



Rockwell Automation Sequencer Object

Process Library 5.00.03 and Later



Allen-Bradley

by ROCKWELL AUTOMATION

User Manual

Original Instructions

Important User Information

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

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.

These 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).

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



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

	About This Publication	5
	Summary of Changes	5
	Additional Resources	5
	Chapter 1	
Sequencer (raP_Opr_Seq)	Guidelines	7
	Functional Description	7
	Step User-defined Type	8
	Operator Prompt	8
	State Machine	8
	Timers	12
	Branching and Looping	12
	Alarm Options	12
	Interlock Options	12
	Required Files and Components	13
	Add-On Instructions	13
	User-defined Data Types	13
	Controller Programming	13
	Step Input/Output Element Sizing	14
	Setting Maximum Input and Output Amounts	14
	Configuration	15
	Sequencer Instructions and Extended Tag Properties	15
	Sequence Configuration	15
	State Machine	16
	Prompt	17
	Input Setup	17
	Output Setup	17
	State Configuration (FactoryTalk View SE)	18
	State Configuration (FactoryTalk Optix)	22
	Graphical Interfaces (FactoryTalk View SE)	26
	Graphical Interfaces (FactoryTalk Optix)	27
	Sequencer Operation	28
	Elements included in the Step Transition Evaluation	28
	Step Force	28
	Input Force	28
	Step Editing	28
	Branching	28
	Tracking	29
	Chapter 2	
raP_Opr_SeqBoolInp	Configuring the Number of Boolean Inputs for a Sequencer	31
	Programming	31
	Extended Tag Properties	32
	Extended Tag Properties for Each Output	33
	Configuration	34
	Sequencer (FactoryTalk View SE)	34
	Sequencer (FactoryTalk Optix)	35

	Step (FactoryTalk View SE)	36
	Step (FactoryTalk Optix).....	37
	Multi-Step (FactoryTalk View SE)	38
	Multi-Step (FactoryTalk Optix).....	38
raP_Opr_SeqBoolOut	Chapter 3	
	Configuring the Number of Boolean Outputs for a Sequencer	39
	Programming.....	39
	Extended Tag Properties	40
	Extended Tag Properties for Each Output	41
	Configuration	42
	Sequencer (FactoryTalk View SE)	42
	Sequencer (FactoryTalk Optix)	42
	Step (FactoryTalk View SE)	44
	Step (FactoryTalk Optix).....	45
	Multi-Step (FactoryTalk View SE)	46
	Multi-Step (FactoryTalk Optix).....	46
	Tracking.....	47
	Control	47
raP_Opr_SeqRealOut	Chapter 4	
	Configuring the Number of Real Outputs for a Sequencer	49
	Programming.....	49
	Extended Tag Properties	50
	Extended Tag Properties for Each Output	51
	Configuration	52
	Sequencer (FactoryTalk View SE)	52
	Sequencer (FactoryTalk Optix)	52
	Step (FactoryTalk View SE)	54
	Step (FactoryTalk Optix).....	55
	Multi-Step (FactoryTalk View SE)	55
	Multi-Step (FactoryTalk Optix).....	56
	Scaling	56
	Tracking.....	58
	Control	58
ACM Considerations for a Sequencer Instance	Appendix A	
	ACM Considerations	59
	ACM-Based Parameters for a Sequencer Instance.....	59
	Additional Sub-Objects for a Sequencer Instance	60
	Inputs Sub-Object Parameters	61
	Outputs Sub-Object Parameters	61
	Outputs Real Sub-Object Parameters.....	61
	Tracking Sub-Object Parameters	61

About This Publication

This manual provides an overview of how to use the Rockwell Automation® Sequencer Object (raP_Opr_Seq). The manual includes a Sequencer programming demonstration, example, and configuration instructions.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Added support for FactoryTalk Optix	Throughout

Additional Resources

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

Resource	Description
Configuration and Implementation User Manual, publication PROCES-UM100	Provides system guidelines and instructions to assist with the development of your PlantPAx system.
EtherNet/IP™ Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
Control Strategies Reference Manual, PROCES-RM201	Provides guidance on when and how to use Control Strategies.
System Security Design Guidelines Reference Manual, SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
UL Standards Listing for Industrial Control Products, publication CMPNTS-SR002	Assists original equipment manufacturers (OEMs) with construction of panels, to help confirm that they conform to the requirements of Underwriters Laboratories.
American Standards, Configurations, and Ratings: Introduction to Motor Circuit Design, publication IC-AT001	Provides an overview of American motor circuit design based on methods that are outlined in the NEC.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley® industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at [rok.auto/literature](#).

Notes:

Sequencer (raP_Opr_Seq)

The Sequencer Object (raP_Opr_Seq) provides a flexible controller-based step sequencing solution that reduces engineering time by automating common operator procedures. The step-by-step configuration makes it easy to adjust procedures directly from the HMI displays without having to create or modify custom code in the controller. The Sequencer can be employed in simple and complex sequences without costly re-engineering and testing. You add, delete, or modify steps that are required to accomplish the object of your sequence.

Guidelines

The Opr_Opr_Seq Add-On Instruction and graphics provide bit-based sequencing with the following features:

- Up to 128 discrete (BOOL) outputs for controlling or commanding devices
- Up to 128 discrete (BOOL) inputs for monitoring device feedback
- Up to 32 floating point number (REAL) outputs for setpoints or parameter values
- A modifiable state machine to accommodate S88, PackML, and NAMUR state machine requirements
- A maximum of 500 steps for use by all states
- Rich and intuitive human machine interface (HMI) screens for operation, monitoring, and configuration
- Short Add-On Instruction scan time for use in fast scan control strategies

Use this instruction in these situations:

- When you implement a procedure to operate equipment in a prescribed order (openvalve, start pump, and so forth). A procedure is described in the International Society of Automation Technical Report ISA-TR106.00.01-2013 as the following:

'A specification of a sequence of actions or activities with a defined beginning and end that is intended to accomplish a specific objective.'

Although the sequencer is intended for basic sequencing that is typical of control and equipment implementation modules (as defined in TR106.00.01), The raP_Opr_Seq instruction can be used at any level and in any application where its functionality is appropriate.

Do **not** use this instruction in these situations:

- The implementation of a batch phase. Use the PhaseManager™ capability of the Logix Controller instead.
- If you need sophisticated sequential function chart (SFC) procedures, such as simultaneous threads and multi-selection branches.

Functional Description

The 128 (max) Boolean outputs are used to assert commands to devices. The 32 (max) Real outputs are used to set setpoints or reference values. Each output (Boolean or Real) can be used optionally in each step, and each output is explicitly defined even if it's not used in a step.

The 128 (max) inputs are used to monitor Boolean signals from devices or logic to determine when a desired state, or combination of states, have been achieved, signaling the end of the step.

In operation, when a step is executed, the output values are presented at the output instructions' outputs before the first check of the input conditions. In this way, the output values for each step are present for at least one scan of the Sequencer.

Step User-defined Type

To achieve the greatest flexibility regarding step information storage and number of steps in a sequence, a separate user-defined data type (UDT) is supplied to store the step information (raP_UDT_Opr_SeqStep). You create an array of these UDT members to hold the step configurations of the sequence. Array length is from 2 ... 500 steps. Step[0] of the array isn't available because it's used by the Sequencer instruction for other features and bookkeeping.

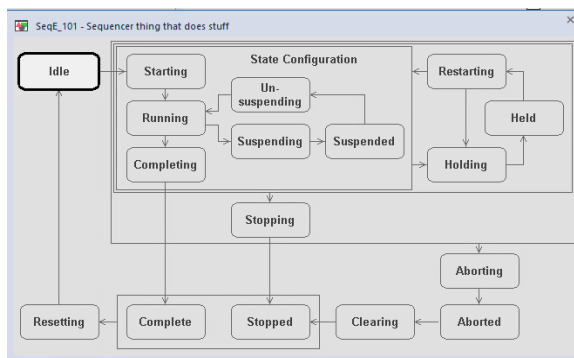
Operator Prompt

The raP_Opr_Prompt_Core instruction can be used with the Sequencer to perform manual prompt operations, such as operator messaging, entering values, or decision-making in the flow of steps.

State Machine

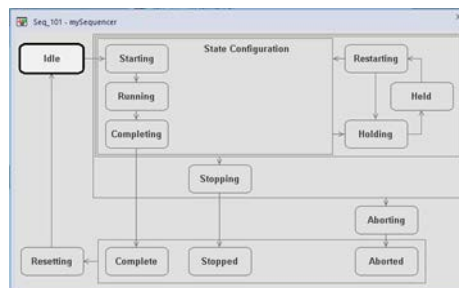
The state machine that is used in the sequencer has a total of 17 predefined states and 10 predefined commands. Not all the states and commands need to be used and can be tailored by the user for multiple state machine configurations dependent upon the application requirements. Nine configuration parameters determine which states and commands are available. These parameters can be configured for each individual instance of the sequencer.

Steps can be added to any state whose name ends with '-ing.' Once steps have been added to a state, the state machine configuration will no longer accept a configuration without that state. All of the steps would need to be deleted from that state in order to remove that state.



The state machine configuration options can be accessed via the Engineering tab of the Sequencer Advanced display.

Default State Machine Configuration

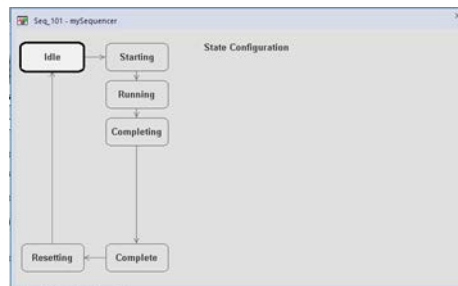


This sequence has these commands / states

- ☒ Hold / Held
- ☒ Stop / Stopped
- ☒ Abort / Aborted
- ☐ Suspend / Suspended (program command only)
- ☐ Complete command
- ☐ Clear / Clearing
- ☐ Start command available in Running state
- ☐ Start command available in Stopped state
- ☐ Abort command available in Stopped state

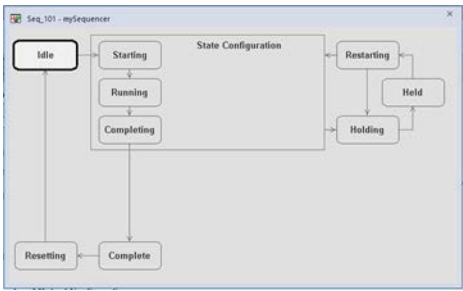
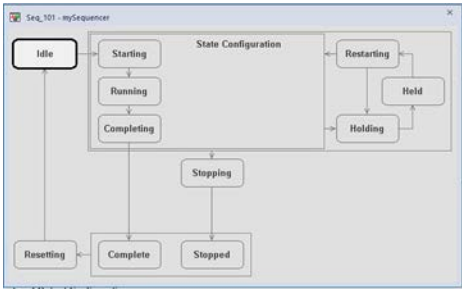
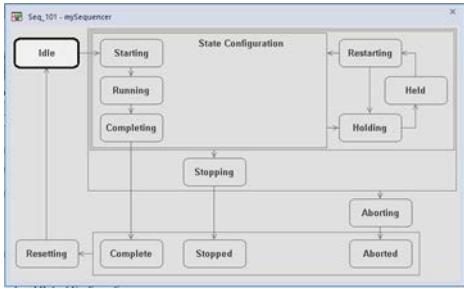
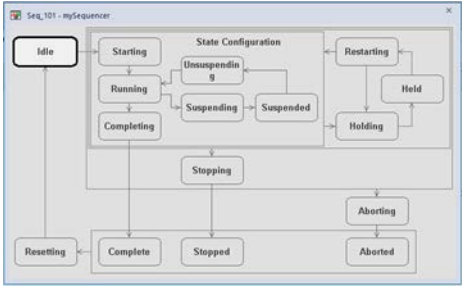
Clearing all state machine configuration options yields the minimal state machine configuration:

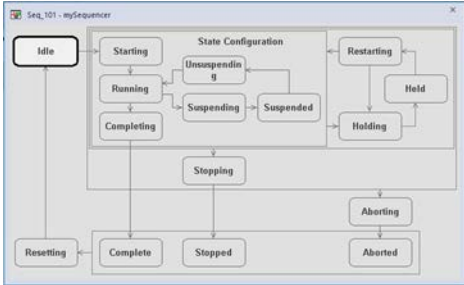
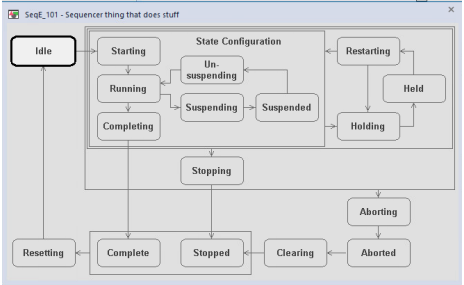
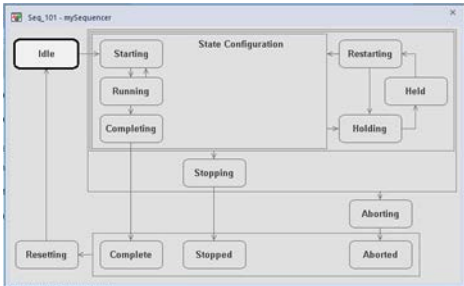
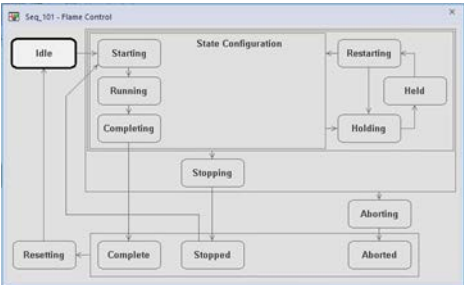
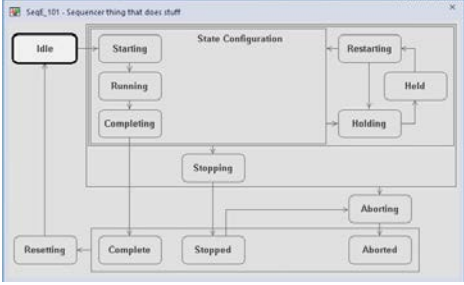
State Machine Configuration (Options Cleared)



This sequence has these commands / states

- ☐ Hold / Held
- ☐ Stop / Stopped
- ☐ Abort / Aborted
- ☐ Suspend / Suspended (program command only)
- ☐ Complete command
- ☐ Start command available in Running state

Parameter	Default	Description
Cfg_HasHold	1	<p>Include the Held/Holding/Restarting states and associated Hold and Restart commands.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input type="checkbox"/> Stop / Stopped <input type="checkbox"/> Abort / Aborted <input type="checkbox"/> Suspend / Suspended (program command only) <input type="checkbox"/> Complete command <input type="checkbox"/> Start command available in Running state
Cfg_HasStop	1	<p>Include the Stopping/Stopped states and associated Stop commands.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input type="checkbox"/> Abort / Aborted <input type="checkbox"/> Suspend / Suspended (program command only) <input type="checkbox"/> Complete command <input type="checkbox"/> Start command available in Running state <input type="checkbox"/> Start command available in Stopped state
Cfg_HasAbort	1	<p>Include the Aborting/Aborted states and associated Abort command.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input checked="" type="checkbox"/> Abort / Aborted <input type="checkbox"/> Suspend / Suspended (program command only) <input type="checkbox"/> Complete command <input type="checkbox"/> Clear / Clearing <input type="checkbox"/> Start command available in Running state <input type="checkbox"/> Start command available in Stopped state <input type="checkbox"/> Abort command available in Stopped state
Cfg_HasSuspend	0	<p>Include the Suspending/Suspended/Unsuspend states and associated Suspend and Unsuspend commands.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input checked="" type="checkbox"/> Abort / Aborted <input checked="" type="checkbox"/> Suspend / Suspended (program command only) <input type="checkbox"/> Complete command <input type="checkbox"/> Clear / Clearing <input type="checkbox"/> Start command available in Running state <input type="checkbox"/> Start command available in Stopped state <input type="checkbox"/> Abort command available in Stopped state

Parameter	Default	Description
Cfg_HasComplete	0	<p>Add a Complete command to transition the Running state to the Completing state.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input checked="" type="checkbox"/> Abort / Aborted <input checked="" type="checkbox"/> Suspend / Suspended (program command only) <input checked="" type="checkbox"/> Complete command <input type="checkbox"/> Clear / Clearing <input type="checkbox"/> Start command available in Running state <input type="checkbox"/> Start command available in Stopped state <input type="checkbox"/> Abort command available in Stopped state
Cfg_HasClear	0	<p>Include the Clearing state and the associated Clear command.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input checked="" type="checkbox"/> Abort / Aborted <input checked="" type="checkbox"/> Suspend / Suspended (program command only) <input checked="" type="checkbox"/> Complete command <input checked="" type="checkbox"/> Clear / Clearing <input type="checkbox"/> Start command available in Running state <input type="checkbox"/> Start command available in Stopped state <input type="checkbox"/> Abort command available in Stopped state
Cfg_HasStartRun	0	<p>Allow the Start command from the Running state.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input checked="" type="checkbox"/> Abort / Aborted <input type="checkbox"/> Suspend / Suspended (program command only) <input type="checkbox"/> Complete command <input type="checkbox"/> Clear / Clearing <input checked="" type="checkbox"/> Start command available in Running state <input type="checkbox"/> Start command available in Stopped state <input type="checkbox"/> Abort command available in Stopped state
Cfg_HasStartStopd	0	<p>Allow the Start command from the Stopped state</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input checked="" type="checkbox"/> Abort / Aborted <input type="checkbox"/> Suspend / Suspended (program command only) <input type="checkbox"/> Complete command <input type="checkbox"/> Clear / Clearing <input type="checkbox"/> Start command available in Running state <input checked="" type="checkbox"/> Start command available in Stopped state <input type="checkbox"/> Abort command available in Stopped state
Cfg_HasAbortStopd	0	<p>Allow the Abort command from Stopped state.</p>  <p>This sequence has these commands / states</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Hold / Held <input checked="" type="checkbox"/> Stop / Stopped <input checked="" type="checkbox"/> Abort / Aborted <input type="checkbox"/> Suspend / Suspended (program command only) <input type="checkbox"/> Complete command <input type="checkbox"/> Clear / Clearing <input type="checkbox"/> Start command available in Running state <input type="checkbox"/> Start command available in Stopped state <input checked="" type="checkbox"/> Abort command available in Stopped state

Timers

Each step has an optional timer which, when configured, is included in the qualification conditions of the step, along with the Boolean inputs configured. The timer configuration options provide the flexibility for the timer to either be started at the beginning of the step or when the Boolean inputs have qualified (default). Further, the step timer can be configured to reset, hold, or continue if the state in which the step resides is interrupted.

Each state has a timer, which logs the amount of time in that state. This timer is run upon entry to each state. The step timer can be configured to reset, hold, or continue if the state is interrupted.

Branching and Looping

The Sequencer normally proceeds from one step to the next through the array of steps. The Sequencer can be configured for four different types of branching to accommodate looping and decisions. Branching lets the Sequencer 'jump' to another step within the same state, and not necessarily run steps in sequential order.

The branch decision and action is made after all step qualification conditions are met.

If branching is configured for a step, there are four options:

- Continuous - Always take a branch
- Loop Counter - Take a branch until the step has been executed a given number of times
- Input Pattern - Take a branch if a specific input pattern exists within the Boolean inputs
- Manual Prompt - Configure the manual prompt to prompt the user for a branching decision

Alarm Options

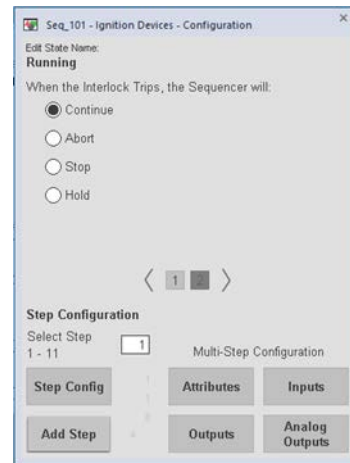
There are optional alarms that can be configured to annunciate. The Alarm Summary tab shows these alarms:

- Interlock Trip - Alerts you that an interlock trip condition has caused a state change
- Sequence Timeout - Alerts you that a sequence has run longer than expected
- State Timeout - Alerts you that a state has run longer than expected
- Step Timeout - Alerts you that a step has run longer than expected

Interlock Options

In response to an interlock trip each state can have a configuration to command to another state if that command is available within the current state.

Example: If the sequencer is in the Running state, the interlock trip can be configured to continue in the current state (default), Hold, Stop, or Abort. The command that is configured for the interlock condition must be configured and allowed in the state.



Required Files and Components

Add-On Instructions

- raP_Opr_Seq
- raP_Opr_VSM
- raP_Opr_SeqBoolInp
- raP_Opr_SeqBoolOut
- raP_Opr_SeqRealOut
- raP_Opr_PromptCore
- raP_Tec_SeqCore
- raP_Tec_SeqEdit

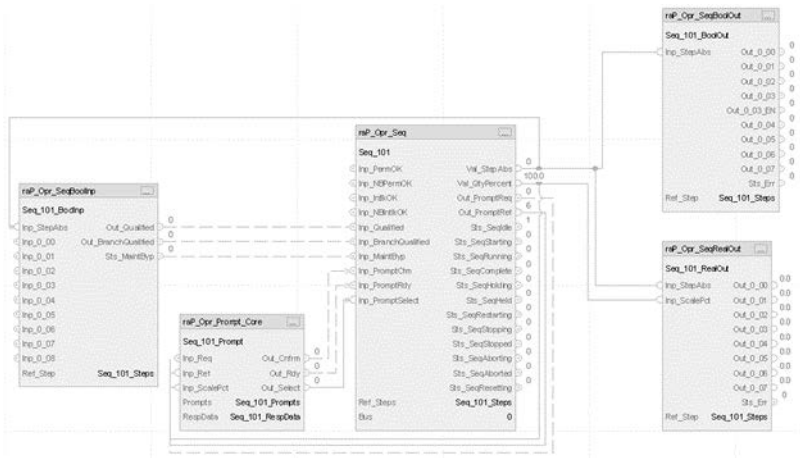
User-defined Data Types

- raP_UDT_Opr_Bus
- raP_UDT_Opr_PromptCfg
- raP_UDT_Opr_PromptResp
- raP_UDT_Opr_SeqState
- raP_UDT_Opr_SeqStep
- raP_UDT_Opr_SeqStep_BoolIn
- raP_UDT_Opr_SeqStep_BoolOut
- raP_UDT_Opr_SeqStep_RealOut
- raP_UDT_Opr_VSM_Cfg

Controller Programming

In a routine, program the raP_Opr_Seq instruction and all of its supporting instructions.

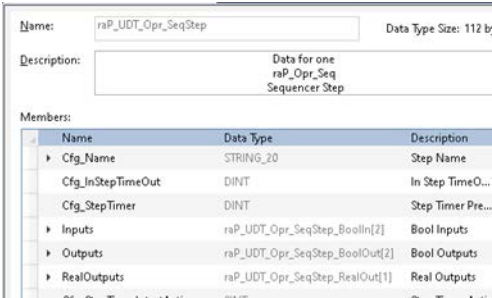
For the supporting instructions, the tag names must have the sequencer tag name as a prefix.



Step Input/Output Element Sizing

Setting Maximum Input and Output Amounts

The `raP_UDT_Opr_SeqStep` UDT contains all of the configuration information of a single step. The user must decide the maximum amount of Boolean and Real inputs and outputs by setting the size of these parameters in the UDT.



- Set the array sizes in the `raP_UDT_Opr_SeqStep` UDT definition for the number of banks of each type of input and output.
- Boolean Inputs: Each bank contains 16 boolean inputs. The user can configure the array for one to eight elements. One element is a maximum 16 boolean inputs. Eight elements is a maximum of 128 boolean inputs.
 - Boolean Outputs: Each bank contains 16 boolean outputs. The user can configure the array for one (1) to eight (8) elements. One element is a maximum 16 boolean outputs. Eight elements is a maximum of 128 boolean outputs.
 - Real outputs: Each bank contains eight real outputs. You can configure the array for one to four elements. One element is a maximum eight real outputs. Four elements is a maximum of 32 real outputs.

The following example allows a maximum of 32 boolean inputs (2 banks of 16), 32 boolean outputs (2 banks of 16), and 8 real outputs (1 bank of 8).

Configuration of inputs and outputs in this UDT applies to all instances of this UDT. The configuration affects all sequencer instances in the controller.

Configuration

Sequencer Instructions and Extended Tag Properties

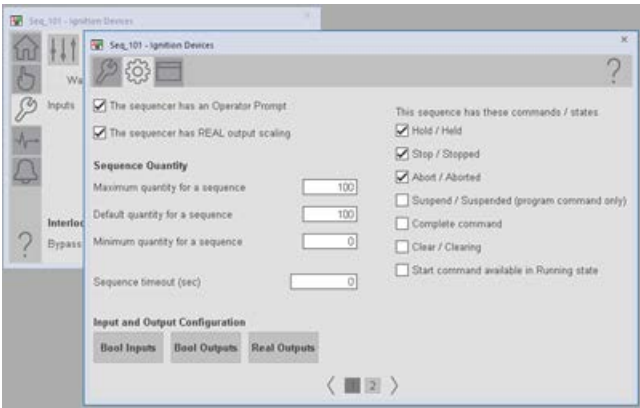
The following table contains a list of instructions used for the sequencer along with their Extended Tag Properties.

Add-On Instruction	Tag	Extended Tag	Description
raP_Opr_Seq		Area	'Area01' (or user defined area)
		Instruction	'raP_Opr_Seq'
		Label	User defined name of this sequencer
		Library	'raP-5.00'
		URL	'n/a' (or nav to user defined help)
	Val_Qty	EngineeringUnit	'%' (or user units)
	Cfg_HasMoreObj	Navigation	'n/a' (or HMI path to object)
raP_Opr_SeqBoolInp		Area	
		Instruction	raP_Opr_SeqBoolInp
		Label	User defined name for inputs
		Library	'raP-5.00'
	Inp_x.yy	Label	name of Input
	Inp_x.yy	Navigation	'n/a' (or HMI path to object)
raP_Opr_SeqBoolOut		Area	
		Instruction	raP_Opr_SeqBoolOut
		Label	user defined name for outputs
		Library	'raP-5.00'
	Out_x.yy	Label	name of Output
	Out_x.yy	Navigation	'n/a' (or HMI path to object)
raP_Opr_SeqRealOut		Area	
		Instruction	raP_Opr_SeqRealOut
		Label	User defined name for real outputs
		Library	'raP-5.00'
	Out_x.yy	Label	name of Output
	Out_x.yy	Navigation	'n/a' (or HMI path to object)
raP_Opr_Prompt_Core		Area	
		Instruction	raP_Opr_Prompt
		Label	
		Library	'raP-5.00'

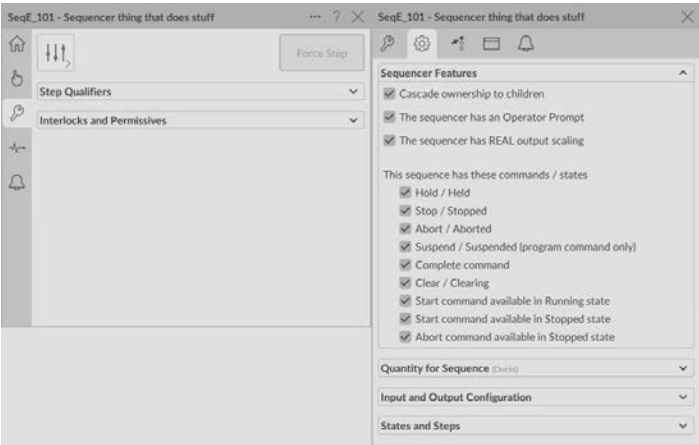
Sequence Configuration

- Cfg_HasPrompt (1=Has an associated raP_Opr_Prompt_Core instruction)
- Cfg_HasScaling (1=Real Output(s) can use scaling)
- Cfg_QtyMin (Minimum value used in Scaling)
- Cfg_QtyMax (Maximum value used in Scaling)
- Cfg_StdQty (The Standard value used in Scaling)
- Quantity Engineering Units (Extended Tag Properties set in the raP_Opr_Seq.Val_Qty tag)
- Sequence Timeout

FactoryTalk View SE Example Faceplate

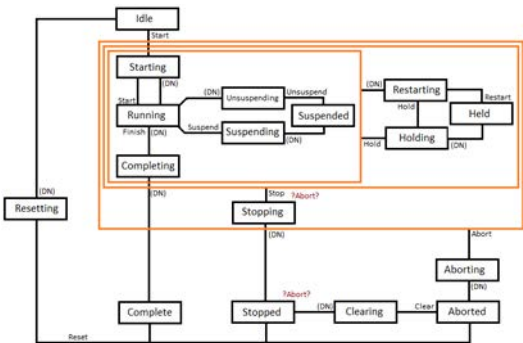


FactoryTalk Optix Example Faceplate



State Machine

The raP_Opr_Seq uses the following state machine:



State Number	State Name	Command Number	Command Name
0	Idle	0	Start
1	Starting	1	Reset
2	Running	2	Clear
3	Completing	3	Suspend
4	Complete	4	Unsuspend
5	Suspending	5	Complete
6	Suspended	6	Hold
7	Unsuspending	7	Restart

State Number	State Name	Command Number	Command Name
8	Holding	8	Stop
9	Held	9	Abort
10	Restarting		
11	Stopping		
12	Stopped		
13	Aborting		
14	Aborted		
15	Clearing		
16	Resetting		

Prompt

The raP_Opr_Prompt Add-On instruction can be used with the Sequencer to perform manual prompt operations, such as operator messaging, entering values, or decisionmaking in the flow of steps.

See Rockwell Automation Library of Process Objects, [PROCES-RM200](#) for more information on the raP_Opr_Prompt Add-On instruction.

Input Setup

- Has Input - There is an input value supplied for this input to the sequencer
- Input Name (Extended Tag Properties set in the raP_Opr_SeqBoolInp tag)
- Allow Force - This input may be forced
- Allow Navigation to Input Source Tag (Extended Tag Properties set in the raP_Opr_SeqBoolOut tag)

See [Configuration on page 34](#)

Output Setup

Boolean Output

- Output Name (Extended Tag Properties set in the raP_Opr_SeqBoolOut tag)
- Track Output (Tracking allows the output to be set from the value of the corresponding Step[0] output when the sequencer is not applying its own value to that output.)
- Allow Navigation to Output Source Tag (Extended Tag Properties set in the raP_Opr_SeqBoolOut tag)

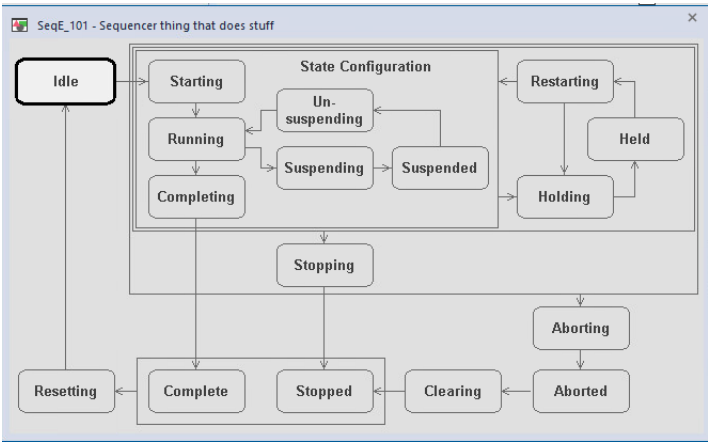
See [Configuration on page 42](#)

Real Output

- Output Name (Extended Tag Properties set in the raP_Opr_SeqRealOut tag)
- Scaled
- Track Output (Tracking allows the output to be set from the value of the corresponding Step[0] output when the sequencer is not applying its own value to that output.)
- Allow Navigation to Output Source Tag (Extended Tag Properties set in the raP_Opr_SeqBoolOut tag)

See [Configuration on page 52](#)

State Configuration (FactoryTalk View SE)



Select the State to configure.

Seq_101 - Flame Control - Configuration

Edit State Name:
Starting

1 → Fault when state timer exceeds this value (sec) (0 does not fault)

2 → If the state is interrupted, the State Timer will:

☒ Stop and reset

☐ Continue timing

☐ Stop and hold its value

< 1 2 >

Step Configuration

Select Step Multi-Step Configuration 1 - 11

Step Config Attributes Inputs

Add Step Outputs Analog Outputs

Item	Description
1	Enter a time in seconds. If the sequencer is in this state for a time exceeding this value then Sts_InStateTimeOut will be high (1) and an associated alarm will be triggered (if enabled).
2	Select a behavior for the in-state timer if the state is interrupted by a state transition.

Seq_101 - Flame Control - Configuration

Edit State Name:
Starting

1 → When the Interlock Trips, the Sequencer will:

☒ Continue

☐ Abort

☐ Stop

☐ Hold

< 1 2 >

Step Configuration

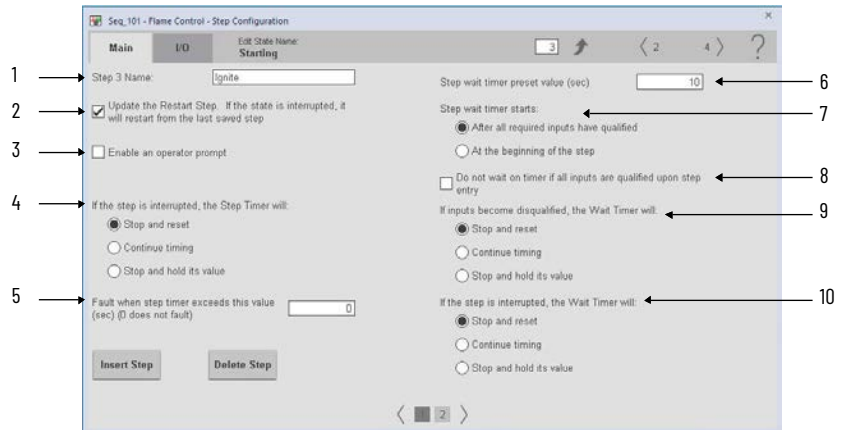
Select Step Multi-Step Configuration 1 - 11

Step Config Attributes Inputs

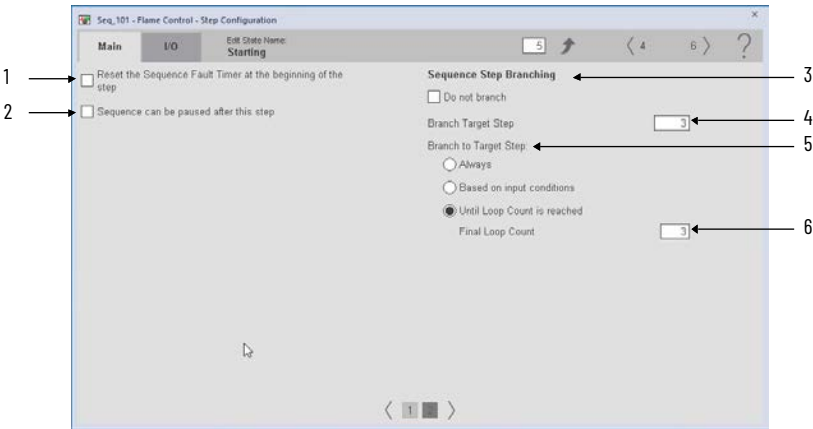
Add Step Outputs Analog Outputs

Item	Description
1	Select the box to indicate the Sequencer action when an interlock trips.

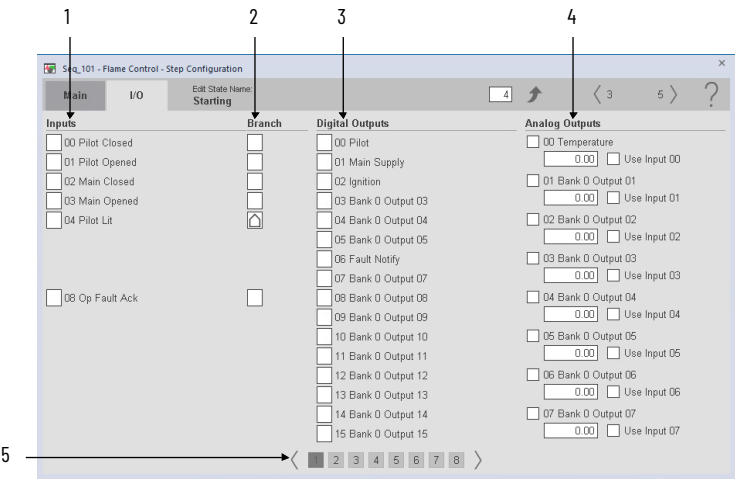
Individual Step Configuration



Item	Description
1	Type a name for the step. IMPORTANT: Make sure to press Enter or press the Page Down key after typing in a text box to save your work.
2	Select for the sequence to restart from the last saved step the 'restart' was configured.
3	Select to enable an operator prompt for the step. A prompt selection box appears. Click the box to configure the operator prompt for the step. See Rockwell Automation Library of Process Objects, PROCES-RM200 for more information on the Operator Prompt.
4	Select a behavior for the step wait timer if the step is interrupted by a state transition.
5	Enter a time in seconds if the sequencer is in this step for a time exceeding this value then Sts_InStepTimeout will be high (1) and an associated alarm will be triggered (if enabled).
6	Type a value to trigger a fault if the time to complete this step exceeds the timer setting.
7	Select the action of the wait timer. IMPORTANT: If you select 'At the beginning of the step', you cannot select the next two wait timer settings for qualified and disqualified inputs.
8	Select to waive the wait timer if all inputs are qualified upon step entry. IMPORTANT: This checkbox is not available if the wait timer is set to start at the beginning of the step.
9	Select the action of the wait timer for disqualified inputs. IMPORTANT: This checkbox is not available if the wait timer is set to start at the beginning of the step.
10	Select the action of the wait timer if this step is interrupted by a state transition.



Item	Description
1	Select this box to reset the sequence fault timer at the beginning of this step. This is useful if you are looping through several steps a number of times. Select this box to reset the sequence fault timer at the beginning of the loop.
2	Select this box if this step is an appropriate place after which to pause. When a pause is requested the sequencer will pause after this step.
3	Clear the checkbox to branch. Select the checkbox to remove the branching boxes.
4	Enter the Branch target step
5	Select the action when branching: <ul style="list-style-type: none">• Always Branch• Based on input qualification bits• Loop until number in Final Loop Count is reached.
6	Enter the final loop count



Item	Description
1	Configure the Boolean Inputs that are used to qualify this step
2	Configure the Boolean Inputs used for branch decision
3	Configure the Boolean Outputs for this step
4	Configure the Real Outputs for this step
5	Navigate through the banks of IO

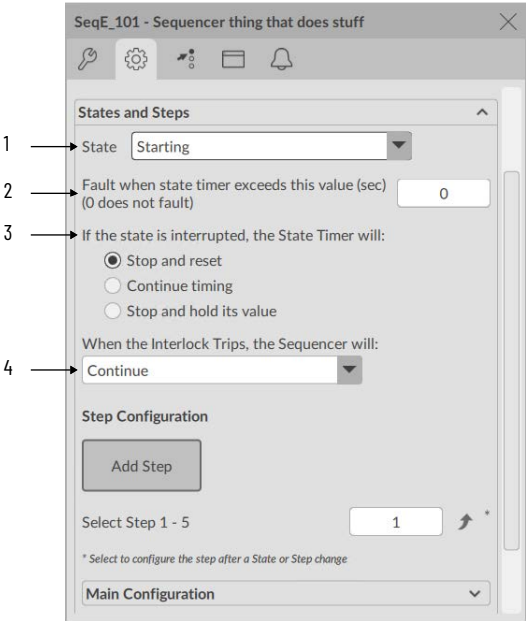
Multi-Step Configuration

Multi-step displays allow configuration of multiple steps at once.

- Step Configuration
- Input Configuration
- Boolean Output Configuration
- Real Output Configuration

Item	Description
1	Type a name for the step. IMPORTANT: Make sure to press Enter or click the Page Down key after typing in a text box to save your work.
2	Select to update the restart address to be used when returning from an interruption caused by a state transition.
3	Select to reset the sequence fault timer at the beginning of the step.
4	Select to let the sequence pause after this step.
5	Select to use a prompt message for an operator to take action. A Browse (...) button appears to provide access to a Manual Prompt faceplate to configure the specific prompt message.
6	Type a value (in milliseconds) for the Step Fault Time. If the time to complete this step exceeds the timer setting, a step timeout is triggered.
7	Type a value to have a step wait based on the conditions of the next field.
8	Choose between: <ul style="list-style-type: none"> • Branch Always • Branch based on input condition • Branch until loop count is reached • Branch based on message prompt • Do not branch (no)
9	Type the number of the step to branch.
10	Type a value for the number of loop counts in the branch.

State Configuration (FactoryTalk Optix)



Item	Description
1	Select a state to configure
2	Enter a time in seconds. If the sequencer is in this state for a time exceeding this value then Sts_InStateTimeout will be high (1) and an associated alarm will be triggered (if enabled).
3	Select a behavior for the in-state timer if the state is interrupted by a state transition.
4	Select the box to indicate the Sequencer action when an interlock trips.

Individual Step Configuration

SeqE_101 - Sequencer thing that does stuff

Step Configuration

Add Step

Select Step 1 - 5: 1

* Select to configure the step after a State or Step change

Main Configuration

Step 1 Name: Step1

☒ Update the Restart Step. If the state is interrupted, it will restart from the last saved step

☒ Enable an operator prompt

Have a nice day

If the step is interrupted, the Step Timer will:

☒ Stop and reset

☐ Continue timing

☐ Stop and hold its value

Fault when step timer exceeds this value (sec) (0 does not fault): 0

Insert Step Delete Step

Step wait timer preset value (sec): 0

Step wait timer starts:

☒ After all required inputs have qualified

☐ At the beginning of the step

☐ Do not wait on timer if all inputs are qualified upon step entry

If inputs become disqualified, the Wait Timer will:

☒ Stop and reset

☐ Continue timing

☐ Stop and hold its value

If the step is interrupted, the Wait Timer will:

☒ Stop and reset

☐ Continue timing

☐ Stop and hold its value

☐ Reset the Sequence Fault Timer at the beginning of the step

☐ Sequence can be paused after this step

Sequence Step Branching

☐ Do not branch

Branch Target Step: 1

Branch to Target Step:

☒ Always

☐ Based on input conditions

☐ Until Loop Count is reached

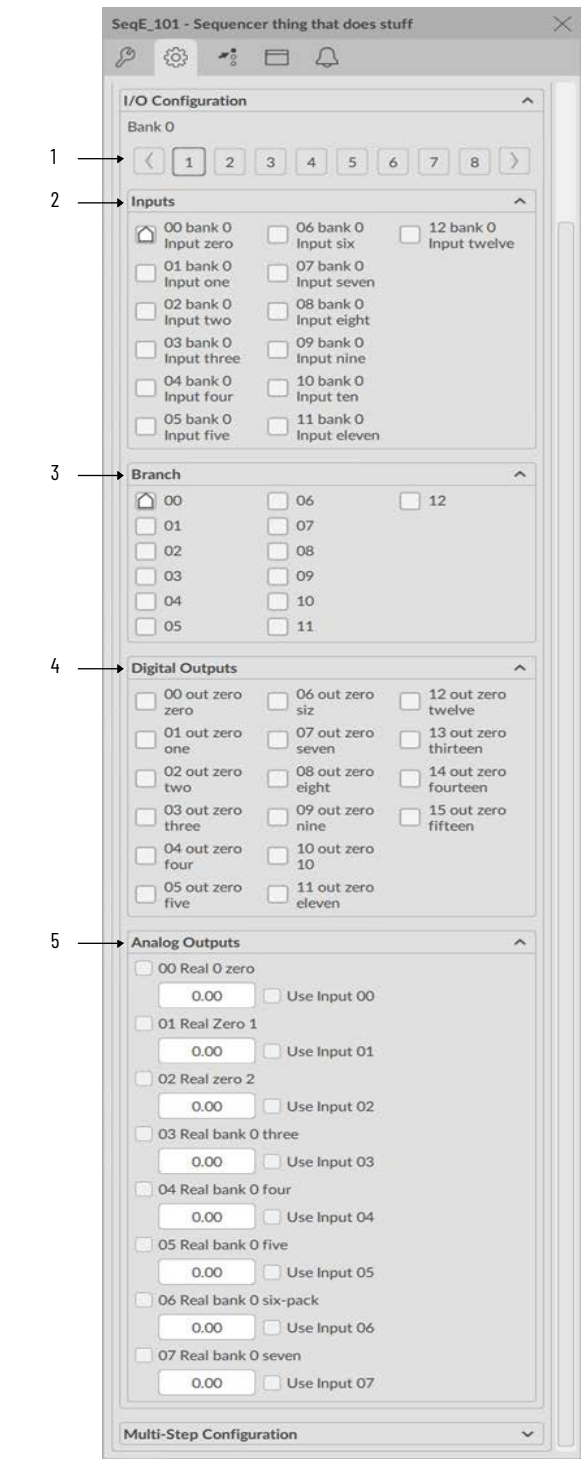
Final Loop Count: 0

☐ Based on Operator Prompt response

I/O Configuration

Multi-Step Configuration

Item	Description
1	Enter the step and select the Submit button to configure.
2	Type a name for the step. IMPORTANT: Make sure to press Enter key after typing in a text box to save your work.
3	Select for the sequence to restart from the last saved step the 'restart' was configured.
4	Select to enable an operator prompt for the step. A prompt selection box appears. Select a prompt and click the Browse (...) button to configure the operator prompt for the step. See Rockwell Automation Library of Process Objects, PROCES-RM260 for more information on the Operator Prompt.
5	Select a behavior for the step wait timer if the step is interrupted by a state transition.
6	Enter a time in seconds if the sequencer is in this step for a time exceeding this value then Sts_InStepTimeOut will be high (1) and an associated alarm will be triggered (if enabled).
7	Type a value to trigger a fault if the time to complete this step exceeds the timer setting.
8	Select the action of the wait timer. IMPORTANT: If you select 'At the beginning of the step', you cannot select the next two wait timer settings for qualified and disqualified inputs.
9	Select to waive the wait timer if all inputs are qualified upon step entry. IMPORTANT: This checkbox is not available if the wait timer is set to start at the beginning of the step.
10	Select the action of the wait timer for disqualified inputs. IMPORTANT: This checkbox is not available if the wait timer is set to start at the beginning of the step.
11	Select the action of the wait timer if this step is interrupted by a state transition.
12	Select this box to reset the sequence fault timer at the beginning of this step. This is useful if you are looping through several steps a number of times. Select this box to reset the sequence fault timer at the beginning of the loop.
13	Select this box if this step is an appropriate place after which to pause. When a pause is requested the sequencer will pause after this step.
14	Clear the checkbox to branch. Select the checkbox to remove the branching boxes.
15	Enter the Branch target step
16	Select the action when branching: <ul style="list-style-type: none"> • Always Branch • Based on input qualification bits • Loop until number in Final Loop Count is reached. • Based on Operator Prompt response
17	Enter the final loop count



Item	Description
1	Navigate through the banks of IO.
2	Configure the Boolean Inputs that are used to qualify this step.
3	Configure the Boolean Inputs used for branch decision.
4	Configure the Boolean Outputs for this step.
5	Configure the Real Outputs for this step.

Multi-Step Configuration

Multi-step displays allow configuration of multiple steps at once.

- Step Configuration
- Input Configuration
- Boolean Output Configuration
- Real Output Configuration

1

SeqE_101 - Sequencer thing that does stuff - Step Configuration

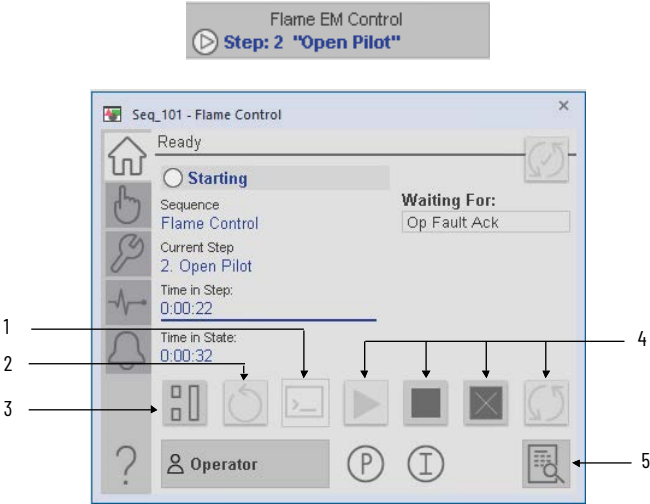
Edit State Name:
Running

	1	2	3	4	5	6	7	8	9	10
	Step Name	Hold RS	Reset TO	Allow Pause	Oper Prompt	Step Fault Time	Step Wait Time	Select	Step Branching Step	Cnt
1	this is step 1!	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0	10	<input type="checkbox"/> no		
2	step two	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5	0	<input type="checkbox"/> no		
3	step three	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	0	<input checked="" type="checkbox"/> Input	4	
4	step four	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	0	<input checked="" type="checkbox"/> Always	2	
5	step five	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	0	<input checked="" type="checkbox"/> Loop	3	3

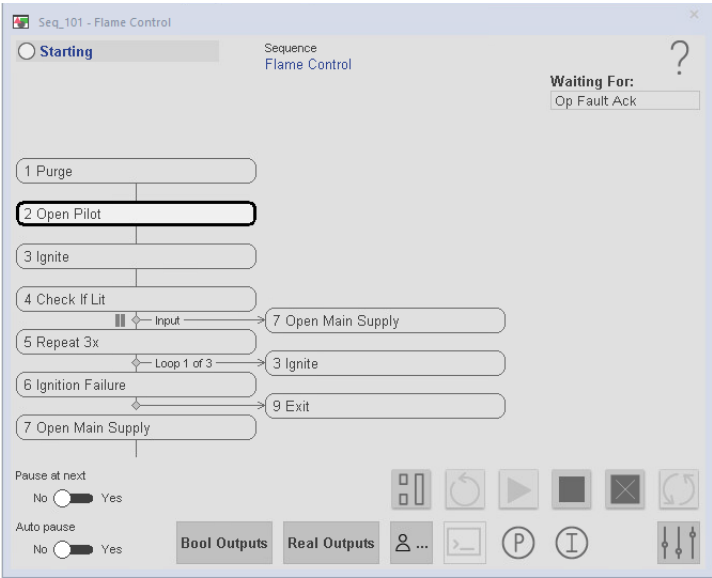
Item	Description
1	Type a name for the step. IMPORTANT: Make sure to press Enter or click the Page Down key after typing in a text box to save your work.
2	Select to update the restart address to be used when returning from an interruption caused by a state transition.
3	Select to reset the sequence fault timer at the beginning of the step.
4	Select to let the sequence pause after this step.
5	Select to use a prompt message for an operator to take action. A Browse (...) button appears to provide access to a Manual Prompt faceplate to configure the specific prompt message.
6	Type a value (in milliseconds) for the Step Fault Time. If the time to complete this step exceeds the timer setting, a step timeout is triggered.
7	Type a value to have a step wait based on the conditions of the next field.
8	Choose between: <ul style="list-style-type: none"> • Branch Always • Branch based on input condition • Branch until loop count is reached • Branch based on message prompt • Do not branch (no)
9	Type the number of the step to branch.
10	Type a value for the number of loop counts in the branch.

Graphical Interfaces (FactoryTalk View SE)

The following graphic symbols and faceplates are examples of the graphical interface tools for this Add-On Instruction.

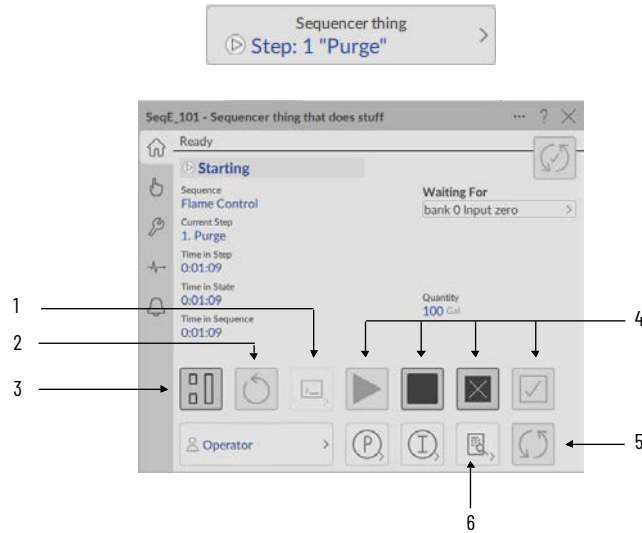


Item	Description
1	Respond to prompt request button
2	Resume sequence button
3	Hold sequence button
4	Sequencer operator buttons from left to right: <ul style="list-style-type: none">• Start sequence• Stop sequence• Abort sequence• Reset sequence
5	Access to the runtime detail faceplate button

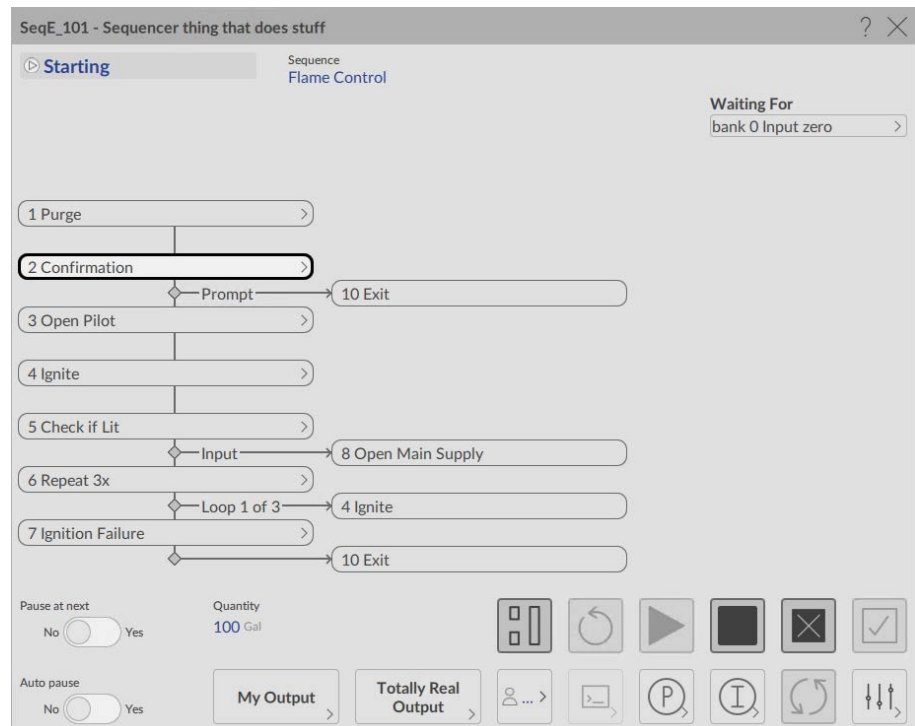


Graphical Interfaces (FactoryTalk Optix)

The following graphic symbols and faceplates are examples of the graphical interface tools for this Add-On Instruction.



Item	Description
1	Respond to prompt request button
2	Resume sequence button
3	Hold sequence button
4	Sequencer operator buttons from left to right: <ul style="list-style-type: none"> Start sequence Stop sequence Abort sequence Complete sequence
5	Reset sequence button
6	Access to the runtime detail faceplate button



Sequencer Operation

Elements included in the Step Transition Evaluation

In order to 'qualify' a step's transition conditions three things must be true: Inp_qualified, Step Timer, and Prompt acknowledgment. If any of these three are not used in the current step then they will be assumed to be true.

Step qualification can be operator influenced by:

- Order of evaluation
- Input Conditions
- Step Timer
- Prompt

Configured outputs are enforced for at least one scan of the raP_Opr_Seq instruction. For example, if an output is configured for a step but the step's transition conditions are already qualified on entry to the step, the configured outputs will be enforced at the sequencer outputs for at least one scan of the sequencer instruction.

Step qualification can be influenced during a running sequence using forces.

Step Force

A step can be forced to proceed to the next step regardless of any configured transition conditions by clicking the 'Force Step' button. Once the step has proceeded the force is automatically reset.

The step can be forced from the Maintenance tab of the faceplate.

Input Force

Input forcing can be used to remove the input from qualification consideration in any given step.

An input can be forced (and unforced) if it is used in the qualification conditions of the current step. Forcing of such an input will remove its consideration from the current step input qualification for the duration of that step. Once the step is completely qualified the force is automatically removed from that input. Several inputs can individually be forced in the same step.

Inputs can be forced from the Maintenance tab of the faceplate.

Step Editing

Step editing includes addition, insertion, and deletion of steps to an editable state. This does not include individual step content configurations that can occur at any time.

Step addition, insertion, and deletion should only be done either off line by directly manipulating the step array fields or by using the faceplate editing functions. This is due to internal 'book-keeping' which maintains the state and step relationships which are only updated on a prog to run transition, an initialization of the sequencer or incrementally by the faceplate resident editing functions.

Editing can only occur when the sequencer is in the Idle state.

Editing will adjust the existing Branch target configurations.

Branching

See [Branching and Looping on page 12](#)

Tracking

Output tracking is the ability for a sequencer output to track a signal in the project. This capability allows the output signal to follow programmatic signals in the control scheme so that the outputs do not overwrite user signal selections when the sequencer is not actively controlling the output. By default the tracking feature is on for each output.

See [Tracking on page 47](#) for more information on raP_OprSeqBoolOut tracking.

See [Tracking on page 58](#) for more information on raP_OprSeqRealOut tracking

Notes:

raP_Opr_SeqBoolInp

raP_Opr_SeqBoolInp is a supporting instruction that is intended to be used as Boolean input processing for the raP_Opr_Seq instruction. Its primary function is to evaluate the satisfaction of input pattern requirements from the step configuration array. When the input states match the required input pattern for the currently designated step then the Out_Qualified is set.

- Boolean Input state qualification for each step configuration.
- Allow for up to 128 Boolean Inputs in banks of 16.
- Optional Boolean Input state branching qualification for each step configuration.
- Optional Boolean Input Force Enable configuration.
- Optional Boolean Input Force requests.
- Maintain HMI annunciation for Boolean Inputs which are Qualified or Unqualified for the current step configuration.
- Maintain HMI annunciation for Boolean Inputs which have had and lost Qualification for the current step configuration.
- Maintain HMI annunciation for Boolean Inputs which are Forced.

Configuring the Number of Boolean Inputs for a Sequencer

The number of Boolean inputs can be increased or decreased by changing the number of Boolean input banks in the step UDT raP_UDT_Opr_SeqStepCfg. This array value can be configured from one to eight banks of 16 Boolean inputs. There must be at least one bank configured. A number greater than eight will result in eight being used. Once configured, this number (amount of Boolean input banks) will be used for all sequencer configurations.

The following example shows a configuration for two Boolean input banks for a total of 2x16=32 Boolean inputs.

Name:raP_UDT_Opr_SeqStepData Type Size: 112 bytes

Description:Data for one raP_Opr_Seq Sequencer Step

Members:

Name	Data Type	Description
▸ Cfg_Name	STRING_20	Step Name
▸ Cfg_InStepTimeOut	DINT	In Step TimeOut Fault Preset (Sec)
▸ Cfg_StepTimer	DINT	Step Timer Preset (Sec)
▸ Inputs	raP_UDT_Opr_SeqStep.BoolIn[2]	Bool Inputs
▸ Outputs	raP_UDT_Opr_SeqStep.BoolOut[2]	Bool Outputs
▸ RealOutputs	raP_UDT_Opr_SeqStep.RealOut[1]	Real Outputs
▸ Cfg_StepTimerIntrptAction	SINT	Step Timer Action on Interrupt 0 Reset, 1 Continue, 2 Hold

Programming

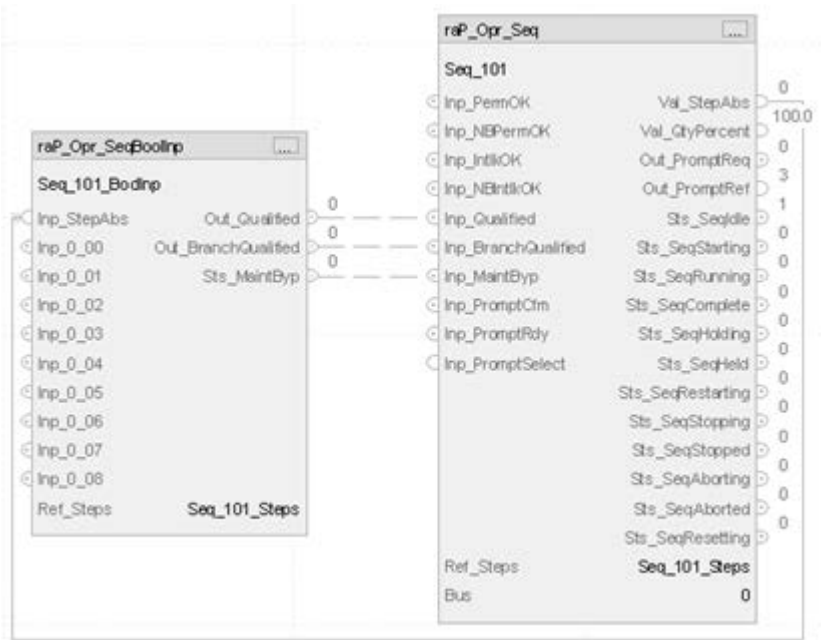
Assign one instance of a raP_Opr_SeqBoolInp instruction to a sequencer.

The name of the raP_Opr_SeqBoolInp must be the name of the sequencer instance with '_BoolInp' appended.

Populate the 'Ref_Steps' InOut parameter with the same raP_UDT_Opr_SeqStep array reference that the sequencer has.

Connect the following:

raP_Opr_SeqBoolInp	raP_Opr_Seq
Seq.Val_StepAbs	BoolInp.Inp_StepAbs
BoolInp.Out_Qualified	Seq.Inp_Qualified
BoolInp.Out_BranchQualified	Seq.Inp_BranchQualified
BoolInp.MaintByp	Seq.Inp_MaintByp

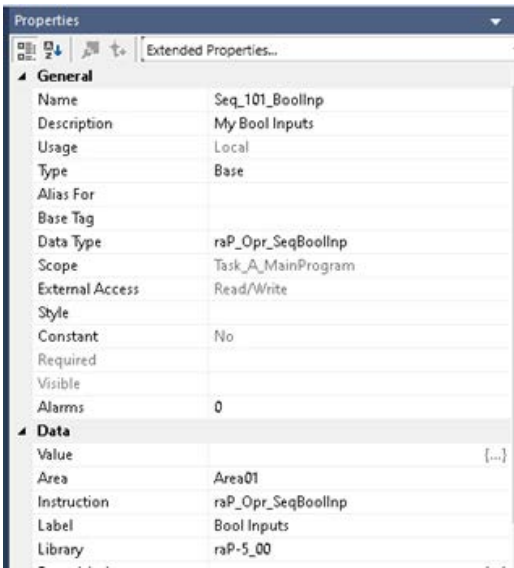


Extended Tag Properties

Each raP_Opr_SeqBoolInp instruction instances must contain the following Extended Tag Properties:

- Area
- Instruction
- Label
- Library

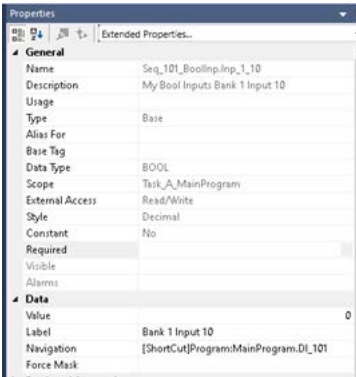
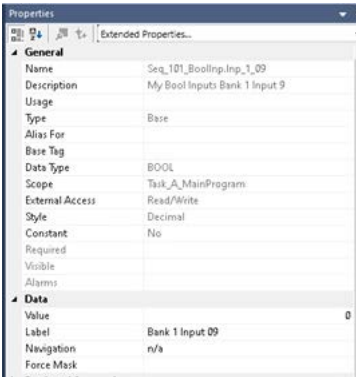
Tag	Description
Area	The user area designation (Default='Area01')
Instruction	'raP_Opr_SeqBoolInp'
Label	This entry appears on the sequencer faceplate buttons to call the Real Output display
Library	'raP-5_00'



Each individual Boolean input in the raP_Opr_SeqBoolInp can be named in the Extended Tag Properties for its specific programmed assignment using the 'Label' field.

Extended Tag Properties for Each Output

The 'Navigation' field can be used to enter the full path to an upstream object. If navigation is not used then this field must be set to 'n/a'.



Tag	Description
Label	User entry which displays in the sequencer faceplate for the corresponding Input
Navigation	'n/a' if not used. The full path of the downstream object if used for navigation

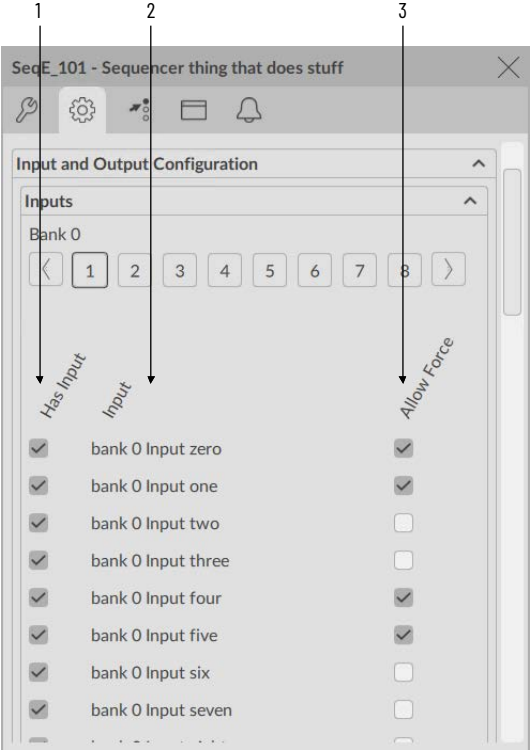
Configuration

Sequencer (FactoryTalk View SE)

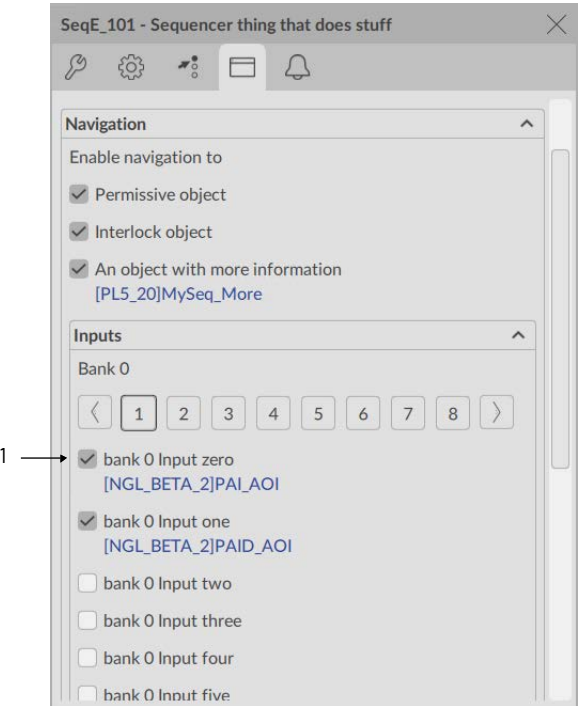
Bank 0 Input		Allow Force	Allow Navigation to Input Source Tag
<input checked="" type="checkbox"/> 0	Pilot Closed	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> 1	Pilot Opened	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> 2	Main Closed	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> 3	Main Opened	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> 4	Pilot Lit	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 5	Bank 0 Input 05	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 6	Bank 0 Input 06	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 7	Bank 0 Input 07	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> 8	Op Fault Ack	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 9	Bank 0 Input 09	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 10	Bank 0 Input 10	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 11	Bank 0 Input 11	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 12	Bank 0 Input 12	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 13	Bank 0 Input 13	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 14	Bank 0 Input 14	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 15	Bank 0 Input 15	<input type="checkbox"/>	<input type="checkbox"/>

Item	Description
1	Has Input (default=0) - This checkbox indicates to the sequencer that the user configuration has the corresponding Boolean input.
2	Name of Boolean Input - The name of the corresponding Boolean input as configured in the appropriate Extended Tag Properties.
3	Allow Force (default=0) - This checkbox indicates that the corresponding Boolean input can be forced to qualify in a step without actually achieving its configured state.
4	Allow Navigation - This checkbox indicates that the corresponding Boolean input is navigable to an upstream element whose path is configured in the appropriate Extended Tag Properties. If checked, the path as configured in the Extended Tag Properties appears next to the checkbox.

Sequencer (FactoryTalk Optix)

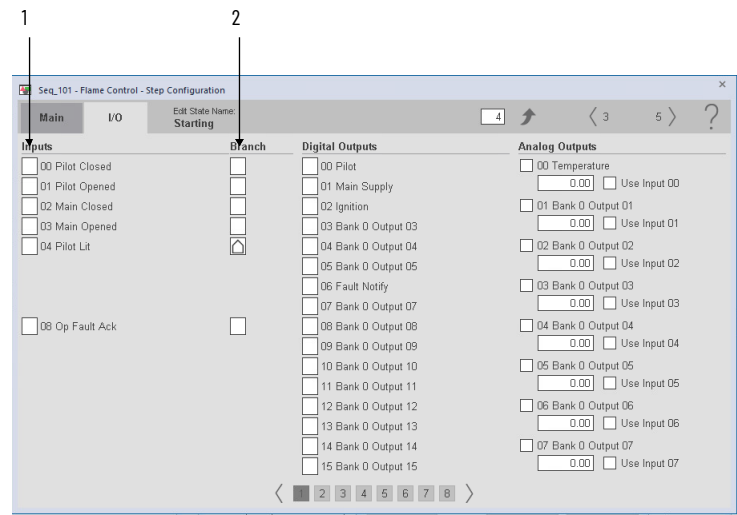


Item	Description
1	Has Input (default=0) - This checkbox indicates to the sequencer that the user configuration has the corresponding Boolean input.
2	Name of Boolean Input - The name of the corresponding Boolean input as configured in the appropriate Extended Tag Properties.
3	Allow Force (default=0) - This checkbox indicates that the corresponding Boolean input can be forced to qualify in a step without actually achieving its configured state.






Item	Description
1	Allow Navigation for Inputs- This checkbox indicates that the corresponding Boolean input is navigable to an upstream element whose path is configured in the appropriate Extended Tag Properties. If checked, the path as configured in the Extended Tag Properties appears next to the checkbox.

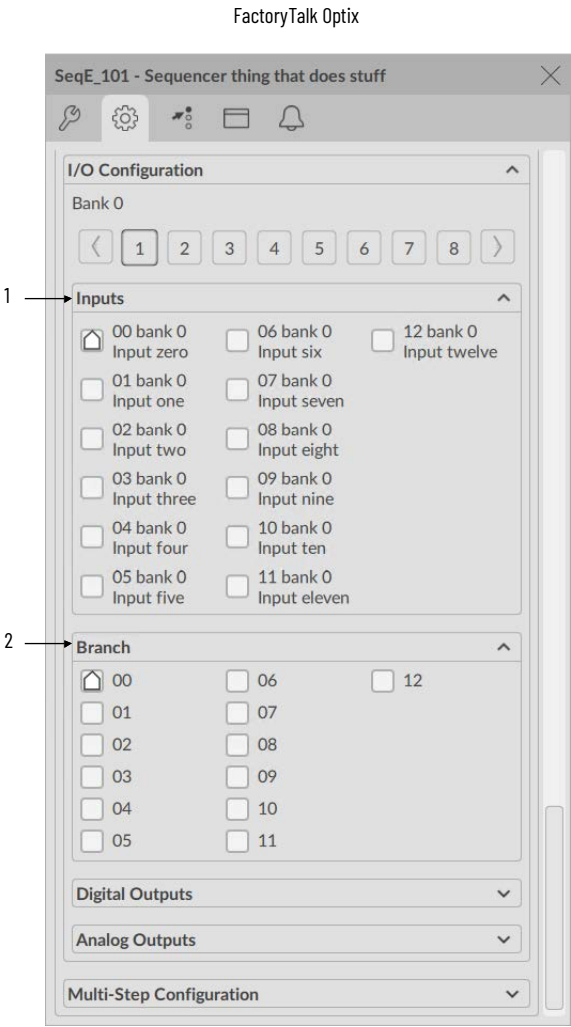
Step (FactoryTalk View SE)



Item	Description
1	Use Boolean Input (default = 0) - This control enables step qualification based on this input. The corresponding input requirement is shown in the following table.
2	Qualification (default = 0) - This control enables branching after this step. The corresponding input requirement is shown in the following table

State	Description
	The corresponding output is not used in this step.
	The corresponding output will be set low (0) in this step.
	The corresponding output will be set high (1) in this step.

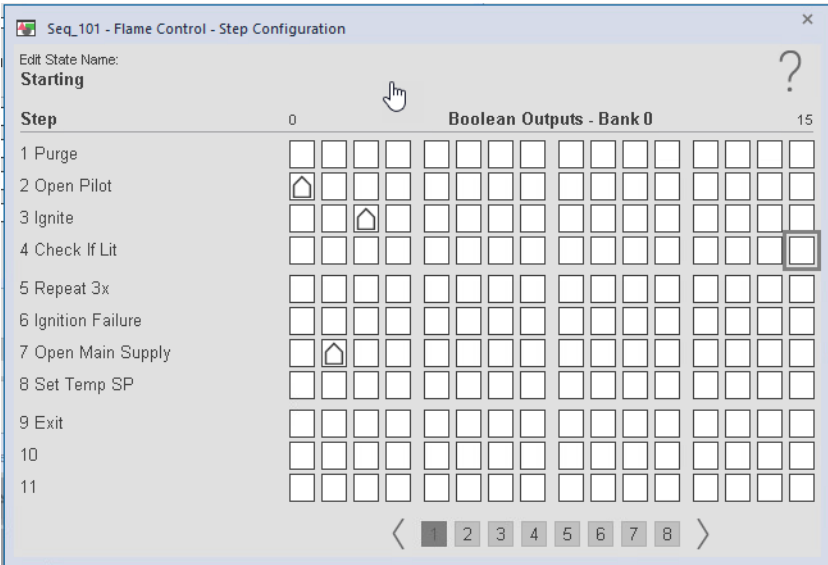
Step (FactoryTalk Optix)



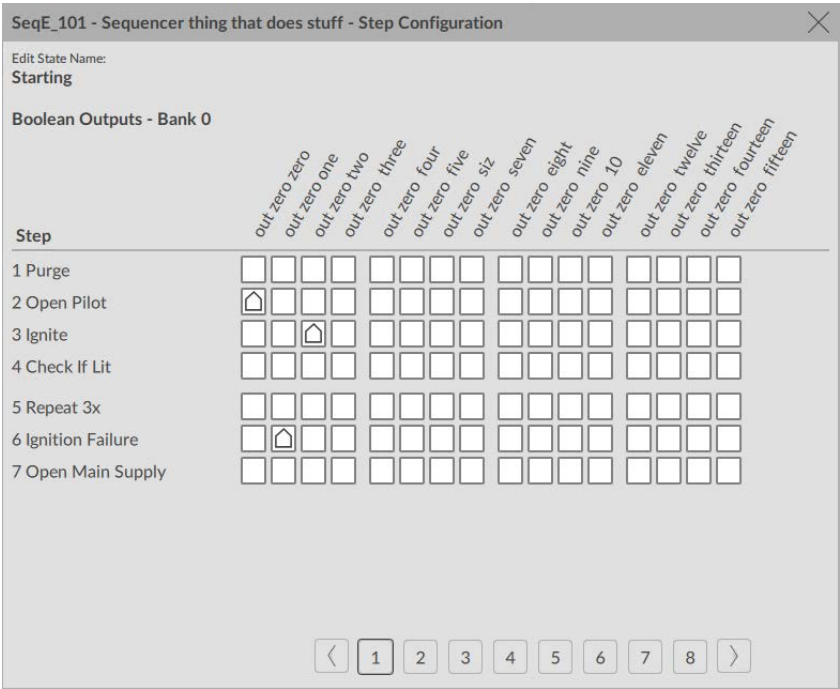
Item	Description
1	Use Boolean Input (default = 0) - This control enables step qualification based on this input. The corresponding input requirement is shown in the following table.
2	Qualification (default = 0) - This control enables branching after this step. The corresponding input requirement is shown in the following table

State	Description
<input type="checkbox"/>	The corresponding output is not used in this step.
<input checked="" type="checkbox"/>	The corresponding output will be set low (0) in this step.
<input checked="" type="checkbox"/>	The corresponding output will be set high (1) in this step.

Multi-Step (FactoryTalk View SE)



Multi-Step (FactoryTalk Optix)



raP_Opr_SeqBoolOut

raP_Opr_SeqBoolOut is a supporting instruction that is intended to be used as Boolean output processing for the raP_Opr_Seq instruction. Its primary function is to maintain the states of Boolean Output requirements from the step configuration array. When the output states are configured to be used for the currently designated step then the outputs are set according to the step configuration.

- Boolean Output state for each step configuration.
- Boolean Output Enable for each step configuration.
- Allow for up to 128 Boolean Outputs in banks of 16.
- Optional Tracking to maintain or set output values which are not being used by the current step configuration.
- Maintain HMI annunciation for Boolean Inputs which are used and the currently selected state for the current step configuration.

Configuring the Number of Boolean Outputs for a Sequencer

The number of Boolean outputs can be increased or decreased by changing the number of Boolean output banks in the step UDT raP_UDT_Opr_SeqStepCfg. This array value can be configured from one to eight banks of 16 Boolean outputs. There must be at least one bank configured. A number greater than eight will result in eight being used. Once configured, this number (amount of Boolean output banks) will be used for all sequencer configurations in the controller.

The following example shows a configuration for two (2) Boolean output banks for a total of 2x16=32 Boolean outputs.

Name: raP_UDT_Opr_SeqStepData Type Size: 112 bytes

Description: Data for one raP_Opr_Seq Sequencer Step

Members:

Name	Data Type	Description
▸ Cfg_Name	STRING_20	Step Name
Cfg_InStepTimeOut	DINT	In Step TimeOut Fault Preset (Sec)
Cfg_StepTimer	DINT	Step Timer Preset (Sec)
▸ Inputs	raP_UDT_Opr_SeqStep_BoolIn[2]	Bool Inputs
▸ Outputs	raP_UDT_Opr_SeqStep_BoolOut[2]	Bool Outputs
▸ RealOutputs	raP_UDT_Opr_SeqStep_RealOut[1]	Real Outputs
Cfg_StepTimerIntrptAction	SINT	Step Timer Action on Interrupt: 0 Reset, 1 Continue, 2 Hold

Programming

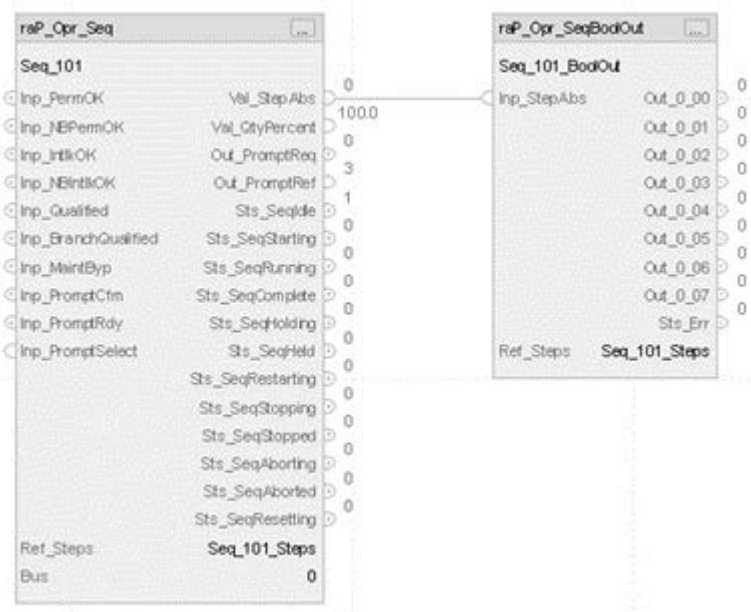
Assign one instance of a raP_Opr_SeqBoolOut instruction to a sequencer.

The name of the raP_Opr_SeqBoolOut must be the name of the sequencer instance with '_BoolOut' appended.

Populate the 'Ref_Steps' InOut parameter with the same raP_UDT_Opr_SeqStep array reference that the sequencer has.

Connect the following:

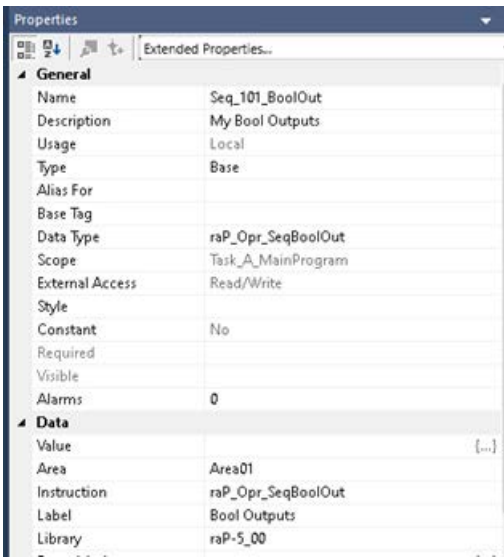
raP_Opr_Seq	raP_Opr_SeqBoolOut
Seq.Val_StepAbs	BoolOut.Inp_StepAbs



Extended Tag Properties

Each raP_Opr_SeqBoolOut instruction instances must contain the following Extended Tag Properties:

- Area
- Instruction
- Label
- Library

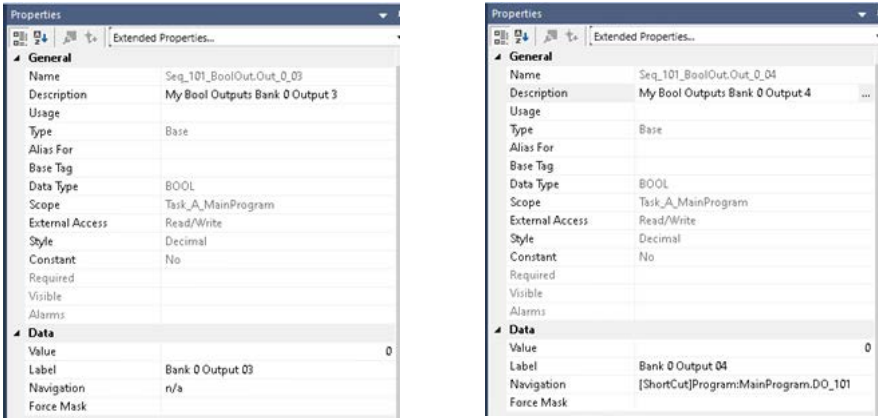


Tag	Description
Area	The user area designation (Default='Area01')
Instruction	'raP_Opr_SeqBoolOut'
Label	This entry appears on the sequencer faceplate buttons to call the Bool Output display
Library	'raP-5_00'

Each individual Boolean output in the raP_Opr_SeqBoolOut can be named in the Extended Tag Properties for its specific programmed assignment using the 'Label' field.

Extended Tag Properties for Each Output

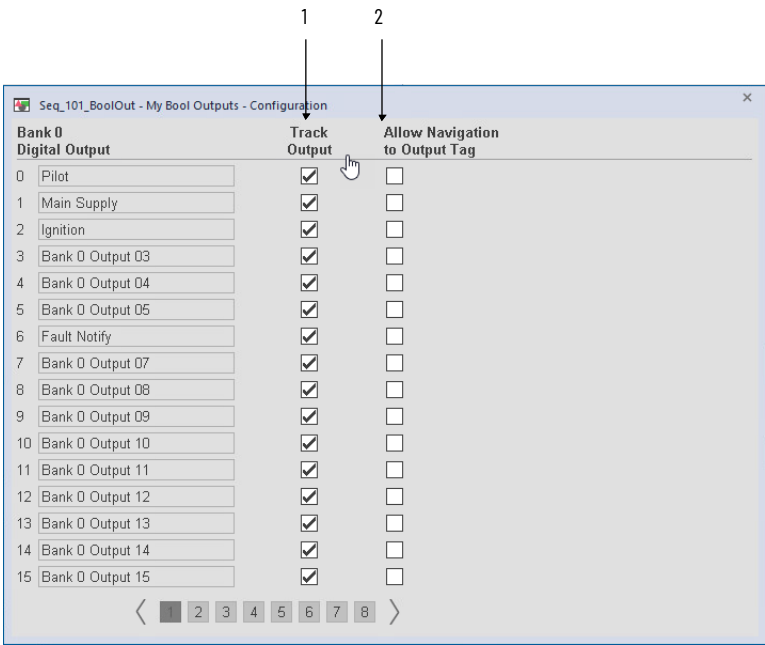
The 'Navigation' field can be used to enter the full path to a downstream object. If navigation is not used then this field must be set to 'n/a'.



Tag	Description
Label	User entry which displays in the sequencer faceplate for the corresponding Output
Navigation	'n/a' if not used. The full path of the downstream object if used for navigation

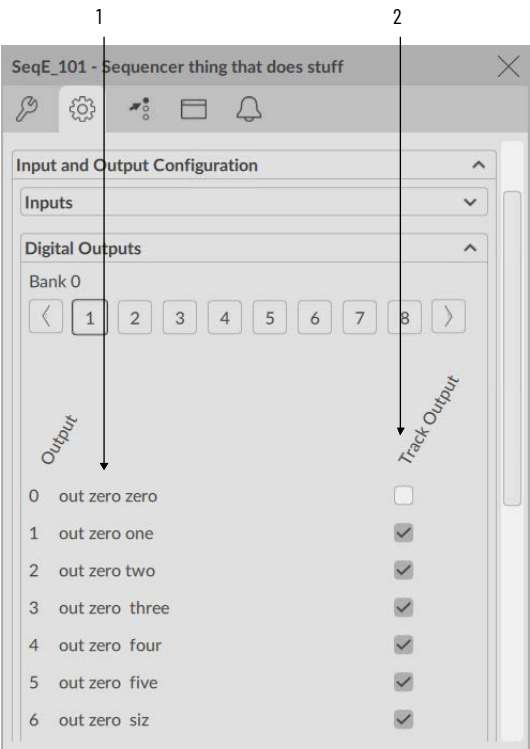
Configuration

Sequencer (FactoryTalk View SE)

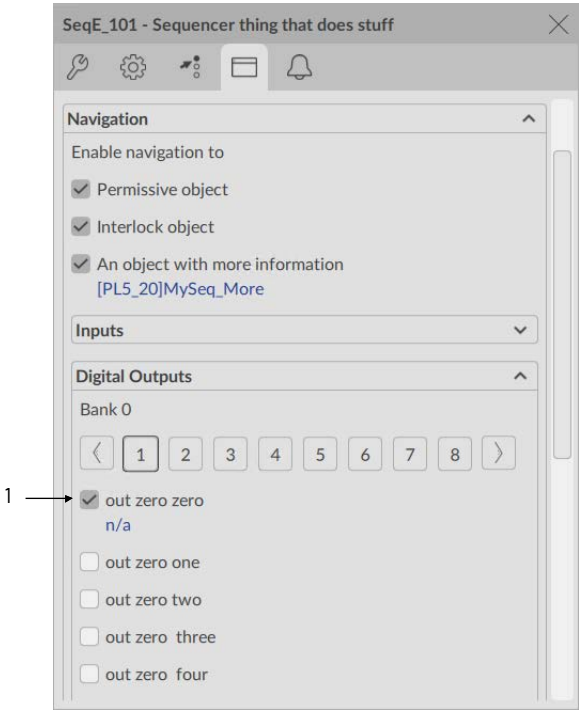


Item	Description
1	Track Output (default=1) - Select to enable the Tracking feature for the corresponding Boolean output.
2	Allow Navigation (default=0) - This checkbox indicates that the corresponding Boolean output is navigable to a downstream element whose path is configured in the appropriate Extended Tag Properties . If checked, the path as configured in the Extended Tag Properties will appear next to the check box.

Sequencer (FactoryTalk Optix)

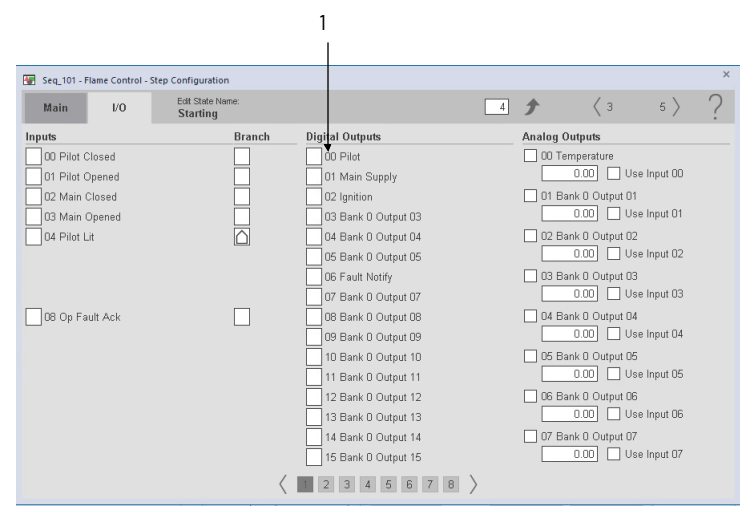


Item	Description
1	Name of Bool Output - The name of the corresponding Bool output as configured in the appropriate Extended Tag Properties.
2	Track Output (default=1) - Select to enable the Tracking feature for the corresponding Boolean output.



Item	Description
1	Allow Navigation for Digital Outputs (default=0) - This checkbox indicates that the corresponding Boolean output is navigable to a downstream element whose path is configured in the appropriate Extended Tag Properties . If checked, the path as configured in the Extended Tag Properties will appear next to the check box.

Step (FactoryTalk View SE)

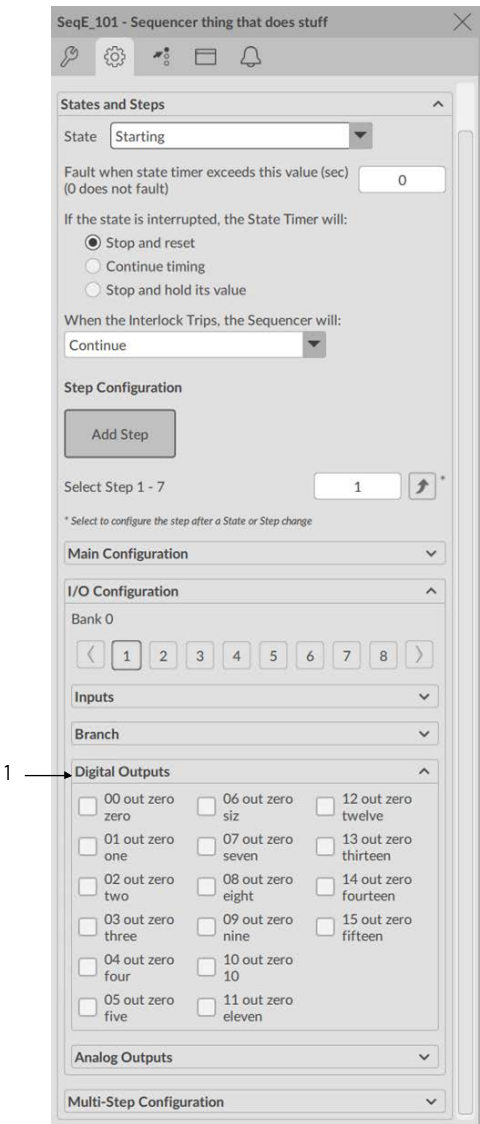


Item	Description
1	Use Digital Output (default = 0) - This control enables the use of the corresponding output in this step. The output used is shown in the table below.

State	Description
<input type="checkbox"/>	The corresponding output is not used in this step.
<input type="checkbox"/>	The corresponding output will be set low (0) in this step.
<input type="checkbox"/>	The corresponding output will be set high (1) in this step.

Step (FactoryTalk Optix)

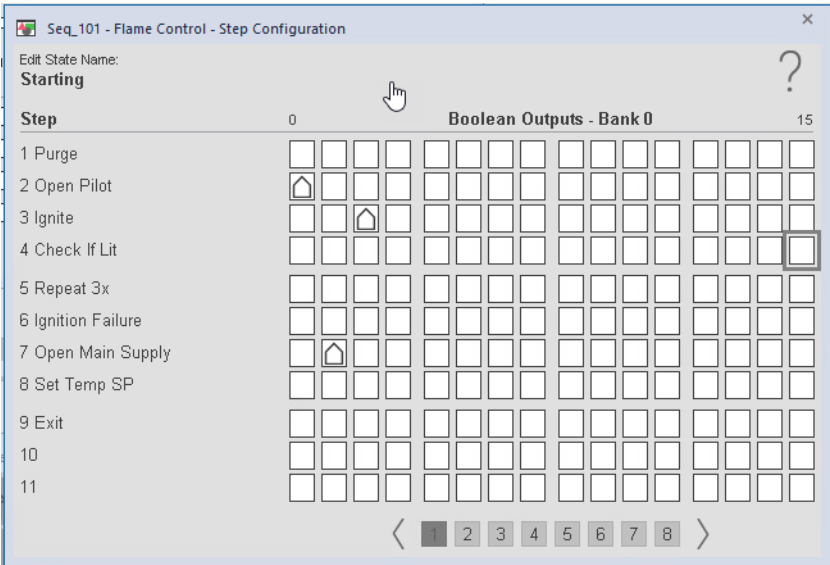
FactoryTalk Optix



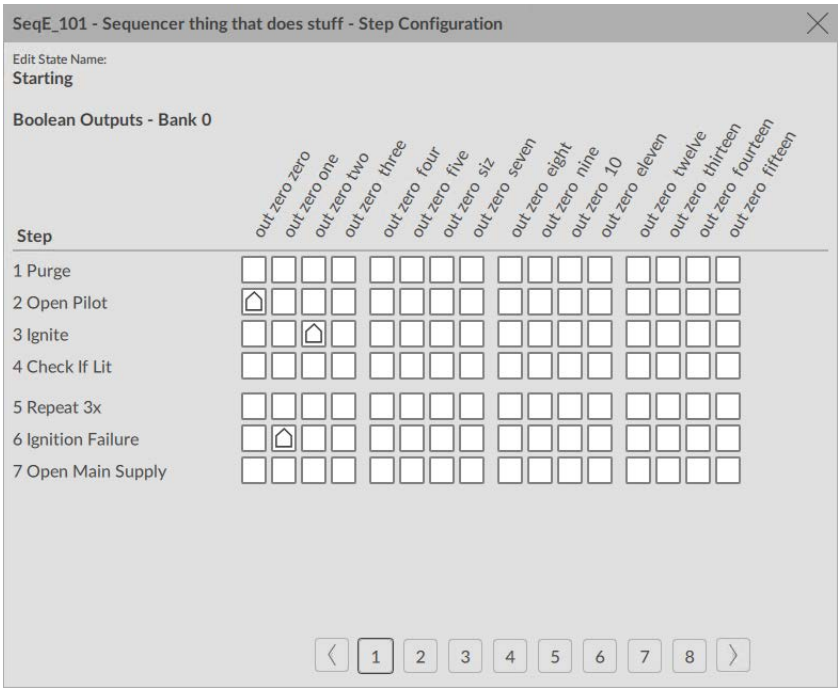
Item	Description
1	Use Digital Output (default = 0) - This control enables the use of the corresponding output in this step. The output used is shown in the table below.

State	Description
<input type="checkbox"/>	The corresponding output is not used in this step.
<input checked="" type="checkbox"/>	The corresponding output will be set low (0) in this step.
<input type="checkbox"/>	The corresponding output will be set high (1) in this step.

Multi-Step (FactoryTalk View SE)



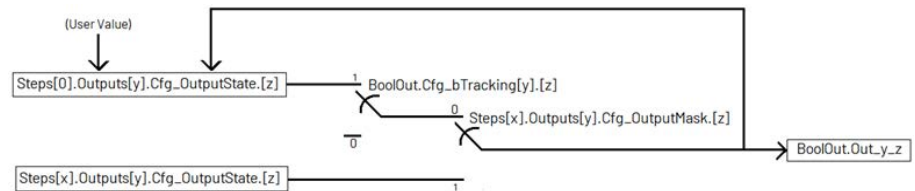
Multi-Step (FactoryTalk Optix)



Tracking

Tracking is the ability for a Boolean output to track a parameter from somewhere in the system. The Boolean output will be set to this parameter value if the current step in the sequencer does not use the Boolean output in the current step. Tracking is useful for initializing Boolean outputs with the current value of that parameter until it is used by the sequencer. Tracking is on by default.

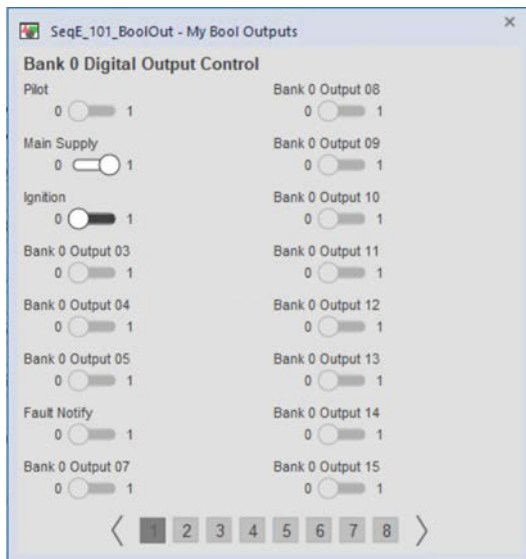
Example: A Boolean output is used to set the Run command for a drive. The actual drive condition (Running/Not Running) is tied to the tracking input of that Boolean output (Steps[0].Outputs[y].Cfg_OutputState.[z]). Until that Boolean output is used by the sequencer the Boolean output will be updated to the current value of the drive condition.



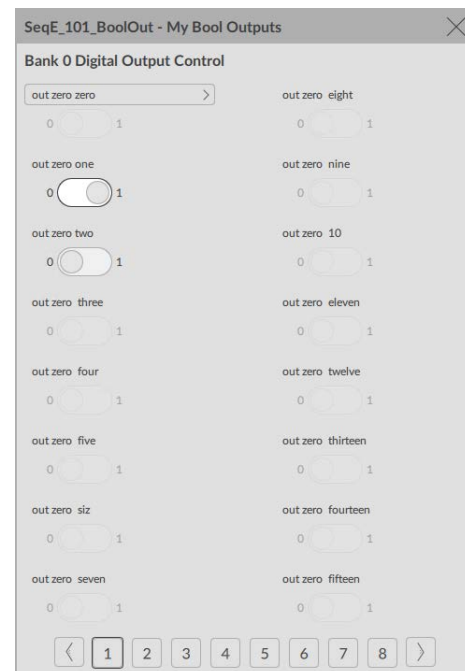
Control

The control display for the sequencer boolean outputs can be accessed from the sequencer detail display. Boolean outputs that are not configured to be used in the current step (Use Output = 0) and to not be tracked (Track Output = 0) will be available for users to toggle during sequencer runtime. The current user must have a security code in the HMI Tag Security\OverrideOutputs to change a boolean output.

FactoryTalk View SE



FactoryTalk Optix



Notes:

raP_Opr_SeqRealOut

raP_Opr_SeqRealOut is a supporting instruction that is intended to be used as Real output processing for the raP_Opr_Seq instruction. Its primary function is to maintain the values of Real Output requirements from the step configuration array. When the output values are configured to be used for the currently designated step then the output values are set according to the step configuration.

- Real Output values for each step configuration.
- Real Output Enable for each step configuration.
- Allow for up to thirty-two (32) Real Outputs in banks of eight.
- Optional Tracking to maintain or set output values which are not being used by the current step configuration.
- Optional Scaling of individual outputs if so configured by the user.
- Optional use of corresponding input for the output value in a step.
- Accept Real valued inputs for each corresponding output when so configured to use by the step configuration.
- Maintain HMI annunciation for Real Inputs which are used and the currently selected value for the current step configuration.

Configuring the Number of Real Outputs for a Sequencer

The number of Real outputs can be increased or decreased by changing the number of Real output banks in the step UDT raP_UDT_Opr_SeqStepCfg. This array value can be configured from one to four banks of eight Real outputs. There must be at least one bank configured. A number greater than four will result in four being used. Once configured, this number (amount of Real output banks) will be used for all sequencer configurations.

The following example shows a configuration for one Real output bank for a total of 1x8=8 Real outputs.

Name:

Data Type Size: 112 bytes

Description:

Data for one
raP_Opr_Seq
Sequencer Step

Members:

Name	Data Type	Description
▸ Cfg_Name	STRING_20	Step Name
Cfg_InStepTimeOut	DINT	In Step TimeOut Fault Preset (Sec)
Cfg_StepTimer	DINT	Step Timer Preset (Sec)
▸ Inputs	raP_UDT_Opr_SeqStep_BoolIn[2]	Bool Inputs
▸ Outputs	raP_UDT_Opr_SeqStep_BoolOut[2]	Bool Outputs
▸ RealOutputs	raP_UDT_Opr_SeqStep_RealOut[1]	Real Outputs
Cfg_StepTimerIntrptAction	SINT	Step Timer Action on Interrupt 0 Reset, 1 Continue, 2 Hold

Programming

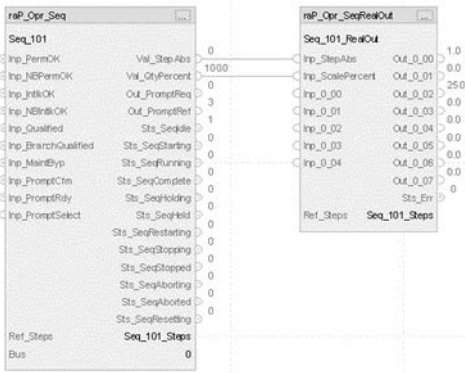
Assign one instance of a raP_Opr_SeqRealOut instruction to a sequencer.

The name of the raP_Opr_SeqRealOut must be the name of the sequencer instance with '_RealOut' appended.

Populate the 'Ref_Steps' InOut parameter with the same raP_UDT_Opr_SeqStep array reference that the sequencer has.

Connect the following:

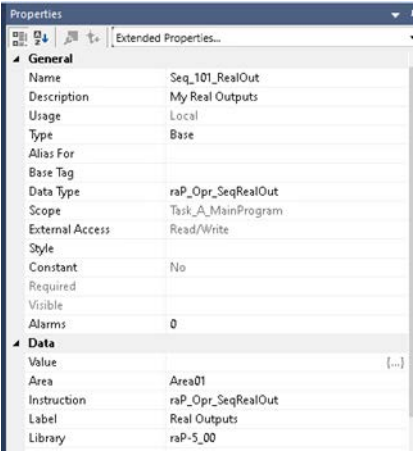
raP_Opr_Seq	raP_Opr_SeqRealOut
Seq.Val_StepAbs	RealOut.Inp_StepAbs
Seq.Val_QtyPercent	RealOut.Inp_ScalePercent



Extended Tag Properties

Each raP_Opr_SeqRealOut instruction instance must contain the following Extended Tag Properties:

- Area
- Instruction
- Label
- Library

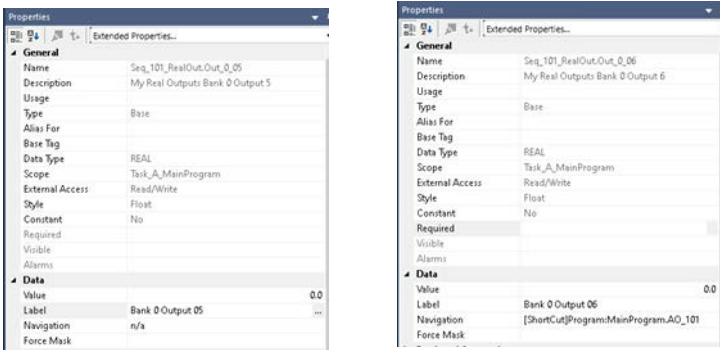


Tag	Description
Area	The user area designation (Default=Area01)
Instruction	'raP_Opr_SeqRealOut'
Label	This entry appears on the sequencer faceplate buttons to call the Real Output display
Library	'raP-5_00'

Each individual Boolean input in the raP_Opr_SeqRealOut can be named in the Extended Tag Properties for its specific programmed assignment using the 'Label' field.

Extended Tag Properties for Each Output

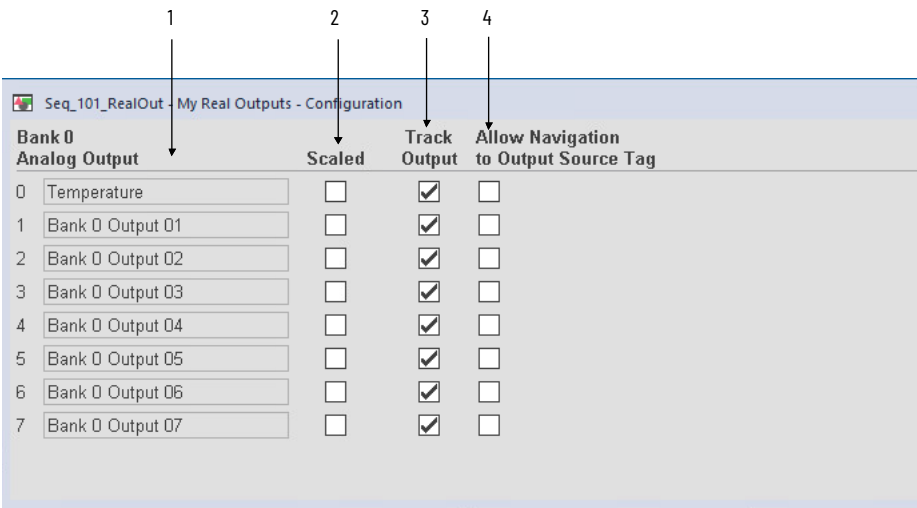
The 'Navigation' field can be used to enter the full path to a downstream object. If navigation is not used, then this field must be set to 'n/a'.



Tag	Description
Label	User entry which displays in the sequencer faceplate for the corresponding Output
Navigation	'n/a' if not used. The full path of the downstream object if used for navigation

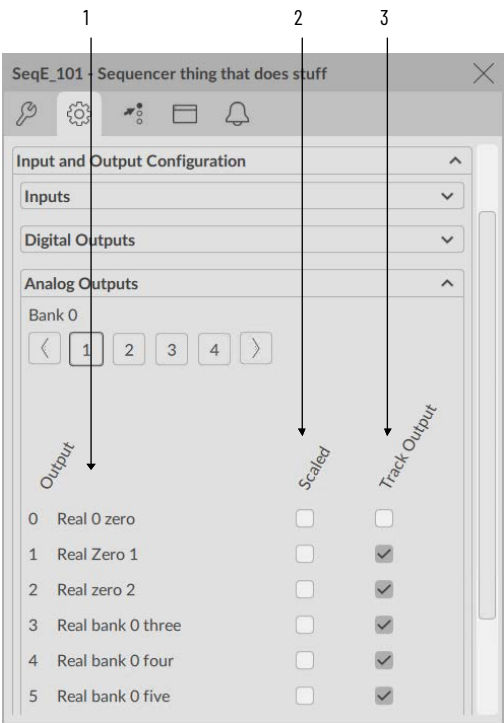
Configuration

Sequencer (FactoryTalk View SE)

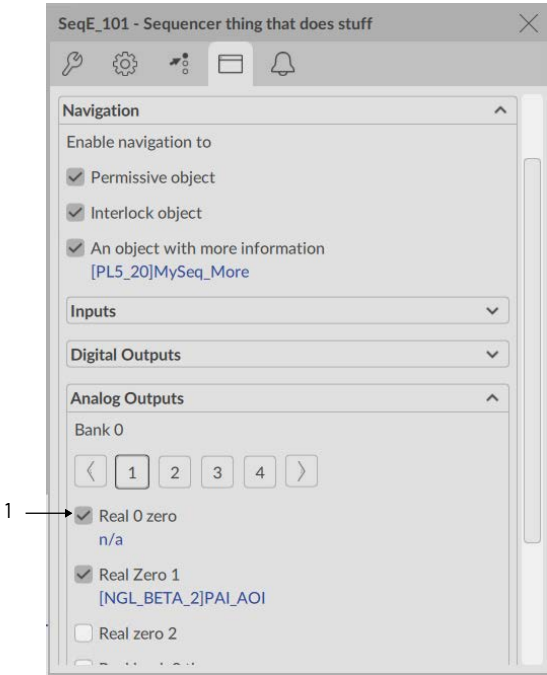


Item	Description
1	Name of Real Output - The name of the corresponding Real output as configured in the appropriate Extended Tag Properties.
2	Scaled (default=0) - Select to enable the Scaling feature for the corresponding Real output.
3	Track Output (default=1) - Select to enable the Tracking feature for the corresponding Real output.
4	Allow Navigation (default=0) - This checkbox indicates that the corresponding Real output is navigable to a downstream element whose path is configured in the appropriate Extended Tag Properties. If checked, the path as configured in the Extended Tag Properties will appear next to the checkbox.

Sequencer (FactoryTalk Optix)

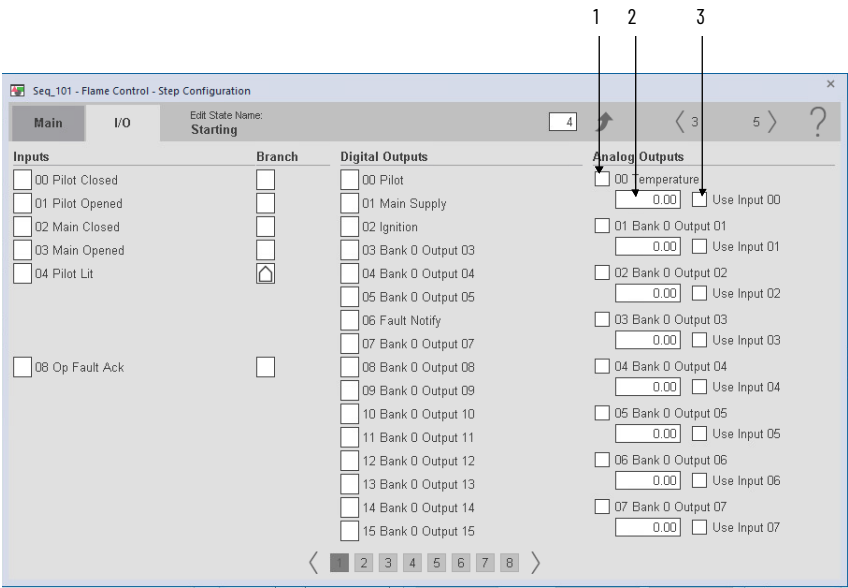


Item	Description
1	Name of Real Output - The name of the corresponding Real output as configured in the appropriate Extended Tag Properties.
2	Scaled (default=0) - Select to enable the Scaling feature for the corresponding Real output.
3	Track Output (default=1) - Select to enable the Tracking feature for the corresponding Real output.



Item	Description
1	Allow Navigation for Real Outputs (default=0) - This checkbox indicates that the corresponding Real output is navigable to a downstream element whose path is configured in the appropriate Extended Tag Properties. If checked, the path as configured in the Extended Tag Properties will appear next to the checkbox.

Step (FactoryTalk View SE)



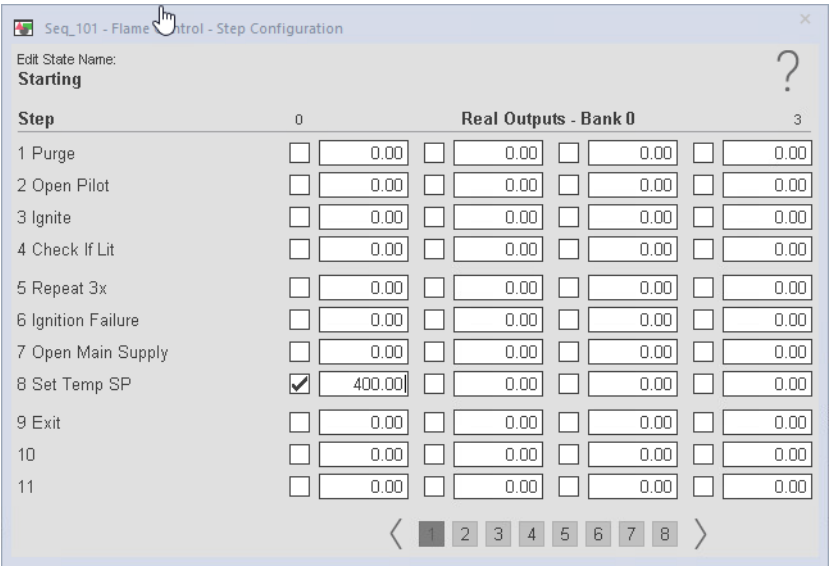
Item	Description
1	Use Output (default=0) - This checkbox enables the use of the corresponding Real output in this step.
2	Value Entry Box - This entry box allows the user to set the value for the Real output in this step (subject to optional scaling if this output is configured for scaling).
3	Use Input (default=0) - This checkbox uses the corresponding instruction input for the Real output value used in this step (subject to optional scaling if this output is configured for scaling).

Step (FactoryTalk Optix)



Item	Description
1	Use Output (default=0) - This checkbox enables the use of the corresponding Real output in this step.
2	Value Entry Box - This entry box allows the user to set the value for the Real output in this step (subject to optional scaling if this output is configured for scaling).
3	Use Input (default=0) - This checkbox uses the corresponding instruction input for the Real output value used in this step (subject to optional scaling if this output is configured for scaling).

Multi-Step (FactoryTalk View SE)



Multi-Step (FactoryTalk Optix)

SeqE_101 - Sequencer thing that does stuff - Step Configuration

Edit State Name:
Starting

Real Outputs - Bank 0

Step	Real 0 zero	Real Zero 1	Real zero 2	Real bank 0 three	Real bank 0 four	Real bank n
1 Purge	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00
2 Open Pilot	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00
3 Ignite	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00
4 Check If Lit	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00
5 Repeat 3x	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00
6 Ignition Failure	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00
7 Open Main Supply	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00	<input type="checkbox"/> 0.00

< 1 2 3 4 >

Scaling

The Scaling feature in the sequencer applies to Real outputs so configured. This allows the user to adjust Real output configured amounts by the scale setting.

Select which Real outputs are subject to scaling in the sequencer Real output configuration.

The units for the scaling are configured in the Extended Tag Properties Engineering Unit field for the Val_Qty in the sequencer.

Properties

Extended Properties...

General

Name

Seq_101.Val_Qty

Description

mySequencer Accepted value of PSet_ / OSet_Q...

Usage

Type

Base

Alias For

Base Tag

Data Type

INT

Scope

Task_A_MainProgram

External Access

Read Only

Style

Decimal

Constant

No

Required

Visible

Alarms

Data

Value

100

Engineering Unit

Gal

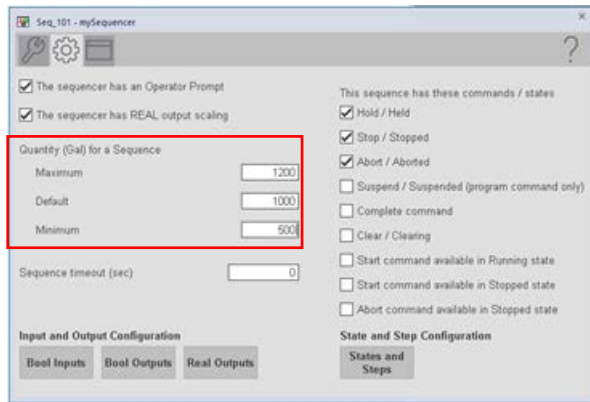
Label

Unit 2 Operation

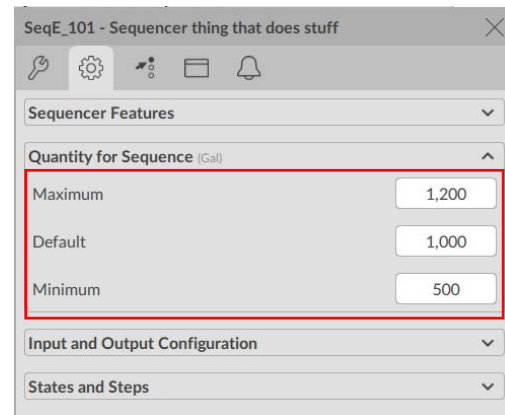
Force Mask

Configure the Quantity Maximum, Default, and Minimum values in the sequencer.

FactoryTalk View SE



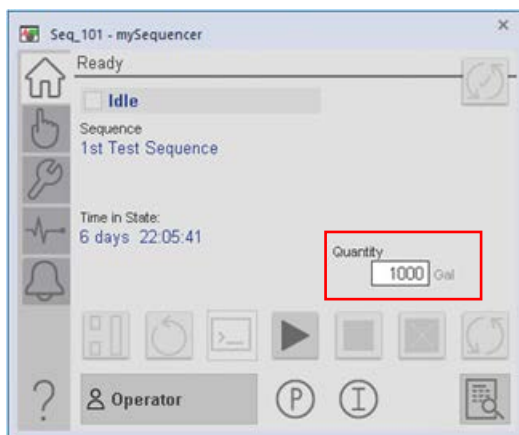
FactoryTalk Optix



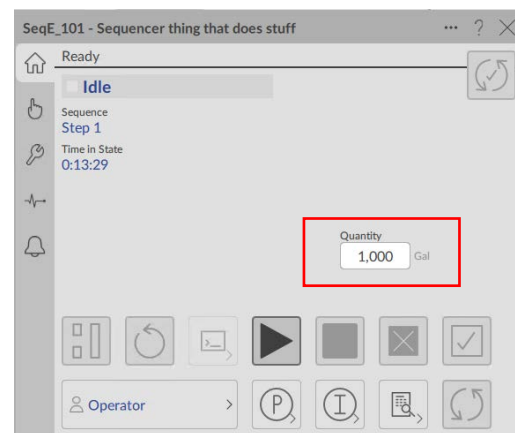
In this example, the quantity is configured such that the unscaled sequence makes '1000 Gal'. You can scale the run to make as little as '500 Gal' or as much as '1200 Gal'.

Set the Quantity amount in the Home tab of the sequencer faceplate before starting.

FactoryTalk View SE



FactoryTalk Optix

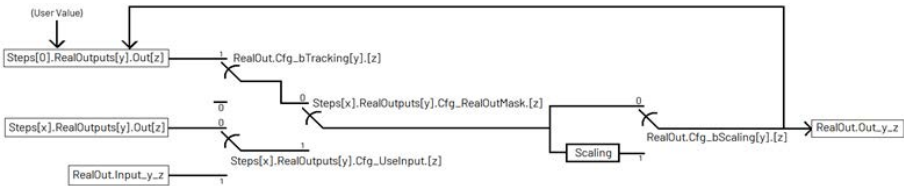


The Quantity amount resets back to the default value when the sequencer returns to Idle or when reset by the user.

Tracking

Tracking is the ability for a Real output to track a parameter from somewhere in the system. The Real output is set to this parameter value if the current step in the sequencer does not use the Real output in the current step. Tracking is useful for initializing Real outputs with the current value of that parameter until it's used by the sequencer. Tracking is on by default.

Example: A Real output is used to set a Setpoint for a drive. The actual drive setpoint is tied to the tracking input of that Real output (Steps[0].RealOutputs[y].Out[z]). Until that Real output is used by the sequencer the Real output will be updated to the current value of the drive setpoint.

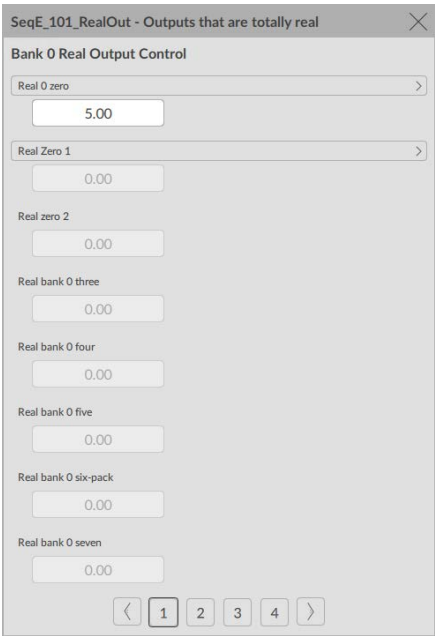
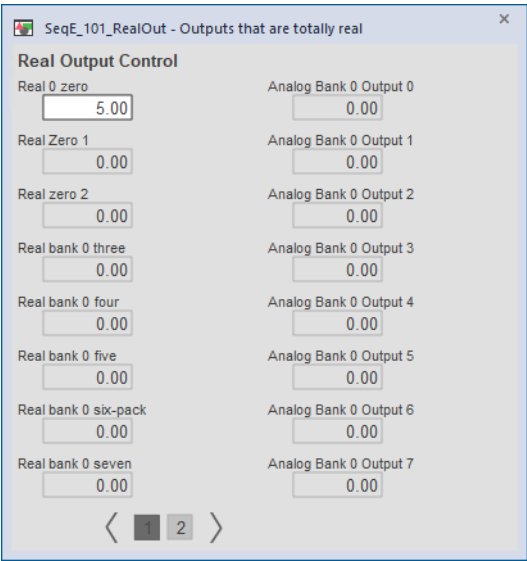


Control

The control display for the sequencer real outputs can be accessed from the sequencer detail display. Real outputs that are not configured to be used in the current step (Use Output = 0) and to not be tracked (Track Output = 0) will be available for users to toggle during sequencer runtime. The current user must have a security code in the HMI Tag Security\OverrideOutputs to change a real output.

FactoryTalk View SE

FactoryTalk Optix



ACM Considerations for a Sequencer Instance

ACM Considerations

Configure the Sequencer parameters to manage a controller-based step sequencing solution.

For more information on the control strategies, see Control Strategies Reference Manual, [PROCES-RM201](#).

ACM-Based Parameters for a Sequencer Instance

Parameter	Visible When	Details
00 - Selection		
Use_OOAP	as_OOAP=True (controller parameter)	Set to use the bus for ownership and arbitration. See Controller Parameters on pg #
01 - Options		
Cfg_HasPermObj	always	Set to create an instance of the PPERM instruction to allow a state command
Cfg_HasIntlkObj	always	Set to create an instance of the PINTLK instruction
UseResetWireConnectors	Cfg_HasIntlkObj=True	Set to connect the Out_Reset of the device to the Inp_Reset of the associated interlock.
Cfg_HasPrompt	always	Set to create an instance of the PROMPT instruction for the HMI
Cfg_HasBranching	always	Set to enable branching in the sequence
04 - Alarm Configuration		
Cfg_HasInSeqTimeOutAlm	always	If Cfg_HasInSeqTimeOutAlm=True, ACM displays section 4.01 - In Sequence Time Out Alarm with additional parameters
Cfg_HasInStateTimeOutAlm	always	If Cfg_HasInStateTimeOutAlm=True, ACM displays section 4.02 - In State Time Out Alarm with additional parameters
Cfg_HasInStepTimeOutAlm	always	If Cfg_HasInStepTimeOutAlm=True, ACM displays section 4.03 - In Step Time Out Alarm with additional parameters
Cfg_HasIntlkTripAlm	always	If Cfg_HasIntlkTripAlm=True, ACM displays section 4.04 - Interlock Trip Alarm with additional parameters

Additional Sub-Objects for a Sequencer Instance

Each sub-object has a tab on the configuration dialog for the control strategy object.

Sub-Object	Description
Interlocks	Configure interlocks for the control strategy see the Interlocks section of PlantPAx Control Strategies, PROCES-RM201 .
Permissives	Configure permissives to allow output commands see the Permissives section of PlantPAx Control Strategies, PROCES-RM201 .
Events	Configure an event to monitor for the control strategy see the Event Logging section of PlantPAx Control Strategies, PROCES-RM201 .
Step	Configure the desired states of each step of the sequencer. This sub object does not affect the structure of the resulting code. All parameters in this sub-object can be configured with an OPC read/write spreadsheet after code generation.
Inputs	Configure inputs to a raP_Opr_SeqBoolInp instruction for use with a Sequencer. The Sequencer can have up to 128 inputs. See Input Sub-Object Parameters below.
Outputs	Configure outputs to a raP_Opr_SeqBoolOut instruction for use with a Sequencer. The Sequencer can have up to 128 outputs. See Outputs Sub-Object Parameters below.
Outputs_Real	The Outputs sub object allows the user to configure outputs to a raP_Opr_SeqBoolREAL instruction for use with a Sequencer. The Sequencer can have up to 32 REAL outputs. See Output_Real SubObject Parameters below.
Tracking	Tracking is the ability for a Boolean output to track a parameter from somewhere in the system. The Boolean output is set to this parameter value if the current step in the sequencer does not use the Boolean output in the current step. Tracking is useful for initializing Boolean outputs with the current value of that parameter until it is used by the sequencer. Tracking is enabled by default. See Tracking Sub Object Parameters below.

Inputs Sub-Object Parameters

Parameter	Available When	Details
Index	always	Determines the input number.
ReferencedTag	UseCustomReferencedTag=False	Link to the input tag. The resulting code includes an XIC of the linked tag.
UseCustomReferencedTag	always	Set to enable custom neutral text entry for the input
Custom_Referenced_Tag	UseCustomReferencedTag=True	Enter the custom neutral text logic for the linked input tag. For example, to have LS101.Out as the input, enter 'XIC(LS101.Out)' into the parameter

Outputs Sub-Object Parameters

Parameter	Available When	Details
Index	always	Determines the PBL output number.
ReferencedTag	UseCustomReferencedTag=False	Link to the output tag. The resulting code includes an OUT/OTL pair of instructions of the linked tag.
UseCustomReferencedTag	always	Set to enable custom neutral text entry for the output
Custom_Referenced_Tag	UseCustomReferencedTag=True	Enter the custom neutral text logic for the linked output tag.

Outputs Real Sub-Object Parameters

Parameter	Visible When	Details
Index	always	Determines the PBL real output number.
ReferencedTag	UseCustomReferencedTag=False	Link to the real output tag. The resulting code includes a MOVE instruction of the linked tag.
UseCustomReferencedTag	always	Set to enable custom neutral text entry for the real output
Custom_Referenced_Tag	UseCustomReferencedTag=True	Enter the custom neutral text logic for the linked real output tag.

Tracking Sub-Object Parameters

Parameter	Visible When	Details
Index	always	Match this index number to the Boolean output index where tracking is desired
BOOL_or_REAL	always	Check if the ReferencedTag is a REAL; uncheck if the ReferencedTag is BOOL
ReferencedTag	always	Link to the tag that the output tracks to when the current step is not setting it. The resulting code includes an OTU/OTL pair of instructions of the linked tag.
UseCustomReferencedTag	always	Set to enable custom neutral text entry for the referenced tag
Custom_Referenced_Tag	always	Enter the custom neutral text for the referenced tag.

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)







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

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

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