Quick Start

Allen-Bradley

Batch Application Toolkit

Allen-Bradley • Rockwell Software

Rockwell Automation

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.

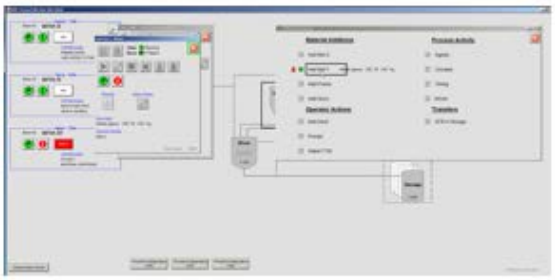
	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal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

Follow this path to install and use your Batch Application Toolkit.

Chapter 1 Overview

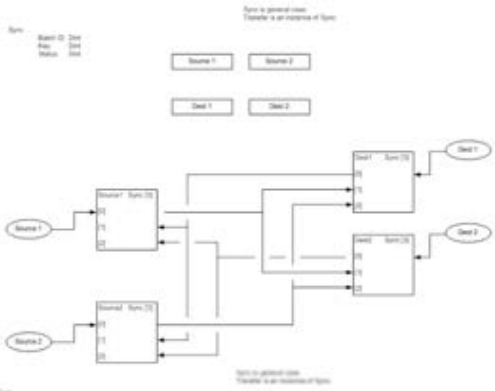


Chapter 2 Equipment Phase Set and Features

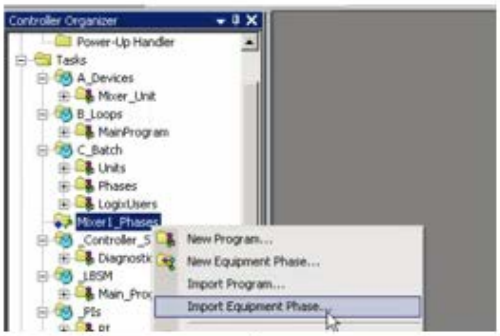
Item	Phase	Comment
1	Initiation)	
2	Timing	With sync to other phases
3	Prompt	Free format, driven from recipe parameters
4	Dose or Material Add w/ Automation	
5	Hand Additions	Operator prompting
6	Transfer In / Transfer Out pairing	Coordination between units
7	Rinse	Device arbitration/allocation
8	Agitation	Non-Terminating w/ Transfer of Control
9	Circulation	Non-Terminating
10	Transfer Out	
11	Unit Message	

Chapter 3 Logic Structure

Chapter 4 Detailed Design Features



Chapter 5 Controller Implementation



Chapter 6 HMI Implementation

Notes:

Chapter 5

Controller Implementation

Chapter 6

HMI Implementation

Appendix A

Index Numbering

Appendix B

Video Listing

About This Publication

This quick start is designed to provide a framework for using the Batch Application Toolkit. Each section guides you through the tasks you need to complete in order to use the components of the Toolkit.

A sound understanding of the current parts of the ISA-88 batch processing control standards is necessary, including ANSI/ISA-88.01-2010 Batch Control Part 1: Models and Terminology. You should be knowledgeable of programming Rockwell Automation® Logix controllers with Studio 5000 environments and programming in FactoryTalk® View Studio. You should also be familiar with how to use the Rockwell Automation Process Library Objects, the FactoryTalk® Batch equipment and recipe editors, and the PlantPAx® Logix Batch and Sequence Manager.

The beginning of each chapter contains the following information. Read these sections carefully before you begin work in each chapter:

- **Before You Begin** – This section lists the steps that must be completed and decisions that must be made before starting that chapter. The chapters in this quick start do not have to be completed in the order in which they appear, but this section defines the minimum amount of preparation that is required before completing the current chapter.
- **What You Need** – This section lists the tools that are required to complete the steps in the current chapter. These tools include, but are not limited to, hardware and software.
- **Follow These Steps** – This section illustrates the steps in the current chapter and identifies which steps are required to complete the examples by using specific networks.

Additional Resources

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

Resource	Description
PhaseManager™ User Manual, publication LOGIX-UM001	Explains how to set up and program a Logix5000™ controller to use equipment phases. Designed for users who program or maintain industrial automation systems.
PhaseManager Step Indexes and Restart Control Application Note, publication PROCES-AT016	Discuses the purposes and uses of the step index in conjunction with the Logix PhaseManager instruction. Suggests numbering conventions and practices that facilitate the development of consistent and maintainable code.
Batch Process Skid Solutions White Paper, publication PROCES-WP001	Provides an overview of how mixing and blending templates can be applied to batch control to help original equipment manufacturers save engineering time while complying with S88 standards.
FactoryTalk Batch User's Guide, publication BATCH-UM011	Provides instructions on how to configure and administer a FactoryTalk batch system. Includes an Administrator's Guide, an Equipment Editor User's Guide, a Recipe Editor User's Guide, a View User's Guide, an Event Archiver User's Guide, and an ActiveX Controls User's Guide.
FactoryTalk Batch Software Suite Product Profile, publication FTALK-PP002	Describes the features and capabilities of the FactoryTalk Batch Software Suite.
PlantPAx Logix Batch and Sequence Manager Product Profile, publication PROCES-PP004	Describes the features and benefits of the PlantPAx Logix Batch and Sequence Manager.
Tips on Using PhaseManager with FactoryTalk Batch White Paper, publication FTALK-WP001	Provides tips and instructions on how to use PhaseManager with FactoryTalk Batch software.
Clean in Place Made Simple White Paper, publication PROCES-WP003	Discusses an approach that makes Clean in Place (CIP) automation a straight forward task. Provides ample modularity and flexibility through the use and application of ANSI/ISA-88 (S-88) concepts.
FactoryTalk Batch Technical Reference Guide, publication BATCH-RM111	Provides information about the interface between the FactoryTalk Batch Server and the FactoryTalk Batch View. Includes a Server API Communication Language Reference, a PCD Programmer's Technical Reference, a System Files Reference Guide

Resource	Description
FactoryTalk Batch Material Manager User's Guide, publication BWMTR-UM011	Provides instructions on how to configure, administer, and develop custom interfaces for a FactoryTalk Batch system. Includes a FactoryTalk Batch Material Editor User's Guide, a FactoryTalk Batch Material Manager Administrator's Guide, and a FactoryTalk Batch Material Servier API Technical Reference.
Batch Management and Control Brochure, publication BATCH-BR001	Discusses the advantages of using the PlantPAx distributed control system in the batch management and control process.
Rockwell Automation Library of Process Objects Reference Manual, publication PROCES-RM002	Describes how to use the Rockwell Automation Library of Process Objects and associated productivity tools. The instructions provide common process objects for controlling and interacting with motors, valves, pumps, and numerous other devices.
Rockwell Automation Library of Process Objects: Interlocks with First Out and Bypass (P_Intlk) Reference Manual, publication SYSLIB-RM004	Defines the P_Intlk (Interlocks with First Out and Bypass) Add-On Instruction and its primary operations. Describes when it is used, and also provides programming examples.
Rockwell Automation Library of Process Objects: Permissives with Bypass (P_Perm) Reference Manual, publication SYSLIB-RM007	Defines the P_Perm (Permissives with Bypass) Add-On Instruction and its primary operations. Describes when it is used, and also provides programming examples.
Rockwell Automation Library of Process Objects: Operator Prompt (P_Prompt) Reference Manual, publication SYSLIB-RM046	Defines the P_Prompt (Operator Prompt) Add-On Instruction and its primary operations. Describes when it is used, and also provides programming examples.
Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094	Provides detailed design information about the Logix5000 controllers.
FactoryTalk View Site Edition User's Guide, publication VIEWSE-UM006	Provides information on how to use the FactoryTalk View Site Edition software to develop and run human-machine interface (HMI) applications that can involve multiple users and servers, distributed over a network.
PlantPAx Process Automation System Reference Manual, publication PROCES-RM001	Elaborates on the application rules required to set up a PlantPAx distributed control system.
PlantPAx Process Automation System Selection Guide, publication PROCES-SG001	Provides basic definitions of system elements and sizing guidelines for procuring a PlantPAx distributed control system.
PlantPAx System Application Templates Quick Start, publication PROCES-QS001	Describes how to configure controller and HMI templates to start development of your PlantPAx distributed control system.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

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.

Overview

In this chapter, you learn about the content and purpose of the Batch Application Toolkit.

The Batch Application Toolkit is a collection of documentation, equipment phases, support routines, and associated HMI components that can assist you in the development of a Batch Solution using Integrated Architecture or the PlantPAx® distributed control system. It serves as a starting point to a batch project, and it demonstrates one chosen and specific batch-control philosophy that can be modified to meet your own specific needs or philosophy.

The Batch Application Toolkit was designed by using a three-unit process. These units illustrate the use of shared resources, coordinated transfers between units, and a wide selection of common equipment modules and phases found in most batch control applications.

The toolkit integrates batch process control with the Rockwell Automation® Library of Process Objects, providing a consistent look and feel at the phase and unit levels. However, the design methodology is not limited to the Rockwell Automation® Library of Process Object users.

Before You Begin

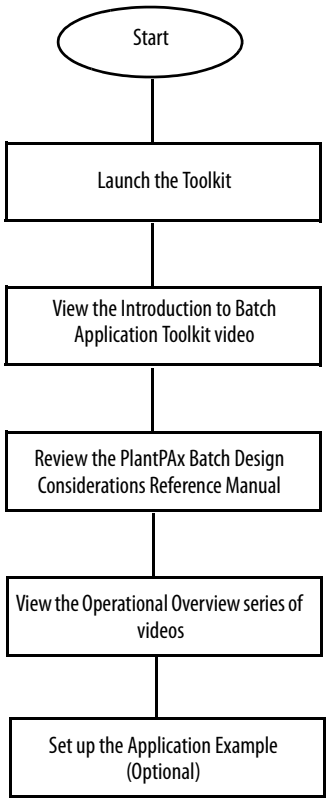
- Download and install the Batch Application Toolkit.

What You Need

- Batch Application Toolkit - Introduction to Batch Application Toolkit video
- Batch Application Toolkit - Operational Overview series of videos
- PlantPAx Batch Design Considerations Reference Manual, publication PROCES-RM008

Follow These Steps

Complete these steps to familiarize yourself with the Batch Application Toolkit.



Launch the Toolkit

When you launch the Batch Application Toolkit, a splash screen appears. It provides links to the Quick Start manual, videos, controller, and HMI files.

View the Introduction to Batch Application Toolkit Video

Review the Introduction to Batch Application Toolkit video for an overview of the content and purpose of the Batch Application Toolkit.

Review the PlantPAx Batch Design Considerations Reference Manual

Review the PlantPAx Batch Design Considerations Reference Manual, publication PROCES-RM008, which provides guidance on selected batch implementation topics in a Rockwell Automation PlantPAx distributed control system. The information helps you make informed decisions when you implement projects by using FactoryTalk Batch, LBSM, or other batch management solutions.

The Batch Application Toolkit illustrates some of the implementation options that are outlined in this document. Table 1 showcases the design consideration choices that were made when creating this first release. Future releases may provide additional application examples to help guide you in making the best design choice for your application.

Table 1 - Design Considerations

PlantPAx Batch Design Considerations (PROCES-RM008)	Batch Application Toolkit Implementation
Unit Coordination and Synchronization	Controller-based - Handshaking takes place using controller tags
Operator Interaction	P_Prompt
Material Management	Not implemented
Process Upsets	Active State Processing
Transitions	Not implemented
Batch Timing	Controller based phase
Resource Arbitration and Allocation	Controller based
Shared Phases	Controller based
Two or Three Layer Mode	Two-layer Model - PhaseManager software hosts the Equipment Phase and Equipment Module as one layer
Implementation Techniques	Recommended techniques were followed in the toolkit: Standard Phases, Device Ownership, Mode, Naming Conventions, Reset/Idle state

View the Operational Overview Videos

The Operational Overview series of videos describe the process cell example that was used to build the library of phases in the toolkit, highlight some of the general design concepts that are applied in the toolkit, and provide an overview of the HMI interface philosophy.

Review the following videos:

- Operational Overview – Process Cell Example
- Operational Overview – Object, Phase, and Unit Faceplates
- Operational Overview – Unit Detail and Summary Display
- Operational Overview – Batch Detail Display
- Operational Overview – Phase Ownership
- Operational Overview – Device Ownership and Interlocks
- Operational Overview – Phase Operation in Operator Mode
- Operational Overview – Device Acquisition and Locking
- Operational Overview – Operator Interface for Managing Batches
- Operational Overview – Material Addition Phase
- Operational Overview – Add Hand Phase
- Operational Overview – Adjust Phase

Set up the Example Application (Optional)

For information on how to set up and run the example application that is provided with the toolkit, refer to the following video:

How To – Setup the Application Example

Notes:

Equipment Phase Set and Features

In this chapter, you learn about the library of phases and features that are included in the Batch Application Toolkit.

Before You Begin

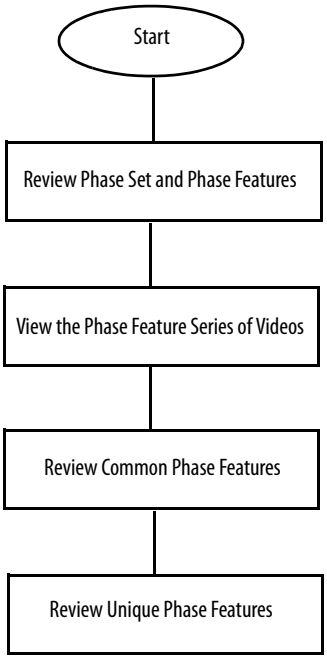
- Review the information in Chapter 1.

What You Need

- Batch Application Toolkit - Phase Features series of videos

Follow These Steps

Complete these steps to learn about the phase set and features included in the Batch Application Toolkit.



Phase Set

The Batch Application Toolkit includes a library of phases that are found in most batch applications.

Table 2 - Phase Set

Item	Phase	Comment
1	Init(iation)	
2	Timing	With sync to other phases
3	Prompt	Free format, driven from recipe parameters
4	Dose or Material Add w/ Automation	
5	Hand Additions	Operator prompting
6	Transfer In / Transfer Out pairing	Coordination between units
7	Rinse	Device arbitration/allocation
8	Agitation	Non-Terminating w/ Transfer of Control
9	Circulation	Non-Terminating
10	Transfer Out	
11	Unit Message	

Phase Features

Using various phases, the following functions are demonstrated. These functions can be cut and pasted as needed between various phases.

Table 3 - Phase Features

Item	Feature – Function	See Phase	Comment
1	Obtaining User / Unique Batch ID	Init	PXRQ implementation
2	Shared Phase	Add_MatX_Shared	
3	Dosing w/ Flow Meter	Add_MatY_T100	
4	Dosing w/ Load Cell	XFI_Slurry_T100	
5	Dosing with Full / Dribble using Valves	XFI_Slurry_T100	
6	Dosing with Full / Dribble using VSD	Add_MatX_Shared	
7	Dosing with phase driven logic	Add_MatY_T100	
8	Dosing with coordinated function blocks	XFI_Slurry_T100	
9	PID Flow Control	Circulate_T100	
10	Transfer of Control	Agitate_T100	New Parameters
11	Dedicated source / destination pair	XFO_Slurry_T400, XFI_Slurry_T100	
12	Multiple source / destination pairs	XFO_Premix_T300, XFI_Premix_T100	
13	Interfacing to PlantPAx objects	Add_MatY_T100 (and most others)	a_Devices routine
14	Sync and Auto-Sync	Timing_T100	
15	Agitation w/ VSD	Agitate_T100	
16	Agitation w/ Fixed Speed Motor	Agitate_T300	

Table 3 - Phase Features

Item	Feature – Function	See Phase	Comment
17	Agitation w/ Process Interlock	Agitate_T300	
18	Device Arbitration / allocation	Rinse_T300/T400	
19	Phase Interlocking	Circulate_T100/XFO_T100	

Phase Features Videos

Review the following videos:

Phase Features – Timing Phase Synchronization
Phase Features – Transfer Phases – Coordinated 1 to 1
Phase Features – Transfer Phases – Coordinated 1 to Many
Phase Features – Transfer Phases – Quick Add
Phase Features – Shared Resources – Shared Phases
Phase Features – Shared Resources – Device Level Allocation and Arbitration
Phase Features – Shared Resources – Interlocked Phases
Phase Features – Handling Device Level Interlocks
Phase Features – Transfer of Control
Phase Features – Initiation Phase
Phase Features – Material Addition Tolerance Checks

Common Phase Features

All phases include the following features.

Table 4 - Common Phase Features

Item	Feature	Comment
1	Mode or ownership model	Distinguish and manage 4 users
2	Operator phase control	
3	Phase alarm processing	In-state w/ operator prompt for resolution
4	Permissive and Interlocking	Rapid detection of ownership or alarm conditions
5	Common structure	Identical Step indexes for all phases
6	Device independence	“Library” phases which can be characterized
7	Activity display	Summary and Detailed
8	HMI Global Object support	Phase Display Element, Phase and Unit Status objects, Phase and Prompt Summary objects,
9	Context prompting	

Operator Phase Control

All phases can be controlled, by the operator, from faceplates.

All phases begin with an operator prompt, getting needed data to execute the phase. Although the phase may need many parameters, operator prompting is limited to necessary data and then supplemented with default parameters.

For example, an addition phase may have Setpoint, High Tolerance, and Low Tolerance Parameters. The recipe author can configure all these parameters in the recipe, but the operator only needs to enter a Setpoint. Entering High Tolerance and Low Tolerance values are a needless nuisance to an operator. Therefore, they are defaulted, typically to where tolerances are ignored on an operator-initiated material addition.

Alarming

Phase alarms can be configured for "Reset Required."

When 'Reset' is "Not Required," the phase immediately continues with its activity when all alarms are cleared. When 'Reset' is "Required," the [Phase Alarm Reset] must be entered after all alarm conditions have been acknowledged and reset. [Phase Alarm Reset] is available on the phase faceplate or phase status object.

Unique Phase Features

Unique phase features include synchronized timing, operator phase control, and interlocked equipment.

Synchronized Timing

Timing features "sync" and "auto-sync" parameters.

"Sync" indicates that timing only occurs when a "synced" or paired phase(s) is in the functioning step (SI=1500). For example, if 'Timing' is "synced" with 'Circulation,' timing only occurs when circulation is in StepIndex = 1500, or when material is actually circulating. If Circulation leaves SI=1500 (eg Alarm or Hold), timing stops. Timing continues when Circulation returns to SI=1500.

The Batch Application Toolkit is provided with capability to synchronize up to two phases (Agitation and/or Circulation). The "synced" phases are defined with alias tags. Follow the code structure and modify accordingly if more than two "synced" phases are needed.

Configuration defines synchronization mode. The following options are provided:

- None
- Auto-Sync
- "A" only
- "B" only
- "A and B"

The configuration can be set by the recipe author as a recipe parameter.

"Auto-Sync" indicates the 'Timing' phase automatically synchronizes to either of the two defined paired phases, if one or both of those phases are configured in parallel in the recipe procedure. This feature reduces recipe author effort and potential errors.

Operator Phase Control

Material Additions

Material Addition phases include a "New" or "Last Entered" option. When "Last Entered" is selected, the phase uses the last Operator entered setpoint for the addition. This option is convenient when the same amount is normally entered, for example, for a repeated scale calibration sequence.

Transfers

Material transfers, coordinated with a transfer in/transfer out (XFI / XFO), include a "Non-Coordinated/Coordinated" option. Transfers need to be initiated from the XFI (destination) side of the link. "Non-Coordinated" indicates the XFI executes the transfer without handshaking, linking, or coordinating to the paired source. "Coordinated" indicates that the paired source XFO phase must be running and "ready to deliver."

The "Non-Coordinated" feature simplifies operator-initiated transfers, since the operator can verify whether the source is ready. "Non-Coordinated" eliminates the need for the operator to also start an XFO phase, which often is a redundant and unnecessary activity.

Interlocked Equipment

Occasionally, interlocked equipment has to be managed differently, depending on mode. Agitation_T300 represents such a scenario and is a method for dealing with this requirement.

In this case, the agitator is interlocked to low level and configured as such at the control module level. This prevents the operator from both starting the agitator, and continuing to run the agitator when the tank level is low. However, when a batch runs, the recipe author wants the agitation phase to begin usually in parallel to other activity. The recipe author should not be burdened with writing procedural logic to handle this low-level interlock situation.

An easy solution is to do the following:

1. Condition the CM interlock based on phase state.
2. Manage starting and stopping the agitator while considering interlock conditions in the phase.

Looking at M300 in the toolkit example, you can see where interlocks are conditioned on the phase being idle. Examining Agitate_T300, SI=900 and SI=1500, you can see where the interlock status is examined, resulting in a start and stop of the agitator.

An extra, interesting function is provided with this phase's configuration. Note at SI=2000, after the agitator is stopped, the phase returns to SI=900. Since this is a non-terminating phase, the phase continues to start and stop the agitator, based on tank level, as long as the phase is active. This simplifies recipe authoring for a tank that is filled and emptied several times during the course of the operation.

Notes:

Logic Structure

In this chapter, you the learn about the logic structures used in the Batch Application Toolkit.

Before You Begin

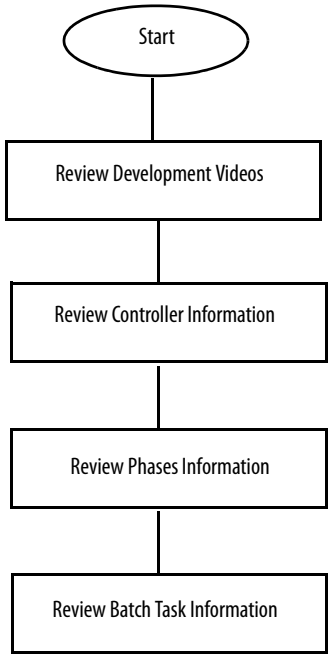
- Review the information in Chapter 2.
- Ensure that you are familiar with Logix controllers.

What You Need

- Batch Application Toolkit - Development series of videos

Follow These Steps

Complete these steps to learn about the logic structure of the Batch Application Toolkit.



Development Videos

Review the following Development videos for information on how the logic structure has been configured in the toolkit:

Development – Phase Design
Development – a_Devices Routine
Development – b_Perm_Intlk Routine
Development – c_HMI_Interface Routine
Development – Equipment Phase Organization and Scheduling
Development – Unit Routine
Development – LogixUser Routine

Controller Information

The controller must be configured with the following considerations,

1. The controller must be based on Logix version 21, or earlier.
   a. Structures can be changed to take advantage of a version 22, or later, controller organizer
2. The controller uses "Event Task" to build a batch unit hierarchy.
   a. Event Task" is called from a single, periodic task.
   b. Concept can only be used in non-redundant controllers.
3. The toolkit does not define an organization model for control modules.
   a. Control modules can be developed and organized following your company standards.
   b. The toolkit leverages Rockwell Automation Process Objects, however, using these objects is not a requirement.
   c. Control module tags need to be controller scoped to accommodate phase access.

Phases Information

Phases are built using PhaseManager and its associated states. In addition to the state routines, phases have a minimum of three supporting routines.

1. Devices characterize the generic phase, identify and interface to explicit control modules, and support the following activities:
   a. Acquire/Release ownership
   b. Lock/Unlock
   c. Open/Close - Start/Stop, as needed
2. Perm_Intlk contains the Phase P_Perm, P_Intlk, and P_Alarm objects. It also contains explicit mapping or "rungs" for each permissive or interlock condition.
3. HMI_Interface contains a number of "sections" to interface phase to system. System interfacing includes unit and HMI. The sections are:
   a. Mode or Ownership, which contains a P_Mode object. It also contains rungs to detect phase ownership (RSLogix_5000, FTBatch), rungs for LogixUsers ownership, and rungs for Operator ownership.

   b. Operator commands
   c. Phase activity
   d. Unit summary
   e. Phase summary
4. The sync routine is only required when the phase is configured as a paired phase (synchronized with another phase).

Batch Task Information

The Batch Task contains a number of programs to support the system.

1. Unit:
   a. Contains a separate routine for each unit.
   b. Each unit routine contains Permissive and Interlock, and Unit Summary.
2. LogixUsers:
   a. Contains a routine for each phase.
   b. Each routine has the PATT and PDET ownership instructions and the PCMD's for external phase control.
3. Phases:
   a. Calls the Unit Event Tasks.

Notes:

Detailed Design Features

In this chapter, you learn about the detailed design features of the Batch Application Toolkit.

Before You Begin

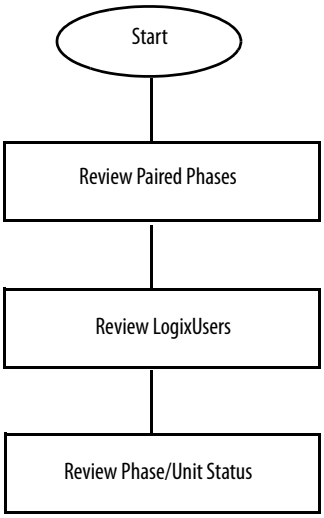
- Review the information in Chapter 1 through Chapter 3.

What You Need

- Batch Application Toolkit – Development – Phase Synchronization video
- Batch Application Toolkit – Development – LogixUsers Interface video
- Batch Application Toolkit – Development – Unit Routine video

Follow These Steps

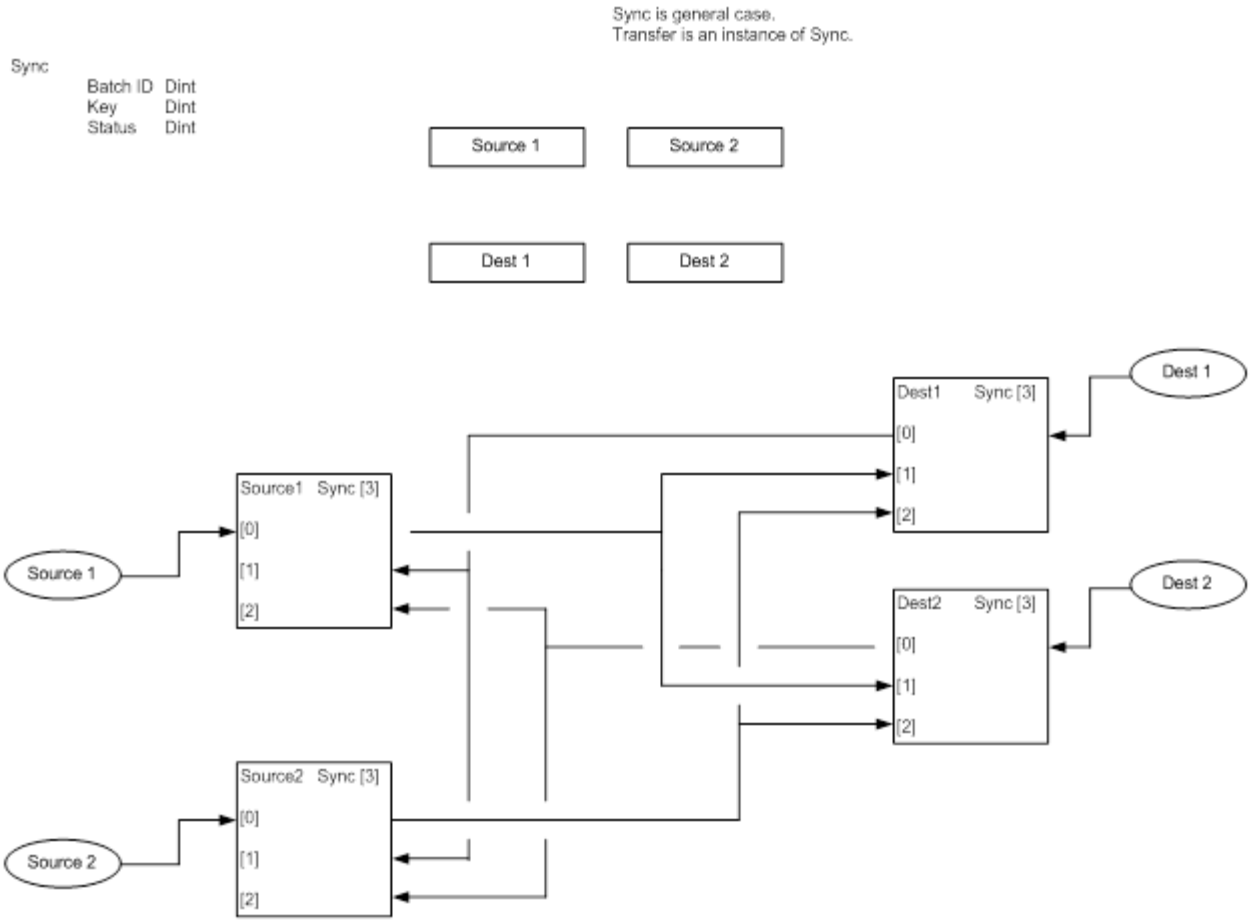
Complete these steps to gain an in-depth understanding of the detailed design features of the Batch Application Toolkit.



Paired Phases

Review the Development – Phase Synchronization video for details on how Paired Phases have been configured in the toolkit. Figure 1 illustrates how synchronization data is mapped between units.

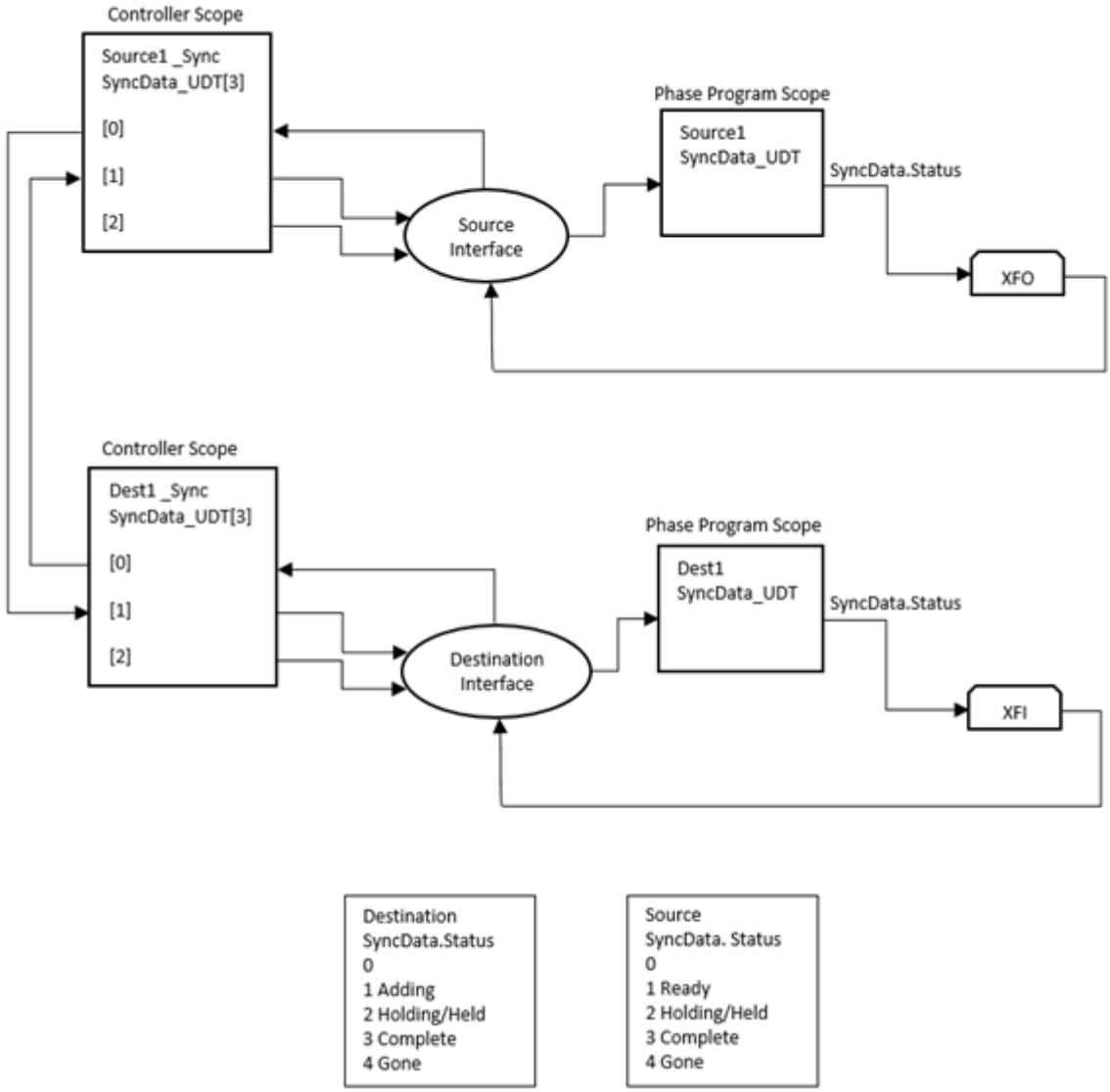
Figure 1 - Sync Data Mapping



The exchange is external to the phase, allowing phase "ing" states to be generic and independent of synchronized units and distribution.

Figure 2 shows the exchange between paired phases.

Figure 2 - Paired Phase Exchange



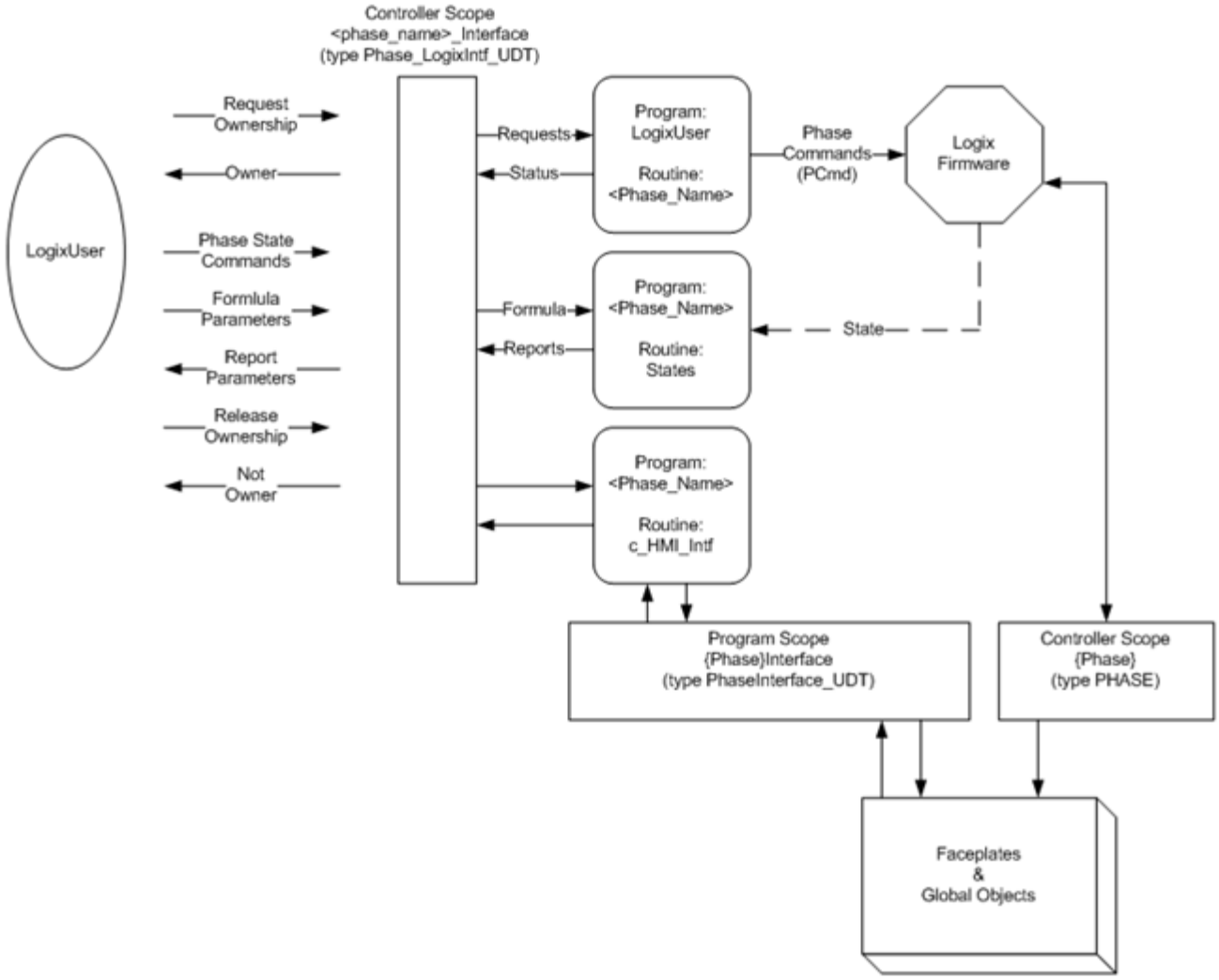
LogixUsers

LogixUsers are entities, other than FTBatch or Operator, that can own and command a phase. Examples of a LogixUser include a phase calling another phase, or a phase being called by a user-created Logix task.

Review the Development – LogixUsers Interface video for details on how this interface is configured in the toolkit.

LogixUsers interface, exclusively, through the controller scoped <phase_name>_Intf tag, as illustrated in Figure 3. Refer to Table 5 for the structure of this user-defined data type.

Figure 3 - LogixUsers Interface



The general interaction for a LogixUser is as follows.

1. LogixUser requests ownership of phase (Reqx = 1).
2. LogixUser waits until ownership is granted (Owner = x).
3. LogixUser sends state commands (Start, Hold, Stop, Reset, for example).
4. LogixUser sends formula parameters and can read report parameters.

5. LogixUser completes phase activity.
6. LogixUser must always leave phase in IDLE state when finished.
7. LogixUser releases ownership of phase (Reqx = 0).

The design supports and arbitrates between four LogixUsers. Additional users can be added, if necessary.

LogixUsers send requests and commands through <phase_name>_Intf. The layout of this interface is as follows:

- Ownership requests and ID's are paired. For example:
  - LogixUser #1 would set PCmd_Dint.16 and wait for Sts_Owner = 1.
  - LogixUser #2 would set PCmd_Dint.17 and wait for Sts_Owner = 2.
- Multiple LogixUsers are arbitrated on a first-come/first-serve basis.
  - Simultaneous requests go to the lowest number (LogixUser#1 wins over LogixUser#2).
- Formula Parameters need to be mapped in StepIndex = 100 of the Phase Running state routine.
- Report Parameters need to be mapped.
- Operator ownership and control (from HMI Global Object faceplates) is available and arbitrated in conjunction with LogixUsers.
- The report and parameter structures follow the formats of and therefore are compatible with P_Prompt and LBSM.

Table 5 - Phase_LogixIntf_UDT Structure

UDT	Element	Data Type	Bit	Significance / Note
Phase_LogixIntf_UDT				
	PCmd_Dint	Dint		
			0	
			1	
			2	
			3	Start
			4	Hold
			5	Resume
			6	Stop
			7	Abort
			8	Reset
			9	(xxxx) reserved
			10	
			11	
			12	
			13	
			14	
			15	
			16	OwnershipReq1
			17	OwnershipReq2
			18	OwnershipReq3
			19	OwnershipReq4
	Sts_Dint	Dint		

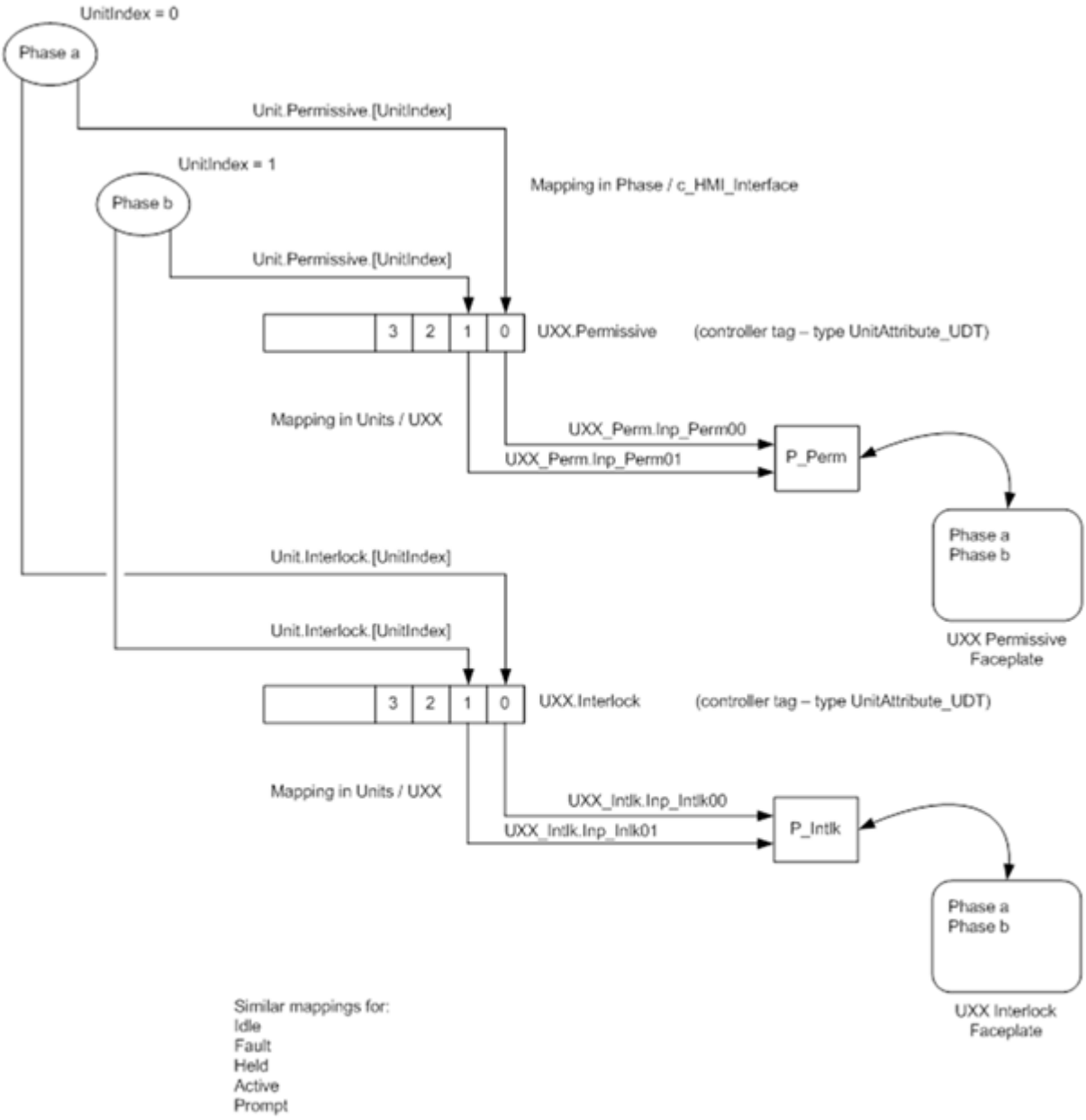
Table 5 - Phase_LogixIntf_UDT Structure

UDT	Element	Data Type	Bit	Significance / Note
			0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
	Sts_Owner	Dint		1 to x for owner ID
	Sts_Mode	Dint		
	PCmd_Target01	Real		
	PCmd_Target02	Real		
	PCmd_Target03	Real		
	PCmd_Target04	Real		
	PCmd_Select	Dint		
	Val_Report01	Real		
	Val_Report02	Real		

Phase/Unit Status

Review the Development – Unit Routine video for details on how the phase status is rolled up into the Unit status. Figure 4 provides additional details on how this is accomplished.

Figure 4 - Phase/Unit Status



Notes:

Controller Implementation

In this chapter, you learn how to configure an equipment phase and supporting routines in the controller.

Before You Begin

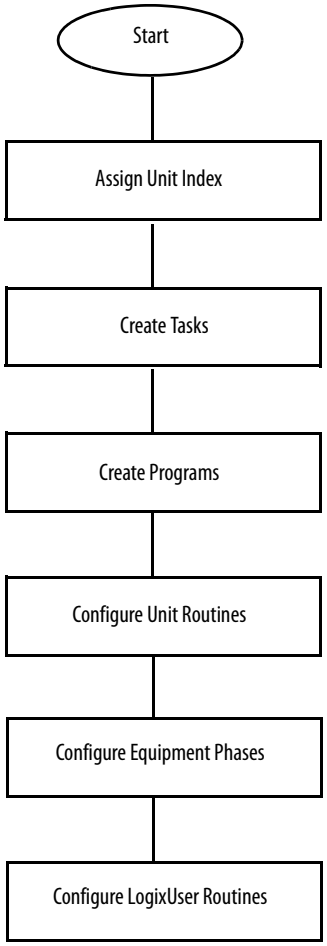
- Review Chapter 1 through Chapter 4.

What You Need

- Batch Application Toolkit – Development series of videos
- Batch Application Toolkit – How To series of videos (Studio 5000 Software)

Follow These Steps

Complete these steps to implement a controller by using the Batch Application Toolkit.



Unit Index

For each unit in your application, identify all of the phases associated with the unit and assign an index number to each. These index values are used in the controller as bit references to roll up the phase status to the unit level. The Indexes for the Batch Application Toolkit example are listed in Table 6.

Table 6 - Unit Index

Unit		Mix-T100	Premix-T300	Slurry-T400
	Index			
	0	Init	Init	Init
	1	Prompt	Prompt	Prompt
	2	Timing	Timing	Timing
	3	Add Mat-X	Add Mat-X	Add Mat-X
	4	Add Mat-Y	Add Hand	Add Hand
	5	Add Hand	Agitate	Agitate
	6	Add Premix	XFR to Mix	XFR to Mix
	7	Add Slurry	Unit Message	Unit Message
	8	Adjust	Rinse	Rinse
	9	Agitate		
	10	Circulate		
	11	XFR to Storage		
	12	Unit Message		

Tasks

1. For Batch Task, create a periodic task for the batch related programs/routines (refer to Chapter 3).
2. For Phase Tasks, create an event task for each unit in your process cell (refer to Chapter 3).

Programs

Add the following programs to the Batch Task:

- Units – This program holds one unit routine for each of the units in your process cell.
- Phases – This program triggers all of the event tasks for phases.
- Logixusers – The program holds a Logixuser routine for each phase in your system.

Unit

In the Batch Task, Units Program, add one routine for each of the units in your process cell.

Unit Routine

Configure a unit routine for each unit in your application. To complete this task, refer to the following videos:

Development – Unit Routine

How To – Import a Unit Routine

Equipment Phases

In the Phase task for your unit, create an instance of each phase required for the unit.

Create Phase Instance

To complete this task, refer to the following videos:

Development – Phase Design

Development – Equipment Phase Organization and Scheduling

How To – Import an Equipment Phase

Modify a_Devices (Development a_Devices Routine video)

To complete this task, refer to the following video:

Development – a_Devices Routine

Modify b_Perm_Intlk (Development b_Perm_Intlk Routine)

To complete this task, refer to the following video:

Development – b_Perm_Intlk Routine

Modify c_HMI_Interface

To complete this task, refer to the following video:

Development – c_HMI_Interface Routine

Scheduling

Schedule the phases for each unit in a consistent order. The Batch Application Toolkit follows this order.

1. Standard phases (Init, Prompt, Timing)
2. Material additions (automatic, hand)
3. Process actions (Agitate, Circulate)

4. Transfer Out
5. Miscellaneous (Adjust)
6. Unit Message

LogixUser Routine

Configure a LogixUser routine for each phase in your application. To complete this task, refer to the following videos:

Development – LogixUser Routine

How To – Import a LogixUser Routine

Notes:

HMI Implementation

In this chapter, you learn how to implement the HMI components from the toolkit in your application.

Before You Begin

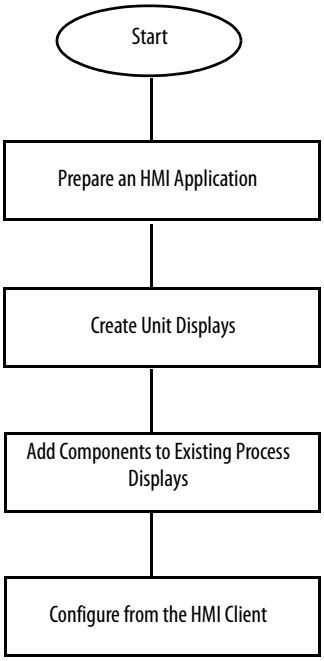
- Review Chapter 1 through Chapter 5.

What You Need

- Batch Application Toolkit - Development series of videos
- Batch Application Toolkit - How To series of videos (FactoryTalk View Studio Software)

Follow These Steps

Complete these steps to learn how to use the Batch Application Toolkit in an HMI implementation.



Prepare an HMI Application

To complete this task, refer to the following video:

How To – Import HMI Components

Create Unit Displays

To complete this task, refer to the following videos:

Development – HMI Displays

Development – HMI Global Objects

For each unit in your application, the following displays are required:

Table 7 - Unit Displays

Display	Display Name Format(1)	Notes
Unit Detail Display	${#103}_Unit_Detail	ex. T100_Unit_Detail
Unit Summary Display	${#103}_Unit_Summary	
Prompt Summary Display	${#103}_Prompt_Summary	
Prompt Configuration Display	${#103}_Prompt_Config	
Batch Detail Display	${#103}_Batch_Detail	Optional: Only needed when using FactoryTalk Batch

(1) #103 is the Unit Name, where Unit Name is the controller scoped tagname for the unit.

Add Components to Existing Process Displays

To complete this task, refer to the following videos:

Development – HMI Displays

Development – HMI Global Objects

Unit Overview Object

Add Unit Overview faceplate objects to your displays where desired. We recommend adding the objects to the process cell overview display and unit detail displays.

Phase Icon

Add Phase Display "Widget" to process displays for each phase, as desired.

Configure from the HMI Client

When the controller and HMI implementation is completed and your application is running, the following items must be configured from the HMI client:

- Unit Interlock Faceplate
- Unit Permissive Faceplate
- Phase Interlock Faceplate
- Phase Permissive Faceplate
- Prompts

To configure Interlocks and Permissives, display the Interlock or Permissive faceplate from the Unit Overview or Phase Faceplate, and then complete the following steps:

1. From the Engineering Tab, Sheet 1, configure the title, label, and tag for your faceplate.
2. From the Engineering Tab, Sheet 2:
   a. Configure the text for each interlock or permissive, as applicable.
   b. Set "Ok Status" for each condition.
   c. Check/Uncheck "Can Bypass," as applicable.
   d. Check/Uncheck "Must Reset," as applicable.

To configure prompts, refer to the Development – Prompt Configuration video.

Additional Resources

For additional information on how to configure the interlock, permissive, and prompt objects, refer to the Rockwell Automation Library of Process Object Reference Manuals:

- Interlocks with First Out and Bypass (P_Intlk), publication SYSLIB-RM004
- Permissives with Bypass (P_Perm), publication SYSLIB-RM007
- Operator Prompt (P_Prompt), publication SYSLIB-RM046

Notes:

Index Numbering

Standard Phase Step Index Numbering

The majority of the phases in the Batch Application Toolkit follow the standard phase step index numbering as shown in Table 8. However, there are minor differences with some of the special case phases, including Add_Hand, Init, Prompt, and Adjust.

Table 8 - Standard Phase Step Index Numbering

Index	Significance	Notes
0-2999	**Running State Step Indexes**	
0	Phase Initiation	
Alarm	Process if phase in alarm	
20	Interlock, share resource	
30	Set up message to sources	XFI only
50	Determine action based on mode	
60	Operator mode post prompt	
65	Wait for prompt response	
70	Store prompt responses	
75	Validate source entry	XFI only
100	Establish SP based on mode	
110	Wait for source	XFI only
115	Destination starting	XFI only
200	Device ownership	
210	Device lock	
220	Tare Check	Totalizers only
230	Tare	
240	Tared	
300	Phase Specific Activity	
900	Wait for operating condition	(Agit = Level)
1000	Move setpoints	
1010	Start totalizer	
1030	Start totalizer flow	
1040	Path open	
1050	Flow start	
1100	Source Ready	XFO Only
1200	Synchronize evaluation	Up to two phases

Table 8 - Standard Phase Step Index Numbering

Index	Significance	Notes
1205	Auto sync delay	
1210	Auto sync calculation	
1215	Wait for synchronized phase(s)	
1500	Adding/Agitating/Circulating, etc…	
1600	Receive new agitation speed setpoint/ Transfer of Control	
1605	Process new setpoint	
2000	Stop flow	
2010	Check Tolerance	
2020	Path close	
2030	Stop totalizer	
2040	Unlock devices	
2700	Alarm Handling – Shutdown flow	
2705	Alarm Handling – Shutdown flow	
2710	Alarm Handling – Shutdown path	
2720	Alarm Handling – Stop Totalizing	
2730	Alarm Handling – Delivery out of tolerance	
2800	Alarm Reset	
2810	Post Prompt	
2815	Wait for prompt response	
2820	Wait for Source	
2830	Post Prompt – Hi Tolerance	
2835	Prompt Response – Hi Tolerance	
2840	Post Prompt – Lo Tolerance	
2845	Prompt Response – Lo Tolerance	
2850	Lo tolerance – Continue with Bump	
2999	Phase Running State Complete	
3000-3999	**Holding State Step Indexes**	
3000	Clear Prompt	
3010	Stop Flow	
3020	Close Path	
3030	Stop the Totalizer Flow	
3040	Process Alarm	
3050	Unlock Devices	
3700	Take Alarm Action	
3800	Alarm Response	
3999	Holding Phase State Complete	
4000-4999	**Restarting State Step Indexes**	
4999	Restarting Phase State Complete	

Table 8 - Standard Phase Step Index Numbering

Index	Significance	Notes
5000-5999	**Stopping State Step Indexes**	
5000	Clear Prompt	
5010	Stop Flow	
5020	Close Path	
5030	Stop the Totalizer Flow	
5040	Stop the Totalizer	
5050	Process Alarm	
5060	Unlock devices	
5700	Take Alarm Action	
5800	Alarm Response	
5999	Stopping Phase State Complete	
6000-6999	**Aborting State Step Indexes**	
6000	Clear Prompt	
6010	Stop Flow	
6020	Close Path	
6030	Stop the Totalizer Flow	
6040	Stop the Totalizer	
6050	Unlock devices	
6999	Aborting Phase State Complete	

Notes:

Video Listing

The following videos are available on Vidyard to help you set up and use the Batch Application Toolkit.

Introduction

Introduction to Batch Application Toolkit

Operational Overview Series

Operational Overview – Process Cell Example
Operational Overview – Object, Phase, and Unit Faceplates
Operational Overview – Unit Detail and Summary Display
Operational Overview – Batch Detail Display
Operational Overview – Phase Ownership
Operational Overview – Device Ownership and Interlocks
Operational Overview – Phase Operation in Operator Mode
Operational Overview – Device Acquisition and Locking
Operational Overview – Operator Interface for Managing Batches
Operational Overview – Material Addition Phase
Operational Overview – Add Hand Phase
Operational Overview – Adjust Phase
Operational Overview – Logix Batch and Sequence Manager

Development Series

Development – Phase Design
Development – a_Devices Routine
Development – b_Perm_Intlk Routine
Development – c_HMI_Interface Routine
Development – Equipment Phase Organization and Scheduling
Development – Unit Routine
Development – LogixUser Routine
Development – LogixUsers Interface
Development – Phase Synchronization

Development – Prompt Configuration
Development – HMI Global Objects
Development – HMI Displays
Development – HMI Security
Development – Logix Batch and Sequence Manager Interface

Phase Feature Series

Phase Features – Timing Phase Synchronization
Phase Features – Transfer Phases – Coordinated 1 to 1
Phase Features – Transfer Phases – Coordinated 1 to Many
Phase Features – Transfer Phases Quick Add
Phase Features – Shared Resources – Shared Phases
Phase Features – Shared Resources – Device Level Allocation and Arbitration
Phase Features – Shared Resources – Interlocked Phases
Phase Features – Handling Device Level Interlocks
Phase Features – Transfer of Control
Phase Features – Initiation Phase
Phase Features – Material Addition Tolerance Checks

How To Series

How To – Import a Unit Routine
How To – Import an Equipment Phase
How To – Import a LogixUser Routine
How To – Import HMI Components
How To – Import a Logix and Batch Sequence Manager Interface Routine
How To – Setup the Application Example

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In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

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If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

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United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
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