User's Manual

SMARTDAC+™

Model GX10/GX20/GP10/GP20/GM10

OPC-UA Server (/E3) User's Manual

YOKOGAWA
Yokogawa Electric Corporation

IM 04L51B01-20EN
6th Edition

Introduction

Thank you for purchasing the SMARTDAC+ GX10/GX20/GP10/GP20 (hereafter referred to as the GX or GP) or the GM.
This manual describes the operating procedure for the GX/GP/GM OPC-UA server (/E3 option). Please use this manual in conjunction with the standard user's manual (IM 04L51B01-01EN (GX/GP) or IM 04L55B01-01EN (GM)).

To ensure correct use, please read this manual thoroughly before beginning operation.
The following manuals are provided for the GX/GP/GM.

● Paper Manuals

Model	Manual Title	Manual No.	Description
GX/GP	Model GX10/GX20/GP10/GP20 Paperless Recorder First Step Guide	IM 04L51B01-02EN	Explains the basic operations of the GX/GP.
GM	Data Acquisition System GM First Step Guide	IM 04L55B01-02EN	Explains the basic operations of the GM.

● Downloadable Electronic Manuals

You can download the latest manuals from the following website.
www.smartdacplus.com/manual/en/

Model	Manual Title	Manual No.	Description
GX/GP	Model GX10/GX20/GP10/GP20 Paperless Recorder First Step Guide	IM 04L51B01-02EN	This is the electronic version of the paper manual.
	Model GX10/GX20/GP10/GP20 Paperless Recorder User's Manual	IM 04L51B01-01EN	Describes how to use the GX/GP. The communication control commands and some of the options are excluded.
	Model GX10/GX20/GP10/GP20 Advanced Security Function (/AS) User's Manual	IM 04L51B01-05EN	Describes how to use the advanced security function (/AS option).
GM	GM Data Acquisition System First Step Guide	IM 04L55B01-02EN	This is the electronic version of the paper manual.
	GM Data Acquisition System User's Manual	IM 04L55B01-01EN	Describes how to use the GM. The communication control commands and some of the options are excluded.
	GM Data Acquisition System Advanced Security Function (/AS) User's Manual	IM 04L55B01-05EN	Describes how to use the advanced security function (/AS option).
GX/GP GM	Model GX10/GX20/GP10/GP20/GM10 Communication Commands User's Manual	IM 04L51B01-17EN	Describes how to use command control communication functions.
	SMARTDAC+ STANDARD Universal Viewer User's Manual	IM 04L61B01-01EN	Describes how to use Universal Viewer, which is a software that displays GX/GP/GM measurement data files.
	SMARTDAC+ STANDARD Hardware Configurator User's Manual	IM 04L61B01-02EN	Describes how to use the PC software for creating setting parameters for various GX/GP/GM functions.
	Model GX10/GX20/GP10/GP20/GM10 Multi-batch Function (/BT) User's Manual	IM 04L51B01-03EN	Describes how to use the multi batch function (/BT option).
	Model GX10/GX20/GP10/GP20/GM10 Log Scale (/LG) User's Manual	IM 04L51B01-06EN	Describes how to use the log scale (/LG option).
	Model GX10/GX20/GP10/GP20/GM10 EtherNet/IP Communication (/E1) User's Manual	IM 04L51B01-18EN	Describes how to use the communication functions through the EtherNet/IP (/E1 option).
	Model GX10/GX20/GP10/GP20/GM10 WT Communication (/E2) User's Manual	IM 04L51B01-19EN	Describes how to use WT communication (/E2 option).
	Model GX10/GX20/GP10/GP20/GM10 OPC-UA Server (/E3) User's Manual	IM 04L51B01-20EN	Describes how to use the OPC-UA server function (/E3 option).
	Model GX10/GX20/GP10/GP20/GM10 SLMP Communication (/E4) User's Manual	IM 04L51B01-21EN	Describes how to use SLMP communication function (/E3 option).
	Model GX10/GX20/GP10/GP20/GM10 Loop Control Function, Program Control Function (/PG Option) User's Manual	IM 04L51B01-31EN	Describes how to use the Loop Control Function, Program Control Function (/PG Option).
GX/GP	DXA170 DAQStudio User's Manual	IM 04L41B01-62EN	Describes how to create custom displays (/CG option).

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Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
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It enables confirming the specifications of purchased products and user's manuals.
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About the Usage of Open Source Software

This product uses open source software.
For details on using open source software, see IM 04L61B01-11EN (*Regarding the Downloading and Installing for the Software, Manuals and Labels*).

Revisions

December 2015	1st Edition	May 2022	6th Edition
March 2016	2nd Edition		
June 2017	3rd Edition		
May 2020	4th Edition		
July 2021	5th Edition		

How to Use This Manual

Recorder Version and Functions Described in This Manual

The contents of this manual apply to the GX/GP/GM10 with the following release numbers (see the STYLE S number) and style numbers (see the STYLE H number), and later.

Model	Release Number	Style Number
GX10/GX20/GP10	5	3
GP20	5	4
GM10	5	1

What This Manual Explains

This manual mainly explains the OPC-UA server. For details on other settings and procedures, see the *Model GX10/GX20/GP10/GP20 Paperless Recorder User's Manual* (IM 04L51B01-01EN) or *Data Acquisition System GM* (IM 04L55B01-01EN).
For details on communication commands, see *Model GX10/GX20/GP10/GP20/GM10 Communication Command User's Manual* (IM 04L51B01-17EN).

The GX20/GP20/GM10 standard type and large memory type are distinguished using the following notations.

- Standard type: GX20-1/GP20-1/GM10-1
- Large memory type: GX20-2/GP20-2/GM10-2

The following terms are used for references to other manuals:

Notation	Description
GX/GP User's Manual	Model GX10/GX20/GP10/GP20 Paperless Recorder User's Manual Refers to the IM 04L51B01-01EN.
GX/GP First Step Guide	Model GX10/GX20/GP10/GP20 Paperless Recorder First Step Guide Refers to the IM 04L51B01-02EN.
GM User's Manual	GM Data Acquisition System User's Manual Refers to the IM 04L55B01-01EN.
GM First Step Guide	GM Data Acquisition System First Step Guide Refers to the IM 04L55B01-02EN.
Communication Command Manual	Model GX10/GX20/GP10/GP20/GM10 Communication Command User's Manual Refers to the IM 04L51B01-17EN.
Universal Viewer Manual	SMARTDAC+ STANDARD Universal Viewer User's Manual Refers to the IM 04L61B01-01EN.
GX/GP Advanced Security Manual	Model GX10/GX20/GP10/GP20 Advanced Security Function (/AS) User's Manual Refers to the IM 04L51B01-05EN.
GM Advanced Security Manual	Data Acquisition System GM Advanced Security Function (/AS) User's Manual Refers to the IM 04L55B01-05EN.
WT Communication Manual	Model GX10/GX20/GP10/GP20/GM10 WT Communication (/E2) User's Manual Refers to the IM 04L51B01-19EN.
SLMP Communication Manual	Model GX10/GX20/GP10/GP20/GM10 SLMP Communication (/E4) User's Manual Refers to the IM 04L51B01-21EN.

Conventions Used in This Manual

Unit

K	Denotes 1024. Example: 768K (file size)
k	Denotes 1000.

Notes

	Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."
Warning	Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.
CAUTION	Calls attention to actions or conditions that could cause light injury to the user or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.
Note	Calls attention to information that is important for the proper operation of the instrument.

Reference Item

▶	Reference to related operation or explanation is indicated after this mark. Example: ▶ section 4.1

Conventions Used in the Procedural Explanations

Bold characters	Denotes key or character strings that appear on the screen. Example: **Voltage**
A a # 1	Indicates the character types that can be used.
Procedure	Carry out the procedure according to the step numbers. All procedures are written with inexperienced users in mind; depending on the operation, not all steps need to be taken.
Explanation	Explanation gives information such as limitations related the procedure.
Path	Indicates the setup screen and explains the settings.
Description	

Revision History

Edition	Model	Product	Description
1	GX/GP	Release number 3 (Version 3.01)	New edition
		Style number 1	
	GM	Release number 3 (Version 3.01)	
		Style number 1	
2	GX/GP/GM	Release number 3 (Version 3.02)	Added new nodes (alarm level setting, batch setting information)
		Style number 1	
3	GX/GP	Release number 4 (Version 4.01)	Support for PID control module has been added.
		Style number 2	
	GM10	Release number 4 (Version 4.01)	
		Style number 1	
4	GX/GP	Release number 4 (Version 4.08)	Support for style up (H: 3 (GX10/GX20/GP10), H: 4 (GP20)).
		Style number 3, 4	
	GM10	Release number 4 (Version 4.07)	—
		Style number 1	
5	GX/GP	Release number 4 (Version 4.09)	Added secondAdmin (user level) to the user privileges.
		Style number 3, 4	
	GM10	Release number 4 (Version 4.09)	
		Style number 1	
6	GX/GP	Release number 5 (Version 5.01)	Corrections.
		Style number 3, 4	
	GM10	Release number 5 (Version 5.01)	
		Style number 1	

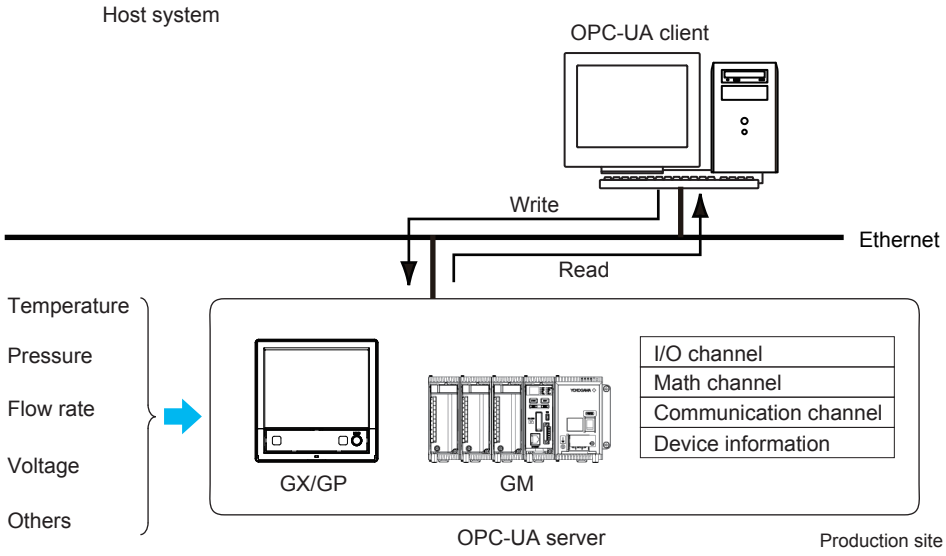
Contents

Introduction i
Notes ii
Trademarks ii
Revisions ii
How to Use This Manual iii
Recorder Version and Functions Described in This Manual iii
What This Manual Explains iii
Conventions Used in This Manual iv
Revision History v
Introduction of Features 1-1
Overview 1-1
OPC-UA Server (/E3) Specifications 1-2
Communication Specifications 1-2
Security 1-3
GX/GP/GM Configuration 1-5
OPC-UA Server Function 1-5
Others 1-5
GX/GP/GM Data Structure 1-6
Entire Structure 1-6
List of Nodes 1-7
Communication Channel Description 1-8
I/O Channel Description 1-9
Math Channel Description 1-10
PID Control Channel Description 1-11
Device Description 1-12
OPC-UA Communication Data 1-13
Handling of Communication Data 1-13
Subscription Operation 1-14

Introduction of Features

Overview

The OPC-UA server function enables OPC-UA clients of a host system (SCADA,[1] MES,[2] etc.) to access the I/O channels, math channels (/MT), and communication channels (/MC) of a GX/GP/GM for data reading and writing through Ethernet.
In addition, the function also includes data change notification and the corresponding message and filtering (subscription) functions.
The maximum number of OPC-UA clients that can connect to a GX/GP/GM is three.



1 SCADA (Supervisory Control And Data Acquisition) is a type of industrial control system. It monitors and controls industrial, infrastructural, or facility processes using computers.
2 MES (Manufacturing Execution System) is a system that is linked to production sites to grasp and manage production process status, provide instructions and aid to operators, and the like.

Features

- Incorporation of the OPC-UA server function allows easy connection to OPC-UA clients.
- Various production process data from production sites can be monitored from a host system such as SCADA and MES.
- Monitoring data changes and sending event notifications are possible through OPC-UA communication (subscription).
- Acquisition data is saved to the GX/GP/GM's internal memory and then to an SD card. As such, even if there is a network communication problem, data is backed up.

Benefits

- Because connecting to a host system is easy, the cost of constructing a system for acquiring various process data in production sites can be reduced.
- Acquisition of various process data of production sites on a host system enables production control including monitoring of production processes and feeding back data to production processes.
- Even if a network communication problem occurs, data stored in the internal memory or SD card can be referred to and used for production control.

OPC-UA Server (/E3) Specifications

Communication Specifications

The following table shows the communication specifications of the GX/GP/GM OPC-UA server.

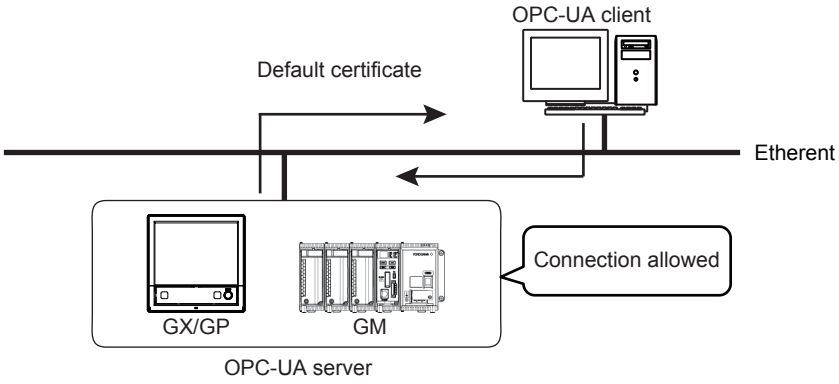
Group	Sub Group	Supported Function
Communication	Type	Server
	Encoding	UA Binary
	Protocol	OPC UA TCP
	Port number	4840/tcp (depends on the setting)
	Maximum number of client connections	3 (Max 3 sessions)
Language	Supported language	English
Security	Mode	None
	Encryption	None
	Login	Anonymous UserName
Function	Server type	Data Access Server (DA)
	Profile	Micro Embedded Device Server
	Maximum number of items	GX20/GP20/GM10: 300 (MonitoredItem/Session) GX10/GP10: 100 (MonitoredItem/Session)
	Maximum number of subscriptions	3/session
	Fastest period	100 ms (Publish Interval)
Supported services	Discovery	FindServers GetEndpoints
	SecureChannel	OpenSecureChannel CloseSecureChannel
	Session	CreateSession ActivateSession CloseSession
	View	Browse BrowseNext TranslateBrowsePathsToNodeIds
	Attribute	Read Write
	MonitoredItem	CreateMonitoredItems ModifyMonitoredItems DeleteMonitoredItems SetMonitoringMode
	Subscription	CreateSubscription ModifySubscription DeleteSubscriptions Publish Republish SetPublishingMode

Security

This section explains the security features of the GX/GP/GM OPC-UA server.

Certificate Authentication

The GX/GP/GM does not perform certificate authentication. All clients are allowed to connect.
The default certificate in the GX/GP/GM is used for the certificate exchange during the initial connection.



User Authentication

The GX/GP/GM supports the following user authentication methods.

Authentication Method	Description
Anonymous authentication	No authentication
Username authentication	Authentication by user name[1, 2] and password[1]

1 The user name and password set with the GX/GP/GM security function are used.
2 If a user ID is in use with the advanced security function (/AS option), the OPC-UA user name is “user name user ID” (a space between the user name and user ID) of the GX/GP/GM.

Which User Authentication Method Is Used

User authentication method that is used depends on the GX/GP/GM communication security setting as follows.

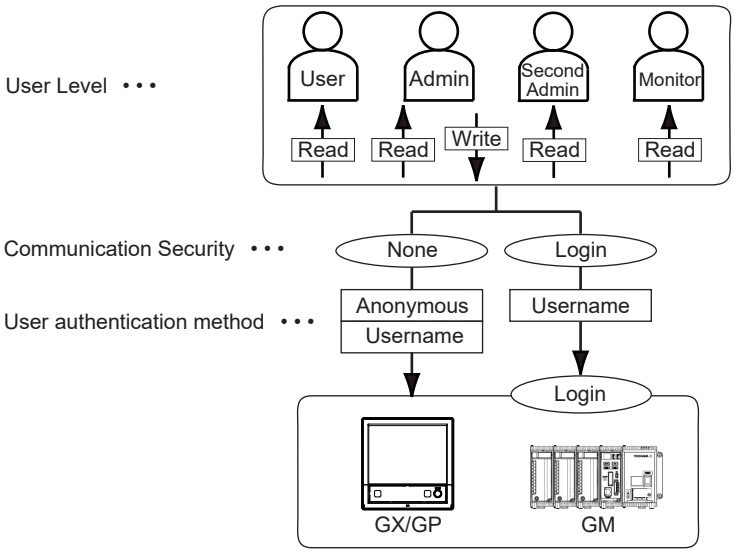
Communication Security Setting	User Authentication Method
Off	Anonymous authentication and username authentication
Login	Username authentication

User Privileges

If the GX/GP/GM communication security is set to Login, the contents that can be accessed depending on the user level are as follows.

Communication Security	User Level	Accessible Contents	Access Level
Login	User	Only data reading is allowed.	Read
	Admin	Data reading and writing are allowed.	Read/Write
	SecondAdmin[1]	Only data reading is allowed.	Read
	Monitor[1]	Only data reading is allowed.	Read

1 Only for the advanced security function (/AS option))



GX/GP/GM Configuration

OPC-UA Server Function

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Communication (Ethernet) settings** > **Server settings** > **Server list**
Web application: **Config.** tab > **Communication (Ethernet) settings** > **Server settings Server list**
Hardware configurator: **Communication (Ethernet) settings** > **Server settings Server list**

Description

OPC-UA

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Port number	1 or 65535	4840

On/Off

Select **On** to use the OPC-UA server function.

Option	Description
On	The OPC-UA server function is enabled.
Off	The OPC-UA server function is disabled.

Port number

Set the port that the OPC-UA server will use. Unless specified otherwise, you do not need to change this number.

Others

Communication Security

For details on the GX/GP/GM communication security settings, see below.

▶ GX/GP: Section 1.24, “Configuring the Security Functions,” in the GX/GP User’s Manual
GM: Section 2.27, “Configuring the Security Functions,” in the GM User’s Manual

For details on advanced security (/AS), see below.

▶ GX/GP: Section 2.1, “Enabling the Advanced Security Function,” in the GX/GP Advanced Security Manual.
GM: Section 2.1, “Registering Users and Setting the Signature Method,” in the GM Advanced Security Manual.

GX/GP/GM Data Structure

This section provides an address space (node list) that represents in a tree structure the groups of node data acquirable from an OPC-UA server.
An OPC-UA client can access a GX/GP/GM and view the address space in order to write and read from required nodes, monitor data, and so on.

Entire Structure

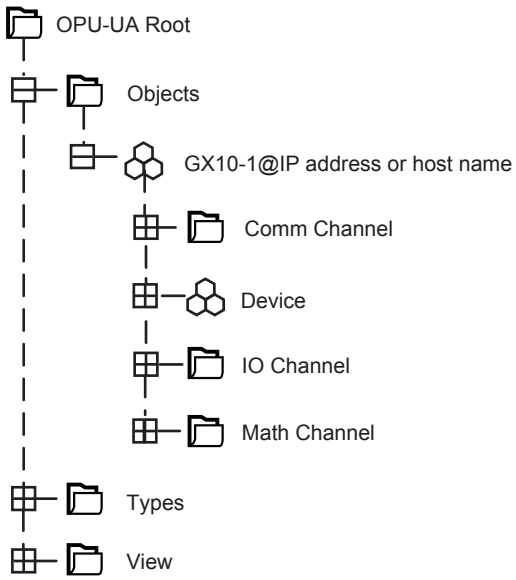
: Object node

: Folder node

: Variable node (with value)

: Property node (with value)

: Data acquirable node

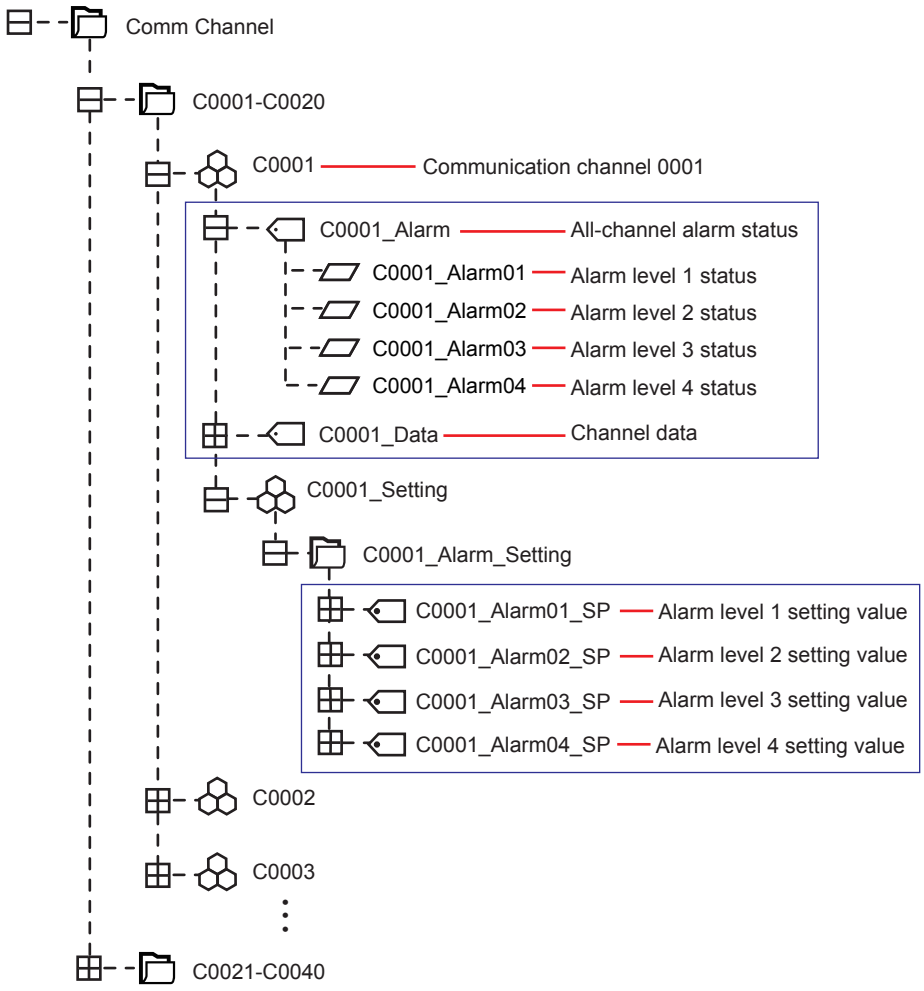


List of Nodes

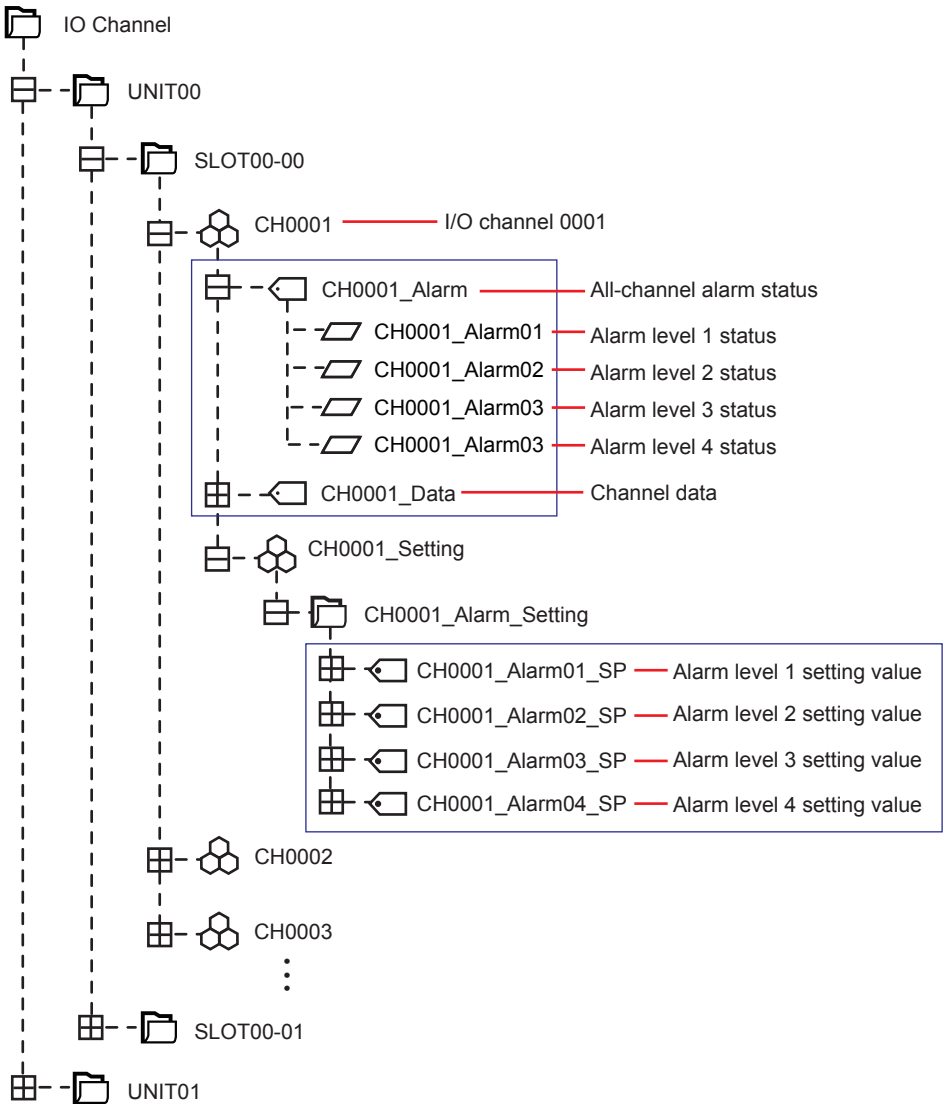
The following table shows a list of address space nodes implemented on the GX/GP/GM.

Group	Name	Description	Data Type	Read/Write	
Device	Model Name	Device name	String	Read Only	ex. GX20-1J
	Serial Number	Device serial number	String	Read Only	ex. S5G905023
	Current Time	Device time	Data Time	Read Only	ex. 2013-05-30 15:30:00
	Status	Registered device status	Int32	Read Only	1=OK, 0=NG
	Batch_NoXX	Batch number XX= Batch group number	String	Read/Write	
	Lot_NoXX	Lot number XX= Batch group number	Int32	Read/Write	
	Batch_CommentXX_PP	Batch comment XX= Batch group number PP= Batch commnent number	String	Read/Write	
	Batch_TextFieldXX_PP	Batch text field characters XX= Batch group number PP= Batch text number	String	Read/Write	
	Batch_TextTitleXX_PP	Batch text field title XX= Batch group number PP= Batch text number	String	Read/Write	
Channels Data	IO Data	I/O channel data	Float	Read/Write	Only DO data is writable.
	Math Data	Math channel data	Float	Read	
	Comm Data	Communication channel data	Float	Read/Write	
	All Alarm Status	Status of all alarms	Boolean	Read Only	If any alarm status is true, this is set to true.
	Alarm Status 1 to 4	Status of each alarm	Boolean	Read Only	
	Alarm SP 1 to 4	Setting value of each alarm	Float	Read/Write	
Loop Data	LPXXX_PV	PV value of loop number XXX	Float	Read Only	
	LPXXX_SP	SP value of loop number XXX	Float	Read/Write	SP of the current SP group
	LPXXX_OUT	Out value of loop number XXX	Float	Read/Write	Writing possible when manually controlling OUT
	LPXXX_RUN_STOP	RUN/STOP switching of loop number XXX	Int32	Read/Write	1: RUN 2: STOP
	LPXXX_AUTO_MAN_CAS	AUTO/MAN switching of loop number XXX	Int32	Read/Write	1: AUTO 2: MAN 3: Cascade
	LPXXX_LOC_REM	REMOTE/LOCAL switching of loop number XXX	Int32	Read/Write	1: LOCAL 2: REMOTE
	LPXXX_SPNO	SP group switching of loop number XXX	Int32	Read/Write	SP group 1 to 8 switching
	LPXXX_PIDNO	PID group switching of loop number XXX	Int32	Read Only	PID group 1 to 8, Reference PID = 9
	LPXXX_ALARM	All alarm status of loop number XXX	Boolean	Read Only	Status of all alarms in the loop
	LPXXX_ALARM01 to 04	Each alarm status of loop number XXX	Boolean	Read Only	Status of each alarm in the loop

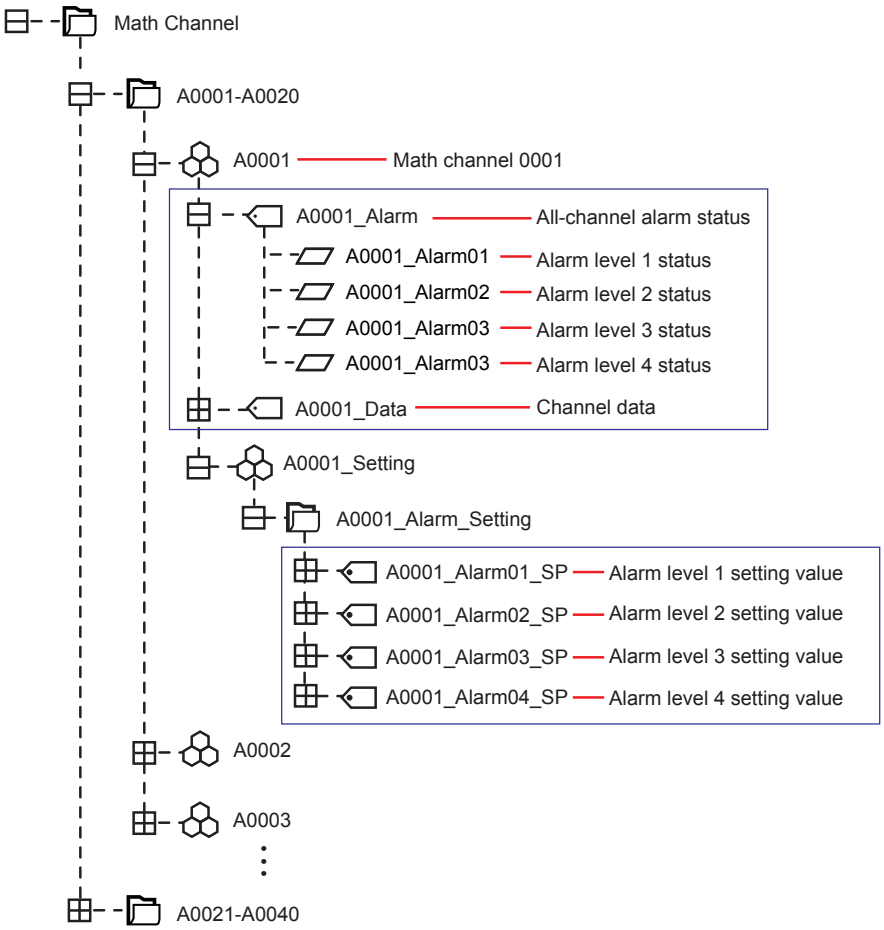
Communication Channel Description



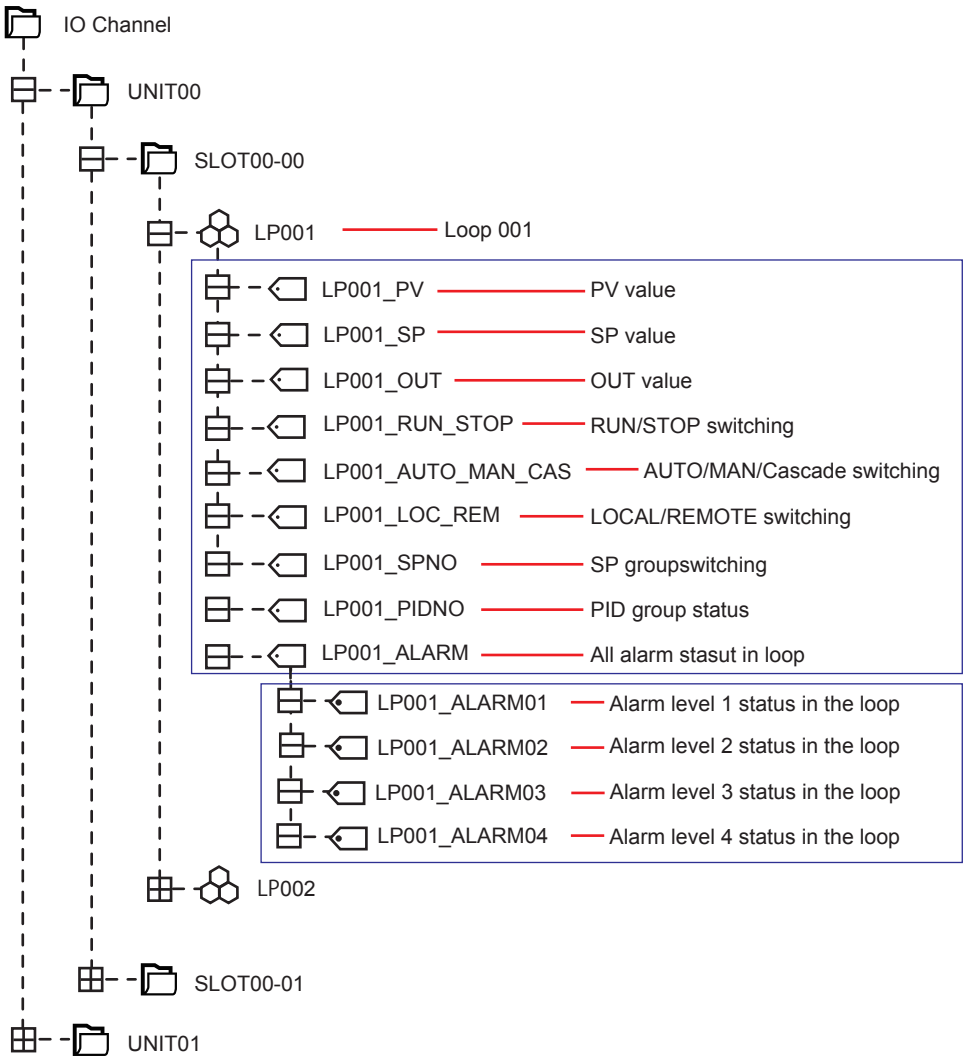
I/O Channel Description



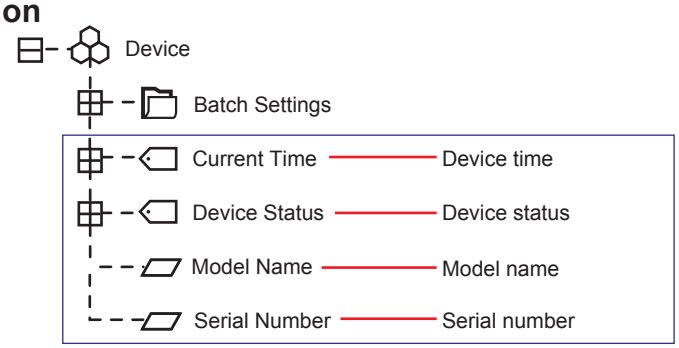
Math Channel Description



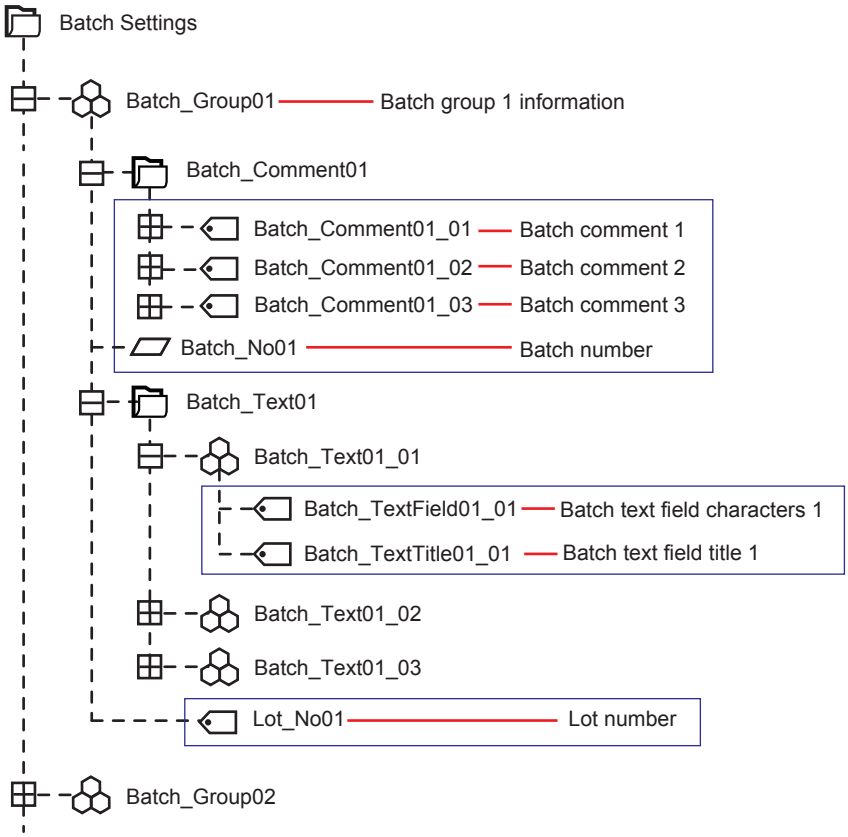
PID Control Channel Description



Device Description



Batch Settings Description



OPC-UA Communication Data

Handling of Communication Data

As described in “GX/GP/GM Data Structure” earlier, the GX/GP/GM OPC-UA communication function allows handling of not only the data values and alarms of I/O channels, math channels, and communication channels but also the status of the data values and alarms.

The items that can be acquired when data is acquired using normal OPC-UA communication are as follows.

1. Node name
2. Data value
3. Data status
4. Time information

The node name and time information are determined by the server, but data values and status vary depending on the GX/GP/GM channel data and channel status.
The data values and status that can be acquired depending on the channel status are shown below.

GX/GP/GM Channel Status	OPC-UA data (float)	OPC-UA status
Skip	0 (0x00000000)	Good
+Over	+∞ (0x7f800000)	Good
–Over	–∞ (0xff800000)	Good
+Burnout	+∞ (0x7f800000)	Good
–Burnout	–∞ (0xff800000)	Good
A/D error	Data value (physical value)	BadDataUnavailable
Invalid	Data value (physical value)	BadDataUnavailable
Math NaN	Data value (physical value)	BadDataUnavailable
Communication error	Data value (physical value)	BadDataUnavailable
RJC error	Data value (physical value)	BadDataUnavailable
A/D configuration error	Data value (physical value)	BadDataUnavailable
No error	Data value (physical value)	Good

Subscription Operation

Subscription is a function for managing data monitoring and event notification in OPC-UA communication.
In OPC-UA communication, data-change and event notification can be achieved by creating a group (subscription) on the server and registering items (MonitoredItem) in that group.
The GX/GP/GM subscription includes data change notification and the corresponding message and filtering (subscription) functions.

Subscription Supported Functions

Group	Sub Group	Supported Function
Subscription	Notification	Data Change Notification
	Max Subscription	3 (Subscription/Session)
	Min Publish Interval	100 ms
	Lifetime Count	3 to 300: Default 60
	Max Keep Alive	1 to 10: Default 5
	Priority	0
	Publish Queue	5
	Retransmission Queue	1

MonitoredItem Supported Functions

Group	Sub Group	Supported Function
MonitoredItem	Max MonitoredItem	GX20/GP20/GM10: 300 (MonitoredItem/Session) GX10/GP10: 100 (MonitoredItem/Session)
	Min Sampling Interval	100 ms
	Monitoring Mode	Disable Sampling Reporting
	Filter	Data Change Filter
	Data Queue Size	1
	Discard Policy	True, False : Default True
	Deadband Type	None