OPC UA in 5590, 5580, and 5380 Logix Controllers

Enabled from V36 firmware

Rockwell Automation

User Manual

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

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The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

Rockwell Automation recognizes that some of the terms that are currently used in our industry and in this publication are not in alignment with the movement toward inclusive language in technology. We are proactively collaborating with industry peers to find alternatives to such terms and making changes to our products and content. Please excuse the use of such terms in our content while we implement these changes.

Summary of changes

This manual includes new and updated information. Use these reference tables to locate changed information.

Grammatical and editorial style changes are not included in this summary.

Global changes

None in this release.

New or enhanced features

This table contains a list of topics changed in this version, the reason for the change, and a link to the topic that contains the changed information.

Change	Topic
Added notation to Safety instruction signature topic.	Safety instruction signature on page

Table of Contents

Preface

This manual describes OPC UA implementation in Logix controllers.

For a complete list of common procedures manuals, refer to the Logix 5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

The term Logix 5000 controller refers to any controller based on the Logix 5000 operating system.

Rockwell Automation recognizes that some of the terms that are currently used in our industry and in this publication are not in alignment with the movement toward inclusive language in technology. We are proactively collaborating with industry peers to find alternatives to such terms and making changes to our products and content. Please excuse the use of such terms in our content while we implement these changes.

Studio 5000 environment

The Studio 5000 Automation Engineering & Design Environment® combines engineering and design elements into a common environment. The first element is the Studio 5000 Logix Designer® application. The Logix Designer application is the rebranding of RSLogix 5000® software and will continue to be the product to program Logix 5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.

The Studio 5000® environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. The Studio 5000 environment is the one place for design engineers to develop all elements of their control system.

Additional resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication, 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Logix 5000™ Controllers Design Considerations, publication 1756-RM094.	Provides information to help design and plan Logix 5000 systems.

Resource	Description
Rockwell Automation product certifications	Provides declarations of conformity, certificates, and other certification details.

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OPC UA in 5580 and 5380 Logix Controllers

Guidelines for environments for OPC UA communication

This list of guidelines for using and implementing OPC UA communication is provided in the 5580 and 5380 family of Logix controllers, firmware release version 36 Environment.

- ControlLogix Process Controllers®
- CompactLogix Process Controllers®
- ControlLogix® 5580
- GuardLogix® 5580
- CompactLogix™ 5380
- Compact GuardLogix® 5380
- Studio 5000 Logix Designer®, version 36 and newer

The OPC UA server in Logix controller runs on port 4840.

Specifics of OPC UA implementation in Logix controllers

These points outline essential considerations for implementing OPC UA communication within the Logix controller:

- OPC UA server can serve up to 10 external OPC UA clients.
- OPC UA client can connect up to 10 external OPC UA servers.
- Starting with version 37 firmware, the controller supports simultaneous operations as both an OPC UA server and client. In version 36 firmware, the controller supports the configuration when operating as either an OPC UA server or client.
- Controller resources used by OPC UA:
  - OPC UA communication shares resources with CIP Class 3 communication.
  - OPC UA communication has lower priority than CIP Class 3 communication;
    - OPC UA traffic does not impact the CIP Class 3 traffic.
    - During periods of high demand for CIP Class 3 traffic, the available CPU time for OPC UA communication can decrease. This reduction in available CPU time can lead to the rejection of OPC UA traffic.
- To ensure sufficient resources for both CIP Class 3 and OPC UA communication, it's recommended to monitor Controller Communication core usage through Controller Communication webpages (section Tasks) (see ControlLogix 5580 and GuardLogix 5580 Controllers User Manual, publication 1756-UM543, or CompactLogix 5380 and Compact GuardLogix 5380 User Manual, publication 5069-UM001 for help on usage of controller webpages).

- ControlLogix 5580 redundancy does not support OPC UA, firmware version 36. OPC UA communication is only available via an embedded Ethernet port, which is disabled in the 5580 ControlLogix Redundancy system.
- Synchronize the controller clock before enabling the OPC UA engine. Refer to 1756-UM543 for clock synchronization.
- With firmware release 36, the following controllers do not support OPC UA: any variant of:
  - 1756-L81E*
  - 5069-L306ER*.

Enable or disable OPC UA Communication

Enable OPC UA communication in the controller. See QA67231 - How to enable or disable OPC UA Communication in Logix controller.

Logix controller sample code

Consider using the sample files provided to enable or disable OPC UA communication in the Logix controller (see QA67231 - How to enable or disable OPC UA Communication in Logix controller).

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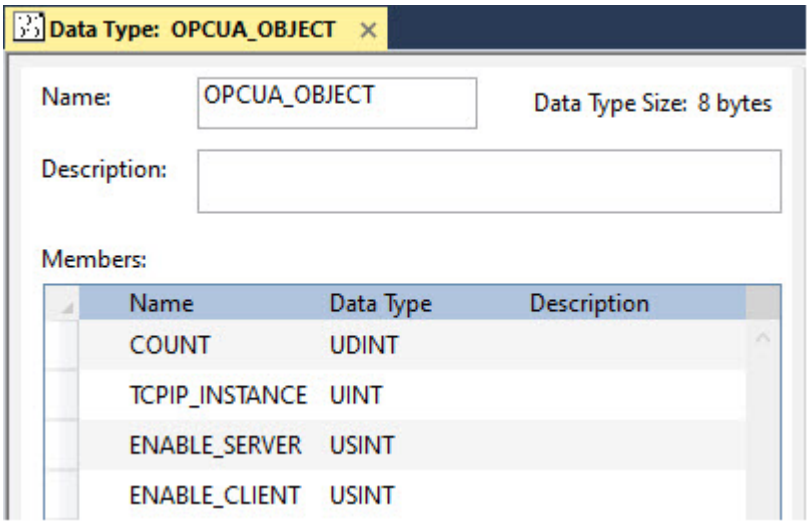
Implement user code to enable/disable OPC UA

By default, both OPC UA server and OPC UA client are disabled. A MESSAGE instruction is used to set or read the status of OPC UA communication 'engine'. The following explains how to configure MSG instructions for enabling or disabling OPC UA communication.

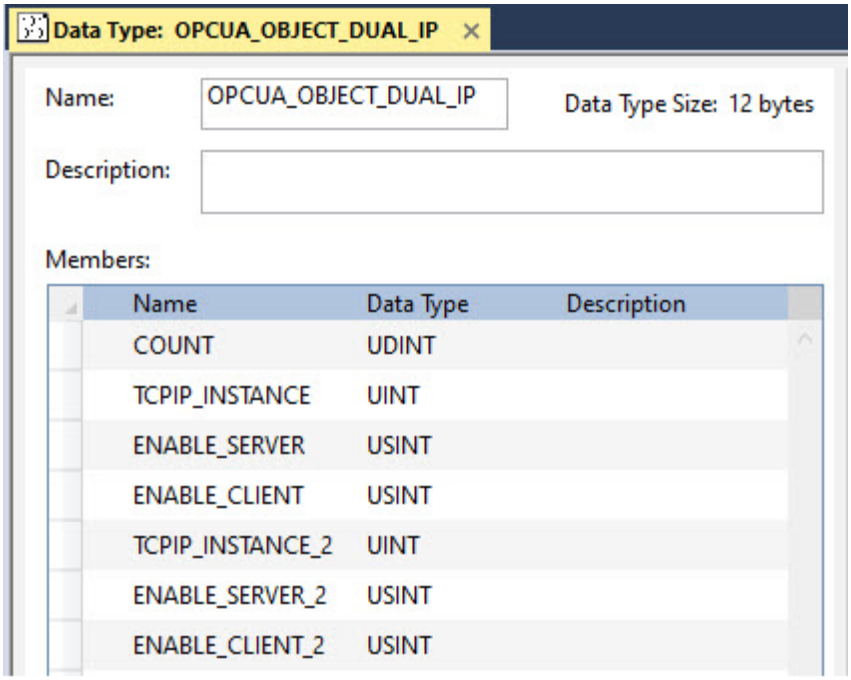
Message instruction source/destination data

OPC UA communication can be enabled or disabled using a MESSAGE instruction with a specific configuration. This section describes the data type used for the source tag of the MSG instruction or destination tag for the enabled / disabled status of OPC UA communication. Create the following UDT, depending on the number of network interfaces of the controller.

- Controller with single embedded Ethernet network interface, 5580 ControlLogix / GuardLogix or 5380 CompactLogix / Compact GuardLogix in Linear / DLR configuration:
  - COUNT [UDINT]
  - TCPIP_INSTANCE [UINT]
  - ENABLE_SERVER [USINT]
  - ENABLE_CLIENT [USINT]



- Controller with dual embedded Ethernet network interface, 5380 CompactLogix / Compact GuardLogix controller in Dual IP configuration:
  - COUNT
  - TCPIP_INSTANCE [UINT]
  - ENABLE_SERVER [USINT]
  - ENABLE_CLIENT [USINT]
  - TCPIP_INSTANCE_2 [UINT]
  - ENABLE_SERVER_2 [USINT]
  - ENABLE_CLIENT_2 [USINT]



1. Create a tag of either of the data type (UDT) OPCUA_OBJECT or OPCUA_OBECT_DUAL_IP.
2. Set the values of the source tag.

   The table lists all valid combinations of tag values for different controllers and operations:

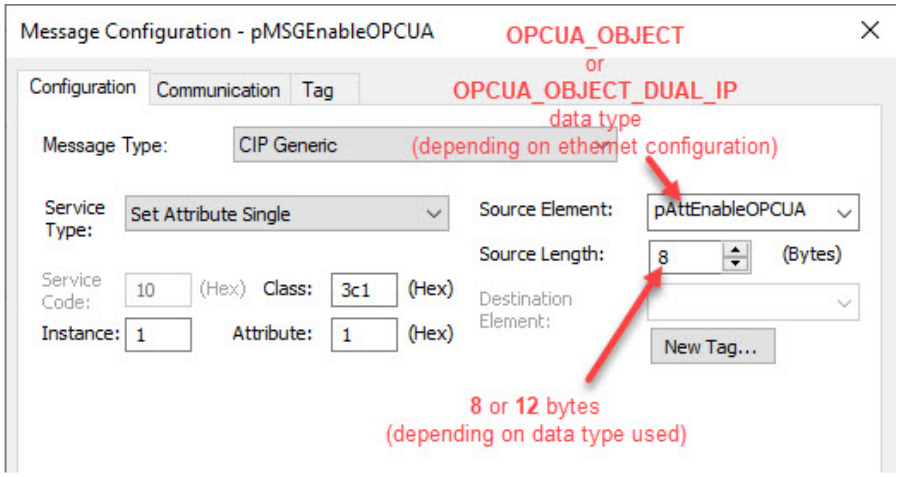
	Single IP		Dual IP		
	Enable	Disable	Enable A1	Enable A2	Disable
COUNT	1	1	2	2	2
TCPIP_INSTANCE	1	1	2	2	2
ENABLE_SERVER	1	0	1	0	0
ENABLE_CLIENT	1	0	1	1	0

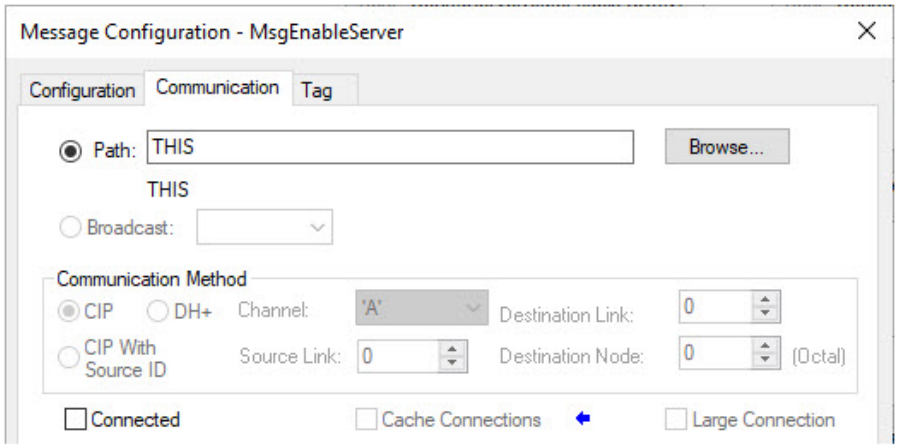
TCPIP_INSTANCE_2	n/a	n/a	3	3	3
ENABLE_SERVER_2	n/a	n/a	0	1	0
ENABLE_CLIENT_2	n/a	n/a	1	1	0

Activating A1 activates the OPC UA server on port A1. The OPC UA client operates on either A1 or A2. The same principle applies to activating A2.

3. Create, configure and execute the MSG instruction:
   - Configuration tab:
     - Message Type: CIP Generic
     - Service Type: Set Attribute Single
     - Class: 3c1 (Hex)
     - Instance: 1
     - Attribute: 1
     - Source Element: The previously created tag of data type OPCUA_OBJECT or OPCUA_OBJECT_DUAL_IP with values per the table above.
     - Source Length:
       - 8 bytes (controllers with single IP address, by using OPCUA_OBJECT)
       - 12 bytes (controllers with dual IP addresses, b7 by using OPCUA_OBJECT_DUAL_IP)
   - Communication tab:
     - Path: THIS

CAUTION: Deviating from the specified combinations of source tag values outlined in the table can result in an MSG instruction error.





Use the Logix controller as OPC UA server

Complete these two procedures to make tags available through the OPC UA server. The order of completing the procedures is flexible and does not impact functionality:

- Enable or disable OPC UA Communication on page 9
- About OPC UA access to individual tags on page 13

About OPC UA access to individual tags

The **OPC UA Access** property setting in Logix Designer Tag Editor specifies the level of access (Read Only, Read/Write, or None) for external OPC UA clients. This property setting applies to tags exposed to OPC UA clients directly from the controller.

This table describes OPC UA settings.

OPC UA Access setting	Description
Read/Write	External OPC UA clients have full access to the tag and can read and change the tag's value.
Read Only	External OPC UA clients can read, but cannot change, the tag's value.
None	External OPC UA clients cannot read or change the tag's value.

After you create a new tag, you can modify the tag's OPC UA access. You can configure OPC UA Access for controller and program-scoped tags.
For safety tags, there are certain limitations:

- When the controller is online, you cannot edit the OPC UA Access of a safety tag.
- When the controller is online and the tag is published in OPC UA server, you cannot delete the safety tag.
- When the controller is online and the tag is published in OPC UA server, you cannot rename a safety tag.
- When the controller is online, you cannot rename safety programs that expose safety tags in OPC UA server or rename safety programs that are parents of those safety programs.
- When creating a safety tag and the controller is online, is the only level of access that is available for selection is None.
- Safety tags have Read Only or None levels of access.

OPC UA node limits in Logix controllers

The number of nodes defines the capacity of an OPC UA server. Firmware version 36 supports these ControlLogix controllers:

- 1756-L81E: no OPC UA nodes (the same for 1756-L81EP)
- 1756-L82E: 600 OPC UA nodes
- 1756-L83E: 1200 OPC UA nodes (the same for 1756-L83EP)

- 1756-L84E: 10000 OPC UA nodes
- 1756-L85E: 15000 OPC UA nodes (the same for 1756-L85EP)

GuardLogix:

- 1756-L81ES: no OPC UA nodes
- 1756-L82ES: 900 OPC UA nodes
- 1756-L83ES: 1500 OPC UA nodes
- 1756-L84ES: 15000 OPC UA nodes

CompactLogix:

- 5069-L306ER*: no OPC UA nodes
- 5069-L310ER*: 300 OPC UA nodes
- 5069-L320ER*: 300 OPC UA nodes
- 5069-L330ER*: 300 OPC UA nodes
- 5069-L340ER*: 600 OPC UA nodes
- 5069-L350ER*: 600 OPC UA nodes
- 5069-L380ER*: 900 OPC UA nodes
- 5069-L3100ER*: 2000 OPC UA nodes

Compact GuardLogix:

- 5069-L306ER*S*: no OPC UA nodes
- 5069-L310ER*S*: 300 OPC UA nodes
- 5069-L320ER*S*: 300 OPC UA nodes
- 5069-L330ER*S*: 300 OPC UA nodes
- 5069-L340ER*S*: 600 OPC UA nodes
- 5069-L350ER*S*: 900 OPC UA nodes
- 5069-L380ER*S*: 1200 OPC UA nodes
- 5069-L3100ER*S*: 4000 OPC UA nodes

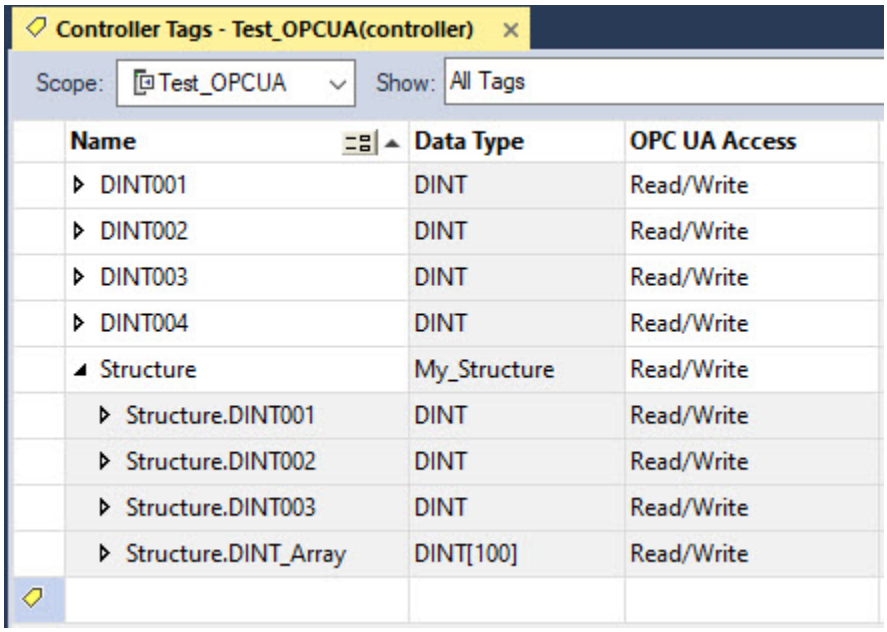
Calculate the number of nodes exposed in the OPC UA server in the Logix controller

Each member of a data structure, including the structure itself, is counted as one node.

Example: A controller contains:

- Four DINT tags
- One UDT (data type My_Structure) consisting of
- Three DINT tags

- One array of
- 100 DINT tags



When the OPC UA server makes all tags available, the total is 4 + 1 + 3 + 1 + 100 = 109 nodes.

Logix OPC UA server specifications

- Data types supported by Logix OPC UA server:
  - Atomic data types
  - Arrays
  - STRINGs
  - UDTs with up to 20 levels of nesting.
- Logix OPC UA server subscription limits:
  - Max number of subscriptions per session: 20
  - Max number of subscriptions: 20
  - Max number of monitored items per subscription: 5000
  - Max number of monitored items: 5000

Implement OPC UA client in Logix controller

Studio 5000 Logix Designer® and Logix controller firmware version 36 adds OPC UA communication to controller capabilities.

Logix client sample code

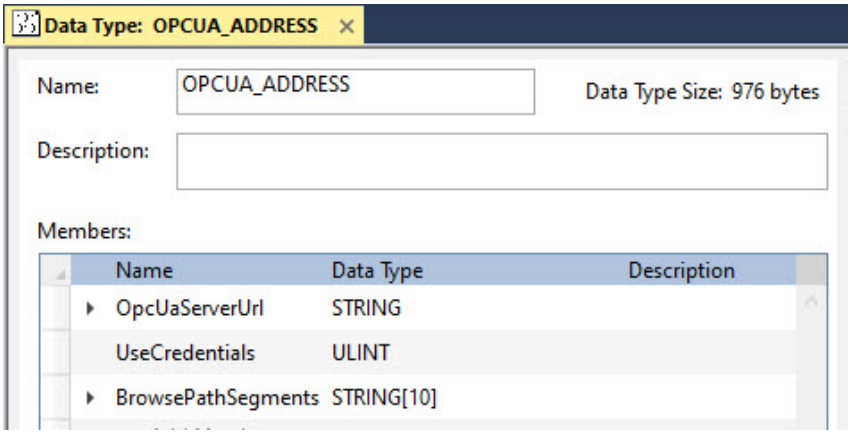
Consider using the sample files provided for implementing the OPC UA project (see QA67232 - How to implement OPC UA client in Logix controller):

- OPCUA_QA67232_Client.L5K. Implements the OPC UA client. The project supports OPCUA_QA67232.L5K and tests the implementation.
- OPCUA_QA67232.L5K. An optional file. Use it as an OPC UA server to support the client project.

NOTE: Review the Logix OPC UA client specifications section.

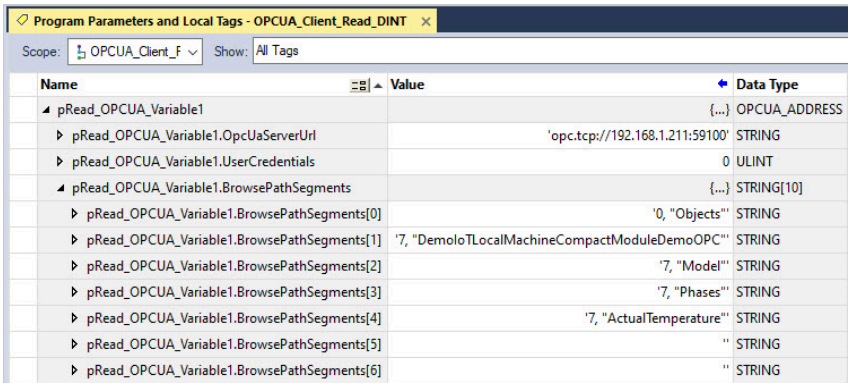
Implement tags and logic to read data from the remote OPC UA server

1. Enable the OPC UA engine (see Enable or disable OPC UA Communication on page 9).
2. Create a User-Defined Type OPCUA_ADDRESS.
   - OpcUaServerUrl [STRING]
   - UseCredentials [ULINT]
   - BrowsePathSegments [STRING[10]]



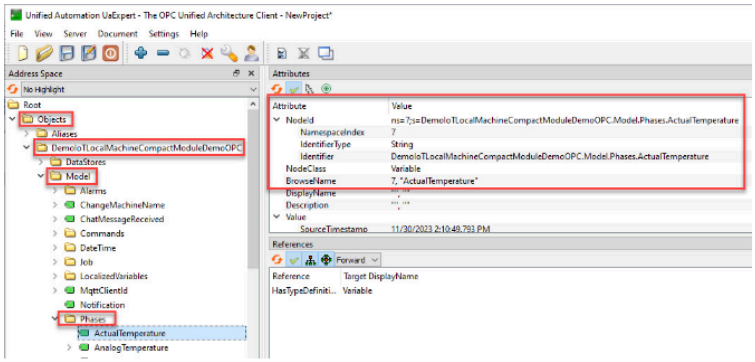
3. Create a tag of previously defined data type OPCUA_ADDRESS and populate the member tags.
   - OpcUaServerUrl: OPC UA server address in format opc.tcp://IP-Address:Port
   - UseCredentials: set to 0
   - BrowsePathSegments: elements of the BrowseName of the node within the OPC UA server tree.

Example: to address a node within an OPC UA server running in the FactoryTalk Optix application:



To obtain the values of a specific Path Segment, use a desktop OPC UA client on a remote OPC UA server, then go to the corresponding node. Record the values of each Path Segment along with the the namespace index.

Example:



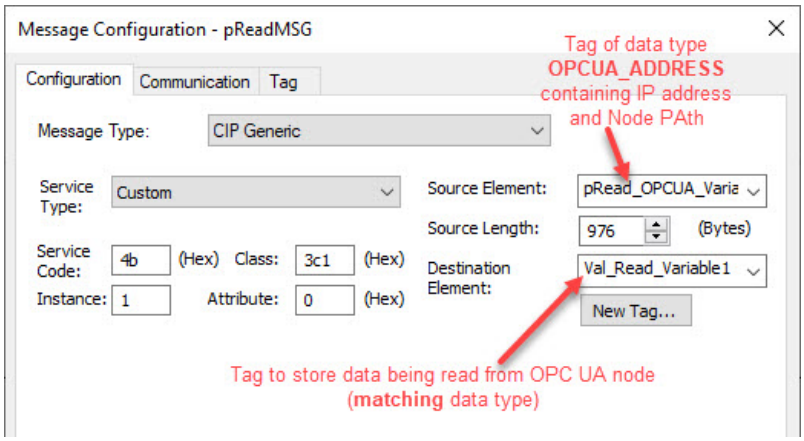
NOTE: The screenshots display an OPC UA server running in a FactoryTalk Optix application. The code is an example of OPC UA client reading values from an OPC UA server running on a ControlLogix controller. The values in the sample code are different from those in the screenshot. Always create the BrowsePathSegment for each node you've worked with.

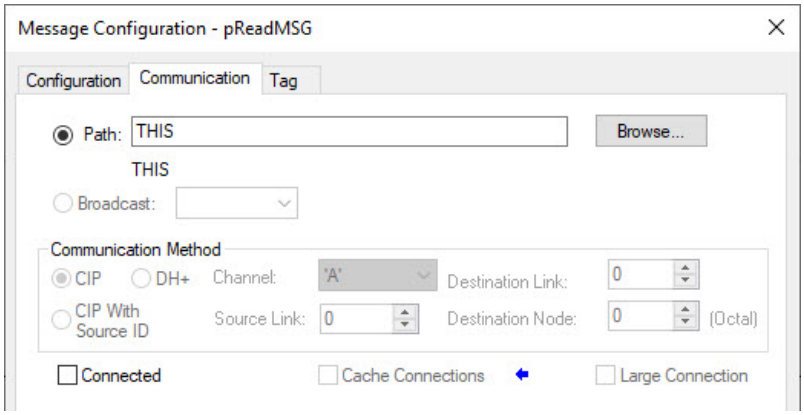
- To get the values of specific Path Segments, go to the corresponding node on a remote OPC UA server using a desktop OPC UA client. Then, record the values of each Path Segment along with the namespace index.

4. Create a destination tag to store the value read from the OPC UA node. For corresponding data types (including information related to reading/writing BOOL data types), see Logix OPC UA client specifications.
5. Create, configure and execute MSG instruction to read node data:
   - Configuration tab:
     - Message Type: CIP Generic
     - Service Type: Custom
     - Service Type: Custom
     - Service Code: 4b (Hex)

- Class: 3c1 (Hex) Instance: 1 Attribute: 0 Source Element: The previously created tag of data type OPCUA_ADDRESS. Source Length: 976 bytes
- Destination Element: Tag to write the data from the OPC UA node (for required datatype, as well as BOOL datatype requirement, see the Logix OPC UA client specifications section below).

- Communication tab:
  - Path: THIS



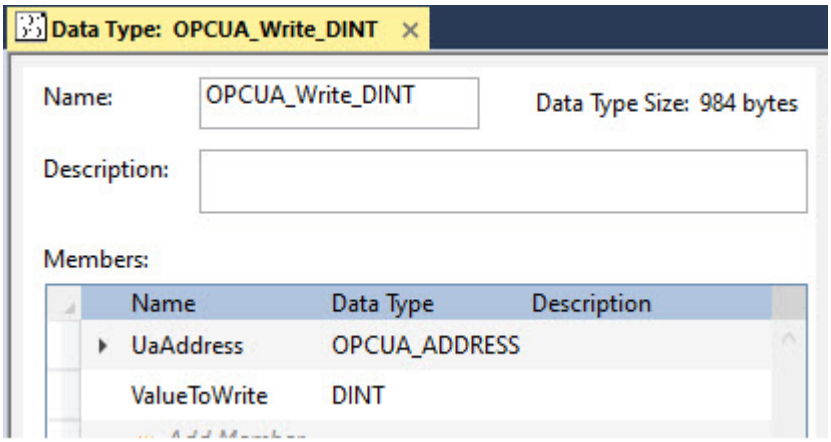


Implement tags and logic to write data to the remote OPC UA server - example writing to a Int32 node (DINT source in Logix)

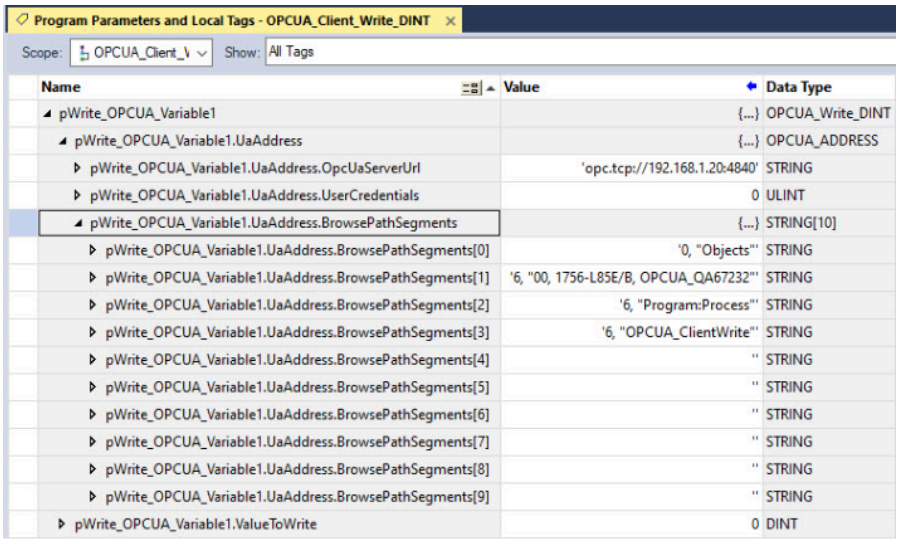
1. Create a User-Defined Type **OPCUA_Write_DINT** with the following structure (this re-uses the **OPCUA_ADDRESS** data type used for reading values on page 16):
   - UaAddress **[OPCUA_ADDRESS]**
   - **ValueToWrite [DINT] ... DINT** is used in this specific example.

     The datatype differs based on the data type of node to be

written to (see the Logix OPC UA client specifications below for relationship between Logix data types and OPC UA data types).

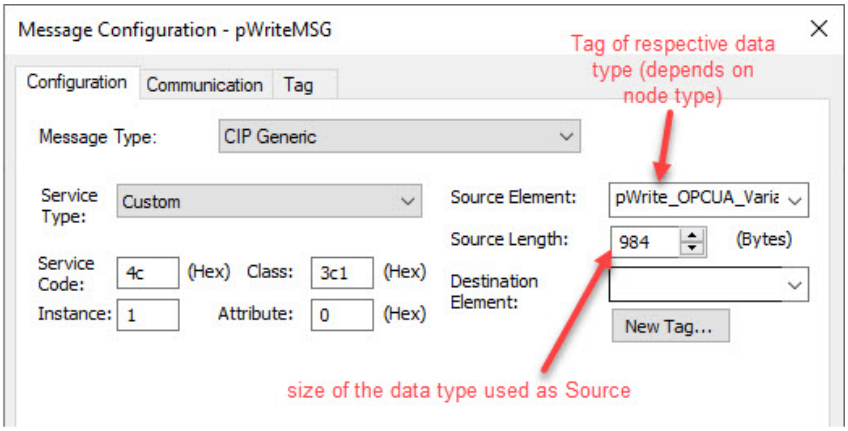


2. Create a tag of the**OPCUA_Write_DINT** type and populate the UaAddress member (see the example in the previous section related to read operation for explanation)



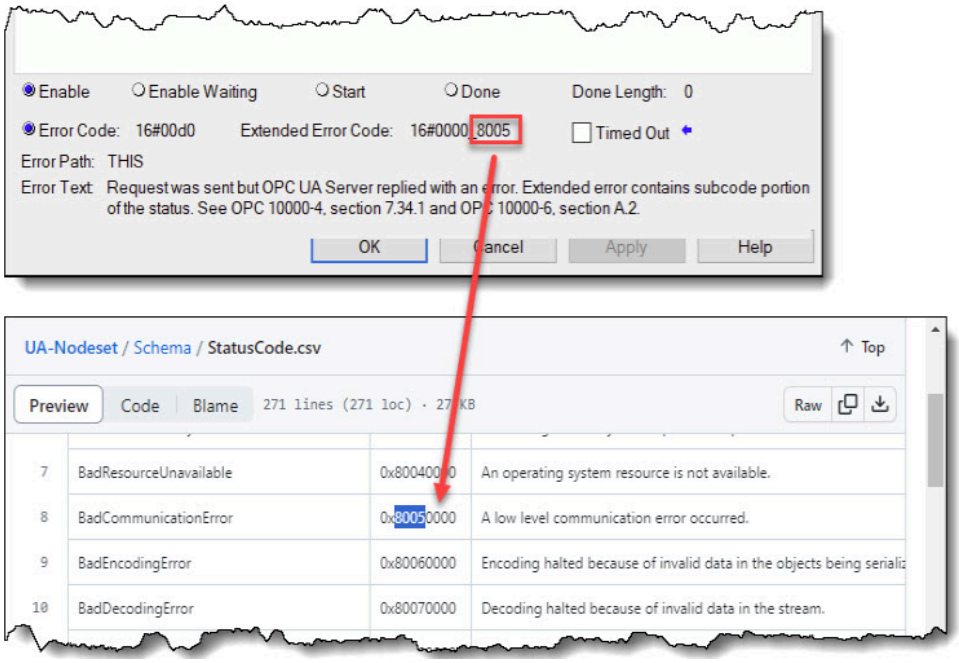
3. Create, configure and execute MSG instruction to write node data:
   - Configuration tab:
   - Message Type: CIP Generic
   - Service Type: Custom
   - Service Code: 4c (Hex)
   - Class: 3c1 (Hex) Instance: 1 Attribute: 0 Source Element: The previously created tag of data type OPCUA_ADDRESS. Source Length: Size of the specific UDT (depends on node type to be written to)
   - Destination Element: leave empty
   - Communication tab:

- Path: THIS



Explanations of Extended Error Codes

If the MSG instruction ends with an error code 16#**00d0**, then the suffix of the Extended Error code can be used to find specific explanation in OPC UA documentation (see http://www.opcfoundation.org/UA/schemas/StatusCode.csv).



If the MSG instruction ends with an error code 16#**0001**, 16#**0002**, 16#**0007**, 16#**00d1**, or 16#**00d3** then the Extended Error Code might optionally contain a suffix that can be used to interpret the error, using the following table:

Extended Error (Hex)	Description of Error
0xFFFF	Generic fault.
0xFFFE	The connection was closed by the peer.
0xFFFD	The connection was shut down by the peer.
0xFFFC	The connection was closed locally.

Extended Error (Hex)	Description of Error
0xFFFB	One or more of the supplied parameters were not valid.
0xFFFA	Allocating a buffer failed.
0xFFF9	A decoding error occurred.
0xFFF8	An encoding error occurred.
0xFFF7	Allocating memory failed
0xFFF6	The called function is not implemented fully or partially.
0xFFF5	The referenced host name could not be resolved.
0xFFF4	An underlying system call failed.
0xFFF3	The operation has been cancelled.
0xFFF2	The operation timed out.
0xFFF1	There is already an operation pending. Call again after completion
0xFFF0	An object is not in the required state for the current operation.
0xFFEF	The result has been truncated.
0xFFEE	The given destination buffer is too small.
0xFFED	The operation would require too many iterations to succeed.
0xFFEC	The requested operation is not supported.
0xFFEB	The certificate passed to the operation was not valid.
0xFFEA	A searched object could not be found.
0xFFE9	The operation failed because of a bad data signature.
0xFFE8	The actual value didn't match the expected value.
0xFFE7	No more resources available.
0xFFE6	Resource is still in use.
0xFFE5	Operation needs at last one more call to succeed.
0xFFE4	parameter is out of range.
0xFFE3	Internal error.
0xFFE2	The message encoding/decoding limits imposed by the stack have been exceeded.
0xFFE1	Request or response would be too large if encoded.
0xFFE0	Access denied.
0xFFDF	A loop exists in symbolic links encountered during resolution of the path argument.
0xFFDE	The file or directory already exists.
0xFFDD	The specified file was not found.

Extended Error (Hex)	Description of Error
0xFFDC	The specified directory was not found.
0xFFDB	For unexpected and unhandled errors to trigger general error handling.
0xFFDA	General error regarding the communication layer.
0xFFD9	The server returned a bad StatusCode in its response.
0xFFD8	An operation failed because of limitations of the active license.
0xFFD7	The reference you tried to add already exists.
0xFFD6	The reference you tried to modify is const.
0xFFD5	The reference you tried to modify is const.
0xFFD4	The security checks for a certificate are failing.
0xFFD3	This entry does already exist.
0xFFD2	Invalid configuration parameters.
0xFFD1	The operation is not permitted over the current secure channel.
0xFFD0	The URI specified in the ApplicationDescription does not match the URI in the certificate.

Logix OPC UA client specifications

The Logix OPC UA client uses these data types:

- STRING

The Logix OPC UA client uses these data types and arrays of data types:

- SINT
- USINT
- INT
- UINT
- DINT
- UDINT
- LINT
- ULINT
- REAL
- LREAL
- DT
- TIME

To read a BOOL node type from a remote OPC UA server:

1. Set the destination tag within Logix controller to USINT type.

To write to a BOOL node type on a remote OPC UA server:

1. Set the source tag within Logix controller to USINT type.

The "mapping" between OPC UA data types and Logix data types:

- Boolean - USINT
- SByte - SINT
- Byte - USINT
- Int16 - INT
- UInt16 - UINT
- Int32 - DINT
- UInt32 - UDINT
- Int64 - LINT
- UInt64 - ULINT
- Float - REAL
- Double - LREAL
- DateTime - DT
- Duration - TIME

The maximum number of simultaneous requests from OPC UA clients (for reading or writing) to external OPC UA servers is 109 or fewer.

Secure connection

For information on Secure Connection, see FactoryTalk Policy Manager Getting Results Guide, FTALK-GR001.

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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