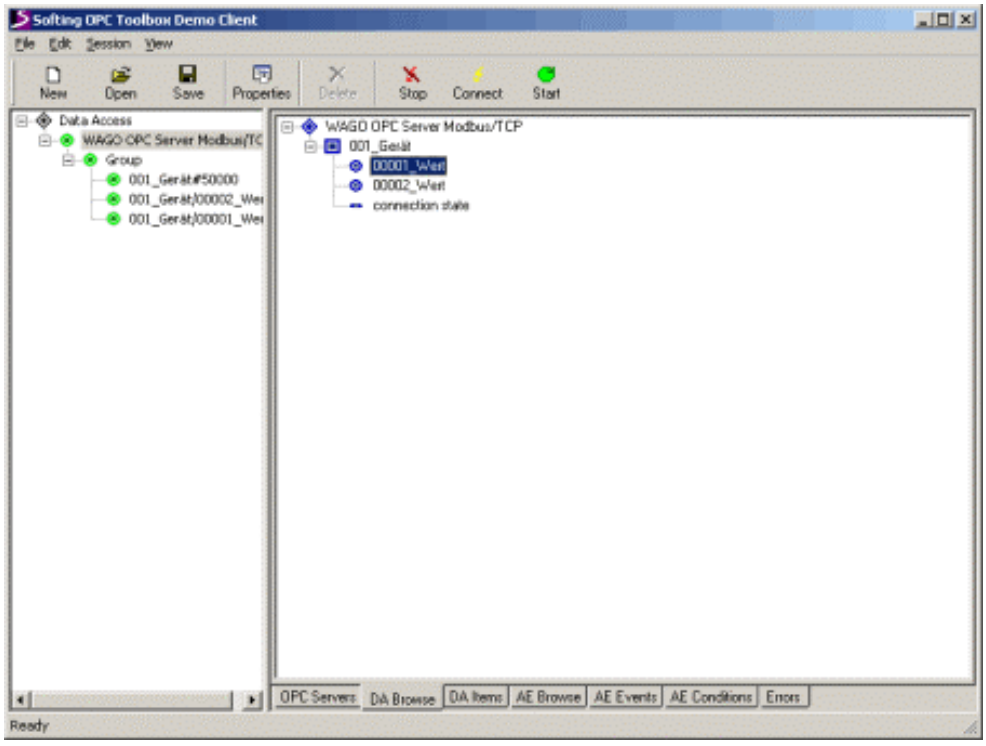
The connection state returns TRUE (-1) if the connection to the OPC-Server is established and FALSE (0) if the connection is interrupted.

The connection state can be used practically only with TCP protocol. Using the connection state with UDP protocol returns always TRUE, since UDP protocol has no connections.

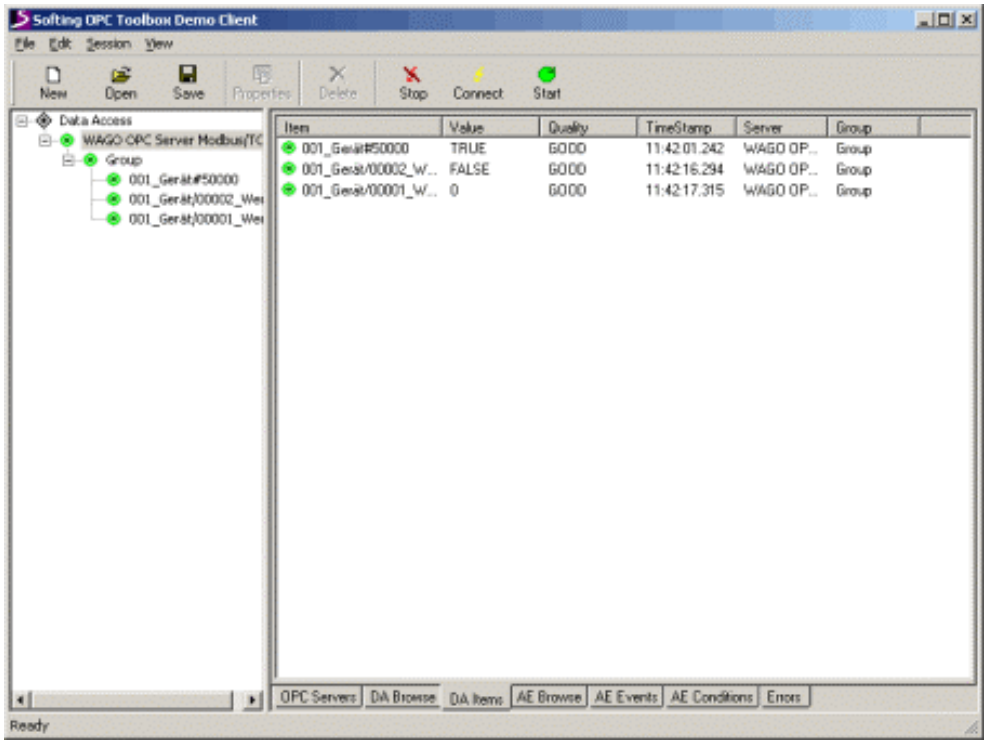
Depending on the used client program the connection state will be detected automatically or has to be configured manually

3.6.1 Automatic Detection of the Connection State

If the used client program detectes the ´Connection State´ device property automatically, the entry ´Connection State´ is shown in the device list.

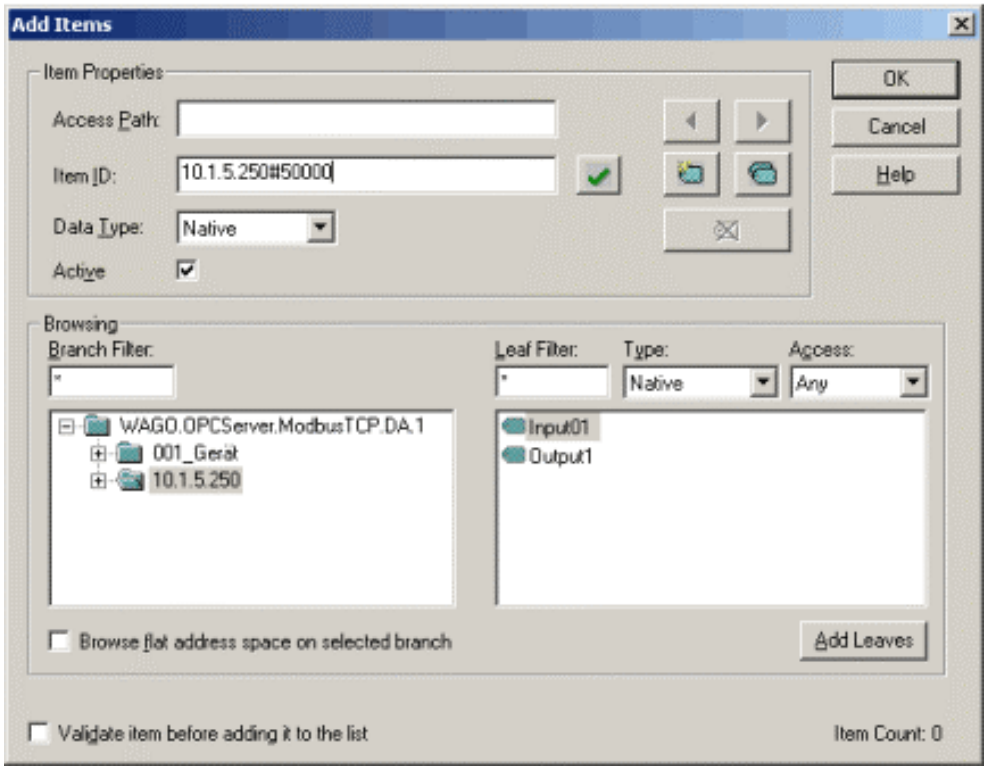


In this case the connection state is shown by the entry <devicename>#50000.

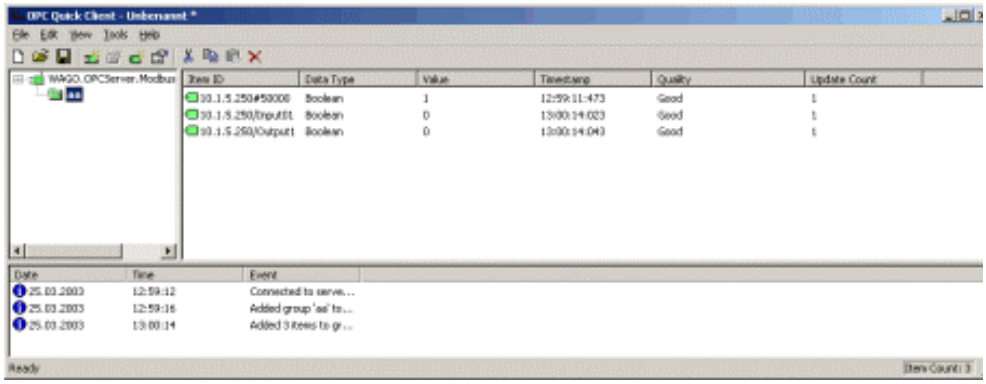


3.6.2 Manual Configuration of the Connection State

If the used client program does not detect the ´Connection State´ device property automatically, the entry ´Connection State´ has to be configured in the device list manually. For this the entry <devicename>#50000 has to be inserted in the device list.



After this the connection state is shown in the list of values by the entry <devicename>#50000.



4 Files and Registry

The Modbus/TCP OPC server consists of the following files:

File	Description
MBTOPC.exe	Executable of the Modbus/TCP OPC server
MBT.dll	Modbus/TCP Communication-DLL
ConfigModbus.exe	Configuration tool of the Modbus/TCP OPC server
ConfigModbusDEU.dll	Language dependent components of the configuration tool in German
ConfigModbusE.chm	English online help for the configuration tool
ConfigModbusD.chm	German online help for the configuration tool
OPCENUM.exe	OPC Server Enumerator
OPCCOMN_PS.dll	OPC Common Interfaces Proxy
OPCPROXY.dll	OPC Data Access Interfaces Proxy

The files MBTOPC.exe, MBT.dll, ConfigModbus.exe, ConfigModbus-DEU.dll, ConfigModbusE.chm and ConfigModbusD.chm are copied by the installation program into the installation directory of the Modbus/TCP OPC server.

The files OPCENUM.exe OPCCOMN_PS.dll and OPCPROXY.dll are installed into the Windows system directory.

During the installation the general OPC files and the Modbus/TCP OPC server are registered.

4.1 Names and IDs

The WAGO Modbus/TCP OPC Server uses the following names and identifiers

OPC DA Server Name	WAGO OPC-Server Modbus/TCP
OPC DA CLSID	{B3CC7FC9-AE9D-4555-BDDB-13B178EE3B69}
OPC DA ProgID	WAGO.OPCServer.ModbusTCP.DA
Vendor Information	WAGO Kontakttechnik GmbH
Version	1.0.<Build number>

4.2 Registry entries

The configuration information is submitted to the Modbus/TCP OPC server by the Registry.

The settings for the server are stored under the following Registry path:

HKLM/Software/WAGO/OPC Server ModbusTCP

The following table shows the possible entries in the Registry.

Value	Type	Description
ConfigFile	String	Path of the configuration file
TraceError	DWORD	Trace settings for Error Level
TraceInfo	DWORD	Trace settings for Info Level
TraceFile	String	Path of the trace file
TraceFileSize	DWORD	Maximum size of the trace file
OptimizeFlags	DWORD	Setting of optimizing (default: total optimizing)
OptimizeArraySize	DWORD	Size of the optimization array (minimum 2, maximum 125; default 125)
MaxConnectThreads	DWORD	Maximum number of connection threads (minimum 1; maximum 20; default: 5)

4.2.1 Configuration

The entry with the path of the configuration file to be used is carried out by the configuration tool (menu file -- set OPC Configuration).

4.2.2 Trace

The Modbus/TCP OPC server supports writing traces into a tracefile.

The trace mechanism has 2 trace levels: fault and information.

For each level the user can select the trace groups to be written to the file.The following table describes the trace groups of the Modbus/TCP OPC server.

Trace group	Description
0x00000001	OPC calls from the OPC clients to the OPC interfaces of the server
0x00000002	OPC notifications from the server to the OPC clients
0x10000000	Initialization/termination of the Modbus/TCP communication
0x20000000	Modbus/TCP commands from the OPC server to the devices
0x40000000	Modbus/TCP answers from the devices to the OPC server

The fault traces are set by default of the OPC server, the information traces are not set.

4.2.3 Optimization

The optimization flags permit to turn off certain parts of the optimization by configuration.

Flag	Description
0x00000001	If this flag is set, the Scanrate optimization is switched on
0x00000002	If this flag is set, the Read optimization is switched on
0x00000004	If this flag is set, the Write optimization is switched on

The optimization of the read commands uses an array. The size of this array determines the maximum number of the Modbus/TCP addresses read in one call. The size also determines the maximum time which the OPC server can use for the optimization of the read commands (the bigger, the longer).

The percent number of unnecessarily read data determines the efficiency of the read optimization.

4.2.4 Threads

The number of connection establishment threads determines how many connection establishments can be attempted at the same time.

5 System requirements

5.1 Operating system

The OPC server supports the operating systems Windows NT 4.0 (starting from SP5), Windows 2000, Windows 95, Windows 98 and Windows ME.

5.2 DCOM

With Windows 95 systems the DCOM support must be installed subsequently (DCOM95 V1.3). The necessary file "DCOM95.exe" is on the CD ROM in the directory "[LW]:\Redist\Dcom".

For Windows 98 system the installation of DCOM98 V1.3 is recommended, since this version runs more stably than the DCOM version, which is supplied with the system. You will find the current DCOM version on the Microsoft homepage at:
"htpp://www.microsoft.com/com/resources/downloads.asp".

For Windows 95, Windows 98 and Windows ME systems the DCOM configuration tool DCOMCNFG must be installed. The necessary file "dcm95cfg.exe" is on the CD ROM in the directory "[LW]:\Redist\Dcom".

5.3 Windows Socket V2.0

The Modbus/TCP communication DLL uses the Windows Socket V2.0 interface. This is not contained in the installation of Windows 95 and must be installed additionally. The necessary files "W95ws2setup.exe" and "y2kvdhcp.exe" are on the CD ROM in the directory "[LW]:\Redist\WinSock2".

5.4 MSXML

The configuration file contains the configuration information in XML format. For reading and writing the XML information the DOM part of the MSXML Parser is used (Microsoft.XMLDOM). This is installed by the Setup program of the OPC server.

6 DCOM Configuration

The DCOM configuration on OPC client and OPC server computers can cause problems at the setup of OPC installations.

The DCOM configuration settings can be changed with the DCOM configuration tool DCOMCNFG.

The following settings solve the most DCOM problems:

Default Authentication Level: None

Default Impersonation Level: Impersonate

It has to be guaranteed also in the DCOM configuration, that for the respective OPC client user the access to the OPC server is permitted. This is made easier, if client and server computer are in the same domain.

The identity the OPC servers runs with should be set to a firm account (domain user).

A DCOM server under Windows 9x and ME systems cannot be started by remote. The OPC server should be started automatically at the system start on these systems (if remote control desired).

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