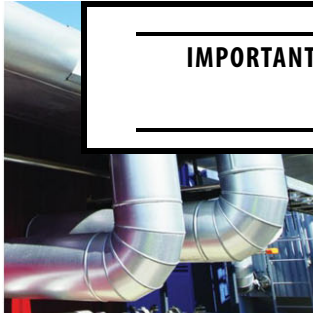


PlantPax Distributed Control System

System Release 4.6

IMPORTANT This manual applies to PlantPax System Release 4.5/4.6.
For PlantPax System Release 5.0, see [PROCES-UM100](#).



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.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.



SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.



ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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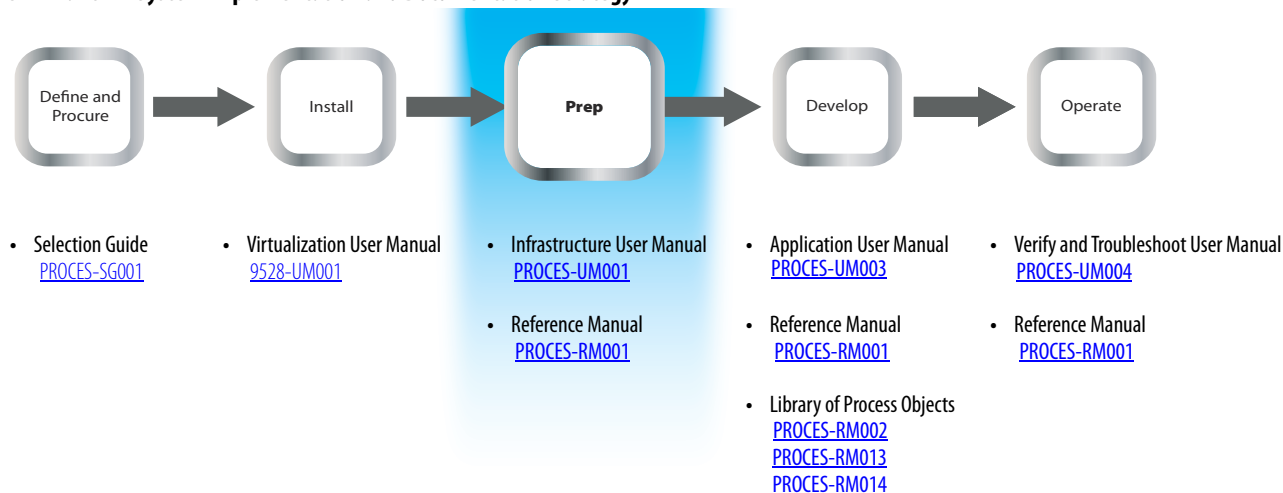
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The PlantPAx® system provides a modern approach to distributed control. The system shares common technology (Integrated Architecture® system) with all other automation disciplines in the plant. This approach creates a seamless information flow across the plant for optimization opportunities and enables a Connected Enterprise.

Our scalable platform provides you with the flexibility to implement a system appropriate for your application. [Figure 1](#) shows the documents (this manual in the highlighted section) that are available to help design and implement your system requirements.

Figure 1 - PlantPAx System Implementation and Documentation Strategy



- **Define and Procure** - Helps you understand the elements of the PlantPAx system to make sure that you buy the proper components.
- **Install** - Provides direction on how to install the PlantPAx system.
- **Prep** - Provides guidance on how to get started and learn the best practices to follow before you develop your application.
- **Develop** - Describes the actions and libraries necessary to construct your application that resides on the PlantPAx system.
- **Operate** – Provides guidance on how to verify and maintain your systems for efficient operation of your plant.

Purpose of the Reference Manual

The PlantPAx Reference Manual builds on the Selection Guide, which specifies system sizing guidelines and catalog numbers for procurement. This manual elaborates on the system sizing and application rules that you need to follow to configure a PlantPAx system.

We strongly recommend that you use the PlantPAx virtual image templates and Rockwell Automation® Library of Process Objects for best system performance and functionality. If you are not able to use the templates or the library, you still must follow the guidelines and rules from the Selection Guide and this Reference Manual. These guide posts make sure that you achieve PlantPAx system performance.

The PlantPAx system utilizes a set of Critical System Attributes (CSAs) as performance metrics. Your system performance can meet the CSA metrics if you follow the sizing guidelines and application rules that are defined in these documents and the PlantPAx System Estimator (PSE).

Summary of Changes

This manual contains new and updated information as indicated in the following table.

Topic	Page
120 OWS clients available in distributed architecture	14
Updates characterized software releases	17
Adds hard disk size for virtual system elements	19, 20, 21, 22, 24, 25, 26, 27
Updates software components of system elements	111

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Table 1 - System Core Resources

Resource	Description
PlantPAx Distributed Control System Selection Guide, publication PROCES-SG001	Provides basic definitions of system elements and sizing guidelines for procuring a PlantPAx system.
PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication PROCES-UM001	Provides screen facsimiles and step-by-step procedures to configure infrastructure components for your system requirements.
PlantPAx Distributed Control System Application Configuration User Manual, publication PROCES-UM003	Provides the steps necessary to start development of your PlantPAx Distributed Control System.
PlantPAx Distributed Control System Verification and Troubleshooting User Manual, publication PROCES-UM004	Provides checklist worksheets to verify and document that your system design aligns with PlantPAx system recommendations.
Rockwell Automation Library of Process Objects, publication PROCES-RM002	Provides information on how to use the Rockwell Automation Library of Process Objects.
Rockwell Automation Library of Logix Diagnostic Objects, publication PROCES-RM003	Provides Add-On Instructions for monitoring and diagnostic information of Logix controllers.
Rockwell Automation Library of Steam Table Instructions, publication PROCES-RM004	Provides Add-On Instructions for calculating temperature and pressure steam tables.
Rockwell Automation Library of Process Objects: Logic Instructions Reference Manual, publication PROCES-RM013	Provides controller codes and tags for Rockwell Automation Library objects. The objects are grouped by family and attached as Microsoft Excel® files to the manual PDF file.
Rockwell Automation Library of Process Objects: Display Elements Reference Manual, publication PROCES-RM014	Provides common display elements for the Rockwell Automation Library. For improved accessibility, the elements are combined into one manual.

Table 1 - System Core Resources

Resource	Description
PlantPAx Hardware Specifications and Certifications, publication PROCES-SR027	Provides information on PlantPAx system hardware specifications and certifications.
PlantPAx Sequencer Object Reference Manual, publication PROCES-RM006	Provides a flexible controller-based step sequencing solution that reduces engineering time by automating common operator procedures.
FactoryTalk® View SE Edition User Manual, publication VIEWSE-UM006	Provides details on how to use this software package for developing HMI applications that can involve multiple users and servers, which are distributed over a network.
FactoryTalk View SE Installation Guide, publication VIEWSE-IN003	Contains procedures for installing FactoryTalk View SE software.
FactoryTalk Alarms and Events System Configuration Guide, publication FTAЕ-RM001	Provides details on how to install, configure, and use FactoryTalk Alarms and Events services as part of a FactoryTalk-enabled automation system.
ControlLogix® System User Manual, publication 1756-UM001	Explains how to use traditional and extreme environment ControlLogix controllers.
ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535	Provides information on the installation and configuration for an enhanced redundancy controller system for greater availability.
Logix5000™ Controllers Design Considerations Reference Manual, publication 1756-RM094	Details how to design and optimize Logix5000 controller applications.
Logix5000 Controllers Common Procedures Programming Manual, Publication 1756-PM001	Provides links to a collection of programming manuals that describe how you can use procedures that are common to all Logix5000 controller projects.
Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003	Provides programming controller applications by using relay ladder instructions.
Logix5000 Controllers Advanced Process Control and Drives Instructions Reference Manual, publication 1756-RM006	Provides details on process control and drives instructions.
Logix 5000 Controllers Execution Time and Memory Use Reference Manual, publication 1756-RM087	Provides a complete list of instruction execution time and memory usage information for Logix5000 controllers in your Studio 5000 Logix Designer® programming software.
PlantPAx Logix Batch and Sequence Manager Reference Manual, publication PROCES-RM007	Explains a controller-based batch and sequencing solution that leverages the Logix Control Platform and FactoryTalk View software for integrated control and visualization.

Table 2 - Infrastructure Resources

Resource	Description
PlantPAx Virtualization User Manual, publication 9528-UM001	Describes how to use the PlantPAx virtual image templates for configuring virtual machines.
EtherNet/IP Network Configuration, publication ENET-UM001	Explains Logix5000 tools that are used in EtherNet/IP topologies and network operation.
Ethernet Design Considerations Reference Manual, publication ENET-RM002	Explains the infrastructure components that allow this open network to communicate seamlessly throughout a plant, from shop floor to top floor.
Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001	Provides collaborative design guidelines that are based on the Cisco Ethernet-to-the-Factory solution and the Rockwell Automation Integration Architecture solution.
Troubleshoot EtherNet/IP Networks, publication ENET-AT003	Provides guidelines for troubleshooting an EtherNet/IP network, such as setting speed and duplex.
1756 ControlLogix Communication Modules Specifications Technical Data, publication 1756-TD003	Contains specifications for the ControlLogix network communication modules.
Application Note: Segmentation Methods within the Cell/Area Zone, publication ENET-AT004	Provides design considerations of network segmentation methodologies for the ControlLogix and CompactLogix™ 5370 controllers.
Stratix® Managed Switches User Manual, publication 1783-UM007	Describes the embedded software features and tools for configuring and managing the Stratix 5410, Stratix 5400, and the Stratix 5700 Ethernet managed switches.
Stratix Ethernet Device Specifications Technical Data, publication 1783-TD001	Provides switch specifications, certifications, and the latest product information.
Stratix/Infrastructure Product Family Quick Reference Drawing, publication IASIMP-QR029	Illustration that shows options for connecting your plant network by using standard Ethernet technology.

Table 2 - Infrastructure Resources

Resource	Description
ControlNet Coax Media Planning and Installation Guide, publication CNET-IN002	Provides procedures for planning, installing, and implementing a ControlNet network.
ControlNet Fiber Media Planning and Installation Guide, publication CNET-IN001	
ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001	
Product Compatibility and Download Center at http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page	Website helps you find product-related downloads including firmware, release notes, associated software, drivers, tools and utilities.

Table 3 - Field Device Integration Resources

Resource	Description
FactoryTalk AssetCentre Installation Guide, publication FTAC-IN005	Provides installation instructions for monitoring your factory automation system.
FactoryTalk AssetCentre Product Profile, publication FTALK-PP001	Explains this tool for securing, managing, versioning, tracking, and reporting automation-related asset information across your entire enterprise.
EtherNet/IP and ControlNet to FOUNDATION Fieldbus Linking Device, publication 1788-UM057	Describes the installation and operation of the 1788-EN2FFR and 1788-CN2FFR linking devices.
1788-EN2PAR User Manual, publication 1788-UM056	Describes the installation and operation of the 1788-EN2PAR linking device.
1788-CN2PAR User Manual, publication 1788-UM055	Describes the installation and operation of the 1788-CN2PAR linking device.
ControlLogix HART Analog I/O Modules User Manual, publication 1756-UM533	Contains information on how to install, configure, and troubleshoot ControlLogix HART analog I/O modules.
Promass 83 Flowmeter via PROFIBUS PA to the PlantPAx Process Automation System, publication PROCES-AP022	Provides procedures for the design and implementation of PROFIBUS PA equipment.
DeviceNet System Quick Reference, publication DNET-QR001	Provides procedures for configuring applications on the DeviceNet® network.
CENTERLINE® Motor Control Centers with EtherNet/IP, publication 2100-TD031	Describes cable system construction and components that are associated with an EtherNet/IP network that is factory-installed in CENTERLINE 2100 and CENTERLINE 2500 and IntelliCENTER® motor control centers (MCCs).
CENTERLINE 2500 Motor Control Centers with EtherNet/IP Network, publication 2500-TD003	
Integrate E+H Instruments in a PlantPAx System Integration Document, publication PROCES-SG003	Provides a step-by-step approach to integrating HART devices from Endress+Hauser into the PlantPAx system.

Table 4 - Batch Resources

Resource	Description
FactoryTalk Batch User's Guide, publication BATCH-UM011	Provides a complement of FactoryTalk recipe management, component guidelines, and software installation procedures.
FactoryTalk Batch Installation Guide, publication BATCH-IN002	Provides information and procedures for installing FactoryTalk Batch software.
PlantPAx Batch Design Considerations Reference Manual, publication PROCES-RM008	Provides guidance on selected batch implementation topics in a PlantPAx system.
Batch Application Toolkit Quick Start, publication IASIMP-QS042	Provides a framework for how to use the tasks to complete the components of the Toolkit.
PhaseManager™ User Manual, publication LOGIX-UM001	Explains how to define a state model for your equipment and develop equipment phases.

Table 5 - Process Safety Resources

Resource	Description
Using ControlLogix in SIL 2 Applications Safety Reference Manual, publication 1756-RM001	ControlLogix components that are supported in SIL 2 configurations.
Redundant I/O System User Manual publication 1715-UM001	Describes how to install and configure the 1715 Redundant I/O system with a ControlLogix Enhanced Redundancy System.
AADvance Solutions Handbook, publication ICSTI-RM447	Explains the features, performance, and functionality of the AADvance controller and systems. It sets out some guidelines on how to specify a system to meet your application requirements.
AADvance System Build Manual, publication ICSTI-RM448	Provides experienced panel builders with information on how to assemble a system, switch on and validate the operation of a controller.
AADvance Configuration Guide, publication ICSTI-RM405	Defines how to configure an AADvance controller by using the AADvance Workbench to meet your Safety Instrument Function (SIF) application requirements.
AADvance Safety Manual, publication ICSTI-RM446	Defines mandatory standards and makes recommendations to safely apply AADvance controllers for a SIF application. Explains how to use traditional and extreme environment ControlLogix controllers.
AADvance Troubleshooting and Repair Manual, publication ICSTI-RM406	Provides plant maintenance personnel with information on how to trace and repair a fault in an AADvance system and perform routine maintenance tasks.

You can view or download publications at <http://www.rockwellautomation.com/literature>. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

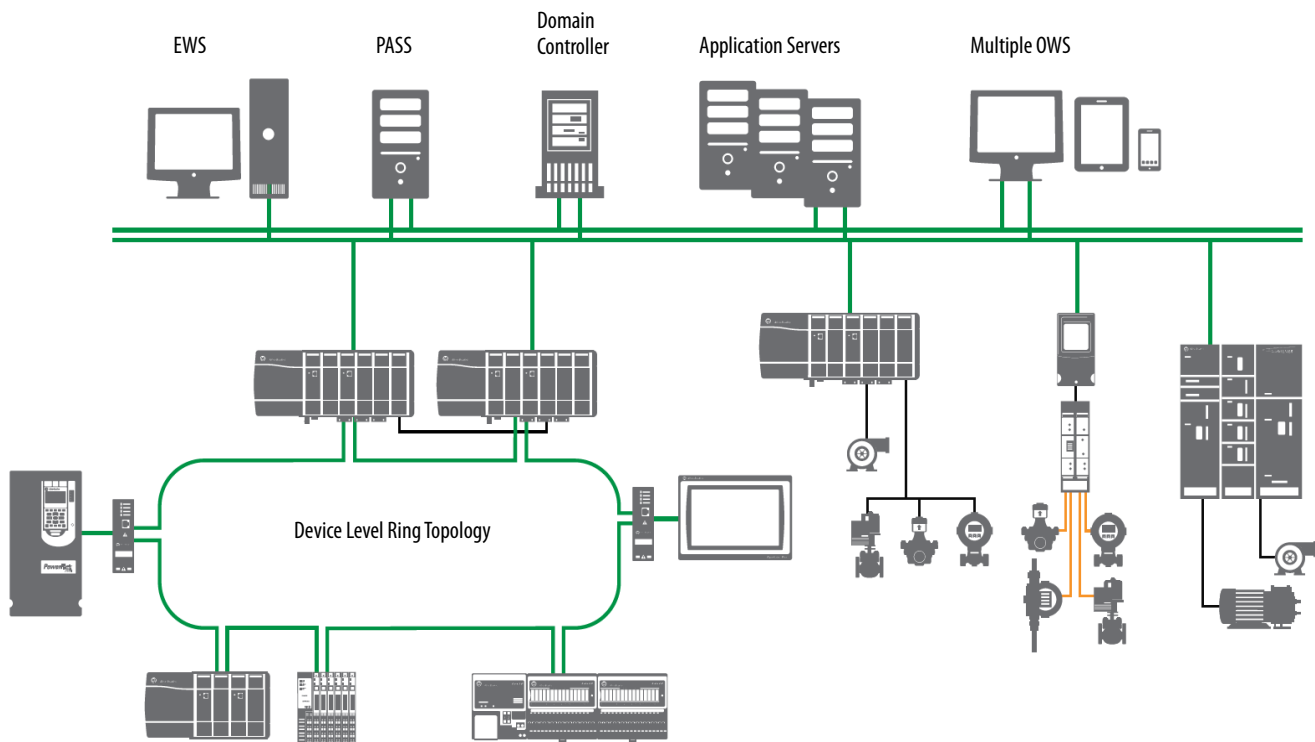
System Architecture Overview

The PlantPAx® system uses standard Rockwell Automation® Integrated Architecture® (IA) products to build a distributed control system (DCS). Our modern DCS is scalable, flexible, and open while still providing the reliability, functionality, and performance expected from a DCS.

This section describes the system elements and architectures that you can use to configure a PlantPAx system.

Topic	Page
Architecture Classes	14
System Elements	14
Critical System Attributes	15
System Procurement Tools	16

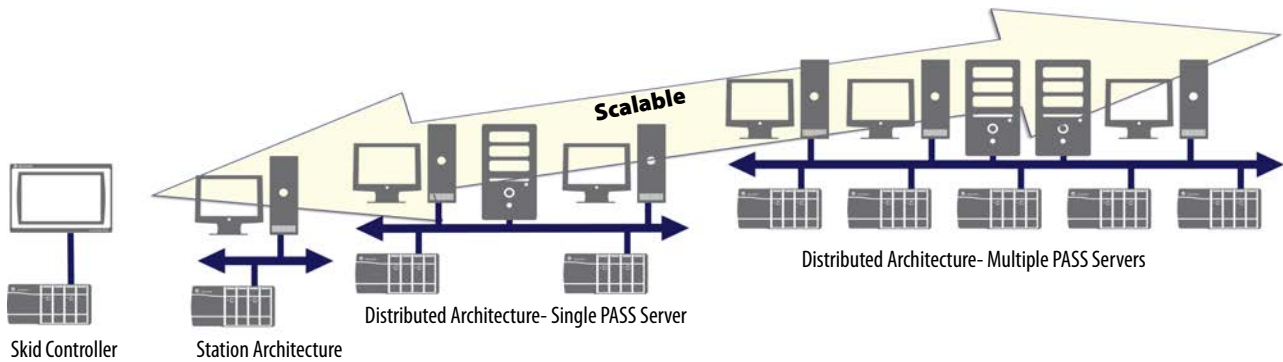
Rockwell Automation characterizes a DCS based on its size or architecture class. A ‘characterized’ classification yields system performance data and recommended hardware and software configurations.



Architecture Classes

Architecture classes define reference architectures that are based on the size of the required system.

Architecture	Description
Skid	Skid architecture with a skid controller and PanelView™ for monitoring data.
Station	A single station that acts as a PlantPAx Automation System Server (PASS), Operator Workstation (OWS), and Engineering Workstation (EWS).
Distributed - Single server	This architecture has a single PASS server and supports multiple OWSs and EWSs.
Distributed - Multiple servers	This architecture has multiple PASS servers and supports multiple OWSs and EWSs. You can add servers for more capacity or to segregate servers by operating areas.



System Elements

System elements are the different elements of a PlantPAx DCS. Elements can be deployed on your system depending on the needs of the application.

Table 6 - Architectures and System Elements

System Element	Skid Architecture	Station Architecture	Distributed Architecture (single PASS (consolidated))	Distributed Architecture (single to multiple PASS servers)
PASS	Not applicable.	Single workstation serves as PASS, EWS, and OWS in an independent workstation	For smaller systems, one PASS (consolidated) is required that typically includes the following: <ul style="list-style-type: none"> • FactoryTalk® Directory server • HMI server • Data server • Alarm and Event Server The PASS-C supports functions that otherwise are hosted on application servers. The PASS-C single computer includes the following in a single workstation: <ul style="list-style-type: none"> • PASS • FactoryTalk Historian • AppServ-Asset Management • AppServ-VantagePoint • AppServ-Info (SQL) IMPORTANT: An additional PASS-C is required for redundancy.	One PASS required and includes one or more of the following: <ul style="list-style-type: none"> • FactoryTalk Directory server • HMI server • Data server • Alarm and Event Server Additional PASS as needed (up to 10 servers or redundant server pairs). ⁽¹⁾
EWS		Included in independent workstation	1 EWS required.	1 EWS required. Can have as many as 5 EWSs.

Table 6 - Architectures and System Elements

System Element	Skid Architecture	Station Architecture	Distributed Architecture (single PASS (consolidated))	Distributed Architecture (single to multiple PASS servers)
OWS	Not applicable. Operator interface typically accomplished with PanelView Plus operator terminal or thin client connected to a distributed architecture.	Included in independent workstation	Included in PASS-C. An .ISO file is available for any single, physical computer. IMPORTANT: PASS-C supports up to 10 clients.	Can have as many as 120 OWS clients. ⁽¹⁾
Controllers	CompactLogix controller.	1...5 ControlLogix® controllers.	1...5 ControlLogix controllers. IMPORTANT: PASS-C supports up to five redundant controllers. Use the PlantPAx System Estimator to verify your design. See page 16 .	There is no hard limit for the number of controllers. The number of controllers that can be supported per PASS (data server) depends on controller selection, controller loading, and number of OWS.
Application servers	Not applicable. In chassis historian and in controller batch capabilities are available. Can also be integrated with a distributed architecture.	AppServ-Asset Management as needed. AppServ-Batch as needed. AppServ-Information Management (SQL, Historian, or VantagePoint®) as needed.	Additional servers can be added as your system scales. For example, AppServ-Batch, AppServ-Information Management. IMPORTANT: An additional PASS-C is required for redundancy.	AppServ-Asset Management as needed. AppServ-Batch as needed. AppServ-Information Management (SQL, Historian, or VantagePoint) as needed AppServ-OWS as needed.

(1) These values are product maximum limits. It's possible that achieving these limits on your system is not feasible based on your system design. Use the PlantPAx System Estimator to make sure that your system is sized properly (see [page 16](#)).

Critical System Attributes

A critical system attribute (CSA) is a visible performance indicator of a system-wide characteristic. CSAs are used to define or identify specified levels of system operation:

- Determine system limits
- Establish system rules
- Establish system recommendations
- Measure system element and system infrastructure performance

The following CSAs are used to verify performance during process system characterization.

Table 7 - CSA Performance Indicators

Critical System Attribute ⁽¹⁾	Performance
Display callup (paint time)	A noncached display is called up by the operator and ready for operator use within 2 seconds.
Display update	The display updates control information within 1 second.
Steady state alarm time	Steady state alarms occurring at 20 per second are timestamped within 1 second.
Alarm burst time	All alarms in a burst of 1000 alarms are timestamped within 3 seconds.
Recovery	A system element returns to full operation within 5 minutes of the restoration after a failure or loss.
Operator-initiated control	Operator-initiated actions are loaded into the controller and the feedback for the operator action is within 2 seconds.
Batch server: operator action time	An operator batch command has been acted on by the controller in 1 second.
Batch server: server action time	A server batch command has been acted on by the controller in 1 second.
Batch server: controller action time	Batch status events display on the operator workstation within 1 second.

(1) CSA performance indicators are a nominal performance number. The actual system performance can intermittently deviate from the documented CSA due to system disturbances that can introduce variability in the network or operating system performance.

System Procurement Tools

The following chapters of this manual contain recommendations and considerations for how to implement your system. If you have not selected or procured your PlantPAx system architecture and components, see the PlantPAx Selection Guide, publication [PROCES-SG001](#), for more information.

The PlantPAx System Estimator (PSE), which is a part of the Integrated Architecture® Builder (IAB) software tool, helps you define a PlantPAx system. The PSE wizard lets you specify your system architecture that is based on your requirements, and verifies that your process control hardware is sized properly.

When the verification is complete, you can transfer the output of the PSE wizard into the IAB tool to develop a bill-of-material for the system based on your inputs.

See <http://www.rockwellautomation.com/en/e-tools/configuration.html> to access the IAB tool.

System Element Recommendations

PlantPAx® system elements refer to the individual servers, clients, and controllers that comprise a PlantPAx system. This chapter describes each system element and its components. A base installation of all server and workstation elements is available as virtual appliances.

The following table lists where to find specific information.

Topic	Page
PlantPAx Software Components	17
Process Automation System Server (PASS)	18
Engineering Workstation (EWS) and Application Server (AppServ-EWS)	20
Operator Workstation (OWS) and Application Server (AppServ-OWS)	21
Independent Workstation (IndWS)	23
AppServ-Info (Historian)	24
AppServ-Info (VantagePoint)	24
AppServ-Info (SQL)	25
Asset Management Server (AppServ-Asset)	25
Batch Management Server (AppServ-Batch)	26
Domain Controller	27
Controller Characteristics	28

PlantPAx Software Components

Integrated Architecture® software components and versions that comprise the PlantPAx system, include the following:

- Studio 5000 Logix Designer® application, version 31.x
- Studio 5000 Architect™ application, version 4.x
- FactoryTalk® View software, version 11.x
- FactoryTalk Batch software, version 13.x
- FactoryTalk AssetCentre software, version 9.x
- FactoryTalk® VantagePoint® software, version 8.x
- FactoryTalk Historian software, version 6.x

Performance guidelines are based on the use of the software versions listed.

For the latest compatible software information and to download associated library tools, see the Product Compatibility and Download Center at <http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page>.

Process Automation System Server (PASS)

The Process Automation System Server (PASS) is a required system element that hosts essential software components to run the system. The essential software components include the data server, HMI server, and alarm server. The PASS can be used as a data, HMI, and/or alarm server.

Software Components	Description
FactoryTalk Network Directory (FTD) server ⁽¹⁾	Secures information from multiple Rockwell Automation® software components across multiple computers and provides central administration throughout the PlantPAx system. Application components, such as display and security settings, can be stored in their original environments and made available to the entire PlantPAx system without the need for duplication.
FactoryTalk Activation server ⁽¹⁾	The FactoryTalk Activation server is part of the FactoryTalk Services Platform. The server allows FactoryTalk-enabled software products to be activated via files generated by Rockwell Automation over the Internet. This server essentially manages the files that are required to license Rockwell Automation products on the PlantPAx system.
FactoryTalk View HMI server	The human machine interface (HMI) server is configured within your FactoryTalk View Site Edition (SE) application. The HMI server stores HMI project components, such as graphic displays, and serves these components to OWSs upon request. The HMI server also can manage tag databases and log historical data. Multiple HMI servers can exist on the PlantPAx system. Each HMI server must be on a separate PASS.
FactoryTalk View Data server	The Data server component provides access to information from the process controllers to servers and workstations on the PlantPAx system. FactoryTalk View software supports two types of data servers: Rockwell Automation Device servers (FactoryTalk Linx software) and OPC Data servers. The Data server that is mentioned in PlantPAx documentation generally refers to the Rockwell Automation Device servers. Data servers are configured within your FactoryTalk View SE application. Multiple data servers can exist on the PlantPAx system.
FactoryTalk View Alarm and Event server	The Alarm and Event server publishes information from controllers and servers available to all subscribing OWSs. Alarm and Event servers are configured within your FactoryTalk View SE application. There are two types of Alarm and Event servers: device-based and server-based. Device-based Alarm and Event servers are configured as an option to the data server. Server-based Alarm and Event servers are configured as a separate component. Each server-based Alarm and Event server must be on a separate PASS. The Alarm and Event server that is mentioned in PlantPAx documentation refers to the Alarm and Event server that is server-based. See Alarm System Recommendations on page 55 for more information.
Optional	
FactoryTalk Batch client software	If a Batch Application server is being used on the system, FactoryTalk Batch client components are required to support replication of batch-related objects on the displays to the OWS.

(1) In redundant PASS configurations, this component is included on the primary PASS only.

PASS Server Redundancy

PASS servers can be configured as redundant for the following software components:

- HMI server
- Data server
- Alarm server

IMPORTANT When you enable redundancy in FactoryTalk View Studio software, select the option to 'Continue using the secondary server even when the primary server becomes available again' to avoid excessive switchovers. This option lets you manage replication of application changes made before or after the switchover occurs. We recommend that you configure your HMI displays to indicate when the system is running without backup.

The FactoryTalk Directory server information is cached on each computer that is participating in a distributed application. If the FTD server computer is disconnected from the network or fails, the OWS, EWS, and other application servers can continue to access everything within the application. This functionality applies as long as the computer has already accessed the FTD server.

Table 8.1 - PASS Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 4 vCPU • 8 GB vRAM min • 60 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • High priority Resource pool⁽²⁾
Operating system	Windows Server 2016 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#).

Table 8.2 - PASS Traditional Requirements

Category	Requirement
Traditional infrastructure	The PASS must be installed on server-class hardware. The following are sample specifications that are based on PlantPAx system characterization: <ul style="list-style-type: none"> • Intel Xeon Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 8 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
PASS - C (for small and medium systems)	For systems with fewer than 2000 I/O points, the PASS - Consolidated contains HMI, data collection, decision-making, and asset management servers. These combined tools form a basic PlantPAx system in a single server, referred to as consolidated. The PASS must be installed on server-class hardware. The following are sample specifications based on PlantPAx system characterization: <ul style="list-style-type: none"> • Intel® Xeon E-31270 v5 • 3.60 GHz CPU min • 32 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure it supports redundant media)
Operating system	Windows Server 2016 operating system, 64 bit

Configure the FactoryTalk Directory

Before starting a project, you must install FactoryTalk Directory (FTD) services on the computer that is hosting the FTD or the PASS. The FTD server manages applications that can exist on multiple clients and servers on separate computers on the PlantPAx system.

IMPORTANT To configure the FTD, see the PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication [PROCES-UM001](#).

Engineering Workstation (EWS)

The EWS supports system configuration, application development, and maintenance functions. This workstation is the central location for monitoring and maintaining the system operation.

If a batch application server is used, the FactoryTalk Batch client and editor components are required to configure the FactoryTalk Batch system and configure the FactoryTalk objects on the displays.

Table 9.1 - EWS Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 2 vCPU • 4 GB vRAM min • 100 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Normal priority Resource pool⁽²⁾
Operating system	Windows 10 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#)

Table 9.2 - EWS Traditional Requirements

Category	Requirement
Traditional infrastructure	The EWS must be installed on workstation-class hardware. The following are sample specifications based on PlantPAx system characterization. <ul style="list-style-type: none"> • Intel Core 2 Duo • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows 10 operating system, 64 bit

Engineering Workstation Application Server (AppServ-EWS)

The AppServ-EWS uses Microsoft® Remote Desktop Services (RDS) technology to serve multiple instances of the EWS as thin clients from a single server. Thin clients can run applications and process data on a remote computer. The recommended limit is five RDS client connections per AppServ-EWS.

Table 10 - AppServ-EWS Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 4 vCPU • 8 GB vRAM min • 100 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Normal priority Resource pool⁽²⁾
Thin client	We recommend a maximum of 5 FactoryTalk View SE clients per application server
Operating system	Windows Server 2016 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#)

Operator Workstation (OWS)

The operator workstation (OWS) provides the graphical view and interface into the process. The OWS supports operator interaction and is not meant to support development or maintenance activities, although these activities are possible if desired.

FactoryTalk View Site Edition (SE) client software must be installed on the OWS. The OWS also can contain clients for non-core application servers, such as FactoryTalk Batch, FactoryTalk Historian, or FactoryTalk AssetCentre.

Table 11.1 - OWS Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 2 vCPU • 4 GB vRAM min • 40 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • High priority Resource pool⁽²⁾
Operating system	Windows 10 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#)

Table 11.2 - OWS Traditional Requirements

Category	Requirement
Traditional infrastructure	The OWS must be installed on workstation-class hardware. The following are sample specifications based on PlantPAx system characterization: <ul style="list-style-type: none"> • Intel Core 2 Duo • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows 10 operating system, 64 bit

Operator Workstation Application Server (AppServ-OWS)

The AppServ-OWS uses Microsoft Remote Desktop Services (RDS) technology to serve multiple instances of the OWS as thin clients from a single server. Thin clients can run applications and process data on a remote computer. The recommended limit is 10 RDS connections per AppServ-OWS.

Table 12 - AppServ-OWS Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 8 vCPU • 16 GB vRAM min • 60 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • High priority Resource pool⁽²⁾
Thin client	We recommend a maximum of 10 FactoryTalk View SE clients per application server
Operating system	Windows Server 2016 operating system, 64 bit

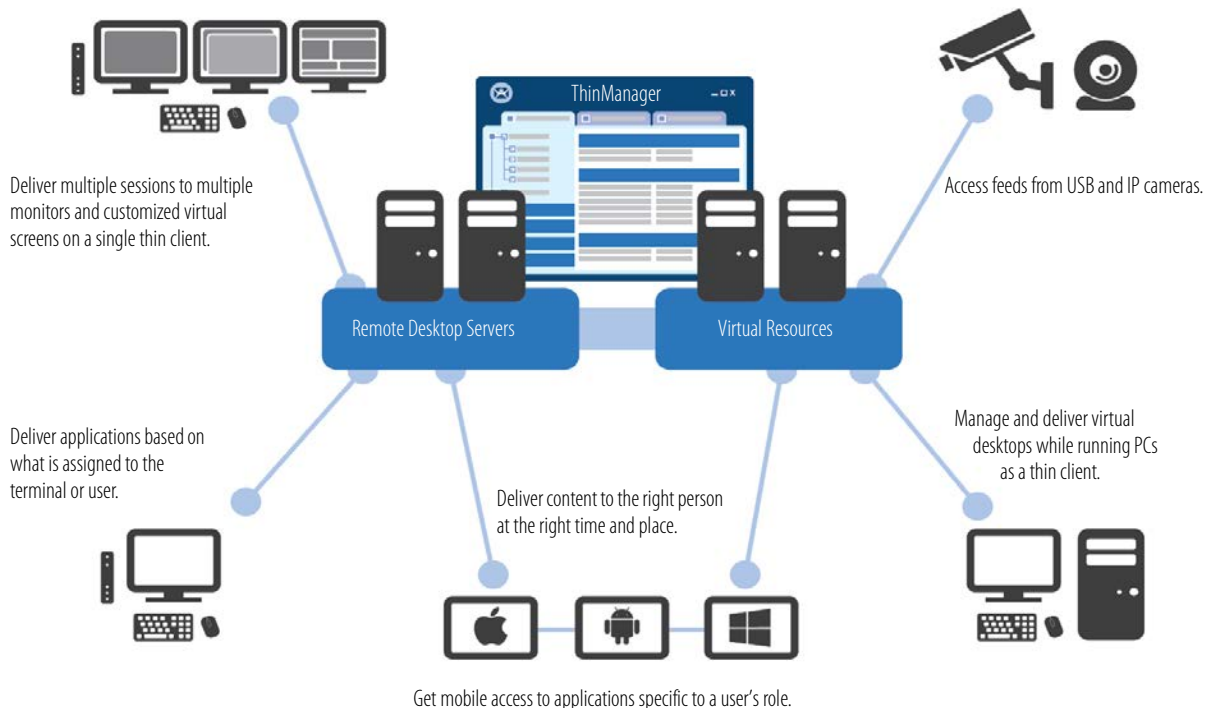
(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#)

ThinManager Server Options

The AppServ-OWS system element virtual image template is pre-configured with Remote Desktop Services (RDS). RDS includes the ThinManager® Server installation file. You can configure the AppServ-OWS as your ThinManager Server and deploy up to 10 OWS sessions to simplify the management of all devices and users.

ThinManager increases your productivity, visualization, mobility, and security from one easy-to-use, centralized, and scalable management platform.



Safely and securely deliver your content to any combination of device, user, and location with the following features:

- Boost productivity by reducing the time that is spent to manage computers
- Enhance visualization by delivering your content to where you need it and the way you want the content shown
- Extend security through encrypted communications, active directory, and secure thin clients
- Smart mobility where QR codes, Bluetooth, Wi-Fi, and GPS make sure that devices receive content in authorized areas

For more information, contact your Rockwell Automation representative.

Independent Workstation (IndWS)

The independent workstation (IndWS) combines the roles of the PASS, EWS, and OWS in one computer. This workstation can be used as a 'shadow system' for emergency purposes.

Table 13 - IndWS Traditional Requirements

Category	Requirement
Traditional infrastructure	The IndWS must be installed on workstation-class hardware. The following are sample specifications based on PlantPAx system characterization: <ul style="list-style-type: none"> • Intel Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 8 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows 10 operating system, 64 bit

AppServ-Info (Historian)

The Information Management server can include a historian application to collect, manage, and analyze data.

Table 14.1 - AppServ-Info (Historian) Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 2 vCPU • 4 GB vRAM min • 120 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Normal priority Resource pool⁽²⁾
Operating system	Windows Server 2016 operating system, 64 bit ⁽³⁾

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#)

(3) To install FactoryTalk View SE Historian software, version 4.6, with Windows Server 2016, you must install a patch from the Product Compatibility and Download Center at <http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page>.

Table 14.2 - AppServ-Info (Historian) Traditional Requirements

Category	Requirement
Traditional infrastructure	The Information Management server must be installed on server-class hardware: <ul style="list-style-type: none"> • Intel Xeon Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows Server 2016 operating system, 64 bit

AppServ-Info (VantagePoint)

The Information Management server can be used as a decision support tool by installing VantagePoint software.

Table 15.1 - AppServ-Info (VantagePoint) Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 2 vCPU • 4 GB vRAM min • 60 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Normal priority Resource pool⁽²⁾
Operating system	Windows Server 2016 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#).

Table 15.2 - AppServ-Info (VantagePoint) Traditional Requirements

Category	Requirement
Traditional infrastructure	The Information Management server must be installed on server-class hardware: <ul style="list-style-type: none"> • Intel Xeon Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows Server 2016 operating system, 64 bit

AppServ-Info (SQL)

An SQL server can be configured with the Information Management server. Software such as FactoryTalk AssetCentre, FactoryTalk VantagePoint, and FactoryTalk Batch use an SQL database to store and access process data. Additionally, the FactoryTalk Alarm and Event server uses an SQL database to store information.

Table 16.1 - AppServ-Info (SQL) Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 2 vCPU • 4 GB vRAM min • 120 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Normal priority Resource pool⁽²⁾
Operating system	Windows Server 2016 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#).

Table 16.2 - AppServ-Info (SQL) Traditional Requirements

Category	Requirement
Traditional infrastructure	The Information Management server must be installed on server-class hardware: <ul style="list-style-type: none"> • Intel Xeon Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows Server 2016 operating system, 64 bit

Asset Management Server (AppServ-Asset)

An asset management server (AppServ-Asset) is an extension to the PlantPAx system that adds maintenance and plant operations to the system. This server provides the following to improve resource availability:

- Disaster recovery controller data
- Diagnostics
- Calibration
- Real-time monitoring
- Auditing equipment
- Network health

Table 17.1 - AppServ-Asset Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 2 vCPU • 4 GB vRAM min • 60 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Normal priority Resource pool⁽²⁾
Operating system	Windows Server 2016 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#).

Table 17.2 - AppServ-Asset Traditional Requirements

Category	Requirement
Traditional infrastructure	The Information Management server must be installed on server-class hardware: <ul style="list-style-type: none"> • Intel Xeon Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows Server 2016 operating system, 64 bit

Batch Management Server (AppServ-Batch)

The batch management server (AppServ-Batch) offers comprehensive batch management, including recipe management, procedural control of automated and manual processes, and material management.

Table 18.1 - AppServ-Batch Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 2 vCPU • 4 GB vRAM min • 60 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Normal priority Resource pool⁽²⁾
Operating system	Windows Server 2016 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#)

Table 18.2 - AppServ-Batch Traditional Requirements

Category	Requirement
Traditional infrastructure	The Information Management server must be installed on server-class hardware: <ul style="list-style-type: none"> • Intel Xeon Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows Server 2016 operating system, 64 bit

Domain Controller

A domain controller is a server that responds to security authentication requests (log in, verify permissions, and so forth) within the Windows server domain. A domain grants you access to a number of network resources (such as applications and printers) with the use of a single user name and password combination. PlantPAX uses a domain controller to store user account information, authenticate users, and enforce security policies.

Domain authentication is recommended, whether it's an existing domain or a new one. Follow these guidelines for the domain controller:

- Domain controllers are required if there are 10 or more workstations or servers.
- The domain controllers are separate computers. Do not load any application software on a domain controller. Load all system application software on the other computers, such as the PASS, application server, OWS, and EWS.
- Microsoft support does not recommend applications to be run on a domain controller, and certainly not applications that require more than Authenticated User privileges to run.
- The domain controllers must be local to the system workstations and servers (within the local firewall) and not remote to the system.

Table 19.1 - Domain Virtual Requirements

Category	Requirement ⁽¹⁾
Virtual infrastructure	Required: <ul style="list-style-type: none"> • 1 vCPU • 4 GB vRAM min • 40 GB vHardDisk Recommended CPU and memory allocation: <ul style="list-style-type: none"> • Low priority Resource pool⁽²⁾
Operating system	Windows Server 2016 operating system, 64 bit

(1) All numbers and figures are referenced for initial sizing only. The values can be adjusted for system performance if needed.

(2) See [Resource Pool Allocation on page 69](#).

Table 20 - Domain Traditional Requirements

Category	Requirement
Traditional infrastructure ⁽¹⁾	The Information Management server must be installed on server-class hardware: <ul style="list-style-type: none"> • Intel Xeon Multicore processor (4 cores or greater) • 2.40 GHz CPU min • 4 GB RAM min • Ethernet card that supports redundant media if NIC-teaming is used (If you plan to use a motherboard-NIC make sure that it supports redundant media)
Operating system	Windows Server 2016 operating system, 64 bit

(1) A Microsoft Excel software license is required.

For redundancy purposes, we recommend that you use at least two domain controllers in the domain. These domain controllers replicate automatically to provide high availability and an online configuration backup.

Controller Characteristics

This section describes the components and sizing attributes for simplex, skid-based, and redundant controllers.

Simplex Controller

Non-redundant controllers are referred to as simplex controllers.

Table 21 - Simplex Controller Hardware Requirements⁽¹⁾

Category	Cat. No.
Process controller ⁽²⁾	ControlLogix® 1756-L71, 1756-L72, 1756-L73, or 1756-L74, or 1756-L75 controller
EtherNet/IP interface	<ul style="list-style-type: none"> For direct DLR connection: 1756-EN2TR For direct PRP connection: 1756-EN2TP For secure connections: 1756-EN2TSC Otherwise: 1756-EN2T, 1756-EN2F (no DLR support) For converting topology or media: 1783-ETAP, 1783-ETAP1F, 1783-ETAP2F (supports DLR topology)
ControlNet interface (if applicable)	<ul style="list-style-type: none"> 1756-CN2, 1756-CN2R 1756-CNB, 1756-CNBR

- (1) If environmental conditions warrant, you can use an extreme temperature controller, for example, the 1756-L74XT. Conformal coated options are also available for protection from harsh environments that can contain moisture and/or chemical contaminants.
- (2) As the PlantPAx system release 4.6 uses controller firmware revision 31, implementation requires use of the 1756-L7x controller family. PlantPAx system release 4.6 can co-exist with older generation controllers.

Table 22 - Simplex ControlLogix Controller Sizing

Category ⁽¹⁾	1756-L71	1756-L72	1756-L73	1756-L74	1756-L75 ⁽²⁾
User memory	2 MB	4 MB	8 MB	16 MB	32 MB
Total I/O recommended, max	375	750	1500	2250	2250
Recommended control strategies, max ⁽³⁾	60	125	250	450	450
Total control strategies @ 250 ms, max	60	125	250	250	250
Total control strategies @ 500 ms, max	60	125	250	450	450
Tags/sec delivered to data server, max	10,000	20,000	20,000	20,000	20,000

- (1) These values are recommended maximum limits. It's possible that achieving all of these values in a single controller is not doable. For more detailed sizing, you can use the PSE (see [page 16](#)).
- (2) The advantages to using the 1756-L75 controller is to maintain common spare parts with redundant systems or if you are doing some memory intensive storage not accounted for in the sizing model.
- (3) Recommended maximum control strategies are based on all controller strategies being simple regulatory control. See [Controller I/O Considerations on page 48](#).

Redundant Controllers

ControlLogix controllers support redundancy on ControlNet and EtherNet/IP networks. In a redundant controller system on PlantPAx, you need these components:

- Two 1756 chassis each set up the same with the following:
 - Number of slots
 - Modules in the same slots
 - Redundancy firmware revisions in each module
 - Two additional ControlNet or Ethernet nodes outside the redundant chassis pair
- One 1756-RM2 module per chassis with fiber media

Table 23 - Redundant Controller Hardware Requirements⁽¹⁾

Category	Cat. No.
Process controller	ControlLogix 1756-L73, 1756-L74, or 1756-L75 controller
Redundancy module	1756-RM2 ⁽²⁾
Ethernet interface	<ul style="list-style-type: none"> • For direct DLR connection: 1756-EN2TR • For direct PRP connection: 1756-EN2TP • For secure connections: 1756-EN2TSC • Otherwise: 1756-EN2T, 1756-EN2F (no DLR support) • For converting topology or media: 1783-ETAP, 1783-ETAP1F, 1783-ETAP2F (supports DLR topology)
ControlNet interface (if applicable)	<ul style="list-style-type: none"> • 1756-CN2, 1756-CN2R • 1756-CNB, 1756-CNBR

(1) If environmental conditions warrant, you can use an extreme temperature controller, for example, the 1756-L74XT. Conformal coated options are also available for protection from harsh environments that can contain moisture and or chemical contaminants.

(2) The PlantPAx system recommendation is to use only one redundant controller in a chassis with a 1756-RM2 redundancy module. While a 1756-RM2 module can support two controllers, the resulting performance of each controller is not easily predicted.

Make sure that each redundant controller has enough memory to store twice the amount of controller data and I/O memory to support program modifications. The increased memory usage in a redundant controller provides for a bumpless transfer during a switchover and makes sure the secondary Logix controller has the same values in its output image as the primary Logix controller. The extra memory helps prevent a switchover to a secondary controller with a mixture of old and new data memory.

When using the PlantPAx System Estimator, the PSE accounts for additional memory requirements required for redundancy as memory used.

Table 24 - Redundant ControlLogix Controller Sizing

Category ⁽¹⁾	1756-L73	1756-L74	1756-L75 ⁽³⁾
User memory	8 MB	16 MB	32 MB
Total I/O recommended, max	750	1500	2250
Recommended control strategies, max ⁽²⁾	125	250	450
Total control strategies @ 250 ms, max	120	120	120
Total control strategies @ 500 ms, max	125	220	220
Tags/sec delivered to data server, max	20,000	20,000	20,000

(1) These values are recommended maximum limits. It's possible that achieving all of these values in a single controller is not doable. For more detailed sizing, you can use the PSE (see [page 16](#)).

(2) Recommended maximum control strategies are based on all controller strategies being simple regulatory control. See [Controller I/O Considerations on page 48](#).

(3) The advantages to using the 1756-L75 controller is to maintain common spare parts with redundant systems or if you are doing some memory intensive storage not accounted for in the sizing model.

Skid-based Controller

The PlantPAx process automation system is a complete, scalable system, from single controller to a fully distributed set of equipment. You can easily integrate skid-based equipment into the overall system.

The CompactLogix™ controller platform offers a solution for skid-based equipment to be part of the overall PlantPAx system if the application requires the following:

- Control of multiple loops for temperature, pressure, flow, or level
- Operating as a subsystem with sequencing and automation
- Controlled as part of the overall process, accepting reference inputs, and delivering process variables to a supervisory controller

IMPORTANT Be aware of memory usage within the CompactLogix family when using Library objects. See the PlantPAx Distributed Control System Application Configuration User Manual, publication [PROCES-UM003](#), for guidance of how to configure controllers with the Library of Process Objects.

Table 25 - Skid-based Controller Sizing

Category ⁽¹⁾	CompactLogix 1769-L24ER-QBFC1B	CompactLogix 1769-L19ER-BB1	CompactLogix 1769-L33ER	CompactLogix 1769-L36ERM
User memory	0.75 MB	1.0 MB	2.0 MB	3.0 MB
Total I/O recommended, max	80	125	250	350
Recommended control strategies, max ⁽²⁾	10	15	30	45
Total control strategies @ 250 ms, max	10	15	30	45
Total control strategies @ 500 ms, max	10	3000	30	45
Tags/sec delivered to data server, max	3000	3000	3000	3000

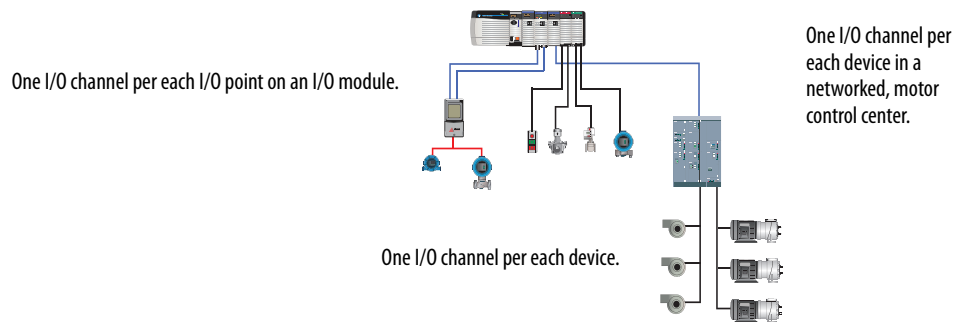
(1) These values are recommended maximum limits. To achieve all of these values in a single controller is likely not feasible. For more detailed sizing, you can use the PSE (see [page 16](#)).

(2) Maximum controller strategy is based on all controller strategies being simple regulatory control. See [Controller I/O Considerations on page 48](#).

Determining I/O Count

The I/O count for controller sizing is often determined directly from the application P&ID or plant design. On existing systems where only classic I/O (for example, 4...20 mA, 24V DC dry contacts, and so forth) is used, the I/O count can be determined by the number of I/O channels available on the I/O cards.

When you have integrated smart devices, such as drives or transmitters, on an EtherNet/IP network, any signal from the device used by your control strategy is considered an I/O point when using the PSE to size based on control strategies.



For example, an I/O count for a system comprised with the following:

- Two 8-channel 4...20 mA input cards
- One 8-channel 4...20 mA output cards
- Two 16-channel 24V DC dry-contact input cards
- One MCC with six drives
 - Each drive provides six signals to the control strategy: speed reference, actual speed, start, stop, running, and fault.
- Two Coriolis flowmeters on PROFIBUS PA, with each meter providing three signals for flow, temperature, and density.

We can roughly calculate the following I/O count for the example system:

4...20 mA AI	$2 \times 8 =$	16	
4...20 mA AO	$1 \times 8 =$	8	
24V DC DI	$2 \times 16 =$	32	
MCC	$6 \times 6 =$	36	(6 AI, 6 AO, 12 DI, 12 DO)
Smart instruments	$2 \times 3 =$	6	(6 AI)
Controller I/O count		<u>98</u>	

This example I/O count method enables you to enter I/O counts into the PSE to determine an appropriate number of control strategy footprints to determine sizing.

Sizing Control Strategies

A control strategy encompasses all of the application code required to implement a specific control function. The application code includes the I/O, controller code, display elements, and faceplates.

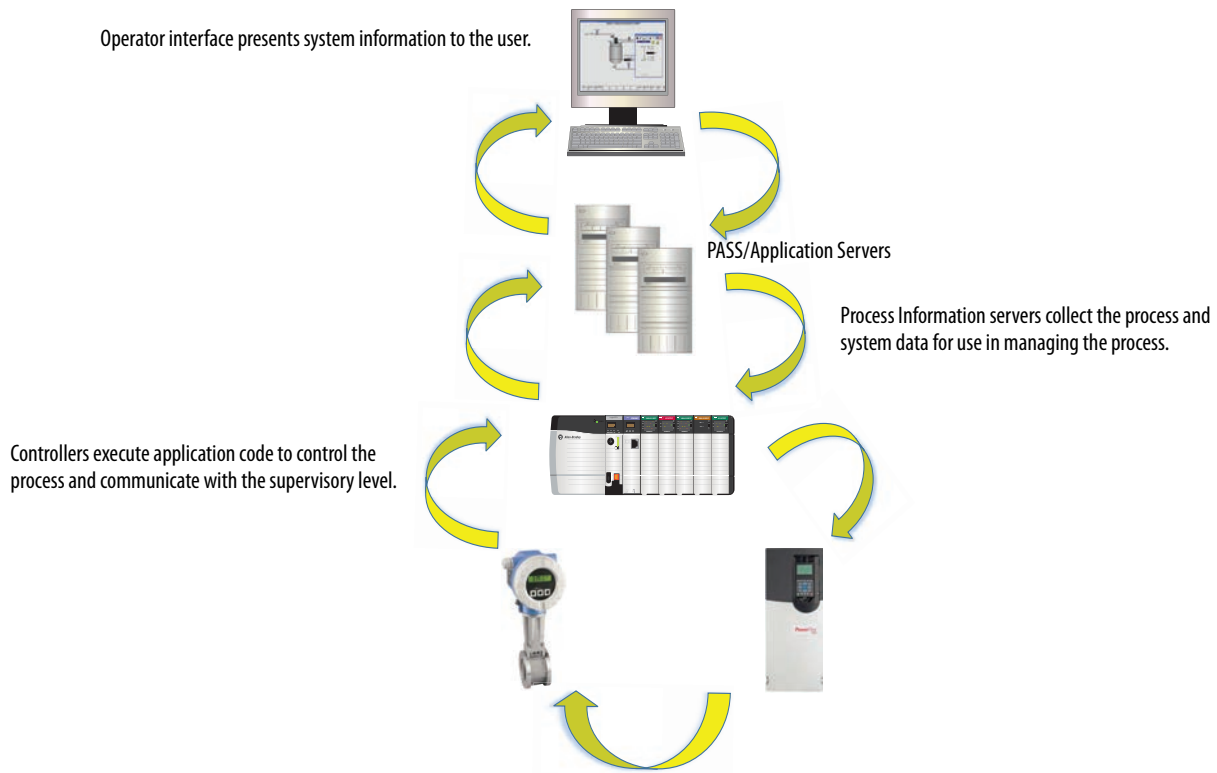
The Rockwell Automation Library of Process Objects contains a Library of Process Strategies. The process strategies include control strategies for I/O processing, device control, and regulatory control.

[Figure 2](#) shows devices that are being controlled and monitored in a loop via pre-engineered logic in Process objects. The object instructions in the controller send data to the HMI to visually evaluate on faceplates the function that is being performed.

By using the control strategy model, we are able to estimate the following system parameters:

- Potential alarms
- Visualization tags (affecting controller and server memory)
- Controller memory usage
- Controller execution time

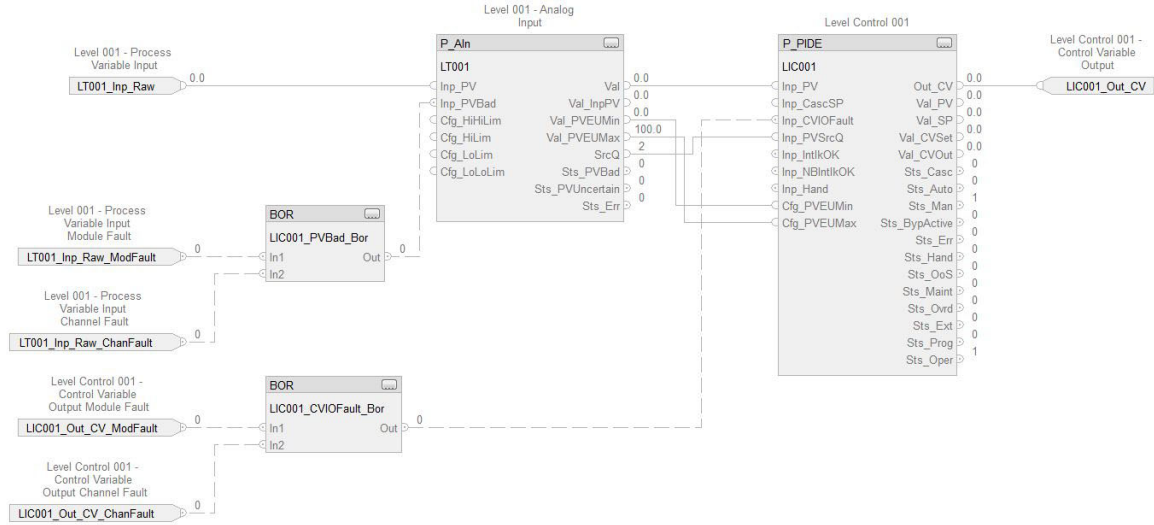
Figure 2 - Control Strategy Example



By estimating the size of control strategies, you have a better prediction of system performance.

The amount of resources consumed by the system elements to support a control strategy provides a ‘footprint’. To size systems, these base control strategies are established as system footprints in the PSE:

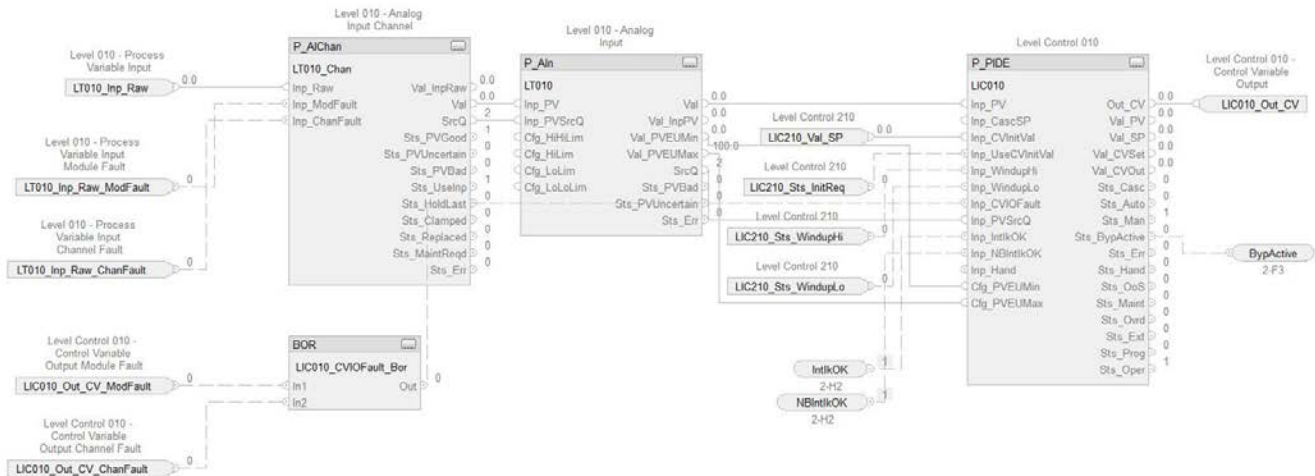
- **Simple regulatory:** This strategy is a simple PID loop with a single analog input and analog output.



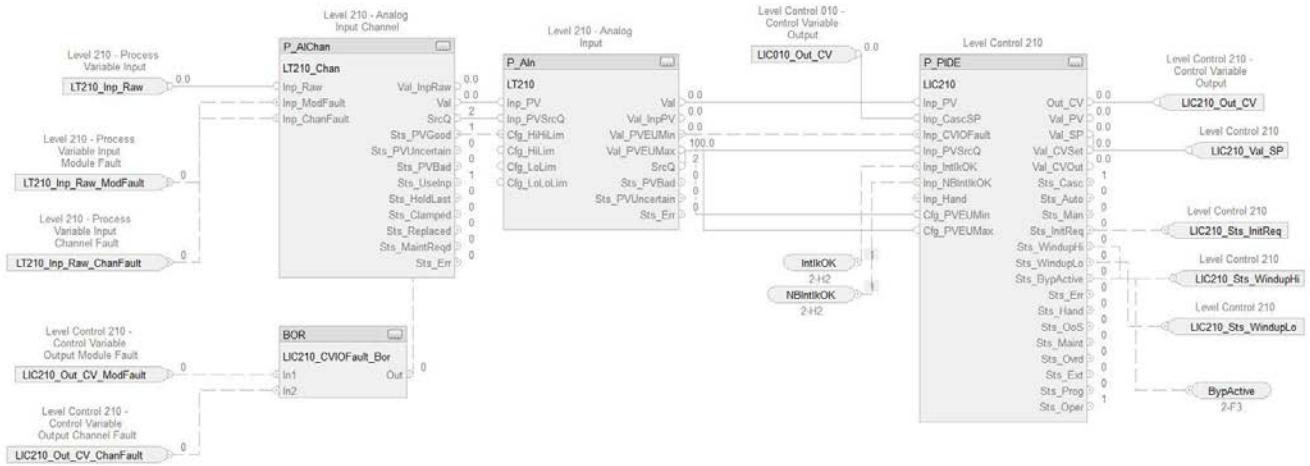
- **Complex regulatory:** This strategy is a more complex regulatory loop such as PID controllers in a cascade configuration with two analog inputs and one analog output.

There are two routines associated with the typical complex regulatory loop. Both routines are shown in the following examples.

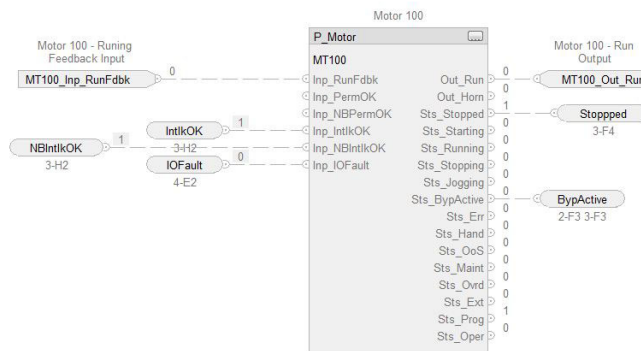
Complex Regulatory — Primary (outer loop)



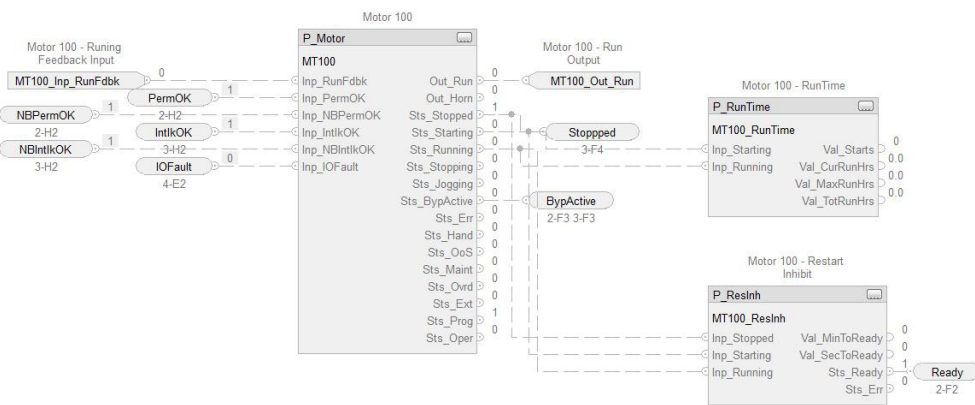
Complex Regulatory — Secondary loop (inner loop)



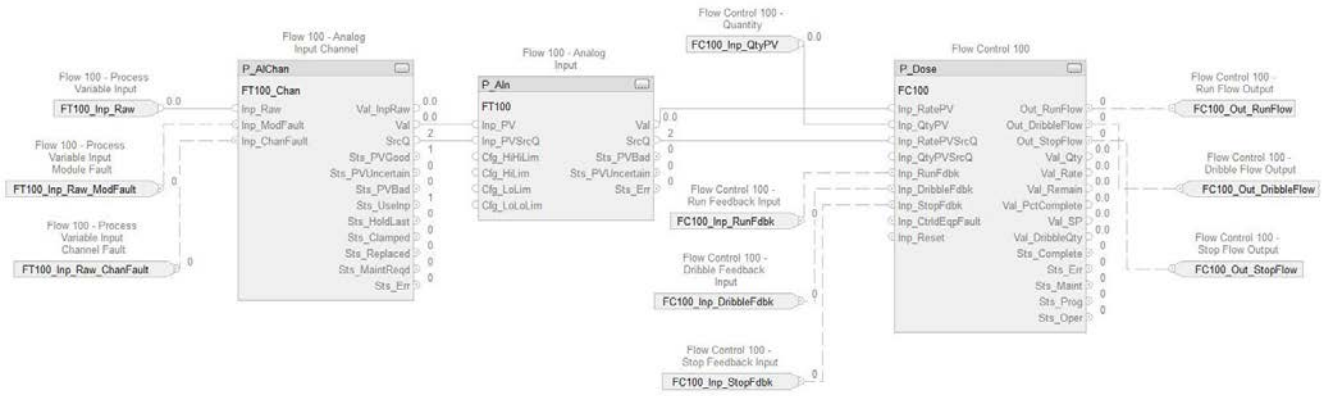
- **Simple 2-state discrete:** A simple valve or motor with interlock logic and as single digital input and output.



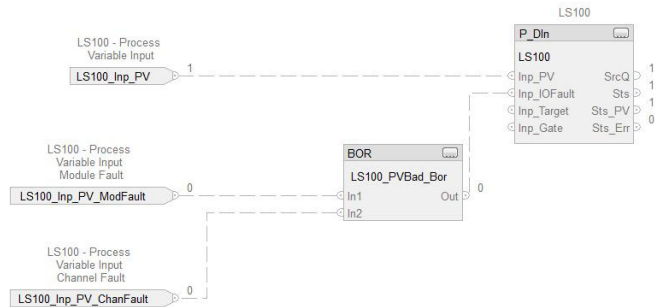
- **Complex 2-state discrete:** A valve or motor with complex interlock, permissive, and runtime logic, which can have up to two digital inputs and two digital outputs.



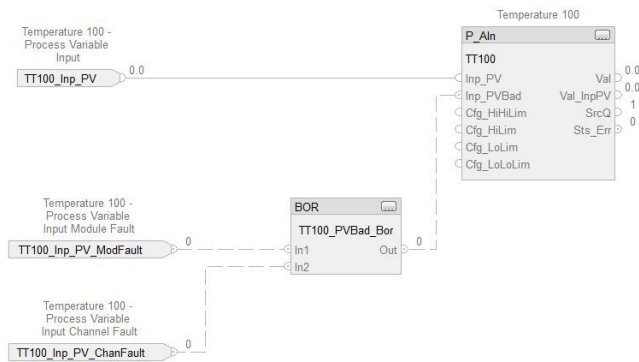
- **Complex regulatory non-PID:** This strategy can be a complex control strategy, such as a loss in weight feeder, which can include an analog input, valves, and a motor.



- **Digital indicator:** A digital input that is used for indication and/or alarm only.



- **Analog indicator:** An analog input that is used for indication and/or alarm only.



The examples are not a comprehensive list of the types of strategies used in an application. But, the strategies do provide a reasonable set of examples that can be used to approximate the loading of the majority of typical application code.

For each control strategy, we can estimate the footprint based on the following:

- **Visualization Tags:** The number of tags within the control strategy that can be visualized through a display or faceplate on the OWS (inclusive of operation, maintenance, and debug activities). This number affects server and controller memory utilization.
- **Historian Tags:** The number of tags within the control strategy that are typically brought into the historian. This number affects communication bandwidth, for example, active tags on scan/sec).
- **# of Potential Alarms:** The maximum number of alarms that can be defined. It is assumed that not every alarm is configured for use. The alarms that are used are configured in the server that contains the controller.
- **Memory, KB:** The amount of memory an instance of the control strategy and its associated tags uses inside of a simplex controller.
- **Execution time (microseconds):** The amount of controller CPU time it takes to run an instance of the control strategy under simulated loading (this is inclusive of the crossloading time for redundant controllers).

When a control strategy is instantiated, its impact to the controller is dependent on task rate for the task that contains a control strategy. A PID loop running every 250 milliseconds takes twice the CPU capacity as the same PID loop running every 500 milliseconds.

Redundancy Considerations

If you are using redundant controllers, the scan rate and memory use increases 1.5...2 times.

When you look at controller memory, you do not see the total memory usage for redundancy. You need to calculate the actual memory that is used.

For more information, see the ControlLogix Enhanced Redundancy System User Manual, publication [1756-UM535](#).

System Application Recommendations

This section contains integral information to configure controllers and other applications on your PlantPAx® system. We strongly recommend that you review these topics to be sure that the system is built and performing properly.

The following table lists where to find specific information.

Topic	Page
Controller Recommendations	38
FactoryTalk View Recommendations	52
Rockwell Automation Library of Process Objects	53
Additional Application Resources	54

Controller Recommendations

Logix controllers must be configured for optimal performance in process applications. From your EWS, follow these recommendations when configuring your controllers:

- Use periodic tasks **only**, with minimum number of tasks that are used to define execution speed, faster tasks getting higher priority (lower number).
- Set up monitoring of your controller utilization by using the L_CPU Add-On Instruction.
- Specify a requested packet interval (RPI) that is two times faster than task execution or based on inherent properties of the signal being measured. For example, a 500 ms task requires a 250 ms RPI on each I/O card, but temperature measurements can be set slower as they are unlikely to change that quickly.
- Limit the number of synchronous copy commands (CPS) as these commands act as an interrupt to the controller. Tasks that attempt to interrupt a CPS instruction are delayed until the instruction is done.
- Use Compatible Keying for configuring I/O module cards. However, in a validated environment that you can use an Exact Match for keying.

For more information, see Electronic Keying in Logix5000™ Control Systems Application Technique, publication [LOGIX-AT001](#).

[Table 26](#) shows memory and CPU recommendations for simplex and redundant controllers.

Table 26 - Simplex and Redundant Controller Memory Recommendations

Environment	Simplex Controllers	Redundant Controllers
Outside of production environment (before connecting FactoryTalk® View and Historian clients)	50% free memory to support communication and handling of abnormal conditions	>50% free memory at all times
	50% free CPU time to handle communication, abnormal conditions, and other transient loads	
In the production environment (while FactoryTalk View and Historian are connected)	25% free memory to support handling of abnormal conditions	>50% free memory at all times
	25% free CPU time	50% free CPU time

Task Configuration and CPU Utilization

The controller operating system is a preemptive, multitasking system that is IEC 61131-3 compliant. ControlLogix® and CompactLogix™ controllers define the schedule and priority of how programs are executed by using tasks.

Periodic Task Configuration

As we stated earlier, controllers that are configured for the PlantPAx system must use periodic tasks **only**. PlantPAx system sizing rules and tools are dependent on this specific execution configuration. For example, a controller is typically configured with three periodic tasks:

- Fast task (100...250 ms) for discrete control, such as motors and pumps
- Medium task (250...500 ms) for flow and pressure loops or analog inputs
- Slow task (1000...2000 ms) for temperature, phases, batch sequencing

As shown in [Table 27](#), a naming convention is used so that tasks are listed in the Studio 5000 Logix Designer® application in the order of execution period: fastest to slowest regardless of the tasks used. A dedicated task is created to monitor status of the controller and other tasks. We recommend that you delete tasks that are not used or create tasks that are required only by the application.

Table 27 - Recommended Task Configurations

Name	Type	Period (ms)	Priority (lower number yields higher priority)	Watchdog (ms)	Disable Automatic Output Processing
Task_A_50ms	Periodic	50	5	150	Unchecked
Task_B_100ms		100	6	300	
Task_C_250ms		250	7	750	
Task_D_500ms		500	8	1500	
Task_E_1s		1000	9	3000	
Task_F_2s		2000	10	6000	
Task_G_5s		5000	11	15,000	
Task_H_10s		10,000	12	30,000	
_Controller_Status		1000	13	3000	

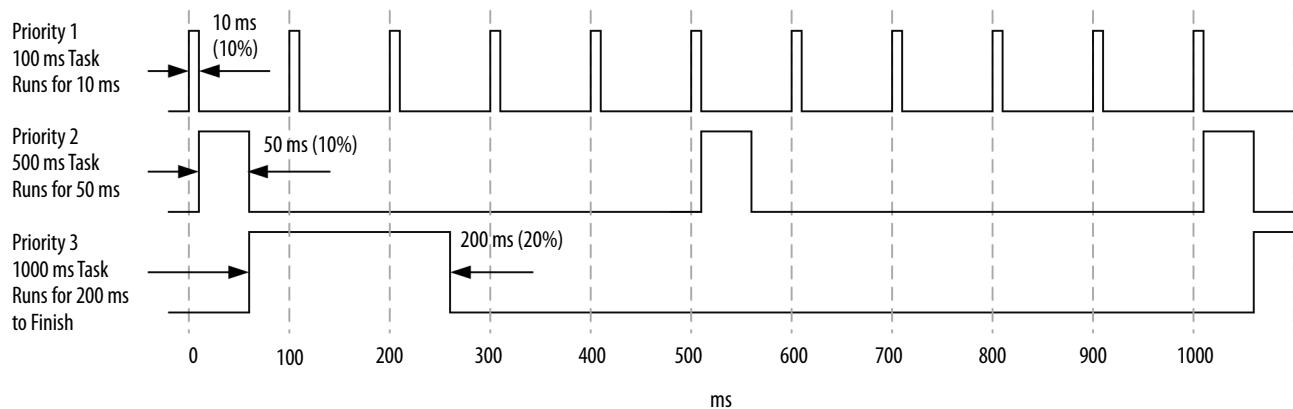
Each task that exists and is not inhibited has execution overhead. For sizing the PlantPAx system, we estimate this overhead as 1000 μ s per task. The PSE calculates CPU utilization by calculating the required CPU time for the selected quantity of control strategies in each task.

Although a project can contain multiple tasks, the controller executes only one task at a time. If a periodic or event task is triggered while another task is executing, the priority of each task tells the controller what to do. Make sure that your periodic task priorities are unique.

We recommend that the total execution time of all tasks is less than half the execution time of the lowest priority task or slowest task. For example, a fast loop in a 100 ms task that executes every 10 ms., your other code could not be greater than 50 ms.

As shown in [Figure 3](#), when you add the percentage for each task, the total is 40% (10 + 10 + 20), which is less than 50% of the slowest task.

Figure 3 - Task Execution Example



Follow these guidelines for task execution:

- **Never use continuous tasks.** Use periodic tasks only, with minimum number of tasks used to define execution speed, faster tasks getting higher priority (lower number).

A continuous task is created by default in the Studio 5000 Logix Designer application. This continuous task **must** be deleted. If left as the default, the continuous task runs in the background of the controller as the lowest priority task. Any controller CPU time that is not allocated to other operations or tasks is used to execute the continuous task.

When the continuous task completes, it restarts automatically and can be stopped only by a system overhead time slice. The system overhead time slice defines the amount of time the controller has available for communication. Thus, an overhead time slice interrupts the continuous task for communicating to HMI devices, processing MSG instructions, and alarm instruction processing.

This function limits the flexibility of the controller to apply resources to handle abnormal conditions in communication. However, the overhead time slice is **ignored** when a continuous task is not configured.

- Removal of the continuous task:
 - Improves predictability of the controller CPU availability for communication to the system
 - Provides a more accurate view of the controller loading at runtime. With continuous task, controller loading is always 100%
 - Reduces the amount of task switching that improves overall application and system performance
- Time-based operations, such as a PID algorithm, do not function accurately when run in a continuous task
- Do not use more than three periodic tasks to maintain optimum CPU performance. Batching can require more tasks, but we recommend that periodic tasks be event tasks if not in a redundant controller.

Estimate Controller CPU Utilization

The PSE uses a sizing model to estimate controller CPU utilization in a production environment. This calculation is as follows:

- Task Execution time is $1000 \mu\text{s} + \text{sum of control strategy execution times assigned to the task}$
- Total controller execution time is a summation of task execution times normalized to the slowest task. For example:

$$250 \text{ ms Task Execution Time} * 4 + 500 \text{ ms Task Execution Time} * 2 + 1000 \text{ ms Task Execution time (if using 3 tasks: 250 ms, 500 ms, and 1000 ms)}$$
- Tasks without assigned control strategies are ignored. It is assumed that these tasks are not created or are inhibited in the controller.
- CPU utilization is a percentage of the controller execution time/slowest task rate

Higher priority tasks interrupt lower priority tasks if needed to run. When the task interrupted is in progress, we call this task switching. A task switch adds execution overhead as well. If your faster tasks have higher priority, task switching does not occur in properly sized controllers. (A properly sized controller is when the total execution time of all of the tasks is less than half of the fastest task rate.) Hence, the PSE sizing model does not account for task switching when estimating utilization.

When periodic tasks have the same priority, the controller task switches every 1 ms until tasks are completed, each switch adding 250 μ s. This functionality is why it's important that periodic tasks are given separate priorities. In Logix, you have up-to 15 user-defined priorities.

Keep in mind we want CPU load in a production environment to be 75% or less for a Simplex controller. For a redundant controller, we want CPU load in a production environment to be 50% or less.

It's important to keep 25% CPU capacity as reserve to handle online edits, data server switchover, and so forth. The PSE provides a warning when the calculated CPU load approaches the stated limits.

A task overlap is when a task is interrupted too frequently or too long that it doesn't complete its execution before it is triggered again. Avoid task overlaps that can be monitored by using the L_TaskMon Add-On Instruction.

For more general information on ControlLogix execution capabilities, see the Logix5000 Controllers Design Considerations Reference Manual, publication [1756-RM094](#).

CPU Utilization Example Estimations

The following examples show how configuration affects the sizing model and actual CPU utilization. For all scenarios, we are assuming a simplex 1756-L7x controller that is running 80 PID loops (800 μ s execution per loop).

Example 1: 80 PID loops in a single periodic task @ 100 ms:

$$\text{Task Execution Time: } 1000 \mu\text{s} + (80 \text{ PID loops} * 800 \mu\text{s}) = 65,000 \mu\text{s}$$

$$\text{CPU} = 65,000 \mu\text{s} / 100,000 \mu\text{s} = 65\% \text{ load}$$

Example 2: 80 PID loops evenly split for two periodic tasks, first @ 50 ms, second @ 250 ms:

$$\text{Task 1 Execution Time: } 1000 \mu\text{s} + (40 \text{ PID loops} * 800 \mu\text{s}) = 33,000 \mu\text{s}$$

$$\text{Task 2 Execution Time: } 1000 \mu\text{s} + (40 \text{ PID loops} * 800 \mu\text{s}) = 33,000 \mu\text{s}$$

$$\text{Total Execution per 250 ms} = ((33,000 \mu\text{s} * 5) + 33,000 \mu\text{s}) = 198,000 \mu\text{s}$$

$$\text{CPU Utilization: } 198,000 \mu\text{s} / 250,000 \mu\text{s} = 79.2\%$$

In this scenario, loading is not okay (> 75%). However, this example matches the PSE calculation that gives you a warning.

Example 3: Loops evenly split to 10 periodic tasks @ 100 ms and different priorities:

$$\text{Task Execution per task: } 1000 \mu\text{s} + (8 \text{ PID Loops} * 800 \mu\text{s}) = 7400 \mu\text{s}$$

$$\text{Total Execution time: } 10 * 7400 \mu\text{s} = 74,000 \mu\text{s}$$

$$\text{CPU} = 74,000 \mu\text{s} / 100,000 \mu\text{s} = 74\%$$

In this example, loading is near the desired limit but still okay (<75%). The PSE assumes proper task configuration, but it doesn't account for the impact of the additional task overhead or the task switching (approximate 20% increase in CPU load).

The goal of the PlantPAx system recommendations and PSE is to make it simple to size the system and provide assurance that everything works as expected. This is a critical need. While the examples are simple; they illustrate how configuration can impact load.

Monitor Controller CPU Utilization

Free process controller CPU time is required to handle communication, abnormal conditions, and other transient loads. Therefore, it's important to consider CPU utilization when implementing the application code.

When defining the application code, make sure that the CPU utilization of the process controller can accommodate these values:

- In the development environment, CPU utilization is recommended to be less than 50% to allow for the additional CPU load that is experienced in the production environment.
- During the operation of the system, monitor the CPU utilization, especially after a change to the application code, and it cannot exceed 75% for a Simplex controller or 50% for redundant controllers.
- During the design of the application code, it's important to account for software components, such as FactoryTalk View or Historian. The software is actively collecting data from the controller so be sure that CPU utilization is less than stated limits to allow for communication with the supervisory system elements (EWS, OWS, Information server).

There are two options for reviewing controller loading:

- Task Monitor - Available from the Studio 5000 Logix Designer application on the EWS. If more than one task monitor is viewing a controller simultaneously, its possible controller data is not reporting correctly.
- Logix Controller CPU Utilization (L_CPU) Add-On Instruction - See the Rockwell Automation Library of Logix Diagnostic Objects Reference Manual, publication [PROCES-RM003](#).

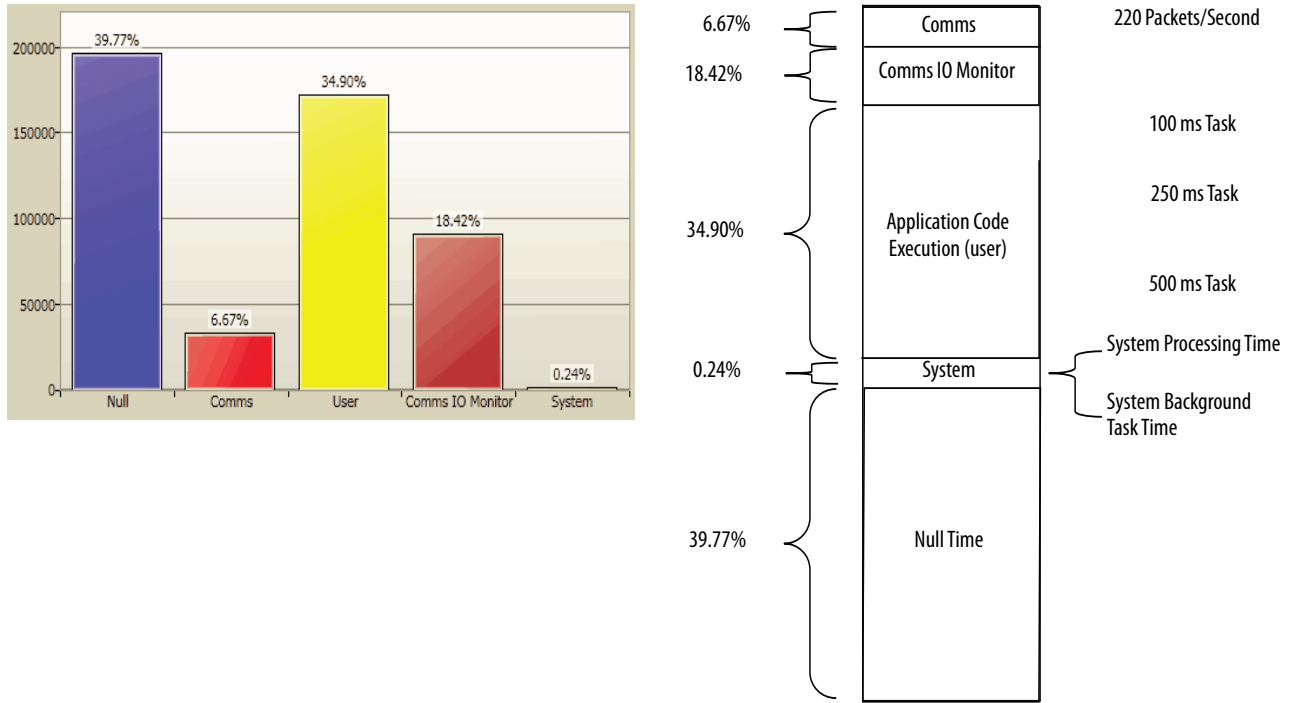
IMPORTANT The L_CPU instruction is the preferred method to monitor controller performance because the logic monitors the Logix controller that is being executed. The controller is used in place of, or in addition to, the task monitor to provide more system-specific controller loading information.

Controller loading includes controller CPU utilization, communication usage, memory usage, and task scan times. This data provides information for diagnosing communication, controlling responsiveness issues, or in tuning the performance of control tasks for optimum controller performance.

The diagram in [Figure 4](#) shows a properly loaded Simplex controller for the following:

- Application code execution is less than 50% CPU
- Total execution including comms is less than 75% CPU

Figure 4 - CPU Utilization



For more information, see the Rockwell Automation Library of Logix Diagnostic Objects Reference Manual, publication [PROCES-RM003](#).

Use of Program Parameters

IMPORTANT The number of program parameters—Input, Output, InOut, Public—are limited to 512 parameters per program.

Input and Output parameters define the data that is passed by value into or out of an executing program. Because these parameters are passed by value, their value cannot change during the execution of the program.

We recommend that you use program parameters to exchange data between your programs and between programs and I/O. Program parameters simplify I/O mapping and can be modified online.

Tag and Memory Allocation

[Table 28](#) shows the memory of a controller is divided into several areas depending on the type of controller.

Table 28 - Controller Memory Allocation

Controller Type	Storage	Memory
1756 ControlLogix 1768 CompactLogix	I/O tags	I/O memory
	Produced/consumed tags	
	Communication via message (MSG) instructions	
	Communication with workstations	
	Communication with polled (OPC/DDE) tags that use RSLinx® software ⁽¹⁾	
	Tags other than I/O, produced, or consumed tags	Data and logic memory
	Logic routines (for example, control strategies)	
	Communication with polled (OPC/DDE) tags that use RSLinx® software ⁽¹⁾	
	UDT and Add-On Instruction definition	
1769-L2x CompactLogix 1769-L3x CompactLogix 1769-L19x CompactLogix	These controllers do not divide their memory. They store all of the elements in one common memory area	

(1) To communicate with polled tags, the controller uses both I/O data and logic memory.

When you configure displays, we recommend that you use direct tag referencing to access data from the controller directly without creating an HMI tag. This requires fewer configuration steps and is easier to maintain.

Use DINT and REAL data types whenever possible. Mathematical routines in the controller consume less CPU resources when DINT and REAL data types are used.

A user-defined data type (UDT) or Add-On Instruction data type lets you organize data to match your machine or process. Additional advantages of using a UDT or an Add-On Instruction include the following:

- One tag contains all the data related to a specific system activity. This keeps related data together and easier to locate, regardless of its data type.
- Each individual piece of data (member) gets a descriptive name. This automatically creates an initial level of documentation for your logic.
- You can use the data type to create multiple tags with the same data layout.

For example, you can use a UDT to store all the parameters for a tank, including temperatures, pressures, valve positions, and preset values. Create a tag for each of your tanks based on that data type.

You can create a UDT when online or offline. However, you can modify an existing UDT definition when offline only.

General Recommendations

- Define tags in arrays and a UDT whenever possible. Tag data that is packed into an array is sent more efficiently to the HMI than if you were using scattered tag data.
- When defining a UDT, group BOOL tags together whenever possible. Inside the controller memory, BOOL tags must align on 8-bit boundaries. But, if they are placed adjacent to each other they can share bytes and use less memory and communication bandwidth.
- BOOL data types that are not members of an array or structure use 4 bytes of controller memory. When communicating multiple BOOL tags between controllers or to displays, use a UDT or array to consolidate multiple BOOL tags into a single word.
- Define a tag naming convention that minimizes the length of the tag names. Long tag names can decrease the bandwidth available for communicating data.

For more information, see the Logix5000 Controllers I/O and Tag Data Programming Manual, publication [1756-PM004](#).

Estimate Controller Memory Utilization

The PSE uses a sizing model that is based on control strategies to estimate controller memory utilization in a production environment. There are three sources of memory that comprise this sizing model:

- Memory for base definitions - Base definition memory varies depending on the amount of Add-On Instruction and UDT definitions in the project. Loading all of the Rockwell Automation Library definitions takes over 1 MB of memory, while loading the most common objects take much less memory. By default, the PSE assumes a base load of 380 KB. This is adjustable in the PSE system preferences, if needed.
- Memory used by control strategies - See [Monitor Controller CPU Utilization on page 42](#).
- Memory to support communication - The defined control strategies have a number of visualization tags for each control strategy (inclusive of operation, maintenance, and debug activities). During operation, the controller uses controller memory to manage the connections to these tags as they are accessed. The amount of memory used varies, but the PSE estimates 16 bytes per tag.

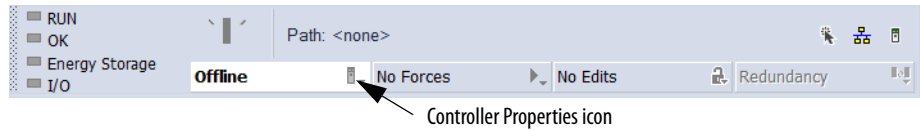
When controller redundancy is used, memory usage increases and additional spare capacity is required to allow for runtime edits. The PSE sizing model accounts for these needs by increasing the estimated amount of memory.

Estimate Memory Information Offline

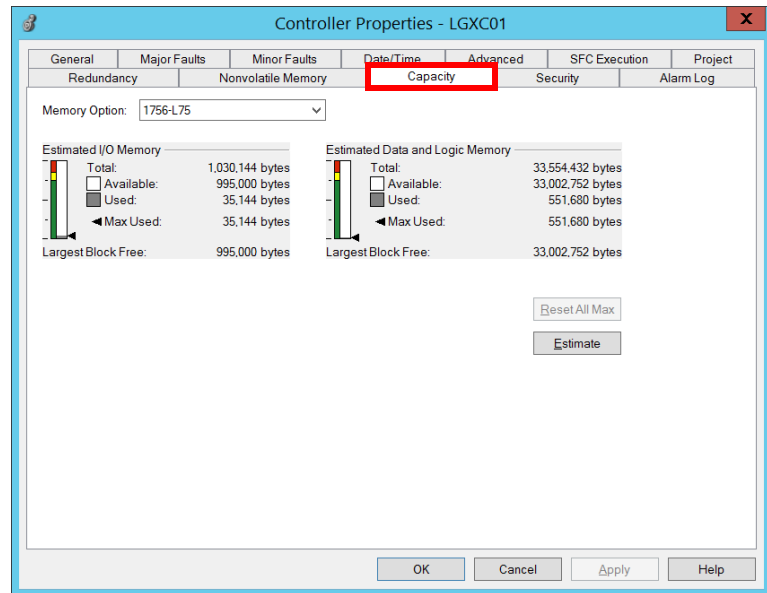
To estimate how much controller memory your project requires, use the Capacity tab of the Controller Properties dialog box. For each of the memory areas of your controller, the dialog box provides an estimate number of bytes for the following:

- Free (unused) memory
- Used memory
- Largest free contiguous block of memory

1. From the Studio 5000 Logix Designer application, click the controller properties icon to access the Controller Properties dialog box.



2. Click the Capacity tab.



In the 'Estimated Data and Logic Memory' section, view the memory information since the last estimate.

3. Click Estimate to re-estimate the amount of controller memory.

View Runtime Memory Information

When online with a controller, the Capacity tab shows the actual memory usage of the controller. While the controller is running, it uses additional memory for communication. The amount of memory the controller needs varies depending on the state of the communication.

The Capacity tab of the controller includes a Max Used entry for each type of memory. The Max Used values show the peak of memory usage as communication occurs.

Click Reset All Max on the Capacity tab to reset values.

For more information, see Chapter 2 in the Logix5000 Controllers Information and Status Programming Manual, publication [1756-PM015](#).

Monitor Controller Memory Utilization

We recommend that 50% of available logic and data memory to be reserved for design time of communication, online editing, and handling of abnormal events. For simplex controllers, we recommend maintaining 25% of available logic and data memory to handle online editing and connection handling in operation.

For redundant controllers, we recommend that you maintain greater than 50% of logic and data memory available to handle online changes.

Memory usage can be monitored by using the L_CPU Add-On Instruction (see [page 42](#)) or the Studio 5000 Logix Designer application (see [page 46](#)).

Controller-to-Controller Communication

There are two ways to set up communication between controllers:

- Produced/consumed tags
- Messages

Table 29 - Compare Messages and Produced/Consumed Tags

Method	Benefits	Considerations
Read/write message	<ul style="list-style-type: none"> • Programmatically initiated • Communication and network resources used when needed only • Support automatic fragmentation and reassembly of large data packets, up to as many as 32,767 elements • Some connections can be cached to improve retransmission time • Generic CIP™ message useful for third-party devices 	<ul style="list-style-type: none"> • Delay can occur if resources are not available when needed • MSG instruction and processing impacts controller scan (system overhead time slice) • Data arrives asynchronous to program scan (use a programmatic handshake or an UID/UIE instruction pair to reduce impact, no event task support) • Can add additional messages online in Run mode
Produced/consumed tag	<ul style="list-style-type: none"> • Configured once and sent automatically based on requested packet interval (RPI) • Multiple consumers can simultaneously receive the same data from a single produced tag • Can trigger an event task when consumed data arrives • ControlNet resources are reserved up front • Does not impact the scan of the controller 	<ul style="list-style-type: none"> • Support limited to Logix5000 and PLC-5® controllers, and the 1784-KTCS I/O Linx and a few third-party devices • Limited to 500 bytes over the backplane and 480 bytes over a network • Must be scheduled when using ControlNet • Data arrives asynchronous to program scan (use a programmatic handshake or CPS instruction and event tasks to synchronize) • Connection status must be obtained separately • On an EtherNet/IP network, you can configure produced/consumed tags to use multicast or unicast connections • Cannot create additional produced/consumed tags online in Run mode.

We recommend that you use an array or user-defined tag for produce-consume communication. As produce/consumed tags cannot be edited online, make sure

to include extra capacity that can be populated by mapping logic so additional information can be shared as needed without requiring a download.

Table 30 - Process Controller Recommendations

Category	Recommendation
Produced and consumed tags	<ul style="list-style-type: none"> • A single produced and consumed tag can contain multiple combinations of data. For example, up to 120 REALs or 100 REALs and 640 BOOLs. • Group produced and consumed tags into a user-defined structure to reduce the number of connections to the controller. • Use the same data type for the produced and consumed tags in each controller that uses that data. • Make sure the number of consumers configured for a produced tag is the actual number of controllers consuming it to reduce the number of connections to the controller. • On produced tags, the maximum consumers configured counts against your total connection count so make it the actual number of connections or set it at the expected number to be in the future. • Always use a handshake when transferring data between controllers through health data or manually configured diagnostics.
Messaging	<ul style="list-style-type: none"> • There is a maximum of 32 cached message connections from message instructions and block transfers combined. • Cache messages when the message needs only to be maintained all the time. If a message instruction is infrequent, then make sure cached connection is unchecked. • Always use message reads, never do message writes. This makes it easier to troubleshoot code. • When messaging between controllers, use DINTs where possible. • Message instructions consume a connection when it is a CIP data table read, write, or generic (if selected).

Controller I/O Considerations

The requested packet interval (RPI) is a user-configured interval of time that determines when the data from an I/O module is sent to a controller. This interval defines the slowest rate that a module multicasts its data. When the specified time frame elapses, the module multicasts data to the controller.

Setting the RPI faster (specifying a smaller number) than what your application needs wastes network resources, such as ControlNet schedule bandwidth, network processing time, and CPU processing time.

Table 31 - I/O Considerations

Category	Consideration
I/O configuration properties	<ul style="list-style-type: none"> • Specify an RPI that is two times faster than task execution: <ul style="list-style-type: none"> – 250 ms task requires a 125 ms RPI – 100 ms task requires a 50 ms RPI • Often RPI defined by the inherent properties of the signal being measured. For example temperature measurement changes slower than pressure. • Use compatible module for keying option on I/O cards configuration. In a validated environment, you can use an exact match for keying.
ControlNet network	<ul style="list-style-type: none"> • Set the network update time (NUT) equal to or less than the fastest RPI of the I/O modules and produced-consumed tags in the system. For example, if your fastest RPI is 10 ms, set the NUT to 5 ms for more flexibility in scheduling the network. • Set the RPI to a binary multiple of the NUT. For example, if the NUT is 10 ms, select an RPI such as 10, 20, 40, 80, 160 ms, and so forth. • Use unscheduled I/O to be able to add ControlNet modules at runtime. (See I/O Module Runtime/Online Considerations.) Dedicate one ControlNet network to I/O communication only. • Unscheduled I/O requires a connection to each module, so the number of modules supported depends on the number of connections supported by the communication module. On the dedicated I/O network, make sure of the following: <ul style="list-style-type: none"> – No HMI traffic – No MSG traffic – No programming workstations – No peer-to-peer interlocking in a multi-processor system architecture
EtherNet/IP network	See Chapter 5 for infrastructure recommendations.

I/O Module Runtime/Online Considerations

[Table 32](#) shows some of the modules that you can add to the Controller Organizer in the Logix Designer application when the controller is in Run mode.

Table 32 - Online Addition of Module and Connection Types

Module Type and Connection Method	In Local Chassis		Remote Via a ControlNet Network				Remote Via an EtherNet/IP Network		Configure Hold Last Output State
	Offline	Runtime	Offline		Runtime		Offline	Runtime	
			Scheduled	Unscheduled	Scheduled	Unscheduled			
Motion - direct	Yes	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Digital - direct	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes - 1756 I/O digital output modules
Digital - rack-optimized	N/A	N/A	Yes	No	Yes	No	Yes	Yes	Yes - 1756 I/O digital output modules
Analog - direct	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Generic third-party - direct	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	N/A
1756-DNB	Yes	No	Yes	No	No	No	Yes	Yes	N/A
1756-DHRIO	Yes	No	Yes	No	No	No	Yes	Yes	N/A
1756-CNx - no connection	Yes	Yes	Yes	Yes	No	Yes	N/A	N/A	N/A
1756-CNx - rack-optimized	N/A	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Generic ControlNet third-party - direct	N/A	N/A	Yes	Yes	No	Yes	N/A	N/A	N/A
1788HP-EN2PA-R	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes	N/A
1788HP-CN2PA-R	N/A	N/A	Yes	Yes	No	Yes	N/A	N/A	N/A
1715 Redundant I/O	No	No	No	No	No	No	Yes	Yes	N/A
1756-ENx - no connection	Yes	Yes	N/A	N/A	N/A	N/A	Yes	Yes	N/A
1756-ENx - rack-optimized	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes	N/A
Generic EtherNet/IP third-party - direct	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes	N/A
1794 FLEX™ I/O	N/A	N/A	Yes	Yes	No	No	Yes	No	Yes - Analog output modules only
1734 POINT I/O™	N/A	N/A	Yes	Yes	No	No	Yes	No	Yes ⁽¹⁾

(1) When you lose communication to the controller, POINT I/O™ ignores the last output state configuration, and sets the outputs to zero.

When you design your network, review these considerations if you are going to add I/O modules at runtime.

Table 33 - Adding I/O Modules at Runtime

Category	Consideration
I/O modules	Currently, 1756 I/O and 1715 modules can be added at runtime. Leave space in the local chassis, remote chassis on a ControlNet network, or remote chassis on an EtherNet/IP network for the I/O modules that you want to add.
Input transmission rate	Make sure each RPI works for the data you want to send and receive. Make sure the added I/O does not depend on change of state data. When adding discrete input modules, unselect Change of State to reduce network traffic.
Network topology	On a ControlNet network, install spare taps so you can add 1756 I/O modules at runtime and not disrupt the network. Each tap must be terminated so as not to ground out the system. Check the ControlNet system requirements to determine how many spare taps your network can support. <ul style="list-style-type: none"> In a ControlNet network with redundant cabling, you can break the trunk and add a tap, but redundant cabling is lost during the module installation. In a ControlNet ring, add a new drop off the rung or add new nodes off the coax and disrupt only part of the network. You could remove a single existing node and add a repeater off the drop. Then read the existing node and add any new nodes off of the new segment. On EtherNet/IP, reserve some connection points on the switch so that you can connect additional nodes or switches in the future.
Network configuration	On a ControlNet network, plan communication that can be scheduled or can be unscheduled. On an EtherNet/IP network, all communication is Immediate and occurs based on a module's RPI (also referred to as unscheduled). If you know that you need a new chassis with digital modules in the future, configure the network and add it to the I/O configuration tree as rack-optimized. Inhibit the communication adapter until you need the chassis.
Network performance	You can add I/O modules at runtime until you impact the capacity of the communication module. Make sure that you have sufficient communication modules for the connections you plan to add.

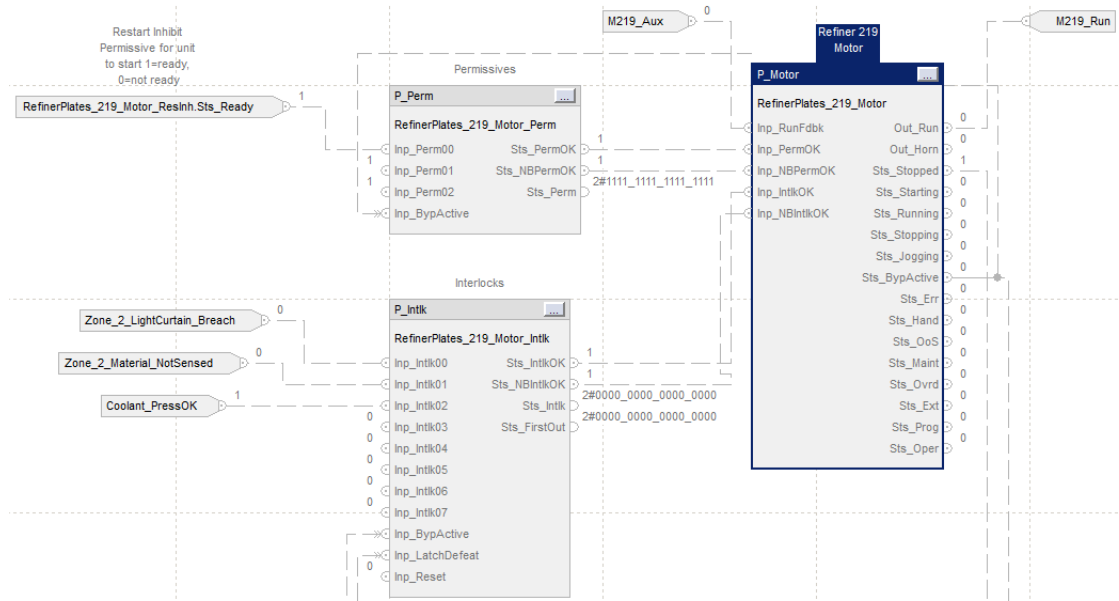
See the Logix5000 Controllers Design Considerations Reference Manual, publication [1756-RM094](#), for more information.

Using Add-On Instructions

Add-On Instructions are reusable code objects that contain encapsulated logic. Each object is provided as an importable Add-On Instruction that can be shared between projects to create a common library of instructions to accelerate engineering from project to project. Add-On Instructions also can be signed with a specific date and time, so that revisions of Add-On Instructions can be managed between projects.

This functionality lets you create your own instruction set for programming logic as a supplement to the instruction set provided natively in the ControlLogix and CompactLogic firmware.

Add-On Instructions are defined once in each controller project, and can be instantiated multiple times in your application code as needed. In the Studio 5000 Logix Designer application, you can view routines within an Add-On Instruction instance online, animated with just the instance value as if it were an individually defined routine.



Add-On Instructions can be source protected. Source protection does not let you edit the definition of an instruction without a source key. To protect intellectual property, routines and local tags also can be hidden on protected Add-On Instructions.

Like a native instruction, the definition of an Add-On Instruction cannot be modified online. Therefore, we do **not** recommend the use of Add-On Instructions to implement control strategies. Control strategies are best developed in a program, built from Add-On Instructions, and native instructions. It's also important that you fully test all configuration options before implementing an Add-On Instruction on your production system.

The Rockwell Automation Library of Process Objects uses Add-On Instructions. For related information, see [page 53](#) and [page 59](#).

FactoryTalk View Recommendations

For implementing FactoryTalk View SE software for a process system operator interface, follow these guidelines:

- Run FactoryTalk View Studio software on the EWS during runtime.
- Configure the FactoryTalk View SE servers to start automatically on startup on the PASS. Let the servers fully start up before starting the client computers.
- In FactoryTalk View Studio software, areas can be used to organize your distributed system. Configure an area for each server of any type. Areas can contain areas. However, do not put more than one server in the root location of an area. This helps prevent potential performance problems. In addition, this name hierarchy can be visible externally, such as in the historian or alarm database.
- Use global objects to display the status of a control module or device when the information to be displayed is stored in a tag structure within Logix (for example, UDT or Add-On Instruction) and there are many identical instances. A global object is a display element that is created once and can be referenced multiple times on multiple displays in an application. When changes are made to the original (base) object, the instantiated copies (reference objects) are automatically updated. Use of global objects, in conjunction with tag structures in the ControlLogix system, can help to make sure of consistency and save engineering time.
- When using global objects, observe the following recommendations to be sure of optimal display call-up performance:
 - Base global objects are stored in FactoryTalk View in displays (.gfx files). If you have a large number of base global objects defined, do not put them all in a single display. Limit the number of global object instances on a single display to 60 or less.
 - As global objects can be instantiated multiple times, the performance impact of their design is amplified by their number of instances. Therefore, design global objects carefully to reduce the number of objects, expressions, and animations that are used within the base object.
- We do not recommend the use of data logs. If necessary, use data logs for short-term data retention only.
- Do not create derived tags that depend on the results of other derived tags. Derived tag processing is not sequential.
- Avoid use of VBA when possible. VBA runs as a single-threaded process so it's possible the application written in VB does not allow the HMI to perform predictably.

Rockwell Automation Library of Process Objects

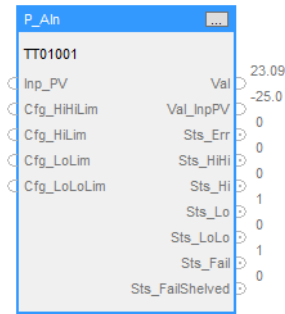
The Rockwell Automation Library of Process Objects is a predefined library of controller code (Add-On Instructions), display elements (global objects), and faceplates that let you quickly assemble large applications with proven strategies, rich functionality, and known performance.

Step 1: Import the Library into the project.

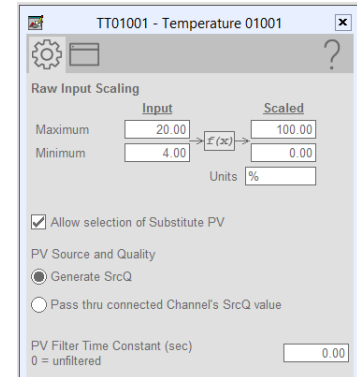
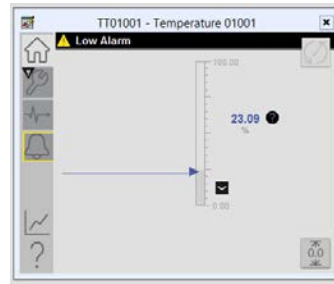
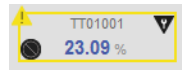
Step 2: Drop and configure the Add-On Instruction.

Step 4: Access small footprint 'quick' faceplates from the global object at Runtime for basic operator control.

Step 5: Access the full faceplate from the global object at Runtime for control, maintenance, and configuration.



Step 3: Drop the global object on the display and assign it to an Add-On Instruction instance.



The PlantPAx Distributed Control System Application Configuration User Manual, publication, [PROCES-UM003](#), describes how to import the process strategies and map them to I/O by using program parameters.

The Library of Process Strategies helps you do the following:

- Makes sure of characterized performance with known control strategy configurations
- Reduces implementation time
- Promotes consistent applications and user experience

When coupled to display elements and faceplates in the FactoryTalk View Studio software program, these objects streamline device configuration in a drag-and-drop environment (as shown in the illustration).

The display elements (global objects) have an associated faceplate that appears when the display element is clicked. These faceplates let you operate and configure the instructions. When additional support functions are added, such as interlocks or permissives, the faceplates for these extended functions are directly accessible for the faceplate of the associated object.

The Rockwell Automation Library of Process Objects includes a Library of Process Strategies. Process strategies are pre-connected routines that use Rockwell Automation Library of Process Objects in the context of their intended use. The Library of Process Strategies includes routines for I/O processing, device control, and regulatory control.

The Library of Process Objects is supported through Technical Support as long as the Add-On Instructions have not been modified from the original deployment.

You can use library objects other than objects provided by Rockwell Automation. For example, you can develop your own library or use the process objects as guides. By using a library of consistent elements from Rockwell Automation, you improve the maintainability and efficiency of your PlantPAx system.

For details on how to initiate objects and HMI displays, see the Rockwell Automation Library of Process Objects Reference Manual, publication [PROCES-RM002](#).

Additional Application Resources

The following resources are available for use to assist with developing your application.

Topics and Tools	Description	Where To Find Information
System deployment guide	Provides procedures that are necessary to start development of your PlantPAx system.	See the PlantPAx Distributed Control System Application Configuration User Manual, publication PROCES-UM003
FactoryTalk Diagnostic sample displays	Sample graphics to display FactoryTalk Linx sample counters.	See the Knowledgebase Answer ID 30148 at http://rockwellautomation.custhelp.com
Server status displays	Sample code is provided to determine a server's status and state by using VBA and displaying the status on the HMI display.	See the Knowledgebase Answer ID 44624 at http://rockwellautomation.custhelp.com
Rockwell Automation Integrated Architecture® tools	These tools can assist you in understanding, planning, and configuring an Integrated Architecture System.	http://www.rockwellautomation.com/solutions/integratedarchitecture/resources.html
Rockwell Automation sample code	Sample code and tools for configuring and programming Rockwell Automation products, including Rockwell specific faceplates.	http://samplecode.rockwellautomation.com/idc/groups/public/documents/webassets/sc_home_page.hcst
Batch implementation tools	Videos, documentation, and sample code to help guide you to the best design decisions for batch system implementation.	See the Batch Application Toolkit Quick Start, publication IASIMP-QS042

Alarm System Recommendations

In the process industries, alarms are a critical function of a control system. Effective alarm systems alert the operator to abnormal situations, providing for a quick response. Effective alarm handling improves the productivity, safety, and environment of a process plant.

There are industry standards that govern alarm management design and engineering practices. The standards help you develop effective alarm systems (for example ANSI/ISA-18.2, Management of Alarm Systems for the Process Industries). This section does not cover the practices that are defined by these standards. We provide recommendations for implementing alarms on the PlantPAx® system within the context of these standards.

The following table lists where to find specific information.

Topic	Page
FactoryTalk Alarm and Event Software	55
Using the Library of Process Objects for Alarms	59
Alarm State Model	60
Monitoring Your Alarm System	63

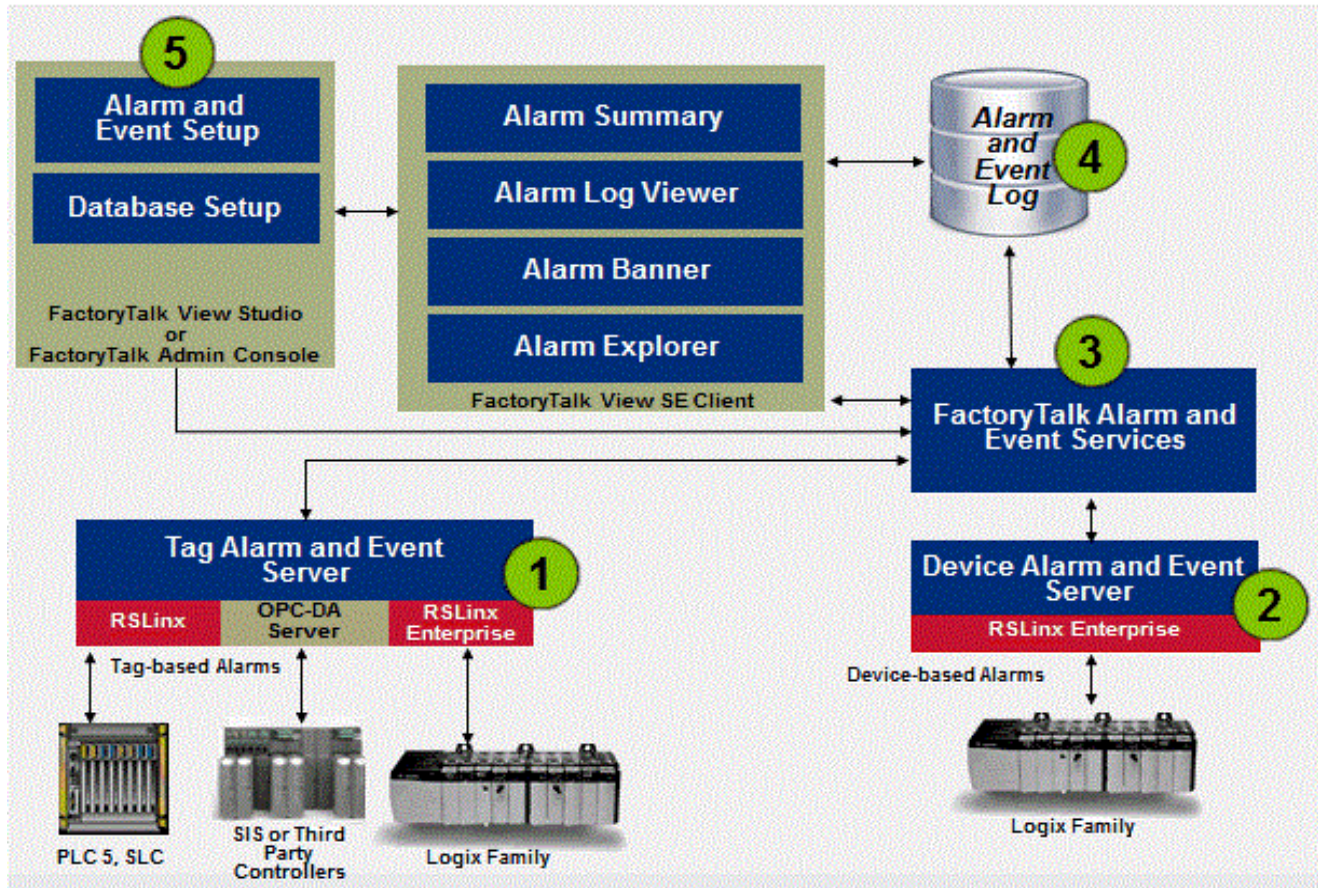
FactoryTalk Alarm and Event Software

The primary method for generating alarms in the PlantPAx system is FactoryTalk® Alarm and Event software, herein referred to as the alarm system. The alarm system supports device-based alarms (ALMA and ALMD instructions in the controller) and tag-based alarms (digital, level, or deviation alarms).

Device-based and tag-based alarms co-exist in an application. PlantPAx system sizing rules and critical system attributes are based on the use of tag-based alarms. While device-based alarms can be used, we recommend limiting their use to enhance system performance.

See [page 57](#) for more information.

Figure 5 - FactoryTalk Services Platform



Alarm Characteristic	Description
1. Tag-based alarm monitoring	Tag-based alarms (digital, level, or deviation) are configured in a Tag Alarm and Event server. When an alarm condition is detected by a controller, the server publishes the information to FactoryTalk Alarm and Event services.
2. Device-based alarm monitoring	The PlantPAX system sizing rules and Critical System Attributes are based on the use of FactoryTalk Alarm and Event tag-based alarms. While device-based alarms can be used, we recommend a limited usage to enhance system performance. Device-based alarms, such as ALMA, ALMD, are programmed via Studio 5000 Logix Designer® and then downloaded to Logix5000™ controllers. The controller detects alarm conditions and notifies FactoryTalk Linx of alarm states. A Rockwell Automation® device server (FactoryTalk Linx software) extracts the alarm information and publishes it to FactoryTalk Alarm and Event services.
3. FactoryTalk Alarm and Event services	Both device-based and tag-based alarms and events are published to FactoryTalk Alarm and Event services. The Alarm and Event services routes the information to FactoryTalk Alarm and Event objects that are hosted in FactoryTalk View software. The information also routes to the alarm and event history log, and to diagnostic logs and audit logs.
4. Alarm and Event log	The Alarm and Event log is a component that installs silently as part of the alarm and event software. It manages connections between alarm servers and databases and logs data from each alarm server to an alarm history database. You can use the Alarm and Event Log Viewer to view and print data from alarm history databases. Third-party database tools can also retrieve, view, analyze, and print alarm history information. To use alarm and event logging, install Microsoft® SQL Server separately, or use an existing Microsoft SQL Server database.
5. Alarm and event setup and monitoring	FactoryTalk Alarm and Event includes a number of software components that let engineers and operators to do the following: define alarm conditions; configure alarm servers; view and interact with alarm conditions; and view and run reports on historical alarm information.

FactoryTalk Alarm and Event Features

As shown in [Figure 5 on page 56](#), FactoryTalk Alarm and Event services have a complete set of visualization components (alarm summary, alarm log viewer, alarm banner, alarm status explorer).

Additional features include the following:

- Up to 10 alarm servers on the system; each server can be made redundant for fault tolerance
- Native ability to log alarm history to SQL database
- Ability to associate up to four additional tags with each alarm to store additional process information with each alarm occurrence
- Ability to associate FactoryTalk View commands with alarms. For example, a command can be used to open the process display associated with the alarm from the Alarm and Event Summary or from the Alarm and Event Banner
- Language switching for alarm messages
- Logs alarm in UTC time

The alarm system does not support PanelView™ Plus terminals. But the Library of Process Objects supports mixed architectures (PanelView Plus terminals plus distributed HMI) while managing the alarm state in the controller. See [page 59](#) for more on the Library.

FactoryTalk Alarm and Event Recommendations

- You can have up to 10 alarm servers in a PlantPAx system.
- The number of alarms per alarm server is limited to 20,000. This limit could be affected when using handshaking with Process objects.
- Configure your alarms by using tag alarm and events on a server connected to Process Objects for alarm detection. This configuration provides integration with the displays and faceplates and makes sure of performance.

The Library of Process Objects contains Alarm Builder, which automates this configuration. See the Rockwell Automation® Library of Process Objects Reference Manual, publication [PROCES-RM002](#), for more information.

- Use alarm groups on tag-based alarm and event servers to organize alarms by operator role.
- Use alarm expressions against user groups to provide rolled up indication of alarms by role or display. For example, `AE_InAlmUnackCount('T1*')` returns a count of unacknowledged alarms within groups that start with T1.

See the FactoryTalk View Site Edition User's Guide, publication [VIEWSE-UM006](#), for more information on alarm expressions.

- Use an alarm class to identify alarms that share common management requirements (for example, testing, training, monitoring, and audit requirements). Do not use alarm class to identify alarms by operator role or display because you cannot retrieve an alarm count by class by using alarm expressions in FactoryTalk View software. However, you can filter by class on the alarm displays.
- Be aware that controller scan time and memory usage are variable with the use of the ALMA or ALMD instructions, depending on the states of the controller. Large alarm bursts can have a significant impact on controller CPU utilization.

For example:

Controller memory used for buffering by each subscriber
(topic in the data server) = 100 KB

Example execution times:

- ALMD in a 1756-L73 controller with no alarm state changes: 7 μ s
- ALMD in a 1756-L73 controller with alarm state changes: 16 μ s

In redundant controller configurations, crossloading of redundancy can add up to 70 μ s per ALMD instruction.

- We recommend that you reserve the use of ALMA and ALMD instructions for the most critical alarms. Although there are no hard-coded limitations, we recommend limiting the number of instructions to the following:
 - 250 per redundant controller
 - 2000 per simplex controller.
- We recommend that you limit the number of alarms to 1500 per controller. Although there are no hard-coded limitations, you could experience longer recovery time during system restoration.

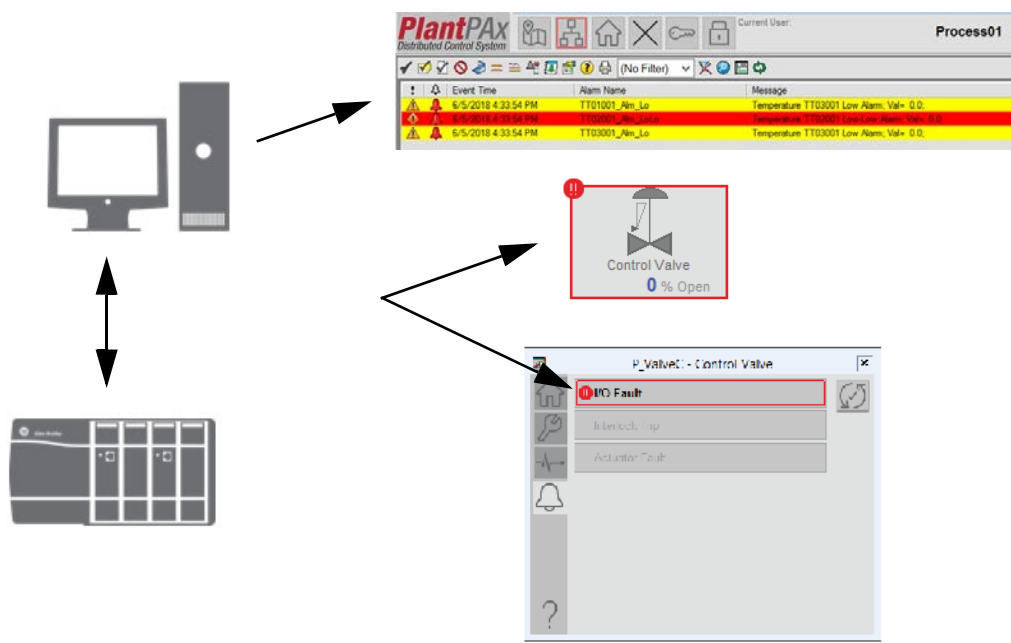
You can use the PSE for sizing the number of alarm instructions for a more accurate limit that is based on your specific configuration. Be sure to add for additional memory that is required to maintain the alarm subscription as it is not accounted for in the PSE memory calculations.

Using the Library of Process Objects for Alarms

The Library of Process Objects uses a dedicated Add-On Instruction, named P_Alarm, for each alarm in each device for alarm detection and to provide an interface to the tag-based alarm. Documentation is provided with the Process Library to describe how to connect the Add-On Instruction instances with the Tag Alarm and Event Server.

Following this method, P_Alarm is responsible for managing state and providing status to process displays and faceplates. Each P_Alarm that is being used is linked to a digital alarm on the alarm server to provide status to alarm displays and alarm history.

Figure 6 - Alarms in PlantPAx Library



The Library of Process Objects approach includes the following advantages:

- Integration of alarms into library objects (Add-On Instructions, global objects, and faceplates) for ease of engineering and deployment
- Supports mixed architectures (PanelView Plus terminals plus distributed HMI) while managing the alarm state in the controller
- Flexible alarm management techniques are built in into the P_Alarm instruction

When using the Library of Process Objects, both the controller and server maintain alarm information to provide status information where needed. For this reason, proper configuration is critical.

We provide tools to automate this configuration. See the Rockwell Automation Library of Process Objects Reference Manual, publication [PROCES-RM002](#).

Alarm State Model

The alarm system provides three mechanisms to help prevent prolonged indications of an alarm in the alarm summary: Suppress, Shelve, and Disable.

The Shelve and Suppress states let you clear the alarm from the alarm summary or banner while you are resolving a known alarm. You do not continue to view the alarm information once the alarm is acknowledged.

The Shelve state has a configurable timeout, after which the alarm is automatically Unshelved and returned to the alarm summary. The Suppress state does not have an automatic timeout. If the alarm is unacknowledged at the time it is Shelved or Suppressed, it continues to appear on the alarm summary and banner until it has been acknowledged, and subsequently removed from these lists.

A Shelved or Suppressed alarm is still able to transition alarm status (except becoming unacknowledged), send alarm state changes to subscribers, log state changes in the historical database, and is responsive to other programmatic or operator interactions. Follow these rules:

- When an alarm is Suppressed or Shelved, it continues to function normally, monitor the In parameter for alarm conditions, and respond to Acknowledge requests. All subscribers are notified of this event, and any alarm messages generated while the alarm is in the Suppressed or Shelved state include the Suppressed or Shelved status. An alarm cannot become Unacknowledged while Shelved or Suppressed.
- When an alarm is Unsuppressed or Unshelved, all subscribers are notified and alarm messages to subscribers no longer include the Suppressed or Shelved status. If the alarm is active when Unsuppressed or Unshelved and Acknowledge is required, the alarm becomes Unacknowledged.

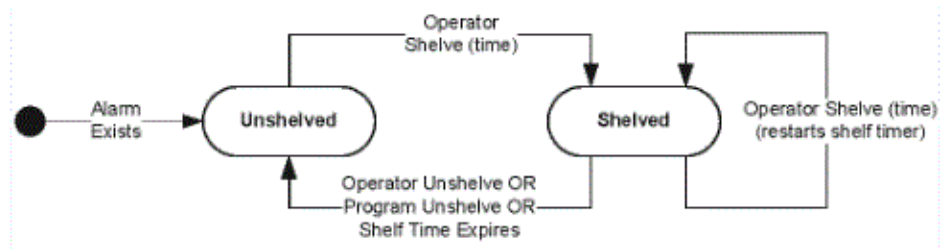
Disable an alarm to take the alarm out-of-service in the control program. A disabled alarm does not transition alarm status or gets logged in the historical database. If the alarm is unacknowledged at the time it is Disabled, it continues to appear on the alarm summary and banner until it has been acknowledged, and subsequently removed from view. A disabled alarm can be re-enabled in the Alarm Status Explorer in FactoryTalk View SE software:

- When an alarm is Disabled, all of its conditions are inactivated (InAlarm is cleared) except the acknowledged status if unacknowledged. The In parameter is not monitored for alarm conditions, but responds to an acknowledged event. All subscribers are notified of this event.
- When an alarm is Enabled, it begins to monitor the In parameter for alarm conditions. All subscribers are notified of this event. If the alarm is active when Enabled and acknowledge is required, the alarm becomes unacknowledged.

Shelve, Suppress, and Disable states are all methods to suppress indication of alarms, following ANSI/ISA-18.2, Management of Alarm Systems for the Process Industries. You can use Shelve, Suppress, and Disable functionality to differentiate operator-initiated actions from design-initiated actions and maintenance actions. See the following examples and accompanying notes.

Operator Actions

Use the Shelve state to initiate this action by the operator (equivalent to the Shelve state in ISA 18.2).



The Program Unshelve command is provided so that the user has a means, by using a small amount of programming, to Unshelve alarms based on an event, for example End of Shift.

Program Actions

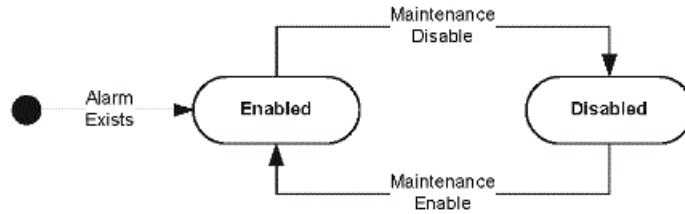
The controller must use the Suppress state to programmatically inhibit operator notification (equivalent to the Suppress-by- Design state in ISA 18.2).



The Suppress state is intended for Suppress-By-Design functionality under control of logic in accordance with ANSI/ISA-18.2. If logging of alarm transitions during suppression is not desired, use logic to suppress the input condition to the alarm. You also can use the P_Alarm Add-On Instruction in the Library of Process Objects, which does not generate new alarm transitions in the Suppress state.

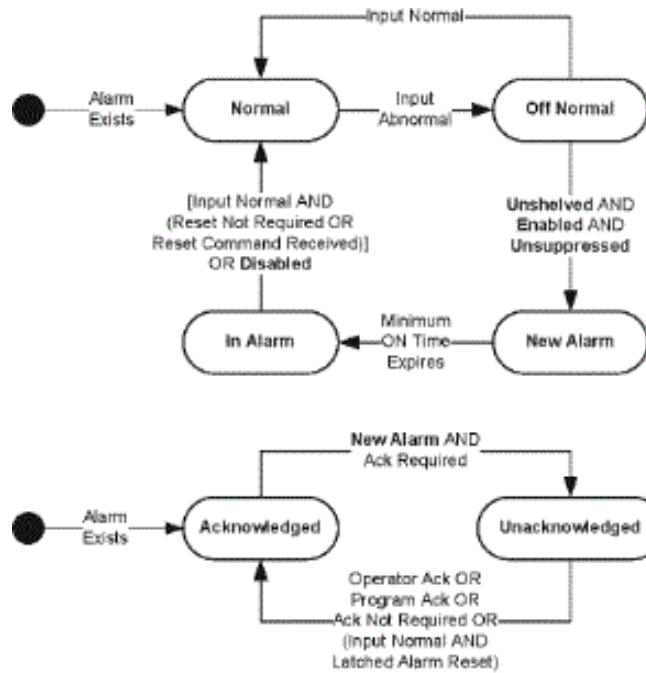
Maintenance Actions

Use the Disable state to inhibit the alarm for maintenance purposes (equivalent to Out-of-Service state in ISA 18.2).



The Disable state is intended for Out-of-Service functionality under control of maintenance in accordance with ANSI/ISA-18.2. If logging of alarm transitions during Disable is desired, the Suppress state of the ALMA or ALMD can be used instead if not required for Suppress-by-Design functionality under control of logic.

Alarm, Return to Normal, Latching, and Acknowledgement



While Disabled, Suppressed, or Shelved, an acknowledged alarm does not become unacknowledged.

While Disabled, Suppressed, or Shelved, if acknowledge is required, an unacknowledged alarm remains unacknowledged until it is acknowledged.

An alarm becomes unacknowledged if the alarm is InAlarm when an alarm changes state to Enabled, Unsuppressed, and Unshelved.

Monitoring Your Alarm System

By using the alarm status explorer, you can browse all of your configured alarms on a server or the entire system. Alarms also are filtered by the Shelved, Suppressed, and Disabled options. The alarm explorer can be preconfigured as a Shelved alarm display to let operators view a list of alarms.

ISA 18.2 provides alarm performance metrics and example target values that are summarized in a single table of section 16.9 of the standard. Some key metrics include the following:

1. Alarm rates: annunciated alarms per operator:
 - a. < 150...300 alarms per day
 - b. Average of 6...12 per hour
 - c. Average 1...2 per 10 minutes
2. Contribution of the top 10 most frequent alarms to the overall alarm load: ~<1...5% maximum, with action plans to address deficiencies
3. Number of alarms that remain in effect continuously for more than 24 hours (stale alarms): Less than 5, with plans to address

When using the FactoryTalk® VantagePoint® software with the alarm system, reports are provided based on the described metrics.

1. Hourly Alarms Report (active count of alarms over 1- hour samples)
2. Alarm Distribution Report (percentage contribution of top 10 most frequent alarms)
3. Alarm Frequency Report (top 10 most frequent alarms)
4. Standing Alarms Report (top 10 currently active alarms by duration)
5. Alarm Duration Report (top 10 alarms by duration)

Alarms can be filtered in FactoryTalk VantagePoint software by class, alarm name, or alarm source so they can be broken down by operator role if required. More information on these reports can be found on the Rockwell Automation Knowledgebase Answer ID 68296 at <http://www.rockwellautomation.custhelp.com>.

Notes:

Infrastructure Recommendations

This chapter describes best practices for infrastructure, including virtualized machines. We also include operating system and network recommendations.

Physical Access Control

We recommend implementing physical security to help protect your PlantPAx® system. Physical securities are measures that guard against unauthorized access to facilities, control rooms, equipment, and resources.

Consider policies and procedures to create layers of protection in their perimeter for authorized access to the system. The standards generally categorize these protections as the following:

- **Passive physical security devices** — This category includes physical controls such as fences, walls, concertina wire (barbed wire, razor wire, and so on). Physical controls also includes anti-vehicle ditches, concrete barriers, earthen walls or mounds, and other access limiting devices. Passive security devices are typically categorized as being of large size or mass, used to either protect physical entities or help prevent access to specific locations, and are active always. These devices require no manual intervention to either engage or disengage their security activities.
- **Active physical security devices** — These devices play an active role in physical security. These devices include doors, locks of various types, gates, retractable road obstructions, or other devices that are intentionally engaged or disengaged based on either time intervals, autonomous control, or at specific intervention from an outside source. These devices are often coupled with additional identification or monitoring devices to enhance their functionality.
- **Identification and monitoring devices** — This category includes still and video cameras, motion sensors, vibration sensors, heat sensors, biometric authentication or recording devices, and various other devices. They do not by themselves specifically control or limit access to a physical location or system. The design and intended use of these devices are specific to detecting, identifying, or recording physical entities. These devices include the state of physical presence of individuals, vehicles, systems, or other identifiable physical objects.

Infrastructure Types

The PlantPAx system infrastructure is built on an IT infrastructure based on the following:

- Commercial off-the-shelf technologies, such as Microsoft Windows and VMware
- Open network technologies, such as Stratix® switches

The platform provides seamless integration between system elements and higher-level business systems.

When building your system, you must decide whether your server and client workstations are in a virtual or traditional environment.

Traditional

In a traditional infrastructure, each server and workstation is installed on its own physical machine. Software and hardware updates are performed on each server and workstation individually. In addition, there is a conventional relationship between switch ports and servers ports and a standard network management.

Virtual

Virtualization breaks the dependency between operating system and physical hardware. Multiple virtual machines (VMs) can run different operating systems and applications from various locations on the same server. You can upgrade hardware without stopping your operation or replacing the operating system on the server or workstation system elements, thus reducing downtime and maintenance costs.

Before designing a virtualized PlantPAx system, we recommend that you have a general understanding of the PlantPAx control system architectures and sizing guidelines.

For more information, see the following:

- PlantPAx Distributed Control System Selection Guide, publication [PROCES-SG001](#) -- Provides descriptions of system elements, architectures, and sizing guidelines for procuring a virtual PlantPAx system
- PlantPAx Virtualization User Manual, publication [9528-UM001](#) -- Contains step-by-step procedures for configuring virtual machines

The following table lists where to find specific information.

Topic	Page
Virtual PlantPAx Configuration Recommendations	67
Operating System Recommendations	72
Network Recommendations	75

Virtual PlantPax Configuration Recommendations

Once the basic architecture is developed, a virtualized PlantPax system benefits from a number of fundamental VMware configuration choices. Most of these choices start with automatic settings, with adjustments made as required to increase speed and improve redundancy.

IMPORTANT The PlantPax system does not require the use of the virtual image templates, nor does their use infer the system design meets PlantPax system specifications. Use of the virtual image templates can save time and make sure consistency of installation with the recommendations contained within this manual.

Servers

The latest Intel™ processors offer onboard virtualization support. The Intel Virtualization Technology in the BIOS must be switched on to take advantage of the performance gains.

Hosts in the same cluster that have different processors are recommended to have Enhanced vMotion Compatibility (EVC) enabled to support the vMotion between hosts. EVC is enabled at the Datacenter/Cluster level. EVC is a fundamental technology that facilitates virtual machine modernization between different generations of CPUs, while vMotion is the utility used to make the modernization. The ability to modernize VMs between servers while they are running with the process transparent to any users is one of the leading benefits of virtualization.

IMPORTANT Keep VMware Tools up-to-date inside each guest operating system. When modernizing or converting a VM from an older version ESXi server, a best practice is to remove the old Tools and install the latest version.

Storage

Network attached storage uses a software network adapter to connect with iSCSI storage through Ethernet. Enable jumbo frames at the physical switch level and also at the virtual switch port level. Jumbo Ethernet frames carry up to 9000 bytes of payload (as opposed to the normal 1500) and can offer increased data throughput with reduced CPU utilization. The network must be configured to support jumbo frames from end to end.

When configuring the physical NICs on a host, set up NIC teaming in the virtual switch configuration to enable greater bandwidth for storage traffic.

Each virtual hard disk drive on a network is assigned a logical unit number (LUN) for unique identification. A LUN is a logical unit number of a virtual partition in a storage array. When assigning virtual hard disk drives from VMs to a LUN, be sure to balance intensive and non-intensive I/O applications. This process improves performance by balancing I/O traffic across multiple hard disk drives. A typical LUN size is 400...800 GB. The maximum number of virtual machine hard disks (VMDK) on a LUN cannot exceed 30, as more VMDKs could impact the performance because of disk queuing.

The LUN size is calculated by adding the total capacity (GB) of storage required plus VM Swap File requirements and additional room for VM Snapshots. When dividing the storage array into LUNs, the following equation can be used to determine appropriate sizing.

$$\begin{aligned} \text{Calculated LUN Size} &= \text{GB Capacity} + \text{VM Swap File Requirements} + \text{Snapshot Reservations} \\ &= 30 * (\text{average VM virtual disk size}) + 30 * (\text{average VM RAM}) + 15\% \text{ of } (30 \times \text{average disk size}). \end{aligned}$$

Virtual Networks

Connect VMs that are on the same ESXi server and same VLAN to use the same virtual switch. If separate virtual switches are used and connected to separate physical NICs, traffic routes separately through the wire and incur unnecessary CPU and network overhead.

Speed and duplex settings mismatches are common issues that can cause network problems. For ESXi, VMware recommends autonegotiate for both devices on the ends of a network link. It is also acceptable to set both ends for '1000 MB/full-duplex' or '100MB/full-duplex' if required by the network hardware.

IMPORTANT If you connect a manually configured device to an autonegotiate device (duplex mismatch), a high rate of transmission errors can occur.

VMware systems demand a high level of network performance by nature, so methods to reduce bottlenecks are to be explored. One such method is NIC teaming, where a single virtual switch can be connected to multiple physical Ethernet adapters. A team that is defined in this way can share the traffic load and provide a means of failover.

There are several options available for load balancing. The default is 'route based on the originating virtual switch port ID', where traffic from a given virtual Ethernet adapter is consistently sent to one physical adapter (unless there is a failover). Another option gives the virtual switch the ability to load balance between multiple physical adapters. This is set by configuring EtherChannel link aggregation on the Cisco® switch and the load balancing setting is set to 'route based on IP hash' in the virtual switch.

A combination of NIC teaming and the Cisco Switch load-balancing settings are recommended for improved performance when you access networked storage.

Resource Pool Allocation

Resource pools group virtual machines (VMs) to provide dynamic allocation of CPU and memory resources. Resource pools also contain child resource pools that enable fine-grained resource allocation.

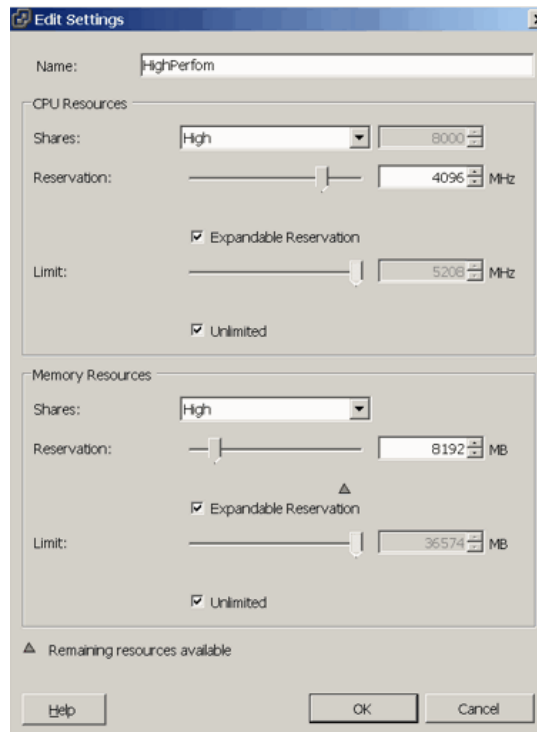
Resource allocation is done on an individual VM basis by using shares, reservations, and limits. Setting these values on every VM is time-consuming, can be error-prone, and doesn't scale effectively. Setting these values on a resource pool is much more efficient, and the values dynamically readjust as VMs and host resources are added and removed.

Generally, the hypervisor provides excellent scheduling. And, if hosts have sufficient resources, you can leave the default settings alone. If you wish to control the VMs that receive more priority or resources, it's more effective and less error-prone to allocate the VMs at a resource pool level.

IMPORTANT In a PlantPAx system, make sure that the PASS servers and workstations have higher priority for consistent performance.

For each resource pool, you set CPU and memory shares, reservations, expandable reservations, and limits, as shown in [Figure 7](#).

Figure 7 - Setting Resource Pool Allocation



We recommend that you build three resource pools with the server-type allotment that is shown in [Table 34](#).

Table 34 - Server Resource Pool Allocation

Resource Pool Name	CPU Shares	CPU Reservation	Memory Shares	Memory Reservation	Server or Workstation
High	High	50% of available host CPU Hz	High	Minimum as specified for each virtual template	PASS OWS AppServ-OWS
Normal	Normal	Zero	Normal	Zero	EWS AppServ-EWS AppServ-Asset AppServ-Batch AppServ-Info
Low	Low	Zero	Low	Zero	FactoryTalk® Directory Domain Controller

An allocation of zero means that no resources get locked from being used by the hypervisor resource allocation algorithm. The Expandable and Unlimited boxes need to be checked.

The CPU or memory shares are relative to any sibling resource pools or VMs. Shares are used only during periods of contention and are always bound first by any reservations or limits. In a well-designed PlantPAx system, sufficient resources are available to all VMs in the resource pool, therefore, we suggest that shares never be invoked. They are built to make sure that the PASS and workstations can consistently supply data if there is contention.

Resource Pool Sizing Example

This example shows how to allocate resources based on system requirements.

System:

- 1 server with 2 quad-core CPUs (each core is 2.0 GHz)
- 32 GB of RAM
- Server has a total of 16 GHz of CPU to allocate to virtual machines

PlantPAx system:

- 4 PASS servers and 1 AppServ-OWS — High resource pool
- 1 AppServ-Hist, 1 EWS, and 1 AppServ-Asset — Normal resource pool
- 1 FactoryTalk Directory and 1 domain controller — Low resource pool

Following the guidelines above, the High resource pool will get 50% of the CPU allocated, or 8 GHz. These 8 GHz are further divided into 5 shares of 20% automatically for each server in the resource pool. Each server receives roughly 1.6 GHz (8 GHz/5 servers) of CPU minimum allocation. The minimum memory for each server used in the High resource pool is 4 GB. Minimum memory allocated is 20 GB (4 GB x 5 servers).

The remaining 8 GHz CPU and 12 GB of RAM is used by the hypervisor resource allocation algorithm to use where needed. The Normal resource pool has priority over the Low resource pool, but there is no minimum resource allocation due to the zeroes used for CPU and memory reservation.

Operating System Recommendations

The following recommendations apply regardless if you are using a virtual or traditional environment and the size or complexity of the system operation.

Domains and Workgroups

We recommend that PlantPAx servers and workstations be members of a Windows domain. However, workgroups are supported for systems with 10 or fewer workstations and servers.

Configuration	Details
Workgroup - decentralized administration (allowed if 10 or fewer computers)	<p>Workgroup advantages:</p> <ul style="list-style-type: none"> No domain controller (Windows Server OS) to purchase or maintain. Recommended for small PlantPAx applications only where user accounts do not change often <p>Workgroup rules:</p> <ul style="list-style-type: none"> Workstation and server system elements in a single PlantPAx system must be members of the same workgroup Users that participate in the workgroup must be members of the Administrators group Create the same set of user accounts and passwords on every computer in a FactoryTalk View application
Domain - centralized administration (recommended)	<p>Domain advantages:</p> <ul style="list-style-type: none"> One place to manage users, groups, and security settings Recommended for larger PlantPAx applications, or environments with changing user accounts <p>Domain rules:</p> <ul style="list-style-type: none"> All workstation and server system elements in a single PlantPAx system must be members of the same domain PlantPAx server system elements must not be used as domain controllers. Required for systems with more than 10 computers The domain controller must be its own independent computer with no other application software.

Domain Recommendations

We recommend that all PlantPAx system servers and workstations be a member of a domain. Follow these additional recommendations:

- Windows Active Directory (AD) domains include the concept of a 'forest' that can consist of a single 'domain tree' or multiple domain trees.

TIP A domain tree can consist of a single (parent) domain or multiple (child) domains. In a Windows 2016 Active Directory, both domains and forests have individual functional levels.

- We recommend configuring at least two domain controllers in the domain. These domain controllers replicate automatically to provide high availability and an online configuration backup. If you have a single domain controller, and it goes offline, your system goes offline.
- The domain servers also must be configured to include Domain Name Service (DNS) that lets you identify devices by name rather than IP addresses.
- Configure time synchronization throughout a domain.

IMPORTANT Do **not** install the Windows domain controller on the PlantPAx PASS server or application servers. For more information, see the PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication [PROCES-UM001](#).

Windows Workgroup Recommendations

The PlantPAx system can use a Windows workgroup network environment for systems with 10 or fewer computers.

For more information, see the Appendix section in the PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication [PROCES-UM001](#).

Server and Workstation Time Synchronization

System time synchronization is important so that the internal clocks in the controllers, workstations, and servers reference the same time for any event or alarm that occurs. Configure the PASS, App-servers, OWS, and EWS to use a single server (for example, a domain controller) as their time reference and keep their clocks tightly synched to it.

Computer Time Synchronization

The Windows Time service uses the network time protocol (NTP) to synchronize computer clocks on the network from the domain controller. Each computer in the process system uses the domain controller as the authoritative time source and synchronizes their clock to it. Check the Event Viewer System log of each computer to verify that the time is updated properly.

After configuring the domain controller for time synchronization, you can use the Windows `w32tm` command-line tool to identify any time difference between an individual computer and the domain controller. This command measures the time difference.

```
w32tm /stripchart /computer:<target>[/period:<refresh>] [/dataonly]
```

Parameter	Identifies
computer:<target>	The computer to measure the offset against.
period:<refresh>	The time between samples, in seconds. The default is 2 s.
dataonly	To display the data only without graphics.

The `w32tm/resync` command manually forces a computer to resynchronize its clock to the domain controller as soon as possible and resets error statistics.

Operating System Optimization

The following recommendations enhance the performance of your operating system:

- Turn off Windows automatic updates to help prevent compatibility issues with existing PlantPAx components on your workstations.
See [Maintenance Recommendations](#) for more information on how to apply Microsoft patches to your PlantPAx system.
- Disable operating system themes that provide personalized computer effects such as sounds and icons. These types of elements diminish processor speed when running some FactoryTalk View SE graphic components, such as alarm summaries.
- Disable or uninstall all third-party firewalls on a workstation before installing FactoryTalk View SE software, which is compatible only with the built-in Windows operating system firewall.
- Remove Enhanced Security Configuration (ESC) from workstations running FactoryTalk View SE software. The Windows 2016 security settings help protect servers by limiting how users can browse the Internet on a computer, but can hinder FactoryTalk clients connecting to application servers.

Network Recommendations

The Ethernet network provides the communication backbone for the supervisory network for the workstations, servers, and the controllers:

- Configure all communication interfaces to operate at the fastest speed possible for your hardware configuration, full-duplex for 100/1000 network adapters. See Important for autonegotiate settings.

IMPORTANT Use of autonegotiate settings is recommended to reduce chance of mis-configuration and failures. However, it is desirable to operate at the fastest speed possible at full-duplex. We recommend verifying your switch settings during commissioning to make sure that the system was able to autonegotiate properly. The speed and duplex settings for the devices on the same Ethernet network must be the same to avoid transmission errors.

- Disable power saving for the Network Interface Card (NIC) that connects a workstation to other devices on the network. The power-saving feature turns off the network card when not in use, which can interfere with network throughput.
- If multiple DCOM protocols are installed and set up on a workstation, to make sure that DCOM communication functions correctly, remove all protocols other than TCP/IP.

For procedures, see the PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication [PROCES-UM001](#).

- Consider cable type for environmental conditions.

Type	Details
Fiber-optic	<ul style="list-style-type: none"> • Long distances • Near high magnetic fields, such as induction-heating processes • For extreme high-noise environments • For poorly grounded systems • For outdoor applications
Shielded twisted-pair	<ul style="list-style-type: none"> • Use Category 5e, 6, or 6a cables and connectors • Use termination sequence 568A for industrial applications

See the following publications for additional information:

- For step-by-step configuration instructions, see the PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication [PROCES-UM001](#).
- For correcting a duplex mismatch, see Troubleshoot EtherNet/IP® Networks, publication [ENET-AT003](#).
- For fiber cable specifications and an example of dB loss, see Appendix C in the EtherNet/IP Modules Installation Instructions, publication [ENET-IN002](#).
- For selecting architecture, see the Ethernet Design Considerations Reference Manual, publication [ENET-RM002](#), or the PlantPAx Selection Guide, publication [PROCES-SG001](#).

Ethernet Switches

The supervisory network must have managed switches that direct specific messages to multicast groups. Do not use unmanaged switches. The behavior of an unmanaged switch is to flood multicast packets to all ports within the same VLAN.

The first switch that Rockwell Automation equipment touches must have IGMP snooping enabled. IGMP snooping enables switches to forward multicast packets to ports that are only part of a particular multicast group.

IMPORTANT All applications require proper configuration to achieve the best system performance. If you do not configure the managed switch, it's possible that system performance can be adversely affected. We recommend that you contact your system administrator if there are any doubts on the installation and configuration.

Select the switch depending on the network functionality.

If	Then
<ul style="list-style-type: none"> Supervisory Routing information to other networks 	Layer 3 switches ⁽¹⁾ <ul style="list-style-type: none"> Stratix 5410 Stratix 5400
<ul style="list-style-type: none"> Connecting control hardware, sensors, and workstations Isolated networks 	Layer 2 switches ⁽¹⁾ <ul style="list-style-type: none"> Stratix 5410 Stratix 5400 Stratix 5700
High availability at switch level	Layer 3 switch ⁽¹⁾ <ul style="list-style-type: none"> Stratix 5410

(1) For uplink cables between Layer 2-3, fiber is recommended for better system performance.

Additional Switch Information

See the Stratix Ethernet Device Specifications Technical Data, publication [1783-TD001](#), for information on these switch components:

- Stratix 5900 Security Appliance
- Embedded EtherNet/IP Taps

We also support the use of Cisco switches. To help make sure of performance, we recommend that all system switches are Cisco or Stratix for common use of protocols.

The following switches are also supported on the PlantPAx system:

- Cisco Catalyst® 3850 (Layer 3)
- Cisco Catalyst 4500x (Layer 3)
- Cisco Catalyst 2960G (Layer 2)
- Cisco Catalyst 9300 (Layer 3)

Field Device Integration Recommendations

Modern field devices, such as drives and flow transmitters, are often microprocessor-based. These smart devices provide digital data that is used for commissioning, maintenance, troubleshooting, and most importantly, control.

Smart field devices use two-way, digital protocols for communication. Common field device communication options on the PlantPAx® system include EtherNet/IP™, ControlNet®, DeviceNet®, FOUNDATION Fieldbus, PROFIBUS PA networks or by using HART.

This section provides general recommendations for how to configure tools on the networks and HART protocol. The tools help gather real-time information and diagnostics to make well-informed business decisions.

Additionally, many other networks and I/O protocols can be integrated into the PlantPAx system. For more information on Encompass™ third-party products, see <http://www.rockwellautomation.com/encompass>.

The following table lists where to find specific information.

Topic	Page
Device Configuration Options	78
EtherNet/IP Recommendations	78
ControlNet Recommendations	80
DeviceNet Recommendations	81
HART Recommendations	82
FOUNDATION Fieldbus Recommendations	83
PROFIBUS PA Recommendations	85
Motor Control Recommendations	87

Device Configuration Options

There are several options to configure field devices:

- Handheld devices for selected field device networks or protocols
- Manually configure some instruments by using the local interface
- Enterprise-wide solution by using FactoryTalk® AssetCentre

FactoryTalk AssetCentre for Enterprise Solution

FactoryTalk AssetCentre software can be used as a centralized tool to manage field devices from multiple vendors, networks, and protocols from one common platform. FactoryTalk AssetCentre software leverages FDT technology that standardizes the communication interface between field devices and host systems. This functionality accesses any device from FactoryTalk AssetCentre software regardless of the communication method.

The FDT interface also enables FactoryTalk AssetCentre software to integrate many different kinds of devices, including handheld diagnostic tools.

For more information, see the following publications:

- FactoryTalk AssetCentre Product Profile, publication [FTALK-PP001](#)
- FDT website at <http://www.fdtgroup.org>

EtherNet/IP Recommendations

The EtherNet/IP protocol is a multi-discipline, control, and information platform for use in industrial environments and time-critical applications. EtherNet/IP uses standard Ethernet and TCP/IP technologies and an open, application layer protocol that is called the Common Industrial Protocol (CIP).

A growing number of field devices, including flow transmitters and drives, are available that support EtherNet/IP.

Table 29 - EtherNet/IP Interfaces

Category	Product	Description
ControlLogix® controller interface	1756-EN2T, 1756-EN2TR, 1756-EN3TR, 1756-EN2F, 1756-ENBT	ControlLogix EtherNet/IP bridge.
	1788-EN2FFR	EtherNet/IP to FOUNDATION Fieldbus linking device. Supports H1 FOUNDATION Fieldbus network. Compatible with ControlLogix redundancy. Built-in functionality for the Ethernet DLR.
	1788-EN2PAR	EtherNet/IP to PROFIBUS PA linking device. Supports PA media. Compatible with ControlLogix redundancy. Built-in functionality for the Ethernet DLR.

EtherNet/IP I/O Communication Options

Follow these guidelines for EtherNet/IP networks:

Network

- Configure all communication interfaces to operate at the fastest speed possible for your hardware configuration, full-duplex for 100/1000 network adapters. See the Important for autonegotiate settings.

IMPORTANT Use of autonegotiate settings is recommended to reduce chance of mis-configuration and failures. However, it is desirable to operate at the fastest speed possible at full-duplex. We recommend verifying your switch settings during commissioning to make sure that the system was able to autonegotiate properly. The speed and duplex settings for the devices on the same Ethernet network must be the same to avoid transmission errors.

- When expanding the I/O configuration tree, make sure your I/O module RPI is two times faster than the periodic task that you are using.
- As you expand the I/O configuration tree, devices can affect the CIP/TCP count differently. Never use more than 80% of the available connections for the bridge modules.
- I/O packets per second (pps) describes an implicit message rate (Class 1). An I/O Comms Utilization value approaching or above 80% can necessitate an adjustment to the RPI.
- HMI packets per second (pps) describes an explicit message rate (Class 3). FactoryTalk Linx connections and message instructions generate CIP traffic. HMI traffic is TCP-based, not UDP-based.
- The combination of implicit and explicit messaging provides a total utilization for a device. If you add implicit messaging (I/O), it takes bandwidth from the HMI because it has higher priority than HMI messaging. The combination of CIP implicit (highest priority) and CIP explicit (second priority) cannot exceed 100% use.

Devices

- Consider packets per second (see network notes) for performance if you use many devices.
- Use compatible keying on Ethernet communication modules. In a validated environment, you can use an exact match for keying.

See the documentation that is listed in [Additional Resources on page 8](#) for more information.

ControlNet Recommendations

The ControlNet network is an open, control network that combines the functionality of an I/O network and a peer-to-peer network, providing high-speed performance for both functions.

ControlNet I/O Communication Options

In a PlantPAx system, the ControlNet network supports controller downlinks and connections to remote I/O and field device interfaces. The network is unaffected when devices are connected or disconnected from the network.

Table 35 - ControlNet Interface

Category	Product	Description
ControlLogix controller interface	1756-CN2, 1756-CN2R 1756-CNB, 1756-CNBR	ControlLogix ControlNet scanner.
	1788-CN2FFR	ControlNet to FOUNDATION Fieldbus linking device. Supports H1 FOUNDATION Fieldbus networks. Compatible with ControlLogix redundancy and redundant ControlNet media.
	1788-CN2PAR	ControlNet to PROFIBUS PA linking device. Supports redundant PROFIBUS PA media and redundant ControlNet media. Compatible with ControlLogix redundancy.

Follow these guidelines for ControlNet networks:

Network

- When you configure the ControlNet network with RSNetWorx™ for ControlNet software, select Optimize and rewrite the schedule for all connections.

If changes are made to the ControlNet configuration, upload the configuration to make sure that it gets backed up to the Studio 5000 Logix Designer® project.

- Use a maximum of five controllers with a rack-optimized, listen-only connection to the module.
- Use a maximum of 64 I/O modules on an unscheduled remote I/O ControlNet network.
- Use a maximum of 20 ControlNet interface modules per controller.

Devices

- A ControlNet node can transmit 480 bytes of scheduled data in a single network update time (NUT).
- I/O modules on ControlNet can be unscheduled to allow adding I/O online.
- Do not leave any ControlNet node addressed 99 (default address on some new devices).

See the documentation listed in [Additional Resources on page 8](#) for more information.

DeviceNet Recommendations The DeviceNet network is an open, device-level network that provides connections between simple industrial devices (such as sensors and actuators) and higher-level devices (such as PLC controllers and computers).

DeviceNet Communication Options

In a PlantPAx system, the DeviceNet network connects networked control devices.

Table 36 - DeviceNet Interface

Category	Product	Description
ControlLogix controller interface	1756-DNB	ControlLogix DeviceNet scanner.

Follow these guidelines for DeviceNet networks:

Network

- Connect up to 48 devices to the scanner when an average amount of data input and outputs is used.
- Use a maximum of 80% of the available scanner input and output memory.
- If you use more input and output device data, we recommend that you reduce the number of devices. For example, an MCC device, such as a soft starter, with all the available data enabled can use up to 40 bytes for input and 40 bytes for output. In this scenario, the maximum devices that we recommend connecting to the scanner is 10.
- To make sure that the network is within limits, calculate the amount of input and output memory that the scanner needs.
- We recommend disabling Auto Address Recovery. If enabled, in some scenarios like a power outage, two devices can auto-recover to the same address.
- Store EDS files in a common location; install on engineering workstations.

Scanner

- Keep DeviceNet communication modules in the local chassis. If the communication module is in a remote chassis, set the input and output sizes to match the data configured in RSNetWorx for DeviceNet software.
- Never have any device set to the default node address of 62 (reserved for personal computer) or 63 (reserved for new device to be configured).
- Set the scanner address to node 0.
- Keep the Interscan Delay ≥ 5 ms.
- Set DeviceNet scanner RPI time to half the scan rate of the fastest task in the controller that uses the DeviceNet network, but not less than 2 ms.
- Use Background poll when possible. Keep (Foreground to Background Poll Ratio) * (Interscan Delay) > 75 ms.

See the documentation listed in [Additional Resources on page 8](#) for more information.

HART Recommendations

HART is an open protocol designed to provide digital data over 4...20 mA analog signals.

HART Communication Options

The PlantPAx system interfaces both directly and via remote I/O modules to provide a single termination point to gather analog process variables and the additional HART digital data.

Table 37 - HART Interface

Category	Cat. No.	Description
Chassis-based I/O modules	1756-IF8IH, 1756-IF16H, 1756-OF8H, 1756-OF8IH	ControlLogix analog isolated I/O modules. These modules provide basic configuration through the I/O tree, provide status and diagnostics information, and provide remote configuration and troubleshooting.
Distributed I/O, high-channel density	1794-IE8H, 1794-OE8H, 1794-IF8IH, 1794-OF8IH, 1794-IF8IHNEXT	FLEX analog I/O modules with the following: <ul style="list-style-type: none"> Standard profiles in Studio 5000 Logix Designer DTMs
Distributed I/O, low-channel density	1734-sc-OE2CIH, 1734-sc-IF4H	Spectrum Controls, analog input module with HART for the POINT I/O™ system.
	1769-sc-IF4IH, 1769-sc-OF4IH	Spectrum Controls, analog, isolated input and output modules with HART for Compact I/O™ modules.
Distributed I/O, intrinsically safe	1719 Ex I/O	Rockwell Automation, chassis-based design for Zone 2 or Class I, Div 2., via EtherNet/IP.
Multiplexers/gateways	N/A	See the Encompass website for Pepperl+Fuchs, ProSoft Technology, and Aparian ⁽¹⁾ product offerings.
Network configuration	Handheld device	Endress+Hauser ⁽¹⁾ , handheld configuration and diagnostic device. See the Encompass website for Endress+Hauser product offerings.

(1) For more information on Encompass third-party products, see <http://www.rockwellautomation.com/encompass>.

Follow these guidelines for connectivity to a HART I/O card:

Network

- For 8-channel HART cards, only enable HART data on the channels that are connected to HART devices and you want to receive HART data. Enabling unused channels reduces system resources and performance.
- For 16-channel HART cards, there is no decrease in system performance by enabling all channels.

Devices

- If using HART data for control, check the data quality bits.
- For controlling fast loops, use only the 4...20 mA output of the instrument for control instead of the extended HART data.

For more information, see the following resources:

- Integrate E+H Instruments in a PlantPAx System Integration Document Manual, publication [PROCES-SG003](#)
- Documentation listed in [Additional Resources on page 8](#)

FOUNDATION Fieldbus Recommendations

The FOUNDATION Fieldbus network is a digital, two-way, multi-drop communication link among multiple intelligent field devices and automation systems.

FOUNDATION Fieldbus Communication Options

The PlantPAx system communicates with FOUNDATION Fieldbus devices through EtherNet/IP and ControlNet linking devices.

Table 38 - FOUNDATION Fieldbus Interface

Category	Cat. No.	Description
EtherNet/IP interface	1788-EN2FFR	EtherNet/IP to FOUNDATION Fieldbus linking device. Supports H1 FOUNDATION Fieldbus network. Compatible with ControlLogix redundancy. Built-in functionality for the Ethernet DLR.
ControlNet interface	1788-CN2FFR	ControlNet to FOUNDATION Fieldbus linking device. Supports H1 FOUNDATION Fieldbus networks. Compatible with ControlLogix redundancy and redundant ControlNet media.
FOUNDATION Fieldbus network components	Power conditioning	Both linking devices have built-in power conditioning.
	1788-FJB4R	Intelligent junction box supports redundancy, includes four drop ports.
	1788-FJB6	Intelligent junction box with six drop ports.
	Additional components	Pepperl+Fuchs ⁽¹⁾ , FOUNDATION Fieldbus components, such as valve couplers, surge protectors, and distributors. See the Encompass website for Pepperl+Fuchs product offerings.
	Segment protection	Helps protect against device or line faults with short- and open-circuit protection. Pepperl+Fuchs ⁽¹⁾ , intrinsic safety components, such as isolated barrier systems, hazardous area enclosures, and equipment. See the Encompass website for Pepperl+Fuchs product offerings.

(1) For more information on Encompass third-party products, see <http://www.rockwellautomation.com/encompass>.

Follow these guidelines for FOUNDATION Fieldbus networks:

Simplex Controllers

- We recommend a maximum of 32 fieldbus segments.
- Use 8...12 devices per segment.
- Use only two terminators per bus segment to help prevent distortion and signal loss. Some linking devices have built-in terminators but typically terminators are placed at the ends of the trunk.

Redundant Controllers

- We recommend a maximum of 16 fieldbus segments.
- Use 8...12 devices per segment.

- Use only two terminators per bus segment to help prevent distortion and signal loss. Terminators are placed at the ends of the trunk.

IMPORTANT Each linking device, whether configured with a simplex or redundant controller, can support one H1 segment.

Network

- To make sure that the fieldbus network is within limits, add up your field device connections per segment to estimate controller I/O memory.
- Ground the network cable only to the distribution side. Do not connect either conductor of the linking device to ground to help prevent communication loss.
- Amount of load and voltage drop determine maximum cable length. For example, the more field devices and junction boxes added to the cable increases the load, which increases signal attenuation. Likewise, the bigger the load and longer the cable, the bigger the voltage drop.
- The voltage specification for the H1 segment is 9...32V DC. We recommend that you use a 24V DC, 1 A Fieldbus Foundation power supply and be sure to keep the voltage above 13V DC at the farthest end of the segment.
- Signal quality can be adversely affected by placing the cable near motors, high-voltage, or high-current cables.
- The update time (macrocycle) for the H1 network is determined by the bandwidth that each device fills. This data is provided in the device's DD files.

Devices

- The linking device is a direct link between field devices on a Logix platform and the EtherNet/IP or ControlNet networks.
- Each linking device in the scanner uses four CIP connections in the controller.
- Built-in power conditioners reduce installation space requirements and open- and short-circuit protection guards against line faults.
- The Studio 5000® Add-on Profile (AOP) and graphical user-interface provides for online device configuration. New devices are automatically shown in the Live List.
- Add-on Profile (AOP) diagnostics that include an onboard oscilloscope report linking device and network statistics, such as noise and signal level and bad termination.
- Multiple levels of device and media redundancy are supported, including ring and dual trunk.

See the documentation listed in [Additional Resources on page 8](#) for more information.

PROFIBUS PA Recommendations

The PROFIBUS PA network connects automation systems and process control systems with field devices such as flow, pressure, and temperature transmitters.

PROFIBUS PA Communication Options

The PlantPAx system communicates with PROFIBUS PA devices through EtherNet/IP and ControlNet linking devices.

Table 39 - PROFIBUS PA Interface

Category	Cat. No.	Description
PROFIBUS interface	1788-EN2PAR	EtherNet/IP to PROFIBUS PA linking device. Supports redundant PROFIBUS PA media and redundant ControlNet media. Compatible with ControlLogix redundancy. Built-in functionality for the Ethernet DLR.
	1788-CN2PAR	ControlNet to PROFIBUS PA linking device. Supports redundant PROFIBUS PA media and redundant ControlNet media. Compatible with ControlLogix redundancy.
PROFIBUS network components	Power conditioning	Both linking devices have built-in power conditioning.
	1788-FJB4R	Intelligent junction box supports redundancy, includes four drop ports.
	1788-FJB6	Intelligent junction box with six drop ports.
	Additional components	Pepperl+Fuchs ⁽¹⁾ , FOUNDATION Fieldbus components, such as valve couplers, surge protectors, and distributors. See the Encompass website for Pepperl+Fuchs product offerings.
	Segment protection	Helps protect against device or line faults with short- and open-circuit protection. Pepperl+Fuchs ⁽¹⁾ , intrinsic safety components, such as isolated barrier systems, hazardous area enclosures, and equipment. See the Encompass website for Pepperl+Fuchs product offerings.

(1) For more information on Encompass third-party products, see <http://www.rockwellautomation.com/encompass>.

Follow these guidelines for PROFIBUS PA networks:

Simplex Controllers

- We recommend a maximum of 32 PROFIBUS segments.
- Use 15...20 devices per segment.

Redundant Controllers

- We recommend a maximum of 16 PROFIBUS segments.
- The PROFIBUS PA segment is split between two physical ports. Use up to 10 devices per port.

Network

- PROFIBUS PA is a master-slave network.
- To make sure that the PROFIBUS network is within limits, add up your field device connections per segment to estimate controller I/O memory.
- Ground the network cable only to the distribution side. Do not connect either conductor of the linking device to ground to help prevent communication loss.

- Amount of load and voltage drop determines maximum cable length. For example, the more field devices and junction boxes added to the cable increases the load, which increases signal attenuation. Likewise, the bigger the load and longer the cable, the bigger the voltage drop.
- The voltage specification for the PROFIBUS PA segment is 9...32V DC. We recommend that you use a 24V DC PA power supply and make sure to keep the voltage above 13V DC at the farthest end of the segment.
- Signal quality can be adversely affected by placing the cable near motors, high-voltage, or high-current cables.

Devices

- The linking device is a direct link between PROFIBUS PA devices and the EtherNet/IP or ControlNet networks, with no intermediate PROFIBUS DP (decentralized peripherals) layer required.
- Each linking device in the scanner uses four CIP connections in the controller.
- Built-in power conditioners reduce installation space requirements and open- and short-circuit protection guards against line faults.
- The Studio 5000 Add-on Profile (AOP) and graphical user-interface provides for online device configuration. New devices are automatically shown in the Live List.
- Add-on Profile (AOP) diagnostics that include an onboard oscilloscope report linking device and network statistics, such as noise and signal level and bad termination.
- Multiple levels of device and media redundancy are supported, including ring and dual trunk.

See the documentation listed in [Additional Resources on page 8](#) for more information.

Motor Control Recommendations

Rockwell Automation offers two low-voltage motor control centers (MCC) that integrate control and power in one centralized location. The CENTERLINE® 2100 or CENTERLINE® 2500 MCCs can house starters, soft-starters, and drives to meet IEC, UL, and NEMA standards.

Devices

- Each MCC EtherNet/IP device consumes one TCP and CIP connection. Using the 1756-EN2TR module, the maximum connections supported are 256 CIP connections and 128 TCP connections.
- Following the 1756-EN2TR module guidelines, we cannot exceed 80% of the maximum connections. Therefore, it's not recommended to use more than 100 MCC EtherNet/IP devices in a single 1756-EN2TR bridge module.

If it is necessary to use more than 100 MCC EtherNet/IP devices, it is recommended to add one more 1756-EN2TR bridge module. The additional module splits the communication and helps balance the bridges' load.

- It is not recommended to use more than 150 devices in a single Simplex controller. Considering this limit, the expected CPU load is almost in recommended limits. In this scenario, we are using only the MCC EtherNet/IP components with the Rockwell Automation Library of Process Objects.

But, in a typical application, it is necessary to have other devices and objects in the same controller. This scenario means that there is a possibility that you cannot achieve the maximum 150 EtherNet/IP MCC components. It depends on your specific application. The PSE helps to determine these loads.

- Another important consideration is to use an adequate requested packet interval (RPI) to each device. We recommend that the RPI is half-speed of the task that is using the device. The default RPI timing can sometimes overuse the communication resources.

Notes:

Batch Management and Control Recommendations

PlantPAX® batch management and control include two options for a scalable solution:

- Controller-based single unit or multiple independent unit solutions, called Logix Batch and Sequence Manager (LBSM)
- AppServ-Batch for a comprehensive batch solution (FactoryTalk® Batch)

LBSM is the controller-based solution consisting of controller code and visualization elements for use on Logix5000™ and FactoryTalk View software.

See the [PlantPAX Selection Guide](#) and Knowledgebase Answer ID 62366 at <http://www.rockwellautomation.custhelp.com> for more information on LBSM.

AppServ-Batch uses FactoryTalk Batch software for a comprehensive, server-based solution that leverages Logix functionality (PhaseManager™). This chapter provides basic setup information for a comprehensive batch solution by using FactoryTalk Batch software.

The following table lists where to find specific information.

Topic	Page
FactoryTalk Batch Critical System Attributes	90
Batch Guidelines for Logix	90
Using a Redundant System with a FactoryTalk Batch Server	91

FactoryTalk Batch Critical System Attributes

The following critical system attributes (CSA) were used to verify performance for FactoryTalk Batch during process system characterization.

Table 40 - FactoryTalk Batch CSA

Batch Critical System Attribute	Performance
Batch server: operator action time	An operator batch command has been acted on by the controller in 1 second.
Batch server: server action time	A server batch command has been acted on by the controller in 1 second.
Batch server: controller action time	Batch status events display on the operator workstation within 1 second.

Batch Guidelines for Logix

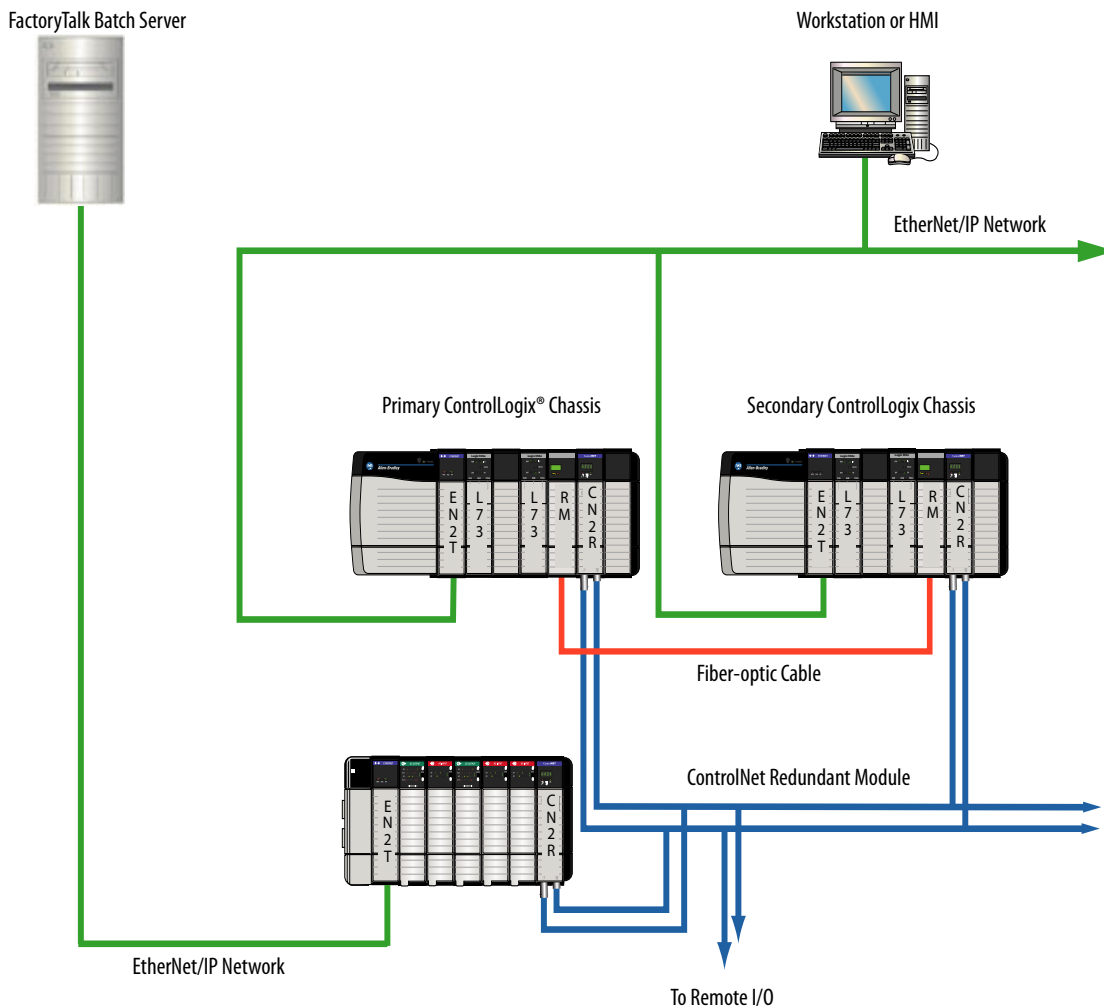
Phases can be developed by using PhaseManager to provide maximum modularity and reusability.

- In each phase, the running routine can track what step it is executing by using a step index variable (part of the equipment phase user-defined structure).
- If you are using sequencer logic (SFC) for state logic programming, the restarting state routine must reset the running SFC back to a specific sequence step, based on the step the running SFC was in when the phase received the Hold command. The function also depends on what actions the Holding state routine took with the equipment controlled.
- A Prestate routine is a state that can be added to each phase and always evaluated. The Prestate routine can be used to keep active or enable functionality (for example, a phase that runs an agitator that does not stop when Held, but you must keep track of the time the agitator ran).
- For SFC, any conditional code that is required for transitions (such as a transition to the next step on a timer done) can be implemented by using separately defined phase tags as opposed to step tag attributes. This task helps to prevent errors when copying sequencer logic.
- For more information, see these resources:
- PhaseManager User Manual, publication [LOGIX-UM001](#).
 - Instructions on how to configure and use a Logix5000 controller with equipment phases.
- Factory Talk Batch PhaseManager Users Guide, publication [BATCH-UM011](#).
 - Specifics on how to use PhaseManager with FactoryTalk Batch software.

Using a Redundant System with a FactoryTalk Batch Server

If your system requirements include the batch not going to hold on a controller switchover, you need to use both a ControlNet® bridge module and an EtherNet/IP™ bridge module to connect to the FactoryTalk Batch server. If batch hold upon controller switchover is acceptable, you can connect to the FactoryTalk Batch server directly from an EtherNet/IP module placed in the redundant chassis.

This illustration demonstrates one method of bridging the ControlNet network of the redundant system to the EtherNet/IP network that the FactoryTalk Batch server is running on.



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Notes:

Information Management Recommendations

Information Management application servers (AppServ-Info) are used for data collection (such as a FactoryTalk® Historian server) or decision support (such as a FactoryTalk® VantagePoint® server).

IMPORTANT We recommend that you host FactoryTalk Historian and FactoryTalk VantagePoint applications on separate information management servers.

The following table lists where to find specific information.

Topic	Page
FactoryTalk Historian Overview	93
Tips and Best Practices	94
Architectural Best Practices	94
FactoryTalk VantagePoint Overview	94
Tips and Best Practices	94

FactoryTalk Historian Overview

This section provides fundamental best-practice guidelines for implementing FactoryTalk Historian Site Edition (SE) software on PlantPAx® systems.

The FactoryTalk Historian SE product is co-developed with OSIsoft. While the SE software shares many of the same features and functionality available in their Plant Information (‘PI’) product, Rockwell Automation owns the development, documentation, and support of the Historian SE software. References to ‘OSIsoft’ and ‘PI’ are included in the product and the documentation.

In a PlantPAx system, the FactoryTalk Historian SE software collects, stores, and manages data from the plant in the PlantPAx system. The software includes these hardware and software components:

- **Data Sources** - Plant floor devices and instruments that generate data, typically controllers. Other Data Sources can include external databases.
- **Historian SE Interfaces** - Compresses and stores the collected data and acts as a data server for Microsoft® Windows-based client applications. It’s also possible to use the Historian SE server to interact with data that is stored in external systems.

- **Historian SE Server** - Compresses and stores the collected data and acts as a data server for Microsoft Windows-based clients applications. It is also possible to use the Historian SE Server to interact with data that is stored in external systems.
- **Historian SE Clients** - Microsoft Windows-based applications that are used by plant personnel to visualize the Historian SE data.

Tips and Best Practices

For access to the collection of tips and best practices, refer to Knowledgebase Answer ID 56070 - FactoryTalk Historian SE Tips and Best Practices TOC at <https://www.rockwellautomation.custhelp.com>

Architectural Best Practices

The following distributed system is representative of how the components can be configured:

- AppServ-Info Historian: Historian SE Server
- PASS: Historian SE Interface, FTLD
- AppServ-Info Reporting: Historian SE Client
- AppServ-OWS, OWS, EWS: Historian SE Client

FactoryTalk VantagePoint Overview

FactoryTalk VantagePoint provides unified access to virtually all manufacturing and plant data sources. The software produces web-based reports, such as dashboards, trends, X-Y plots, and Microsoft Excel® software reports.

The FactoryTalk VantagePoint Trend tool and add-on alarm reports provide advanced analytics.

Tips and Best Practices

For access to the collection of tips and best practices, refer to Knowledgebase Answer ID 59149 - FactoryTalk VantagePoint EMI Tips and Best Practices TOC at <https://www.rockwellautomation.custhelp.com>.

Maintenance Recommendations

Good control system maintenance keeps your PlantPAx® system operating efficiently and helps protect the operation of your plant. This chapter provides recommendations for monitoring, backing up data (application and process data), and maintaining your PlantPAx system.

We suggest that you develop a plan to back up your control system configuration and process data on a regular schedule. Consider involving your IT department to develop this plan. An effective backup plan can help protect you from loss of resources and revenue.

[Table 40](#) summarizes the types of backups and updates for routine and annual maintenance. Click the link or see the page for a description of each type.

The time frames are examples, and can be modified based on the attributes and risk factors in your plant.

Table 40 - Maintenance Type Recommendations

Backups	Why?	When?	What?
System - See page 96	Virtual infrastructure disaster recovery	Periodic	<ul style="list-style-type: none"> • Host machine • PlantPAx virtual images • Hypervisor management
Application configuration - See page 97	Roll back or file protection	Periodic	<ul style="list-style-type: none"> • Controllers • PASS servers <ul style="list-style-type: none"> – FactoryTalk® Directory – HMI, FactoryTalk Linx data servers – FactoryTalk Alarm and Event servers • Network switches
Data - See page 100	Archive or project protection	Periodic and on-demand	<ul style="list-style-type: none"> • FactoryTalk Historian • FactoryTalk Batch • FactoryTalk AssetCentre
Updates	Why?	When?	What?
Microsoft® operating system - See page 105	Resolve known issue and system protection	Periodic	Servers and workstations
Antivirus - See page 106		Periodic and on-demand	Rockwell Software
Software - See page 106			Controllers
Firmware - See page 106			

Backup and update maintenance schedules are routine maintenance activities, but they have different operational impacts. Updates typically affect system operation while backups typically can be done without an impact on system operation.

The PlantPAx system can be configured to back up control system configuration data automatically. FactoryTalk AssetCentre software stores data in a SQL server. This safeguard provides a roll back, or pulling back, of earlier protected data that can be used to access data that has since been corrupted or lost.

Data backups for FactoryTalk software packages (Historian, VantagePoint®, AssetCentre) can occur any time without impacting system operation. We recommend that process data backups be routinely scheduled so that data loss is minimized if computer issues occur.

We recommend that you verify operating system or software updates on a non-production system or when the affected system components are not-active. These precautions help to prevent unexpected results. For equipment monitoring and safety, we recommend that you follow the procedures of the manufacturer.

PlantPAx System Backup

When using a virtual infrastructure, follow these consideration for disaster recovery:

- We recommend that the configuration of each host machine is backed up.
- Make periodic backups of your server and workstation virtual images. If using a traditional environment, backup your servers and workstations.
- If using a hypervisor, backup the hypervisor management software.

The following subsections expand on these considerations.

Host Machine

Host administrator credentials are to be stored in a secure location, respective to each host that is backed up. ESXi server configuration can be backed up by using the command-line interface of the ESXi server or by using a hypervisor management application. The protected information includes the host IP address or DHCP server address.

Virtual Image Disaster Recovery

To retain system configuration with patches and other custom operating system (OS) configurations, we recommend that you back up each PlantPAx system server or workstation. Servers and workstations can be backed up individually by exporting and copying virtual machines (VMs). Each VM can be copied and stored off-site for safekeeping. Do VM maintenance on a dedicated network to prevent any input on your system operation.

Snapshots are not backups, they are change logs. Snapshots can be rendered useless if the base is lost due to host or other system failures. To use storage resources more effectively, back up virtual machines at the virtualization layer.

Hypervisor Management Applications

Many virtual environments leverage the use of a server management platform, such as vCenter Server. Whether this server management is an appliance running on a host or a Windows OS with installed management software, it is to be backed up.

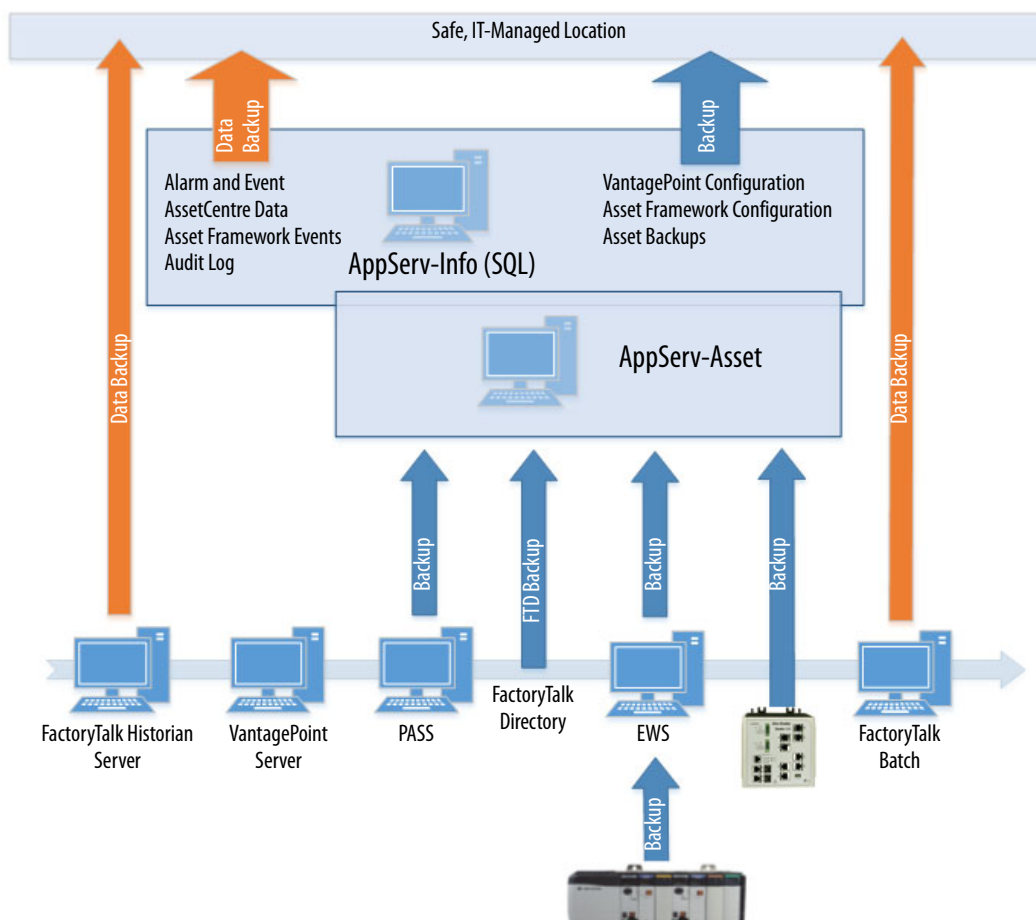
Host management appliances or installations store respective configurations on a database server like SQL, which is typically a local instance. To back up your server management platform, back up the SQL database in accordance with your IT department or other published recommendations.

Application Configuration

Application configurations for PlantPAx system servers and workstations are to be backed up separately and more regularly. The frequent backups mitigate the risk of losing configuration and application information that was generated between PlantPAx system backups. Frequent backups simplify the process of restoring only a portion of your application, if needed.

[Figure 8](#) shows PlantPAx system elements with data flow leading to and from the system SQL server. The SQL server acts as a central repository for application data in a PlantPAx system.

Figure 8 - Protect Vital Information with Routine Maintenance



The long arrows in [Figure 8](#) represent the flow of data from FactoryTalk Historian and FactoryTalk Batch servers directly to a safe, IT-managed location. An IT-managed storage location accommodates continuous backup data. See page [100](#) for more information.

[Table 41](#) shows examples of project files that are to be backed up regularly. Some files contain configuration scripts and collected data.

Table 41 - Recommended Configuration Backup

Configuration	Host Environment	Tool	Files Backed Up
Controller project file	Studio 5000® application	FactoryTalk AssetCentre Disaster Recovery	.ACD
FactoryTalk Directory	FactoryTalk Administration Console	Distributed Application Manager	.APB
PASS servers	FactoryTalk View Studio software		
Network switches	System network	User choice	.TXT (based)

[Figure 8](#) shows how the individual illustrations complement a comprehensive maintenance schedule.

Controller Project File

Use FactoryTalk AssetCentre software on your AppServ-Asset server to back up Logix5000™ software and Studio 5000 Logix Designer® application project files (.ACD). Logix5000 assets are created in the AssetCentre project tree for each controller and files can be checked into FactoryTalk AssetCentre software.

A schedule can be created to back up the project files on common intervals. Use an EWS to perform check-out and check-in features to make all modifications to the project file. However, the Logix5000 agent can be hosted on any computer with FactoryTalk AssetCentre Agent installed.



FactoryTalk AssetCentre software is integrated with the Logix Designer application to let you move files back-and-forth without leaving the design environment. Use change tracking on project files to capture all modifications.

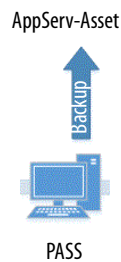
FactoryTalk Directory

Our recommendation is to back up the FactoryTalk Directory regularly. The backup includes any FactoryTalk security, users, and computers, among other configurations.

The backup is contained in the output .APB file of the Distributed Application Manager, which is installed on the PASS with the FactoryTalk View software, version 8.1 and later.



PASS Servers



The core FactoryTalk View SE project servers need to be backed up each time a change is made to the project, and regularly. The PASS server can comprise HMI, FactoryTalk Linx Data, and Alarm an Event servers.

TIP AssetCentre software, version 9, includes an asset for FactoryView SE version 11. This new asset can be created to support disaster recovery for a FactoryTalk View SE application.

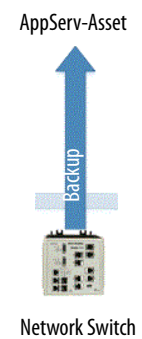
If using an older version, a FactoryTalk AssetCentre custom asset can be created by following the procedure in Knowledgebase Answer ID 818741 at <https://www.rockwellautomation.custhelp.com>. The project servers store the output .APB file to the FactoryTalk AssetCentre server. Schedule the custom asset to run regularly.

Network Switches

TIP AssetCentre software, version 9, includes an asset for managed Stratix switches.

If using an older version of AssetCentre software, back up the network switch configuration to retain the network architecture by using a custom asset. An export of the switch configuration can be generated by using various tools, including the following:

- Studio5000 Logix Designer application software
- Third-party applications, for example the Cisco® Network Assistant Tool
- Command-line interface
- Other desired methods of your IT department



The custom asset pulls the contents of the backup into the FactoryTalk AssetCentre server. You specify the file location in the custom asset configuration. Schedule the FactoryTalk AssetCentre software to back up the exported switch configuration regularly.

Data Back up and Restore

FactoryTalk Historian and FactoryTalk Batch servers produce process system data to document historic production data. The software configurations, which create the system data, must be protected along with the data.

Table 42 - Recommended Data Backup

Configuration	Host Environment	Tool	Files Backed Up
Historian configuration and data	FactoryTalk Historian software	Pibackup.bat	Backup folder contents
Batch configuration and data	FactoryTalk Batch software	Batch system files	System folder contents
AssetCentre data	SQL server	SQL Management Studio	AssetCentre.BAK
SQL server data			[DBName].BAK

Consider the following when using FactoryTalk AssetCentre software:

- No single asset (verification or custom asset) is to exceed 1 GB.
- The system is not to exceed 100 assets that are scheduled in a 12-hour period.

Historian Configuration and Data

The FactoryTalk Historian server contains historian points, configurations, and data that need to be regularly backed up. As a part of the Historian standard installation, a script file pibackup.bat is installed on the Historian server. This script is used to back up the Historian server.

The output of this tool is a folder hierarchy that contains all components necessary to back up and recover the Historian server. We suggest that you consider separating the historical data from the configuration for scheduling purposes.

The historical backup data, which is generated by FactoryTalk Historian, is stored on the Historian server. Consult with your IT department to determine the appropriate location to move and store these files outside of the AppServ-Info (Historian) server.



Batch Configuration and Data



There are multiple components of a FactoryTalk Batch system that require a backup plan depending on the implementation of your system. See Knowledgebase Answer ID 538578 (at <https://www.rockwellautomation.custhelp.com>) for a list of the files that are to be backed up for each of the following components of a batch system:

- Batch server files
- Batch client files
- eProcedure® files
- Material manager files

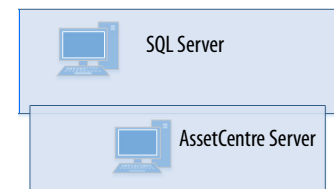
The file contents of the various Batch system components need to be separated into two groups: (1) configuration or system files and (2) data files.

The configuration files are all files that comprise the Batch project, such as area models and recipes. The data files are the batch journals that are constantly created by a running Batch server.

The configuration files and data can be backed up at different intervals to a safe, IT-managed location outside of your AppServ-Batch server.

AssetCentre Data

FactoryTalk AssetCentre software manages the information that is produced by each of its assets and processes the data into an SQL server. When performing a backup of AssetCentre software, nothing must be done within AssetCentre. To back up the AssetCentre configuration and data, back up the AssetCentre database in your SQL server.



For guidelines on how to back up your AssetCentre database in SQL, see the Knowledgebase Answer ID 59541 at <https://www.rockwellautomation.custhelp.com>.

SQL Server Data

The FactoryTalk Alarm and Event History software is configured to log to a SQL database. In addition, the VantagePoint software configuration is natively stored in the SQL server that is specified during the VantagePoint installation.

To back up the FactoryTalk VantagePoint software, see the Knowledgebase Answer ID 62884 at <https://www.rockwellautomation.custhelp.com>.

We recommend that you use the methodologies outlined in the Knowledgebase Answer ID 62884 to backup other SQL server databases. These databases include the following:

- For FactoryTalk Alarm and Event database, open FactoryTalk Administration Console and expand System>Connections>Databases. Double-click the database to view the information on the Alarm and Event Historian Database Properties dialog box.
- For FactoryTalk Historian Asset Framework, the SQL Database 'PIFD' contains the Asset Framework data and configuration content.

Backup Verification

We recommend that your system use a dedicated, non-production environment that is capable of accepting and validating backups. You need a strategy for how frequently the backups are validated.

System Restore

We recommend that you consider a strategy for recovering and restoring your PlantPAx system to a known secure state after a disruption or failure.

System recovery and restore to a known secure state means that all system parameters (either default or configurable) are set to secure values. If any security-critical information, such as patches, is installed after the last backup, the information must be reinstalled. For example:

- Security-related configuration settings re-established
- System documentation and operating procedures available
- Application and system software that is reinstalled and configured with secure settings
- Information from the most recent, known secure backup is loaded and the system that is fully tested and functional.

Retention Considerations

There are two ways to retain data: archived records and a detailed backup policy. While archiving provides historical records, backups are typically not useful unless you can access the data for a restore. You must take the time to design a retention policy for the reuse of dated materials.

For example, a backed up .ACD file from the Studio 5000 Logix Designer application could possibly not be saved in the most current version of Studio 5000 environment. Accessing the contents of this .ACD file could be problematic. But an archived printout of the logic that is stored in PDF format could help restore a system project.

Secure archived data and make sure that you can search for the data if requested. There are numerous reasons to archive data, including, but not limited to, the following:

- Compliance with government regulations
- Retention of production knowledge
- Reduction of backup storage footprint

Your retention policy must apply to all backups that are reviewed in this chapter. We recommend that you include your IT department in the backup retention policy discussion.

Consider the following when developing a backup retention policy:

- Location – Backup information is only worthwhile if retrievable for a restore. To mitigate risk, duplicate the backup contents to an off-site location in the event an 'Act of God' renders the on-site copy unusable.
- Storage – The type of storage medium that is used to backup data can affect how quickly you are able to restore data. Cloud storage provides scalable backup potential and requires the least amount of on-site hardware. But, the cloud requires additional steps if the process facility is not connected to the enterprise cloud servers. Disk mirroring can provide the fastest time to restore and smaller data loss intervals. This process can cost more than periodic backups to a hard disk drive.
- Security – The confidentiality and importance of backup information must be carefully evaluated. Limit access to the retained backup storage devices and locations to help reduce the risk of threats. Password protection and encryption can improve risk mitigation.
- Cost – The cost of backing up a process system can be justified with one application configuration restore. The time alone to re-engineer a process configuration can justify the cost of physical media and IT infrastructure. Automated backup policies can reduce time and money for IT to complete regular backups.

System Storage Rates

The following tables provide an estimate of storage usage for a PlantPAx system. The values in [Figure 10](#) are estimates based on assumptions in [Figure 9](#). Make sure to evaluate your system size and adjust appropriately according to your corporate policy.

Figure 9 - System Operating Assumptions

Description	Small ⁽¹⁾	Medium ⁽²⁾	Large ⁽³⁾
Alarms SQL database (alarms/min according to the ISA 18.2 peak alarm rate)	20	50	100
FactoryTalk Historian Event Frames SQL database (event frames per hour)	250	500	1000
FactoryTalk AssetCentre SQL database (commands/min per PlantPAx audit log guidelines)	2	5	10
FactoryTalk Historian points	5000	10,000	20,000

Figure 10 - Storage Rates

Description	Small ⁽¹⁾	Medium ⁽²⁾	Large ⁽³⁾
Microsoft SQL server	4 GB/month	5 GB/month	9 GB/month
FactoryTalk Historian server	2 GB/month	3 GB/month	6 GB/month

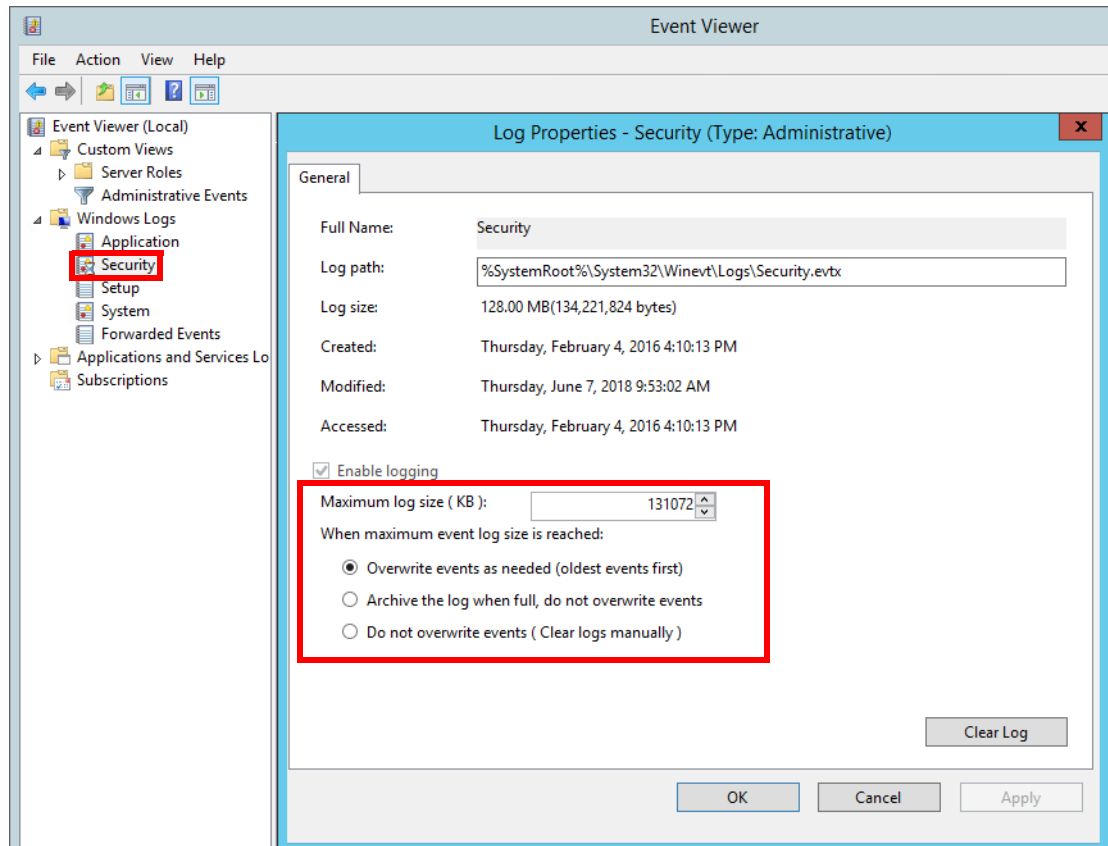
(1) 3000 I/O points and 10 operator workstations

(2) 3000 I/O points and 25 operator workstations

(3) 5000 I/O points and 50 operator workstations

Security Audit Logs

Microsoft Windows OS captures security audit records locally for every PlantPAx server and workstation. We recommend that you make sure the log is sized adequately to capture sufficient records to satisfy your retention policy. In Windows Event Viewer adjust the configuration of the security log according to your system requirements.



Microsoft Updates

Microsoft releases a range of security updates, operating system, and other software updates. Rockwell Automation qualifies certain Microsoft updates that potentially impact Rockwell Automation software products. The results of these patch qualifications are published on Knowledgebase Answer ID 35530 at <http://www.rockwellautomation.custhelp.com>.

We recommend that you do not apply or install Microsoft updates until they are qualified by Rockwell Automation. Before implementing qualified Microsoft updates, we recommend that you verify them on a non-production system or when the facility is non-active. This precaution helps to make sure that there are no unexpected results or side effects.

For more information, contact Rockwell Automation Technical Support representatives at <http://www.rockwellautomation.com/global/support>.

Use Antivirus Software

It is best practice to install antivirus software on your PlantPAx servers and workstations. Keep the antivirus software up-to-date based on whether your software is a managed or an unmanaged client.

A managed client communicates with an antivirus management server, which is on the network. This antivirus management server configures the protection settings for the client and downloads virus definition files to stay current.

An unmanaged client does not communicate with any management server and the antivirus definition files are updated manually.

See Knowledgebase Answer ID 35330 at <http://www.rockwellautomation.custhelp.com> for more information on compatibility and considerations for antivirus software installation.

Software Patches and Firmware Updates

We recommend that you periodically review and update the available software patches and firmware updates for the Rockwell Automation® components on your PlantPAx system. Before implementing Rockwell Automation updates, we recommend that you verify them on a non-production system or when the facility is non-active. This precaution helps to make sure that there are no unexpected results or side effects.

Use Proactive Industrial Security Advisory Index

Rockwell Automation offers a subscription service. The Industrial Security Advisory Index is a publicly available resource that points to specific Rockwell Automation product security alerts, advisories, and security recommendations. As new disclosures are added, subscribers to the service receive a proactive notification.

There are related links to information to raise awareness of risks to affected product operation or performance. The recommendations include how to reduce or remove such risks. The advisory index is available at <https://rockwellautomation.custhelp.com>.

Verify Software Patches

For Rockwell Automation software (that is, FactoryTalk View, Factory Talk Batch, FactoryTalk Historian SE, and FactoryTalk AssetCentre), Rockwell Automation provides the Patch Validator tool. This tool verifies the current file version that is installed, the expected file version (based on the version of Patch Validator used), and completes installation of patch roll-up.

To install patches with the Patch Validator tool, see Chapter 4 in the PlantPAx Distributed Control System Infrastructure Configuration User Manual, publication [PROCES-UM001](#).

Compare Latest Firmware Updates

For Rockwell Automation firmware, Rockwell Automation provides a System Ferret tool that can be installed on the EWS. The tool collects device serial numbers, and revisions of all devices through RSLinx® Classic software. System Ferret is available through ab.com as an Integrated Architecture® Productivity Tool; see <http://www.ab.com/go/iatools>.

The devices and firmware that are listed can be compared against the latest firmware compatible with your Logix firmware revision by reviewing the firmware compatibility. You also can download the latest firmware release at <http://www.rockwellautomation.com/support/ControlFlash/>.

Use the ControlFLASH™ Utility through the Studio 5000 Logix Designer application to update firmware as documented in the ControlFLASH Firmware Upgrade Kit User Manual, publication [1756-UM105](#).

Considerations for Software and Firmware Upgrades

If you install a new PlantPAx system, we recommend that you use the specifications in the PlantPAx Selection Guide, publication [PROCES-SG001](#).

When you update software versions or firmware revisions, we recommend that you verify the impact on performance and memory utilization before implementing the upgrade on the production system. For FactoryTalk View or ControlLogix® platforms, we recommend that you review the release notes and verify the impact of the upgrade on performance and memory utilization.

You also can verify the compatibility of the upgraded version with the other software and operating systems in use on your PlantPAx system. See the Product Compatibility and Download Center at www.rockwellautomation.com.

A comparison tool (<http://www.rockwellautomation.com/compatibility/#/scenarios>) lets you compare features and compatibilities of different products and firmware revisions. You can contact Rockwell Automation Technical Support for assistance.

Rockwell Automation Services and Support

System Support offers technical assistance that is tailored for control systems. Some of the features include the following:

- Highly experienced team of engineers with training and systems experience
- Process support at a systems-level that is provided by process engineers
- Unlimited online support requests
- Use of online remote diagnostic tools
- Access to otherwise restricted TechConnectSM Knowledgebase content
- 24-hour, 7 days per week, 365 days per year of phone-support coverage upgrade option

For more information, contact your local distributor or Rockwell Automation representative or see <http://www.rockwellautomation.com/support>.

Verify and Monitor Your System Health

Rockwell Automation provides checklist worksheets to verify and document that your system design aligns with PlantPAx® system recommendations. In addition, we also provide examples on how to troubleshoot your system if performance expectations are not being met.

For details, see the PlantPAx Distributed Control System Verification and Troubleshooting User Manual, publication [PROCES-UM004](#).

Additional Monitoring Resources

The Counter Monitor tool is installed with the FactoryTalk® Services Platform (FTSP) on the PASS. It is on the drive where FTSP is installed under Program Files(x86)/Common Files /Rockwell/ftcountermonitor.exe.

Counter Monitor checks the runtime values of counters and strings that are made available by network clients for diagnostic purposes. You also can use the Counter Monitor tool to take a snapshot of the status and submit it to Rockwell Automation Technical Support.

Rockwell Automation also provides tools to collect log files for submission to technical support.

The Rockwell Software® Data Client program can browse the FactoryTalk Directory to see all tags in the directory. It can also get live data from any tag. The Rockwell Software® Data Client program does not automatically load the application. Before you use it, make sure that the application is open by either opening the application from any computer with RSVIEW® Studio or by running an RSVIEW® SE Client™.

Notes:

System Element Software Components

[Table 44](#) lists the typical software for the system element components that comprise your PlantPAx® system.

Table 44 - System and Software Requirements

Element	Category	Description
Process Automation System Server (PASS)	Operating system	Microsoft® Windows Server 2016 Standard
	Rockwell Automation® software	<ul style="list-style-type: none"> • FactoryTalk® Services Platform <ul style="list-style-type: none"> – FactoryTalk Services platform software, version 6.11.00 – FactoryTalk Activation Manager software, version 4.03.03 – FactoryTalk Linx software, version 6.11.00 • FactoryTalk View Site Edition Client software, version 11.00.00 • FactoryTalk View Site Edition Server software, version 11.00.00 • FactoryTalk View Studio Enterprise software, version 11.00.00 • FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk Diagnostics software, version 6.11.00 • FactoryTalk Historian SE Live Data Interface, version 6.00.00 • Rockwell Automation® Windows Firewall Configuration Utility, version 1.00.12
Engineering Workstation (EWS)	Operating system	Microsoft Windows 10
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services Platform software, version 6.11.00 – FactoryTalk Linx software, version 6.11.00 – RSLinx® Classic software, version 4.11.00 – FactoryTalk Activation Manager software, version 4.03.03 • FactoryTalk View Site Edition Client software, version 11.00.00 • FactoryTalk View Site Edition Server software, version 11.00.00 • FactoryTalk View Studio Enterprise software, version 11.00.00 • FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk Diagnostics software, version 6.11.00 • RSLogix 5000® Professional software, versions 20.05.00 • Studio 5000 Logix Designer® application, versions 31.01.00, 24.02.00 • Studio 5000 Architect Software, version 4.00.00 • RSNetWorx™ <ul style="list-style-type: none"> – RSNetWorx for EtherNet/IP™ software, version 28.00.00 – RSNetWorx for ControlNet® software, version 28.00.00 – RSNetWorx for DeviceNet® software, version 28.00.00 • FactoryTalk AssetCentre <ul style="list-style-type: none"> – FactoryTalk AssetCentre Client software, version 9.00.00 • FactoryTalk Historian SE Management Tools, version 6.00.00 • Studio 5000® Logix Emulate™, version 31.01.00 • ControlFLASH Plus™ software, version 2.00.00 • ControlFLASH software, version 15.01.00 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.12
	Additional third-party software	<ul style="list-style-type: none"> • LOOP-PRO TUNER (Rockwell Automation Edition) software, version 1.9 • Microsoft SQL Server 2012 SP4 Management Tools • Microsoft SQL Server 2012 SP4 Client Connectivity

Table 44 - System and Software Requirements

Element	Category	Description
Operator Workstation (OWS)	Operating system	Microsoft Windows 10
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services Platform software, version 6.11.00 – FactoryTalk Linx software, version 6.11.00 – RSLinx Classic software, version 4.11.00 – FactoryTalk Activation Manager software, version 4.03.03 • FactoryTalk Diagnostics software, version 6.11.00 • FactoryTalk View Site Edition Client software, version 11.00.00 • FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk AssetCentre Client software, version 9.00.000 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.12
Process Automation Domain Controller (PADC)	Operating system	Microsoft Windows Server 2016 Standard
Application Server OWS (AppServ-OWS)	Operating system	Microsoft Windows Server 2016 Standard
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services Platform software, version 6.11.00 – FactoryTalk Linx software, version 6.11.00 – RSLinx Classic software, version 4.11.00 – FactoryTalk Activation Manager software, version 4.03.03 • FactoryTalk View Site Edition Client software, version 11.00.00 • FactoryTalk Diagnostics software, version 6.11.00 • FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk AssetCentre Client software, version 9.00.00 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.12
Application Server EWS (AppServ-EWS)	Operating system	Microsoft Windows Server 2016 Standard
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services Platform software, version 6.11.00 – FactoryTalk Linx software, version 6.11.00 – RSLinx® Classic software, version 4.11.00 – FactoryTalk Activation Manager software, version 4.03.03 • FactoryTalk View Site Edition Client software, version 11.00.00 • FactoryTalk View Site Edition Server software, version 11.00.00 • FactoryTalk View Studio Enterprise software, version 11.00.00 • FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk Diagnostics software, version 6.11.00 • RSLogix 5000® Professional software, versions 20.05.00 • Studio 5000 Logix Designer® application, versions 31.01.00, 24.02.00 • Studio 5000 Architect Software, version 4.00.00 • RSNetWorx™ <ul style="list-style-type: none"> – RSNetWorx for EtherNet/IP software, version 28.00.00 – RSNetWorx for ControlNet software, version 28.00.00 – RSNetWorx for DeviceNet software, version 28.00.00 • FactoryTalk AssetCentre <ul style="list-style-type: none"> – FactoryTalk AssetCentre Client software, version 9.00.00 • FactoryTalk Historian SE Management Tools, version 6.00.00 • Studio 5000® Logix Emulate™, version 31.01.00 • ControlFLASH Plus™ software, version 2.00.00 • ControlFLASH software, version 15.01.00 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.12
	Additional third-party software	<ul style="list-style-type: none"> • LOOP-PRO TUNER (Rockwell Automation Edition) software, version 1.9 • Microsoft SQL Server 2012 SP4 Management Tools • Microsoft SQL Server 2012 SP4 Client Connectivity

Table 44 - System and Software Requirements

Element	Category	Description
Application Server Historian (AppServ-Info Historian)	Operating system	Microsoft Windows Server 2016 Standard
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk ®Services Platform <ul style="list-style-type: none"> – FactoryTalk Services Platform software, version 3.00.00 – FactoryTalk Activation Manager software, version 4.02.00 – FactoryTalk Diagnostics software, version 3.00.00 • FactoryTalk Alarm and Event software, version 3.00.00 • FactoryTalk Historian Site Edition Server, version 6.00.00 • FactoryTalk Historian ActiveView software, version 3.20.03 • FactoryTalk Historian DataLink software, version 4.20.02 • FactoryTalk Historian Management software, version 6.00.00 • FactoryTalk Historian ProcessBook software, version 3.20.03 • FactoryTalk Historian SE Live Data Interface, version 6.00.00 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.10 • FactoryTalk Linux software , version 6.00.00
Application Server Asset Management (AppServ-Asset)	Operating system	Microsoft Windows Server 2016 Standard
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services Platform software, version 6.11.00 – FactoryTalk Diagnostics software, version 6.11.00 – FactoryTalk Linux software, version 6.11.00 – RSLinx Classic software, version 4.11.00 – FactoryTalk Activation Manager software, version 4.03.03 – FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk AssetCentre <ul style="list-style-type: none"> – FactoryTalk AssetCentre Server software, version 9.00.00 – FactoryTalk Asset Centre Client software, version 9.00.00 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.12
	Additional third-party software	<ul style="list-style-type: none"> • Microsoft SQL Server Express 2012 SP4 Advanced (includes Management Studio)
Application Server Information SQL (AppServ-Info-SQL)	Operating system	Microsoft Windows Server 2016 Standard
	Microsoft software	<ul style="list-style-type: none"> • Microsoft SQL Server Standard 2012 SP4 (includes Management Studio)
Application Server Information VantagePoint® (AppServ-Info-VantagePoint)	Operating system	Microsoft Windows Server 2016 Standard
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services Platform software, version 3.00.00 – FactoryTalk Activation Manager software, version 4.02.00 – FactoryTalk Diagnostics software, version 3.00.00 – FactoryTalk Linux software, version 6.00.00 • FactoryTalk VantagePointSystem Server software, version 8.10.00 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.10
Application Server Batch Management (AppServ-Batch)	Operating system	Microsoft Windows Server 2016 Standard
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Activation Manager software, version 4.02.00 – FactoryTalk Diagnostics software, version 3.00.00 – FactoryTalk Services Platform software, version 3.00.00 – RSLinx Classic software, version 3.81.00 • FactoryTalk Batch, version 13.00.02 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.10

Table 45 - Build Details for USB Devices

Element	Category	Description
PASS-C (consolidated)	Operating system	Microsoft Windows Server 2016 Standard
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services platform software, version 6.11.00 – FactoryTalk Activation manager software, version 4.03.03 – FactoryTalk Linx software, version 6.11.00 – RSLinx Classic software, version 4.11.00 • FactoryTalk View Site Edition Client software, version 11.00.00 • FactoryTalk View Site Edition Server software, version 11.00.00 • FactoryTalk View Studio Enterprise software, version 11.00.00 • FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk Diagnostics software, version 6.11.00 • FactoryTalk Historian SE Live Data Interface, version 6.00.00 • Rockwell Automation Windows Firewall Configuration Utility, version 1.00.12 • FactoryTalk Historian SE software, version 6.00.00 • FactoryTalk AssetCentre Server, version 9.00.00 • FactoryTalk AssetCentre Client, version 9.00.00 • Studio 5000 Logix Designer®, version 31.01.00 • Studio 5000 Logix Designer, version 24.02.00 • RSLinx 5000, version 20.05.00 • VantagePoint® System Server, version 8.10.00 • ControlFLASH software, version 15.01.00 • ControlFLASH Plus software, version 2.00.00
	Additional software	Microsoft SQL Server Express 2012 SP4 Advanced (includes Management Studio)
Operator Workstation (OWS ISO)	Operating system	Microsoft Windows 10
	Rockwell Automation software	<ul style="list-style-type: none"> • FactoryTalk Services Platform <ul style="list-style-type: none"> – FactoryTalk Services platform software, version 6.11.00 – FactoryTalk Linx software, version 6.11.00 – RSLinx Classic software, version 4.11.00 – FactoryTalk Activation manager software, version 4.03.03 • FactoryTalk Diagnostics software, version 6.11.00 • FactoryTalk View Site Edition Client software, version 11.00.00 • FactoryTalk Alarm and Event software, version 6.11.00 • FactoryTalk AssetCentre Client, version 9.00.00 • Rockwell Automation 111Windows Firewall Configuration Utility, version 1.00.12

The following terms and abbreviations are used throughout this manual. For definitions of terms that are not listed here, refer to the Allen-Bradley® Industrial Automation Glossary, publication [AG-7.1](#).

- Add-On Instruction** Add-On Instructions are reusable code objects that contain encapsulated logic that can streamline the implementation of your system. The objects let you create your own instruction set for programming logic as a supplement to the instruction set provided natively in the ControlLogix® firmware. An Add-On Instruction is defined once in each controller project, and can be instantiated multiple times in your application code as needed.
- alarm** An audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition that requires a response.
- alarm event** A push notification from the alarm object to the alarm subscriber that indicates a change in alarm state.
- alarm management** The processes and practices for determining, documenting, designing, operating, monitoring, and maintaining alarm systems.
- alarm object** The alarm system element that owns the alarm; it is responsible to identify an alarm, managing the state, and generating an alarm event.
- alarm priority** An attribute of In-Alarm event that informs you of the salience of the event.
- alarm system** The collection of hardware and software that detects an alarm state, communicates the indication of that state to the operator, and records changes in the alarm state.
- application server** The application server (AppServ) is a server on the Process Automation System Server (PASS), which is typically a FactoryTalk® Directory client of the PASS. Examples are AppServ-Batch for a FactoryTalk Batch application or AppServ-Info for a Historian application.
- architecture** An architecture is a representation of a control and software system, as well as the process and discipline for effectively implementing the designs for such a system. An architecture conveys the information content of the related elements comprising a system, the relationships among those elements, and the rules governing those relationships.
- characterization** A characterization is the operation and collection of performance data for a representative process system to determine scalability, stability, and usability of a specific system configuration. A characterization is the following:
- Aimed at defining a complete system
 - Used to determine if the system is performing at specified level
 - Used to identify usability issues
 - Used to check and create rules, relationships, limits, and recommendations for system elements

- client** A client is hardware (personal computer) and software that provides an interface with a link into a system server application. In the Rockwell Automation® architecture, a client is a computer that is loaded with runtime software.
- control strategy** A control strategy is a system footprint to show the complexity of the following:
- Data servers
 - Information storage
 - Operator interface (graphics, faceplates)
 - Control code (sequence, procedure, phases)
 - I/O
- Control strategies are used to determine a set of comprehensive process system footprints. These footprints establish a representative system loading that can be measured to identify the boundaries and limitations (implementation rules) of a process system.
- critical system attribute (CSA)** A critical system attribute (CSA) is a customer-facing characteristic that defines or identifies whether the system is performing as expected. CSAs are specific, visible indicators of overall system performance and usability.
- CSAs have specified parameters that must be maintained and that set the base operational requirements for the system. There are many other attributes that are associated with system elements such as controller loading, computer loading, and network settings that must be configured properly to maintain system CSAs.
- development software** Development software is a program application that is used to configure various system components and not required at runtime. For example, Studio 5000 Logix Designer®, FactoryTalk View Studio software.
- display object** A display object is a functional group of display elements with animations.
- engineering workstation (EWS)** The engineering workstation (EWS) provides system configuration, development, and maintenance functions of the PlantPAx® system. The EWS contains development software, including FactoryTalk View SE Studio and Studio 5000 Logix Designer.
- FactoryTalk directory software** FactoryTalk Directory software defines where system data is stored for access. FactoryTalk Directory software provides a common address book of factory resources that are shared among FactoryTalk-enabled products.
- FactoryTalk services platform** The FactoryTalk Services Platform (FTSP) is a service-oriented architecture (see SOA) that delivers value through FactoryTalk-enabled products. This platform reduces the customer learning curve and project engineering time through commonality and reuse. For example, activation, FactoryTalk Directory, security, diagnostics, audit, live data, and alarms and events.
- global object** An object that is created once and can be referenced multiple times on multiple displays in an application.

historian	A historian is a data collection system with the following components: collection, storage, compression, retrieval, reports, and analysis. Historian functions include raw sampling, compression, storage, retrieval, reconstitute, analyze, summarize, and present (reports and displays).
historical data	Historical data is data that is used for the long-term analysis of past operation.
host machine	A computer on which a hypervisor runs one or more virtual machines is called a host machine.
integrated architecture® (IA)	Integrated Architecture® (IA) is the identifying name of Rockwell Automation group of products that use Rockwell Automation core-enabling technologies. The PlantPAx system is a defined set of IA products that are configured in a prescribed way to provide optimal performance as a distributed control system.
operator workstation (OWS)	The operator workstation (OWS) provides the graphical view and interface into the process. The workstation is a client of either a PASS or AppServ-HMI.
PlantPAx distributed control system	The PlantPAx system has all the core capabilities that are expected in a world-class distributed control system (DCS). The system is built on a standards-based architecture by using Integrated Architecture components that enable multi-disciplined control and premier integration with the Rockwell Automation® intelligent motor control portfolio.
Process Automation System Server (PASS)	The Process Automation System Server (PASS) is the core PlantPAx system server that provides central administration throughout the PlantPAx system. The PASS is a required component.
RSLinx software	RSLinx® software is the communication driver (data server) for computer-based programs to access information in Rockwell Automation controllers. There is RSLinx Classic software and FactoryTalk Linx software. FactoryTalk View SE software uses FactoryTalk Linx software to directly access tags in a controller.
server	Software component that serves data to an application (for example, data server). Typically, server software components are installed on server-class computers.
system attribute	A system attribute is an operational functionality that can be manipulated or measured and is used to establish the operational boundaries or system capability. For example workstation memory, number of parameters on a screen, and number of control loops. A system attribute can be independent or dependent.
system element	A system element is a distinctive system entity that is made up of a combination of hardware and software products that support an identifiable system function or role. A system element can be manipulated to vary system operation or capability. For example, engineering workstation (EWS), operator workstation (OWS), process automation system server (PASS), and controller.
system infrastructure	System infrastructure is the commercial off-the-shelf hardware and software that is required to enable system elements to work together as a system. For example, network switches, computers, and so forth.

system server A system server expands the scope of a system by providing support for additional system capacity or optional system functions. For example, the Process Automation System Server (PASS) is a required component for all centralized and distributed process systems. The PASS provides central name resolution and system-wide, FactoryTalk services. The PASS provides the capability to distribute information to the OWS and add to optional application servers to increase the scope of the process system.

user-defined data type (UDT) Tag types that you create once and reuse in multiple tag templates, multiple times.

workstation A workstation is a computer running development, configuration, and optional maintenance software. A workstation is not a server.

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Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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