



Allen-Bradley

Logix5000 Controllers

1756 ControlLogix, 1769 CompactLogix, 1789 SoftLogix,
1794 FlexLogix, PowerFlex 700S with DriveLogix

System Reference

Rockwell
Automation

Important User Information

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Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

Logix Controllers

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Logix Family of Controllers

Rockwell Automation Logix Platforms provide a single integrated control architecture for discrete, drives, motion, and process control.

The integrated Logix architecture provides a common control engine, programming software environment, and communication support across multiple hardware platforms. All Logix controllers operate with a multitasking, multiprocessing operating system and support the same set of instructions in multiple programming languages. One RSLogix 5000 programming software package programs all Logix controllers. And all Logix controllers incorporate the NetLinx architecture to communicate via EtherNet/IP, ControlNet, and DeviceNet networks.

PowerFlex 700S with DriveLogix
An integrated drives and control solution



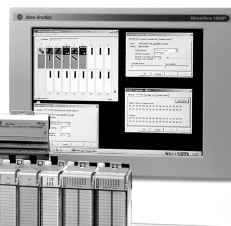
ControlLogix
High-performance, multi-processing
control platform



FlexLogix
Small to mid-sized
control applications
using FLEX I/O

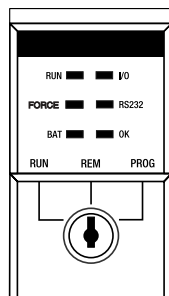


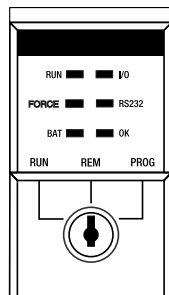
CompactLogix
Compact I/O and control for
smaller applications



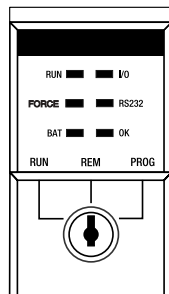
SoftLogix5800
High-performance, PC-based control

ControlLogix Controllers (1756-Lx, -LxMx)



Front Panel:	Indicator:	Color:	Description:
	RUN	off	The controller is in Program or Test mode.
		solid green	The controller is in Run mode.
	I/O	off	Either: <ul style="list-style-type: none"> There are <i>no</i> devices in the I/O configuration of the controller. The controller does <i>not</i> contain a project (controller memory is empty).
		solid green	The controller is communicating with all the devices in its I/O configuration.
		flashing green	One or more devices in the I/O configuration of the controller are <i>not</i> responding.
		flashing red	The chassis is bad. Replace the chassis.
	FORCE	off	No tags contain I/O force values. I/O forces are inactive (disabled).
		solid amber	I/O forces are active (enabled). I/O force values may or may not exist.
		flashing amber	One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled.
	RS232	off	There is no activity.
		solid green	Data is being received or transmitted

Front Panel:



Indicator:

Color:

Description:

BAT

off

The battery supports memory.

solid red

Either the battery is:

- not installed.
- 95% discharged and should be replaced.

OK

off

No power is applied.

flashing red

If the controller is:
a new controller
not a new controller

Then:

the controller requires a firmware update
A major fault occurred. To clear the fault, either:
- Turn the keyswitch from PROG to RUN to PROG
- Go online with RSLogix 5000 software

solid red

The controller detected a non-recoverable fault, so it cleared the project from memory. To recover:

1. Cycle power to the chassis.
2. Download the project.
3. Change to Run mode.

If the OK LED remains solid red, contact your Rockwell Automation representative or local distributor.

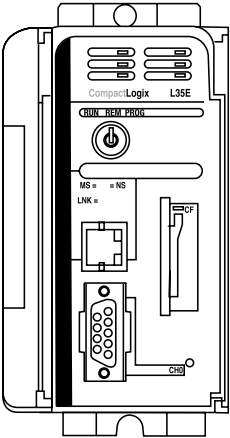
solid green

The controller is OK.

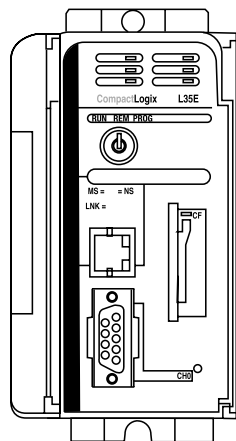
flashing green

The controller is storing or loading a project to or from nonvolatile memory.

CompactLogix Controllers (1769-L35E)

Front Panel:	Indicator:	Color:	Description:
	RUN	off	The controller is in Program or Test mode.
		solid green	The controller is in Run mode.
	FORCE	off	No tags contain I/O force values. I/O forces are inactive (disabled).
		solid amber	I/O forces are active (enabled). I/O force values may or may not exist.
		flashing amber	One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled.
	BAT	off	The battery supports memory.
		solid red	Either the battery is: <ul style="list-style-type: none"> • not installed. • 95% discharged and should be replaced.
	I/O	off	Either: <ul style="list-style-type: none"> • There are <i>no</i> devices in the I/O configuration of the controller. • The controller does <i>not</i> contain a project (controller memory is empty).
		solid green	The controller is communicating with all the devices in its I/O configuration.
		flashing green	One or more devices in the I/O configuration of the controller are <i>not</i> responding.
		flashing red	The controller is not communicating to any devices. The controller is faulted.

Front Panel:



Indicator:

Color:

Description:

OK

off

No power is applied.

flashing red

If the controller is:
a new controller
not a new controller

Then:

the controller requires a firmware update
A major fault occurred. To clear the fault, either:
- Turn the keyswitch from PROG to RUN to PROG
- Go online with RSLogix 5000 software

solid red

The controller detected a non-recoverable fault, so it cleared the project from memory. To recover:

1. Cycle power to the chassis.
2. Download the project.
3. Change to Run mode.

If the OK LED remains solid red, contact your Rockwell Automation representative or local distributor.

solid green

The controller is OK.

flashing green

The controller is storing or loading a project to or from nonvolatile memory.

DCH0
(RS-232)

off

User-configured communications are active.

solid green

Default communications are active.

CompactFlash
CF

off

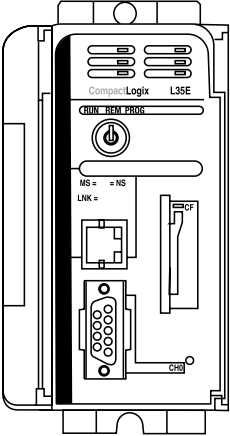
No activity.

flashing green

The controller is reading from or writing to the CompactFlash card.

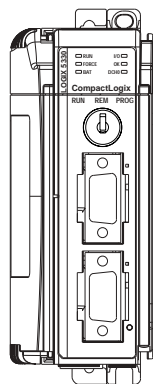
flashing red

CompactFlash card does not have a valid file system.

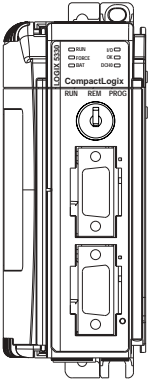
Front Panel:	Indicator:	Color:	Description:
	EtherNet/IP MS	off	There is no activity.
		flashing green	The EtherNet/IP port does not have an IP address and is operating in BOOTP mode.
		solid green	EtherNet/IP communications are active.
		solid red	One of the following occurred: <ul style="list-style-type: none">• The controller is holding the EtherNet/IP port in reset or the controller is faulted.• The EtherNet/IP port is performing its power-up self-test.• An unrecoverable fault has occurred. Cycle power to the controller.
		flashing red	Firmware is being updated.
	EtherNet/IP NS	off	There is no activity. The EtherNet/IP port does not have an IP address and is operating in BOOTP mode.
		flashing green	The EtherNet/IP port has an IP address but there are no CIP connections established.
		solid green	The EtherNet/IP port has an IP address and CIP connections are established.
		solid red	The assigned IP address is already in use.
		flashing red/green	The EtherNet/IP port is performing its power-up self-test.
	EtherNet/IP LNK	off	The EtherNet/IP port is not properly connected to the EtherNet/IP network. Make sure that all Ethernet cables are connected and that the Ethernet switch has power.
		flashing green	One of the following occurred: <ul style="list-style-type: none">• The EtherNet/IP port is performing its power-up self-test.• The EtherNet/IP port is communicating on the network.
		solid green	The EtherNet/IP port is properly connected to the EtherNet/IP network.

CompactLogix Controllers (1769-L30, -L20)

Front Panel:

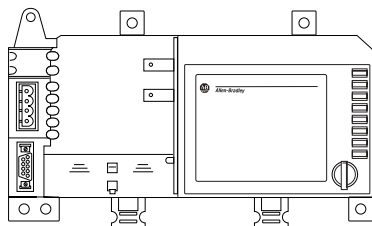


Indicator:	Color:	Description:
RUN	off	The controller is in Program or Test mode.
	solid green	The controller is in Run mode.
FORCE	off	No tags contain I/O force values. I/O forces are inactive (disabled).
	solid amber	I/O forces are active (enabled). I/O force values may or may not exist.
	flashing amber	One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled.
BAT	off	The battery supports memory.
	solid red	Either the battery is: <ul style="list-style-type: none"> not installed. 95% discharged and should be replaced.
I/O	off	Either: <ul style="list-style-type: none"> There are <i>no</i> devices in the I/O configuration of the controller. The controller does <i>not</i> contain a project (controller memory is empty).
	solid green	The controller is communicating with all the devices in its I/O configuration.
	flashing green	One or more devices in the I/O configuration of the controller are <i>not</i> responding.
	flashing red	The controller is not communicating to any devices. The controller is faulted.

Front Panel:	Indicator:	Color:	Description:
	OK	off	No power is applied.
		flashing red	If the controller is: a new controller not a new controller Then: the controller requires a firmware update A major fault occurred. To clear the fault, either: - Turn the keyswitch from PROG to RUN to PROG - Go online with RSLogix 5000 software
		solid red	The controller detected a non-recoverable fault, so it cleared the project from memory. To recover: 1. Cycle power to the chassis. 2. Download the project. 3. Change to Run mode. If the OK LED remains solid red, contact your Rockwell Automation representative or local distributor.
		solid green	The controller is OK.
		flashing green	The controller is storing or loading a project to or from nonvolatile memory.
	DCH0	off	User-configured communications are active.
		solid green	Default communications are active.
	Channel 0 and Channel 1	off	There is no activity.
		flashing green	Data is being received or transmitted.

FlexLogix Controllers (1794-L33, -L34)

Front Panel:



Indicator:

Color:

Description:

RUN

off

The controller is in Program or Test mode.

solid green

The controller is in Run mode.

OK

off

No power is applied.

flashing red

If the controller is:
a new controller
not a new controller

Then:

the controller requires a firmware update
A major fault occurred. To clear the fault, either:
- Turn the keyswitch from PROG to RUN to PROG
- Go online with RSLogix 5000 software

solid red

The controller detected a non-recoverable fault, so it cleared the project from memory.
To recover:

1. Cycle power to the chassis.
2. Download the project.
3. Change to Run mode.

If the OK LED remains solid red, contact your Rockwell Automation representative or local distributor.

solid green

The controller is OK.

flashing green

The controller is storing or loading a project to or from nonvolatile memory.

BATTERY

off

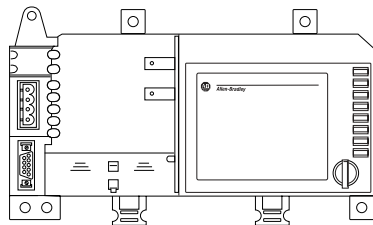
The battery supports memory.

red

Either the battery is:

- not installed.
- 95% discharged and should be replaced.

Front Panel:



Indicator:

Color:

Description:

I/O

off

Either:

- The controller project is not downloaded (the condition after power up).
- No I/O or communications are configured.

solid green

The controller is communicating to **all** devices.

flashing green

One or more devices are not responding.

LOCAL
and
LOCAL2

off

The rail is inhibited.

solid green

The controller is communicating to **all** devices on that rail.

flashing green

One or more devices on that rail not responding.

flashing red

No modules exist on that rail.

RS232

off

There is no activity.

solid green

Data is being received or transmitted.

FORCE

off

No tags contain I/O force values.
I/O forces are inactive (disabled).


solid amber


I/O forces are active (enabled).
I/O force values may or may not exist.

flashing amber

One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled.

SoftLogix5800 Controllers (1789-L10, -L30, -L60)

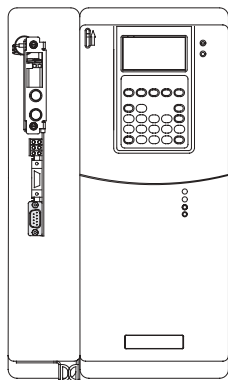
Front Panel:	Indicator:	Color:	Description:
 <p>The image shows the front panel of a SoftLogix5800 controller. It features a digital display at the top showing 'SoftLogix'. Below the display are four status LEDs labeled 'RUN', 'FRC', 'BAT', and 'OK'. Below these are three more LEDs labeled 'RUN', 'REM', and 'PR'. At the bottom is a large rotary switch with a black handle.</p>	RUN	off	The controller is in Program or Test mode.
		solid green	The controller is in Run mode.
	I/O	off	Either: <ul style="list-style-type: none"> There are <i>no</i> devices in the I/O configuration of the controller. The controller does <i>not</i> contain a project (controller memory is empty).
		solid green	The controller is communicating with all the devices in its I/O configuration.
		flashing green	One or more devices in the I/O configuration of the controller are <i>not</i> responding.
		flashing red	A virtual chassis error was detected. Contact your Rockwell Automation representative or local distributor.
	FRC	off	No tags contain I/O force values. I/O forces are inactive (disabled).
		flashing green	At least one tag contains an I/O force value. I/O force values are inactive (disabled).
		solid green	I/O forces are active (enabled). I/O force values may or may not exist.
	RS232 ⁽¹⁾	off	No COM port was selected.
		solid green	The selected COM port was successfully assigned to channel 0 of the controller.
		solid red	There is a COM port conflict or you selected an invalid COM port number.

Front Panel:	Indicator:	Color:	Description:
	BAT ⁽¹⁾	off	Normal operation.
		flashing amber	The controller is in power-up mode.
		solid red	Persistent storage for the controller has failed.
	OK	flashing red	If the controller is: a new controller not a new controller Then: the controller requires a firmware update A major fault occurred. To clear the fault, either: - Turn the keyswitch from PROG to RUN to PROG - Go online with RSLogix 5000 software
		solid red	The controller detected a non-recoverable fault, so it cleared the project from memory. To recover: 1. Cycle power to the chassis. 2. Download the project. 3. Change to Run mode. If the OK LED remains solid red, contact your Rockwell Automation representative or local distributor.
		solid green	The controller is OK.

⁽¹⁾ Note that these LEDs function slightly different than the same LEDs on a ControlLogix controller.

PowerFlex 700S with DriveLogix

Front Panel:



Indicator:

Color:

Description:

RUN

off

The controller is in Program or Test mode.

solid green

The controller is in Run mode.

FORCE

off

No tags contain I/O force values.
I/O forces are inactive (disabled).

flashing amber

At least one tag contains an I/O force value.
I/O force values are inactive (disabled).

solid amber

I/O forces are active (enabled).
I/O force values may or may not exist.

BAT

off

The battery supports memory.

solid red

Either the battery is:

- not installed.
- 95% discharged and should be replaced.

I/O

off

Either:

- There are *no* devices in the I/O configuration of the controller.
- The controller does *not* contain a project (controller memory is empty).

solid green

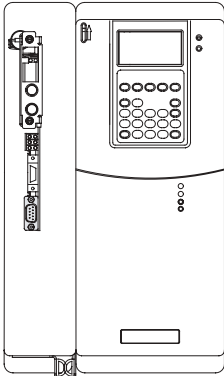
The controller is communicating with all the devices in its I/O configuration.

flashing green

One or more devices in the I/O configuration of the controller are *not* responding.

flashing red

No required I/O connections can be made, controller is in Run mode.

Front Panel:	Indicator:	Color:	Description:
	RS232	off	No COM port was selected.
		solid green	The selected COM port was successfully assigned to channel 0 of the controller.
		solid red	There is a COM port conflict or you selected an invalid COM port number.
	OK	flashing red	If the controller is: a new controller not a new controller Then: the controller requires a firmware update A major fault occurred. To clear the fault, either: - Turn the keyswitch from PROG to RUN to PROG - Go online with RSLogix 5000 software
		solid red	The controller detected a non-recoverable fault, so it cleared the project from memory. To recover: 1. Cycle power to the chassis. 2. Download the project. 3. Change to Run mode. If the OK LED remains solid red, contact your Rockwell Automation representative or local distributor.
		solid green	The controller is OK.
		flashing green	The controller is storing or loading a project to or from nonvolatile memory.

Controller Comparison

Common Characteristics	1756 ControlLogix		1769 CompactLogix		1789 SoftLogix		1794 FlexLogix		PowerFlex 700S with DriveLogix
controller tasks <ul style="list-style-type: none"> continuous periodic event 	<ul style="list-style-type: none"> 32 tasks (only 1 continuous) event tasks: supports all event triggers 		<ul style="list-style-type: none"> 1769-L35E: 8 tasks (only 1 continuous) 1769-L20, -L30: 4 tasks (only 1 continuous) event tasks: supports EVENT instruction 		<ul style="list-style-type: none"> 32 tasks (only 1 continuous) event tasks: supports all event triggers 		<ul style="list-style-type: none"> 8 tasks (only 1 continuous) event tasks: supports EVENT instruction 		<ul style="list-style-type: none"> 8 tasks (only 1 continuous) event tasks: supports axis and motion event triggers
user memory	1756-L55M12	750 Kbytes	1769-L20	64 Kbytes	1789-L10	2 Mbytes	1794-L33	64 Kbytes	256 Kbytes
	1756-L55M13	1.5 Mbytes	1769-L30	256 Kbytes		3 slots	1794-L34	512 Kbytes	768 Kbytes with memory expansion
	1756-L55M14	3.5 Mbytes	1769-L35E	1.5 Mbytes		no motion			
	1756-L55M16	7.5 Mbytes			1789-L30	64 Mbytes			
	1756-L55M22	750 Kbytes				5 slots			
	1756-L55M23	1.5 Mbytes			1789-L60	64 Mbytes			
	1756-L55M24	3.5 Mbytes				16 slots			
	1756-L61	2 Mbytes							
	1756-L62	4 Mbytes							
	1756-L63	8 Mbytes							
nonvolatile user memory	1756-L55M12	none	1769-L20	64 Kbytes	none		1794-L33	64 Kbytes	768 Kbytes with memory expansion
	1756-L55M13	none	1769-L30	256 Kbytes			1794-L34/B	512 Kbytes	
	1756-L55M14	none	1769-L35E	CompactFlash					
	1756-L55M16	none							
	1756-L55M22	750 Kbytes							
	1756-L55M23	1.5 Mbytes							
	1756-L55M24	3.5 Mbytes							
	1756-L61	CompactFlash							
	1756-L62	CompactFlash							
	1756-L63	CompactFlash							

Common Characteristics	1756 ControlLogix	1769 CompactLogix	1789 SoftLogix	1794 FlexLogix	PowerFlex 700S with DriveLogix
built-in communication ports	<ul style="list-style-type: none"> 1 port RS-232 serial (DF1 or ASCII) 	<ul style="list-style-type: none"> 1769-L20: 1 RS-232 serial port (DF1 or ASCII) 1769-L30: 2 RS-232 ports (one DF1 only, other DF1 or ASCII) 1769-L35E: 1 EtherNet/IP port and 1 RS-232 serial port (DF1 or ASCII) 	depends on personal computer	<ul style="list-style-type: none"> 1 port RS-232 serial (DF1 or ASCII) 2 slots for 1788 communication cards 	<ul style="list-style-type: none"> 1 port RS-232 serial (DF1 or ASCII) 1 slot for 1788 communication cards
communication options (these options have specific products and profiles for their platform - other options are available via 3rd party products and generic profiles)	EtherNet/IP ControlNet DeviceNet Data Highway Plus Universal Remote I/O serial DH-485 SynchLink	EtherNet/IP DeviceNet serial DH-485	EtherNet/IP ControlNet DeviceNet serial	EtherNet/IP ControlNet DeviceNet serial DH-485	EtherNet/IP ControlNet DeviceNet serial DH-485
redundancy	controller via ControlNet ControlNet media power supplies	none	ControlNet media	controller via DeviceNet ControlNet media	ControlNet media
motion support	SERCOS interface analog interface hydraulic interface	not applicable	SERCOS interface analog interface	not applicable	1 full servo 1 feedback axis
programming languages	<ul style="list-style-type: none"> relay ladder structured text function block sequential function chart 	<ul style="list-style-type: none"> relay ladder structured text function block sequential function chart 	<ul style="list-style-type: none"> relay ladder structured text function block sequential function chart external routines (Windows DLLs developed using C/C++) 	<ul style="list-style-type: none"> relay ladder structured text function block sequential function chart 	<ul style="list-style-type: none"> relay ladder structured text function block sequential function chart

Select the Operating Mode of the Controller

Use this table to determine the operating mode of the controller:

If you want to:	Select one of these modes:				
	Run	Remote			Program
		Run	Test	Program	
turn outputs to the state commanded by the logic of the project	X	X			
turn outputs to their configured state for Program mode			X	X	X
execute (scan) tasks	X	X	X		
change the mode of the controller through software		X	X	X	
download a project		X	X	X	X
schedule a ControlNet network				X	X
while online, edit the project		X	X	X	X
send messages	X	X	X		
send and receive data in response to a message from another controller	X	X	X	X	X
produce and consume tags	X	X	X	X	X

Turn the key on the front panel of the controller to select the mode.

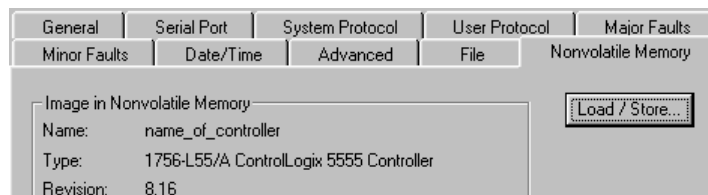
Non-Volatile Memory

These controllers have nonvolatile memory for project storage.

Controller Type:	Catalog Number:	Firmware Revision:
CompactLogix5335E	1769-L35E ⁽¹⁾	12.x or later
CompactLogix5330	1769-L30	10.x or later
CompactLogix5320	1769-L20	10.x or later
ControlLogix5555	1756-L55M22	10.x or later
	1756-L55M23	8.x or later
	1756-L55M24	8.x or later
ControlLogix5561 and ControlLogix5562	1756-L61, -L62 ⁽¹⁾	12.x or later
ControlLogix5563	1756-L63 ⁽¹⁾	11.x or later
DriveLogix5720	various	10.x or later
FlexLogix5433	1794-L33	10.x or later
FlexLogix5434 Series B	1794-L34/B	11.x or later

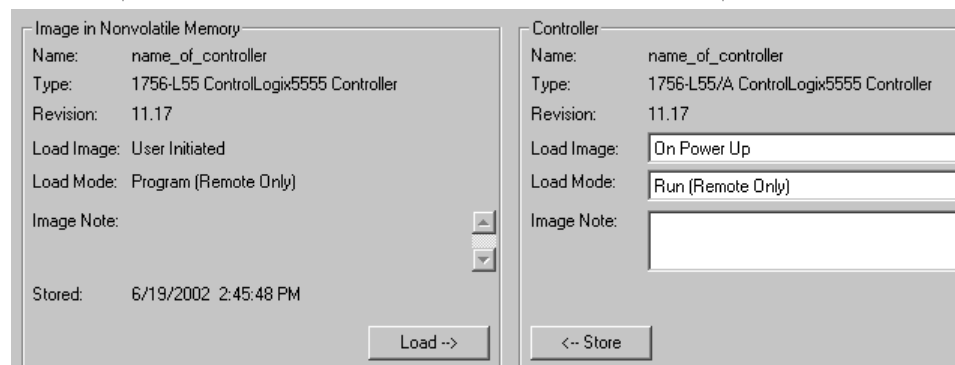
⁽¹⁾ Requires a 1784-CF64 Industrial CompactFlash memory card.

On the controller properties, you select to store/load a project to/from non-volatile memory:



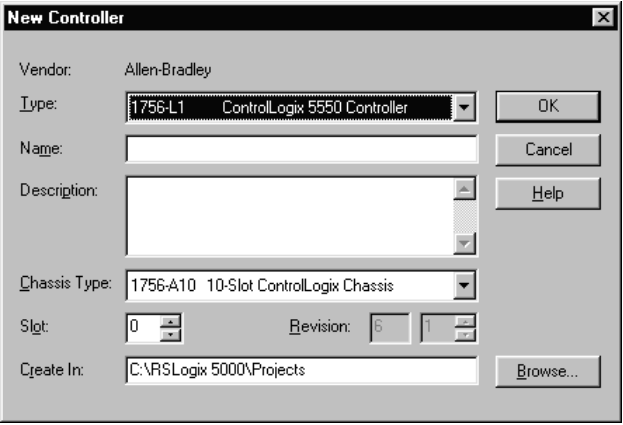
↓ Project that is currently in the nonvolatile memory of the controller
(if any project is there).

↓ Project that is currently in the user memory (RAM) of the controller.



Create a Project

From RSLogix 5000 software, select File → New.

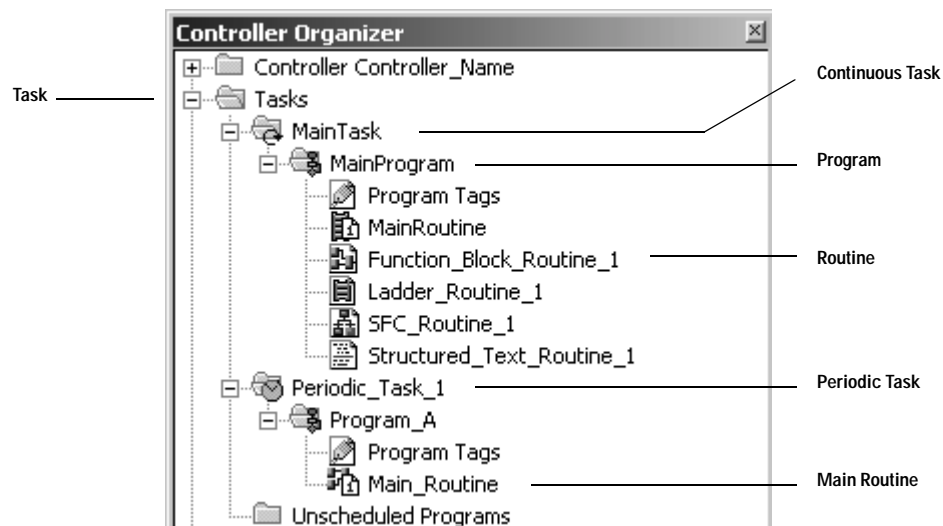


The image shows a 'New Controller' dialog box from the RSLogix 5000 software. The dialog has a title bar with 'New Controller' and a close button. It contains several input fields and buttons. The 'Vendor' field is set to 'Allen-Bradley'. The 'Type' field is a dropdown menu showing '1756-L1 ControlLogix 5550 Controller'. The 'Name' field is an empty text box. The 'Description' field is a larger empty text box. The 'Chassis Type' field is a dropdown menu showing '1756-A10 10-Slot ControlLogix Chassis'. The 'Slot' field is a spinner box set to '0'. The 'Revision' field is a spinner box set to '6'. The 'Create In' field is a text box showing 'C:\RSLogix 5000\Projects'. There are buttons for 'OK', 'Cancel', 'Help', and 'Browse...'.

Vendor:	Allen-Bradley	
Type:	1756-L1 ControlLogix 5550 Controller	OK
Name:		Cancel
Description:		Help
Chassis Type:	1756-A10 10-Slot ControlLogix Chassis	
Slot:	0	Revision: 6 1
Create In:	C:\RSLogix 5000\Projects	Browse...

Controller Organizer

The programming software uses the Controller Organizer to define a project.



Controller Tasks

A task provides scheduling and priority information for a set of one or more programs that execute based on specific criteria. Once a task is triggered (activated), all the programs assigned (scheduled) to the task execute in the order in which they are displayed in the controller organizer.

Task:	Definition:
continuous task	<p>The continuous task runs in the background. Any CPU time not allocated to other operations (such as motion, communications, and periodic or event tasks) is used to execute the programs within the continuous task.</p> <ul style="list-style-type: none"> • The continuous task runs all the time. When the continuous task completes a full scan, it restarts immediately. • A project does not require a continuous task. If used, there can be only one continuous task.
periodic task	<p>A periodic task performs a function at a specific rate.</p> <ul style="list-style-type: none"> • Whenever the time for the periodic task expires, the periodic task interrupts any lower priority tasks, executes one time, and then returns control to where the previous task left off. • You can configure the time period from 1 ms to 2000 s. The default is 10 ms. The performance of a periodic tasks depends on the type of Logix controller and the logic in the task. <p>You assign a priority level (1 is the highest, 15 is the lowest) to each periodic task:</p> <ul style="list-style-type: none"> • The highest priority task interrupts all lower priority tasks. • A higher priority task can interrupt a lower priority task multiple times. • Tasks at the same priority execute on a time-slice basis at 1 ms intervals.
event task	<p>An event task performs a function only when a specific event (trigger) occurs. Whenever the trigger for the event task occurs, the event task interrupts any lower priority tasks, executes one time, and then returns control to where the previous task left off.</p> <p>Available triggers are Module Input Data State Change, Consumed Tag, Axis Registration 1 or 2, Axis Watch, Motion Group Execution, EVENT Instruction.</p>

The number of tasks supported depends on the controller:

Controller:	Number of Tasks Supported:
ControlLogix	32 tasks, one of which can be continuous There are 15 configurable priority levels for periodic tasks(1-15), with 1 being the highest priority and 15 being the lowest priority.
CompactLogix	8 tasks, one of which can be continuous There are 15 configurable priority levels for periodic tasks(1-15), with 1 being the highest priority and 15 being the lowest priority. The CompactLogix controller uses a dedicated periodic task at priority 7 to process I/O data. This periodic task executes at the fastest RPI you have scheduled for the system. Its total execution time is as long as it takes to scan the configured I/O modules.
FlexLogix and PowerFlex 700S with DriveLogix	8 tasks, one of which can be continuous There are 15 configurable priority levels for periodic tasks(1-15), with 1 being the highest priority and 15 being the lowest priority. The controller uses a dedicated periodic task at priority 7 to process I/O data. This periodic task executes at the fastest RPI you have scheduled for the system. Its total execution time is as long as it takes to scan the configured I/O modules.
SoftLogix5800	32 tasks, one of which can be continuous There are 3 configurable priority levels for periodic tasks (1-3), with 1 being the highest priority and 3 being the lowest priority.

A task can have as many as 32 separate programs, each with its own executable routines and program-scoped tags. Once a task is triggered (activated), all the programs assigned to the task execute in the order in which they are grouped. Programs can only appear once in the Controller Organizer and cannot be shared by multiple tasks.

When a task is triggered, the scheduled programs within the task execute to completion from first to last. Each program contains program tags, a main routine, other routines, and an optional fault routine. When a program executes, its main routine executes first. Use the main routine to call (execute) other routines (subroutines). To call another routine within the program, use a Jump to Subroutine (JSR) instruction.

Event task details

Not all Logix controllers support all event task triggers:

If you have this controller:	Then you can use these event task triggers:					
	Module Input Data State Change	Consumed Tag	Axis Registration 1 or 2	Axis Watch	Motion Group Execution	EVENT instruction
CompactLogix						X
FlexLogix						X
ControlLogix	X	X	X	X	X	X
DriveLogix			X	X	X	X
SoftLogix5800	X ⁽¹⁾	X ⁽²⁾	X	X	X	X

(1) Requires a 1756 I/O module or a virtual backplane.

(2) A SoftLogix5800 controller produces and consumes tags only over a ControlNet network.

To use an input module to trigger an event task, the module must support event task triggering. If the module is in a remote location, the associated communication modules must also support event triggering. Use the following table to make sure that your module or modules can trigger an event task.

Category	Module	Category	Module	Category	Module
1756 Discrete	1756-IA16, -IA16I	1756 Analog	1756-IF16	1756 Communication	1756-CNB/A, -CNB/B, -CNB/D
	1756-IA8D		1756-IF4FXOF2F/A		1756-CNBR/A, -CNBR/B, -CNBR/D
	1756-IB16, -IB16D, -IB16I		1756-IF6CIS		1756-DNB
	1756-IB32/A, -IB32/B		1756-IF6I		1756-ENBT/A
	1756-IC16		1756-IF8		1756-SYNCH/A
	1756-IH16I		1756-IR6I	1756 Generic	1756-MODULE
	1756-IM16I		1756-IT6I	SoftDNB	1784-PCIDS/A
	1756-IN16		1756-IT6I2	1789 Generic	1789-MODULE
	1756-IV16/A	1756 Specialty	1756-CFM/A		
	1756-IV32/A		1756-HSC		
			1756-PLS/B		

Controller Tags

The most common data types are.

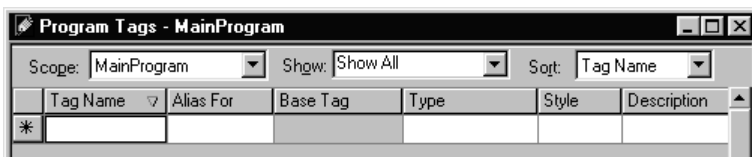
For:	Select:	For:	Select:
analog device in floating-point mode	REAL	digital I/O point	BOOL
analog device in integer mode (for very fast sample rates)	INT	floating-point number	REAL
ASCII characters	string	integer (whole number)	DINT
bit	BOOL	sequencer	CONTROL
counter	COUNTER	timer	TIMER

To organize your data:

For a:	Use a:
group of common attributes that are used by more than one machine	user-defined data type
group of data with the same data type	array
single value	tag of a single element
I/O device	

Create a tag

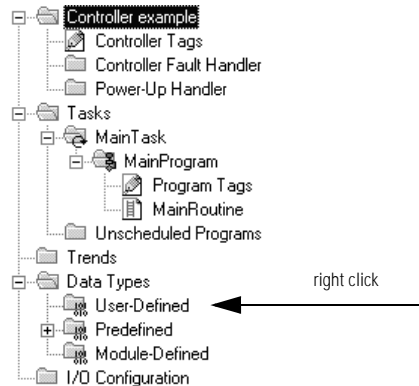
From the *Logic* menu, select *Edit Tags*.



You can configure tags to communicate directly with other controllers:

To:	Use a:
send data over the backplane and ControlNet network at a specified interval	produced tag
receive data from another controller over the backplane or ControlNet network at a specified interval	consumed tag

Create a user-defined data type



A dialog box titled 'Data Type: New UDT2' with a standard Windows window border. It contains the following fields and controls:

- Name:** A text input field.
- Size:** A text input field containing '??'.
- byte(s):** A label indicating the unit of the size.
- Description:** A large text area with a vertical scrollbar.
- Members:** A section containing a table.

	Name	Data Type	Style	Description
*				

Aliases

An alias tag lets you create one tag that represents another tag.

- Both tags share the same value (s).
- When the value (s) of one of the tags changes, the other tag reflects the change as well.

drill_1_depth_limit is an alias for *Local:2:I.Data.3* (a digital input point). When the input turns on, the alias tag also turns on.

drill_1_on is an alias for *Local:0:O.Data.2* (a digital output point). When the alias tag turns on, the output tag also turns on.

Tag Name	Alias For	Base Tag	Type	Style
[-] drill_1			DRILL_STATION	
drill_1_depth_limit	Local:2:I.Data.3(C)	Local:2:I.Data.3(C)	BOOL	Decimal
drill_1_forward	Local:0:O.Data.3(C)	Local:0:O.Data.3(C)	BOOL	Decimal
drill_1_home_limit	Local:2:I.Data.2(C)	Local:2:I.Data.2(C)	BOOL	Decimal
drill_1_on	Local:0:O.Data.2(C)	Local:0:O.Data.2(C)	BOOL	Decimal
drill_1_retract	Local:0:O.Data.4(C)	Local:0:O.Data.4(C)	BOOL	Decimal
[+] hole_position			REAL[6,6]	Float
machine_on			BOOL	Decimal
[+] north_tank	tanks[0,1]	tanks[0,1]	TANK	
north_tank_drain			BOOL	Decimal

The (C) indicates that the tag is at the controller scope.

Choose a Programming Language

In general, if the function or group of functions represent:	Then use this language:
continuous or parallel execution of multiple operations (not sequenced)	ladder logic
boolean or bit-based operations	
complex logical operations	
message and communication processing	
machine interlocking	
operations that service or maintenance personnel may have to interpret in order to troubleshoot the machine or process	function block diagram
continuous process and drive control	
loop control	
calculations in circuit flow	
high-level management of multiple operations	sequential function chart (SFC)
repetitive sequences of operations	
batch process	
motion control using structured text	
state machine operations	
continued	

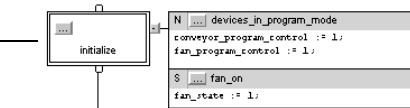
In general, if the function or group of functions represent:	Then use this language:
complex mathematical operations	structured text
specialized array or table loop processing	
ASCII string handling or protocol processing	

Notes:

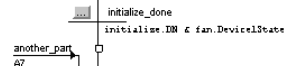
Sequential Function Chart

A sequential function chart (SFC) is similar to a flowchart. It uses steps and transitions to perform specific operations or actions.

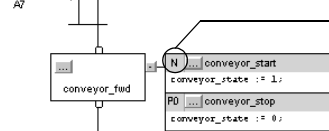
A step represents a major function of your process. It contains the actions that occur at a particular time, phase, or station.



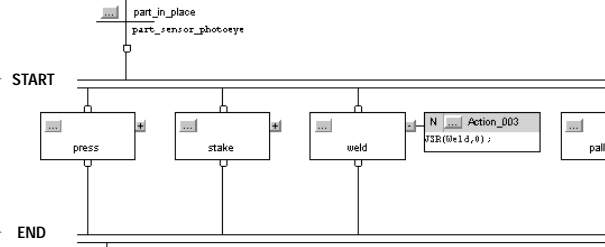
An action is one of the functions that a step performs.



A transition is the true or false condition that tells the SFC when to go to the next step.



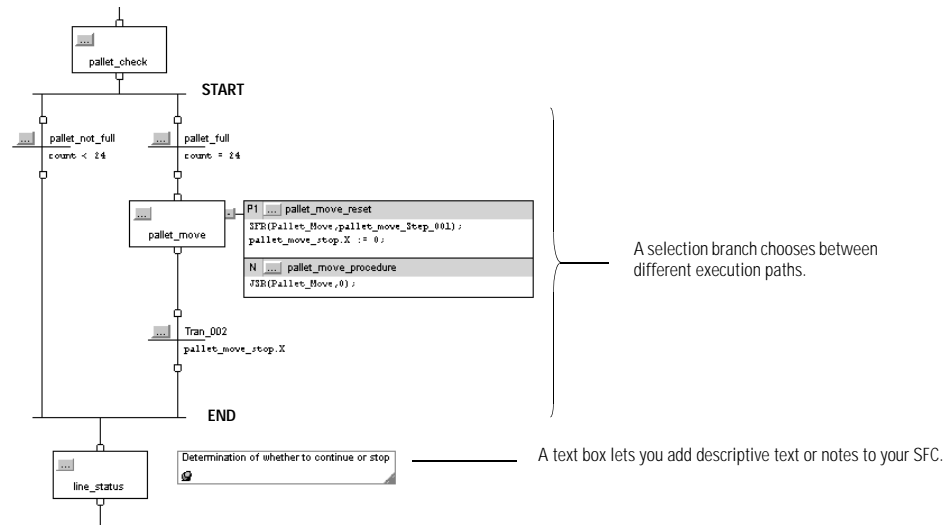
A qualifier determines when an action starts and stops.



A simultaneous branch executes more than 1 step at the same time.

continued

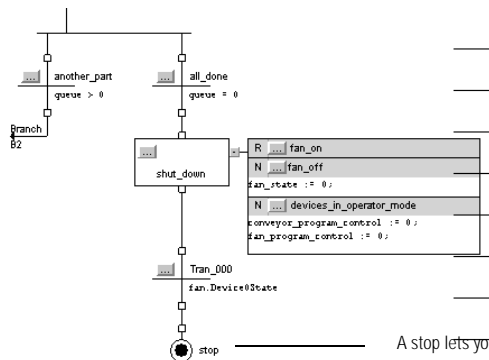
Example SFC continued



continued

Example SFC continued






A wire connects one element to another element anywhere on the chart.










A stop lets you stop and wait for a command to restart.

Editing an SFC



This toolbar button:	Creates this SFC element:	Description:
	step and transition pair	Add a step and transition pair. See the descriptions for step and transition below.
	step	Add a step. A step represents a major function of a process. It contains the events that occur at a particular time, phase, or station.
	transition	Add a transition. A transition is the true or false condition or conditions that determine when to go to the next step.
	action	Add an action or a boolean action to the selected step. Click the step and then press this button. An action represents a functional division of a step. Several actions make up a step. Each action performs a specific function, such as controlling a motor, opening a valve, or placing a group of devices in a specific mode.
	boolean action	Each action includes a qualifier. When a step is active (executing) the qualifier determines when the action starts and stops.

This toolbar button:	Creates this SFC element:	Description:
	selection branch diverge	Starts a selection branch. Use the new path button to add paths to the branch structure.
	simultaneous branch diverge	Starts a simultaneous branch. Use the new path button to add paths to the branch structure.
	converge SFC elements	Ends the current branch. Select the last step of each path in the branch and then press this button. A simultaneous branch ends with a double horizontal line and no transition. A selection branch ends with a transition for each path and a single horizontal line.
	extend branch	Add a path to a branch. Click the first step of the path that is to the left of where you want to add the new path and then press the button.
	stop	End a path in a branch without connecting to other SFC elements.
	subroutine/return	Add a subroutine call.
	text box	Create a text box. Once the text box appears, you can click and drag the text box to the location you want. Double-click the text box to add text.

SFC_STEP Structure

Member:	Data type:	Details:
T	DINT	When a step becomes active, the Timer (T) value resets and then starts to count up in milliseconds. The timer continues to count up until the step goes inactive, regardless of the Preset (PRE) value.
PRE	DINT	Enter the time in the Preset (PRE) member. When the Timer (T) reaches the Preset value, the Done (DN) bit turns on and stays on until the step becomes active again. As an option, enter a numeric expression that calculates the time at runtime.
DN	BOOL	When the Timer (T) reaches the Preset (PRE) value, the Done (DN) bit turns on and stays on until the step becomes active again.
LimitLow	DINT	Enter the time in the LimitLow member (milliseconds). <ul style="list-style-type: none"> • If the step goes inactive before the Timer (T) reaches the LimitLow value, the AlarmLow bit turns on. • The AlarmLow bit stays on until you reset it. • To use this alarm function, turn on (check) the AlarmEnable (AlarmEn) bit.
AlarmEn	BOOL	To use the alarm bits, turn on (check) the AlarmEnable (AlarmEn) bit.
AlarmLow	BOOL	If the step goes inactive before the Timer (T) reaches the LimitLow value, the AlarmLow bit turns on. <ul style="list-style-type: none"> • The bit stays on until you reset it. • To use this alarm function, turn on (check) the AlarmEnable (AlarmEn) bit.
LimitHigh	DINT	Enter the time in the LimitHigh member (milliseconds). <ul style="list-style-type: none"> • If the Timer (T) reaches the LimitHigh value, the AlarmHigh bit turns on. • The AlarmHigh bit stays on until you reset it. • To use this alarm function, turn on (check) the AlarmEnable (AlarmEn) bit.
AlarmEn	BOOL	To use the alarm bits, turn on (check) the AlarmEnable (AlarmEn) bit.

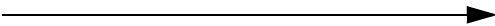
Member:	Data type:	Details:
AlarmHigh	BOOL	If the Timer (T) reaches the LimitHigh value, the AlarmHigh bit turns on. <ul style="list-style-type: none"> The bit stays on until you reset it. To use this alarm function, turn on (check) the AlarmEnable (AlarmEn) bit.
X	BOOL	The X bit is on the entire time the step is active (executing).
FS	BOOL	The FS bit is on during the first scan of the step.
SA	BOOL	The SA bit is on when the step is active except during the first and last scan of the step.
LS	BOOL	The LS bit is on during the last scan of the step. Use this bit only if you do the following: On the <i>Controller Properties</i> dialog box, <i>SFC Execution</i> tab, set the <i>Last Scan of Active Step</i> to <i>Don't Scan</i> or <i>Programmatic reset</i> .
Reset	BOOL	An SFC Reset (SFR) instruction resets the SFC to a step or stop that the instruction specifies. <ul style="list-style-type: none"> The Reset bit indicates to which step or stop the SFC will go to begin executing again. Once the SFC executes, the Reset bit clears.
TMax	DINT	Use this for diagnostic purposes. The controller clears this value only when you choose the <i>Restart Position</i> of <i>Restart at initial step</i> and the controller changes modes or experiences a power cycle.
OV	BOOL	Use this for diagnostic purposes.
Count	DINT	This is <i>not</i> a count of scans of the step. <ul style="list-style-type: none"> The count increments each time the step becomes active. It increments again only after the step goes inactive and then active again. The count resets only if you configure the SFC to restart at the initial step. With that configuration, it resets when the controller changes from program mode to run mode.

Member:	Data type:	Details:	
Status	DINT	For this member:	Use this bit:
		Reset	22
		AlarmHigh	23
		AlarmLow	24
		AlarmEn	25
		OV	26
		DN	27
		LS	28
		SA	29
		FS	30
		X	31

SFC_ACTION Structure

Member:	Data type:	Details:	
Q	BOOL	The status of the Q bit depends on whether the action is a boolean action or non-boolean action:	
		If the action is:	Then the Q bit is:
		boolean	on (1) the entire time the action is active, including the last scan of the action
		non-boolean	on (1) while the action is active but off (0) at the last scan of the action
		To use a bit to determine when an action is active, use the Q bit.	
A	BOOL	The A bit is on the entire time the action is active.	
T	DINT	When an action becomes active, the Timer (T) value resets and then starts to count up in milliseconds. The timer continues to count up until the action goes inactive, regardless of the Preset (PRE) value.	
PRE	DINT	Enter the time limit or delay in the Preset (PRE) member. The action starts or stops when the Timer (T) reaches the Preset value.	
Count	DINT	This is <i>not</i> a count of scans of the action. <ul style="list-style-type: none">• The count increments each time the action becomes active.• It increments again only after the action goes inactive and then active again.• The count resets only if you configure the SFC to restart at the initial step. With that configuration, it resets when the controller changes from program mode to run mode.	
Status	DINT	For this member:	Use this bit:
		Q	30
		A	31

Action Qualifiers

If you want the action to:	And:	Assign this qualifier:	Which means:
start when the step is activated	stop when the step is deactivated	N	Non-Stored (default)
	execute only once	P1	Pulse (Rising Edge)
	stop before the step is deactivated or when the step is deactivated	L	Time Limited
	stay active until a <i>Reset</i> action turns off this action	S	Stored
	stay active until a <i>Reset</i> action turns off this action or a specific time expires, even if the step is deactivated	SL	Stored and Time Limited
start a specific time after the step is activated <i>and</i> the step is still active	stop when the step is deactivated	D	Time Delayed
	stay active until a <i>Reset</i> action turns off this action	DS	Delayed and Stored
start a specific time after the step is activated, even if the step is deactivated before this time	stay active until a <i>Reset</i> action turns off this action	SD	Stored and Time Delayed
execute once when the step is activated	execute once when the step is deactivated	P	Pulse
start when the step is deactivated	execute only once	P0	Pulse (Falling Edge)
turn off (reset) a stored action: <ul style="list-style-type: none">• S Stored• SL Stored and Time Limited• DS Delayed and Stored• SD Stored and Time Delayed		R	Reset

SFC_STOP Structure

Member:	Data type:	Details:	
X	BOOL	<ul style="list-style-type: none">When the SFC reaches the stop, the X bit turns on.The X bit clears if you configure the SFCs to restart at the initial step and the controller changes from program to run mode.In a nested SFC, the X bit also clears if you configure the SFCs for automatic reset and the SFC leaves the step that calls the nested SFC.	
Reset	BOOL	An SFC Reset (SFR) instruction resets the SFC to a step or stop that the instruction specifies. <ul style="list-style-type: none">The Reset bit indicates to which step or stop the SFC will go to begin executing again.Once the SFC executes, the Reset bit clears.	
Count	DINT	This is <i>not</i> a count of scans of the stop. <ul style="list-style-type: none">The count increments each time the stop becomes active.It increments again only after the stop goes inactive and then active again.The count resets only if you configure the SFC to restart at the initial step. With that configuration, it resets when the controller changes from program mode to run mode.	
Status	DINT	For this member:	
		Use this bit:	
		Reset	22
		X	31

How Do You Want to Use the Action?

There are two types of actions:

If you want to:	Then use a:
execute structured text directly in the SFC	non-boolean action
call a subroutine	
use the automatic reset option to reset data upon leaving a step	boolean action
only set a bit and program other logic to monitor the bit to determine when to execute.	

Use a non-boolean action

A non-boolean action contains the logic for the action. It uses structured text to execute assignments and instructions or call a subroutine. With non-boolean actions, you also have the option to postscan (automatically reset) the assignments and instructions before leaving a step:

- During postscan the controller executes the assignments and instructions as if all conditions are false.
- The controller postscans both embedded structured text and any subroutine that the action calls.

Use a boolean action

A boolean action contains no logic for the action. It simply sets a bit in its tag (SFC_ACTION structure). To do the action, other logic must monitor the bit and execute when the bit is on. With boolean actions, you have to manually reset the assignments and instructions that are associated with the action. Since there is no link between the action and the logic that performs the action, the automatic reset option does not effect boolean actions. You can reuse a boolean action multiple times within the same SFC.

Configure the Execution of an SFC

From Controller Properties:

The screenshot shows a dialog box with several tabs. The 'SFC Execution' tab is selected. The tabs are: General, Serial Port, System Protocol, User Protocol, Major Faults, Minor Faults, Date/Time, Advanced, SFC Execution, and File. The 'SFC Execution' tab contains the following settings:

Execution Control:

- ☒ Execute current active steps only
- ☐ Execute until FALSE transition

Restart Position:

- ☐ Restart at most recently executed step
- ☒ Restart at initial step

Last Scan of Active Steps:

- ☐ Automatic reset
- ☒ Programmatic reset
- ☐ Don't scan

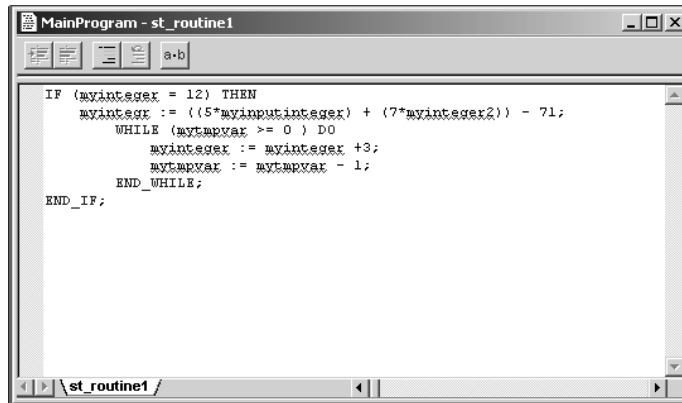
Notes:

Structured Text Syntax

Structured text is a textual programming language that uses statements to define what to execute.

- Structured text is not case sensitive.
- Use tabs and carriage returns (separate lines) to make your structured text easier to read. They have no effect on the execution of the structured text.

This is an example of a structured text routine.



```
IF (myInteger = 12) THEN
  myInteger := ((5*myInputInteger) + (7*myInteger2)) - 71;
  WHILE (myTempVar >= 0) DO
    myInteger := myInteger + 3;
    myTempVar := myTempVar - 1;
  END_WHILE;
END_IF;
```

3 - 2 Structured Text

Structured text can contain these components:

Term:	Definition:	Examples:
assignment (see page 3-4)	Use an assignment statement to assign values to tags. The := operator is the assignment operator. Terminate the assignment with a semi colon ";".	<i>tag := expression;</i>
expression (see page 3-6)	An expression is part of a complete assignment or construct statement. An expression evaluates to a number (numerical expression) or to a true or false state (BOOL expression). An expression contains: tags A named area of the memory where data is stored (BOOL, SINT,INT,DINT, REAL, string). immediates A constant value. operators A symbol or mnemonic that specifies an operation within an expression. functions When executed, a function yields one value. Use parentheses to contain the operand of a function. Even though their syntax is similar, functions differ from instructions in that functions can only be used in expressions. Instructions cannot be used in expressions.	<i>value1</i> <i>4</i> <i>tag1 + tag2</i> <i>tag1 >= value1</i> <i>function(tag1)</i>
instruction (see page 3-13)	An instruction is a standalone statement. An instruction uses parenthesis to contain its operands. Depending on the instruction, there can be zero, one, or multiple operands. When executed, an instruction yields one or more values that are part of a data structure. Terminate the instruction with a semi colon ";". Instructions cannot be used in expressions. Functions can only be used in expressions.	<i>instruction();</i> <i>instruction(operand);</i> <i>instruction(operand1, operand2,operand3);</i>

Term:	Definition:	Examples:
construct (see page 3-15)	A conditional statement used to trigger structured text code (i.e., other statements). Terminate the construct with a semi colon ";".	IF...THEN CASE FOR...DO WHILE...DO REPEAT...UNTIL EXIT
comment (see page 3-25)	Text that explains or clarifies what a section of structured text does. Use comments to make it easier to interpret the structured text. Comments do not affect the execution of the structured text. Comments can appear anywhere in structured text.	//comment (*start of comment . . . end of comment*) /*start of comment . . . end of comment*/

Entering spaces in structured text syntax is optional. Spaces have no effect on the execution of the structured text. For example, both of these statements execute the same:

Tag_B:=Tag_A

Tag_B := Tag_A

Assignments

Use an assignment to change the value stored within a tag. An assignment has this syntax:

```
tag := expression;
```

where:

Component:	Description:	
tag	represents the tag that is getting the new value the tag must be a BOOL, SINT, INT, DINT, or REAL	
:=	is the assignment symbol	
expression	represents the new value to assign to the tag	
	<div><div>If tag is this data type:</div><div>Use this type of expression:</div></div>	
	<div><div>BOOL</div><div>BOOL expression</div></div>	
	<div><div>SINT DINT INT REAL</div><div>numeric expression</div></div>	
;	ends the assignment	

The *tag* retains the assigned value until another assignment changes the value.

Specify a non-retentive assignment

A non-retentive assignment is reset to zero each time the controller:

- enters the RUN mode
- leaves the step of an SFC if you configure the SFC for *Automatic reset*.

A non-retentive assignment has this syntax:

tag [:=] *expression* ;

where:

Component:	Description:	
<i>tag</i>	represents the tag that is getting the new value the tag must be a BOOL, SINT, INT, DINT, or REAL	
[:=]	is the non-retentive assignment symbol	
<i>expression</i>	represents the new value to assign to the tag	
	If <i>tag</i> is this data type:	Use this type of expression:
	BOOL	BOOL expression
	SINT DINT INT REAL	numeric expression
;	ends the assignment	

Expressions

An expression is a tag name, equation, or comparison. To write an expression, use any of the following:

- tag name that stores the value (variable)
- number that you enter directly into the expression (immediate value)
- functions, such as: ABS, TRUNC
- operators, such as: +, -, <, >, And, Or

BOOL expression: An expression that produces either the BOOL value of 1 (true) or 0 (false).

- A bool expression uses bool tags, relational operators, and logical operators to compare values or check if conditions are true or false. For example, `tag1 > 65`.
- A simple bool expression can be a single BOOL tag.
- Typically, you use bool expressions to condition the execution of other logic.

Numeric expression: An expression that calculates an integer or floating-point value.

- A numeric expression uses arithmetic operators, arithmetic functions, and bitwise operators. For example, `tag1 + 5`.
- Often, you nest a numeric expression within a bool expression. For example, `(tag1 + 5) > 65`.

Arithmetic operators

Arithmetic operators calculate new values.

To:	Use this operator:	Optimal data type:
add	+	DINT, REAL
subtract/negate	-	DINT, REAL
multiply	*	DINT, REAL
exponent (x to the power of y)	**	DINT, REAL
divide	/	DINT, REAL
modulo-divide	MOD	DINT, REAL

Arithmetic functions

Arithmetic functions perform math operations. Specify a constant, a non-boolean tag, or an expression for the function.

For:	Use this function:	Optimal data type:
absolute value	ABS (<i>numeric_expression</i>)	DINT, REAL
arc cosine	ACOS (<i>numeric_expression</i>)	REAL
arc sine	ASIN (<i>numeric_expression</i>)	REAL
arc tangent	ATAN (<i>numeric_expression</i>)	REAL
cosine	COS (<i>numeric_expression</i>)	REAL
radians to degrees	DEG (<i>numeric_expression</i>)	DINT, REAL
natural log	LN (<i>numeric_expression</i>)	REAL
log base 10	LOG (<i>numeric_expression</i>)	REAL
degrees to radians	RAD (<i>numeric_expression</i>)	DINT, REAL
sine	SIN (<i>numeric_expression</i>)	REAL
square root	SQRT (<i>numeric_expression</i>)	DINT, REAL
tangent	TAN (<i>numeric_expression</i>)	REAL
truncate	TRUNC (<i>numeric_expression</i>)	DINT, REAL

Relational operators

Relational operators compare two values or strings to provide a true or false result. The result of a relational operation is a BOOL value:

If the comparison is:	The result is:
true	1
false	0

For this comparison:	Use this operator:	Optimal Data Type:
equal	=	DINT, REAL, string
less than	<	DINT, REAL, string
less than or equal	<=	DINT, REAL, string
greater than	>	DINT, REAL, string
greater than or equal	>=	DINT, REAL, string
not equal	<>	DINT, REAL, string

Logical operators

Logical operators let you check if multiple conditions are true or false. The result of a logical operation is a BOOL value:

If the comparison is:	The result is:
true	1
false	0

For:	Use this operator:	Data Type:
logical AND	&, AND	BOOL
logical OR	OR	BOOL
logical exclusive OR	XOR	BOOL
logical complement	NOT	BOOL

Bitwise operators

Bitwise operators manipulate the bits within a value based on two values.

For:	Use this operator:	Optimal Data Type:
bitwise AND	&, AND	DINT
bitwise OR	OR	DINT
bitwise exclusive OR	XOR	DINT
bitwise complement	NOT	DINT

Determine the order of execution

The operations you write into an expression are performed in a prescribed order, not necessarily from left to right.

- Operations of equal order are performed from left to right.
- If an expression contains multiple operators or functions, group the conditions in parenthesis “()” to ensure the correct order.

Order:	Operation:
1.	()
2.	function (...)
3.	**
4.	– (negate)
5.	NOT
6.	*, /, MOD
7.	+, - (subtract)
8.	<, <=, >, >=
9.	=, <>
10.	&, AND
11.	XOR
12.	OR

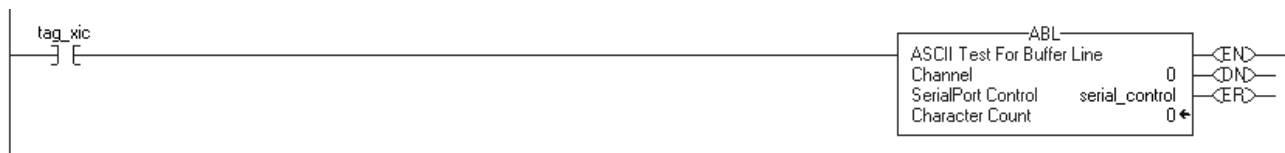
Instructions

Structured text statements can also be instructions. See the Locator Table at the beginning of this manual for a list of the instructions available in structured text. A structured text instruction executes each time it is scanned. A structured text instruction within a construct executes every time the conditions of the construct are true. If the conditions of the construct are false, the statements within the construct are not scanned. There is no rung-condition or state transition that triggers execution.

This differs from function block instructions that use EnableIn to trigger execution. Structured text instructions execute as if EnableIn is always set.

This also differs from relay ladder instructions that use rung-condition-in to trigger execution. Some relay ladder instructions only execute when rung-condition-in toggles from false to true. These are transitional relay ladder instructions. In structured text, instructions will execute each time they are scanned unless you pre-condition the execution of the structured text instruction.

For example, the ABL instruction is a transitional instruction in relay ladder. In this example, the ABL instruction only executes on a scan when *tag_xic* transitions from cleared to set. The ABL instruction does not execute when *tag_xic* stays set or when *tag_xic* is cleared.



In structured text, if you write this example as:

```
IF tag_xic THEN ABL(0,serial_control);  
  
END_IF;
```

the ABL instruction will execute every scan that *tag_xic* is set, not just when *tag_xic* transitions from cleared to set.

If you want the ABL instruction to execute only when *tag_xic* transitions from cleared to set, you have to condition the structured text instruction. Use a one shot to trigger execution.

```
osri_1.InputBit := tag_xic;  
OSRI(osri_1);  
  
IF (osri_1.OutputBit) THEN  
    ABL(0,serial_control);  
END_IF;
```

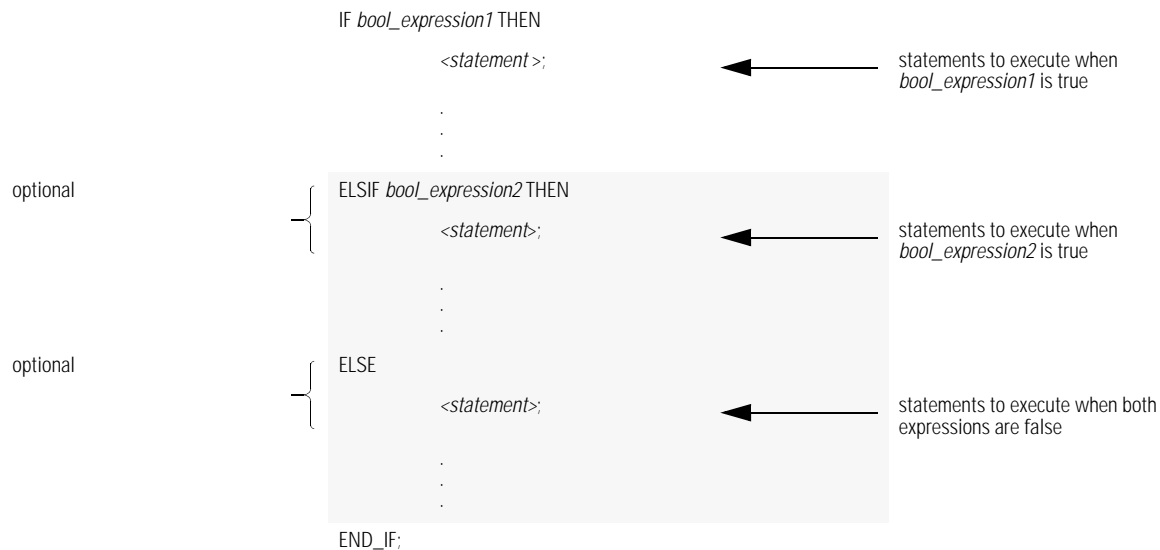
Constructs

Constructs can be programmed singly or nested within other constructs.

If you want to:	Use this construct:	See page:
do something if or when specific conditions occur	IF...THEN	3-16
select what to do based on a numerical value	CASE...OF	3-17
do something a specific number of times before doing anything else	FOR...DO	3-19
keep doing something as long as certain conditions are true	WHILE...DO	3-21
keep doing something until a condition is true	REPEAT...UNTIL	3-23

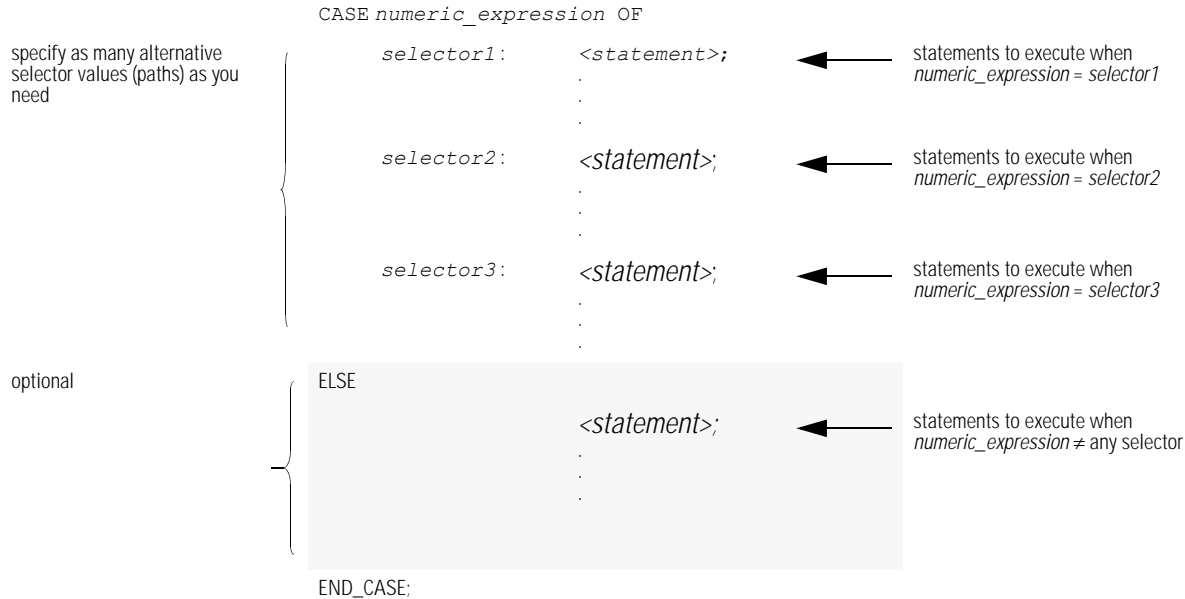
IF...THEN

Use IF...THEN to do something if or when specific conditions occur. The syntax is:



CASE...OF

Use CASE to select what to do based on a numerical value. The syntax is:



The syntax for entering the selector values is:

When selector is:	Enter:
one value	<i>value: statement</i>
multiple, distinct values	<i>value1, value2, valueN: <statement></i> Use a comma (,) to separate each value.
a range of values	<i>value1..valueN: <statement></i> Use two periods (..) to identify the range.
distinct values plus a range of values	<i>valuea, valueb, value1..valueN: <statement></i>

FOR...DO

Use the FOR...DO loop to do something a specific number of times before doing anything else. The syntax is:

```

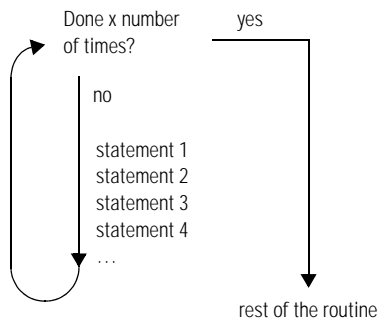
FOR count := initial_value
    TO final_value
optional { BY increment
DO
    <statement>;
optional { IF bool_expression THEN
    EXIT;
    END_IF;
END_FOR;
```

If you don't specify an increment, the loop increments by 1.

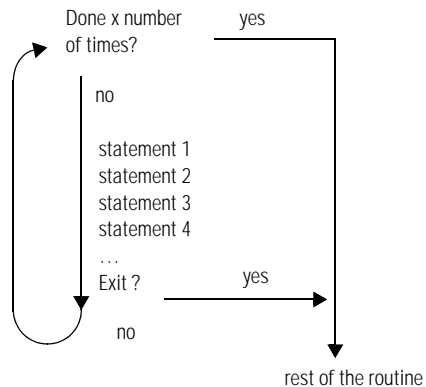
If there are conditions when you want to exit the loop early, use other statements, such as an IF...THEN construct, to condition an EXIT statement.

A major fault will occur if:	Fault type:	Fault code:
the construct loops too long	6	1

The following diagrams show how a FOR...DO loop executes and how an EXIT statement leaves the loop early.



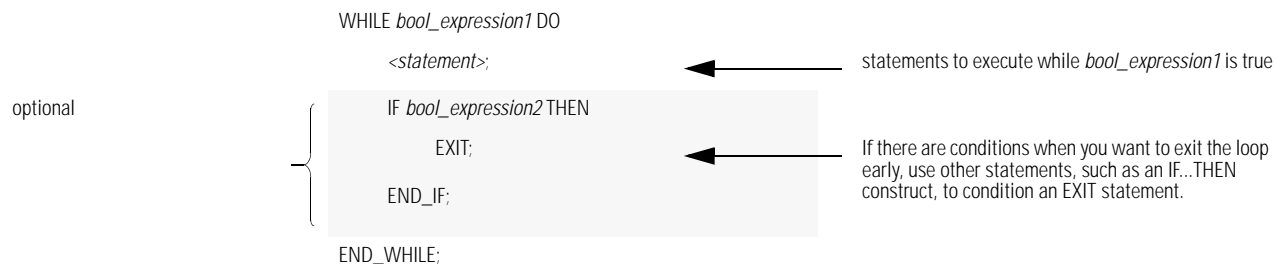
The FOR...DO loop executes a specific number of times.



To stop the loop before the count reaches the last value, use an EXIT statement.

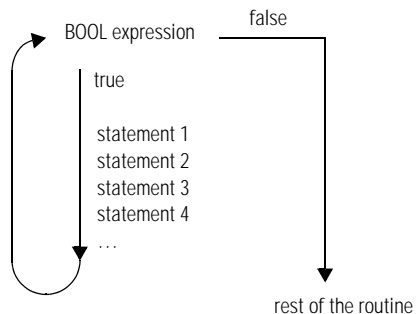
WHILE...DO

Use the WHILE...DO loop to keep doing something as long as certain conditions are true. The syntax is:

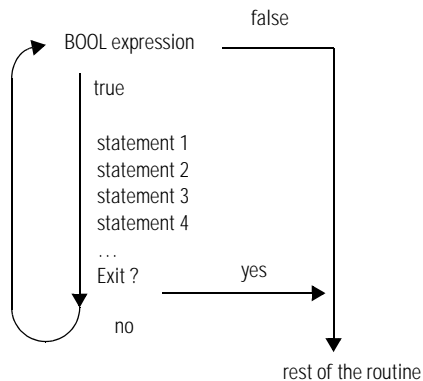


A major fault will occur if:	Fault type:	Fault code:
the construct loops too long	6	1

The following diagrams show how a WHILE...DO loop executes and how an EXIT statement leaves the loop early.



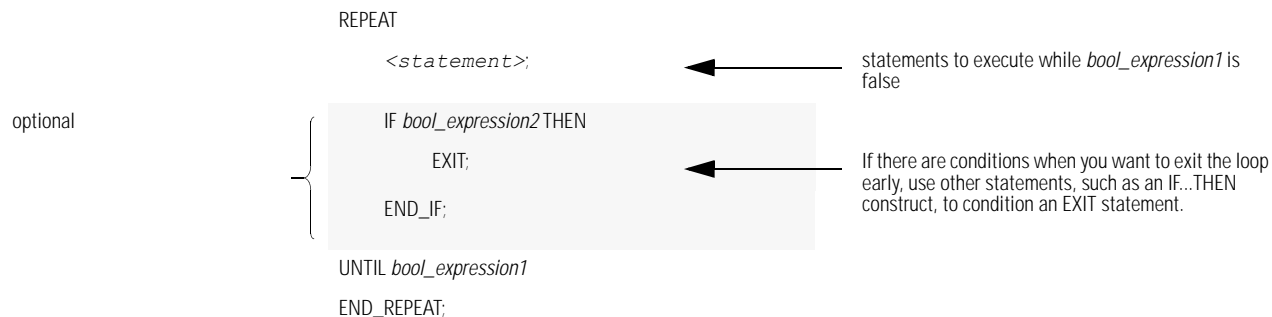
While the *bool expression* is true, the controller executes only the statements within the WHILE...DO loop.



To stop the loop before the conditions are true, use an EXIT statement.

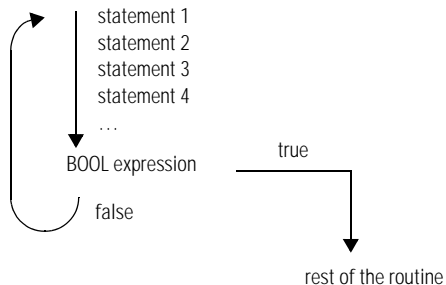
REPEAT...UNTIL

Use the REPEAT...UNTIL loop to keep doing something until conditions are true. The syntax is:

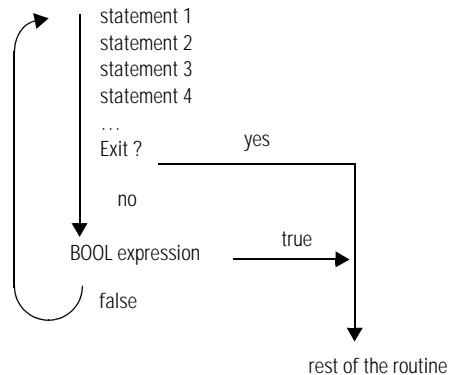


A major fault will occur if:	Fault type:	Fault code:
the construct loops too long	6	1

The following diagrams show how a REPEAT...UNTIL loop executes and how an EXIT statement leaves the loop early.



While the *bool expression* is false, the controller executes only the statements within the REPEAT...UNTIL loop.



To stop the loop before the conditions are false, use an EXIT statement.

Comments

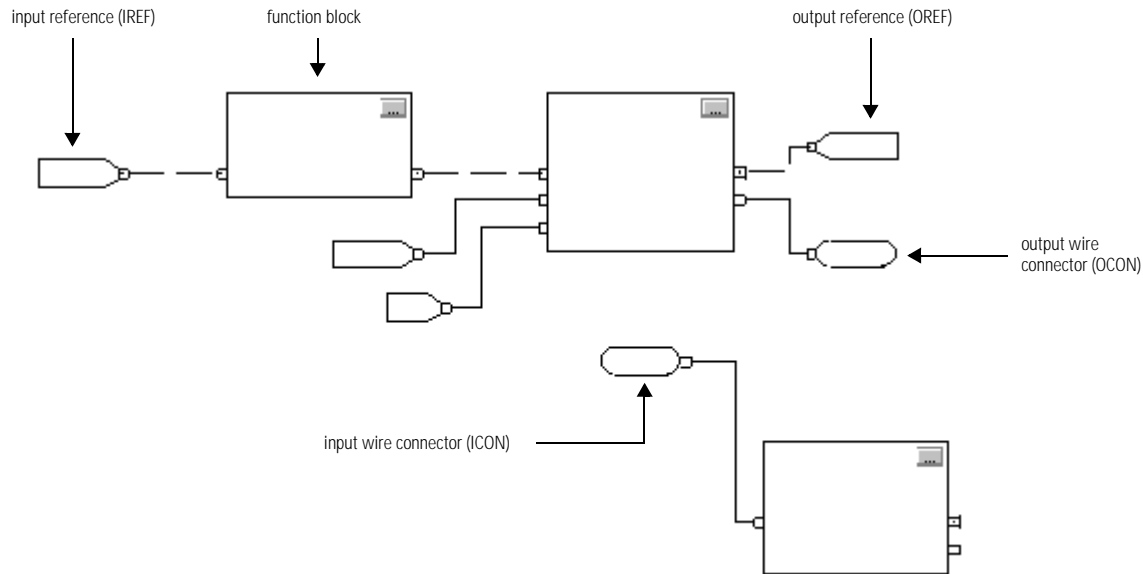
To add comments to your structured text:

To add a comment:	Use one of these formats:
on a single line	<i>//comment</i>
at the end of a line of structured text	<i>(*comment*)</i> <i>/*comment*/</i>
within a line of structured text	<i>(*comment*)</i> <i>/*comment*/</i>
that spans more than one line	<i>(*start of comment . . . end of comment*)</i> <i>/*start of comment . . . end of comment*/</i>

Notes:






Function Block Diagram

Function block diagrams are visual programs that can contain the following elements. Each function block is an instruction that defines a control action.:



Editing a Function Block Diagram.



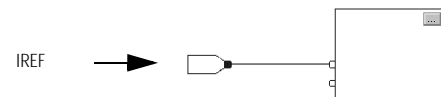
This toolbar button:	Creates this ladder element:	Description:
	IREF	Add an input reference to supply a value from an input device or tag.
	OREF	Add an output reference to send a value to an output device or tag.
	ICON	Add input and output wire connectors. Use wire connectors to transfer data between function blocks when they are: <ul style="list-style-type: none"> • far apart on the same sheet • on different sheets within the same routine
	OCON	Use wire connectors to disperse data to several points in the routine by assigning one OCON to multiple ICONs.
	instruction	Select a specific function block to perform an operation on an input value or values and produce an output value or values Use the tabs on the bottom of the toolbar to display other available function blocks.

Data Latching

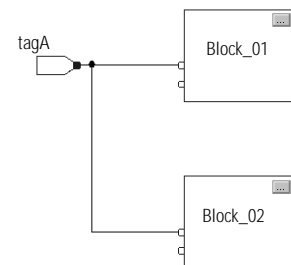
Condition:

If you use an IREF to specify input data for a function block instruction, the data in that IREF is latched for the scan of the function block routine. The IREF latches data from program-scoped and controller-scoped tags. The controller updates all IREF data at the beginning of each scan.

Example:



In this example, the value of tagA is stored at the beginning of the routine's execution. The stored value is used when Block_01 executes. The same stored value is also used when Block_02 executes. If the value of tagA changes during execution of the routine, the stored value of tagA in the IREF does not change until the next execution of the routine.

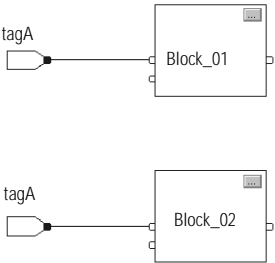


4 - 4 Function Block Diagram

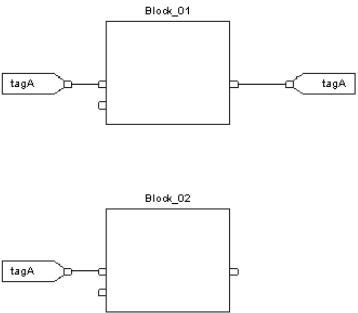
Condition:

Example:

This example is the same as the one above. The value of tagA is stored only once at the beginning of the routine's execution. The routine uses this stored value throughout the routine.



You can use the same tag in multiple IREFs and an OREF in the same routine. Because the values of tags in IREFs are latched every scan through the routine, all IREFs will use the same value, even if an OREF obtains a different tag value during execution of the routine. In this example, if tagA has a value of 25.4 when the routine starts executing this scan, and Block_01 changes the value of tagA to 50.9, the second IREF wired into Block_02 will still use a value of 25.4 when Block_02 executes this scan. The new tagA value of 50.9 will not be used by any IREFs in this routine until the start of the next scan.



Order of Execution

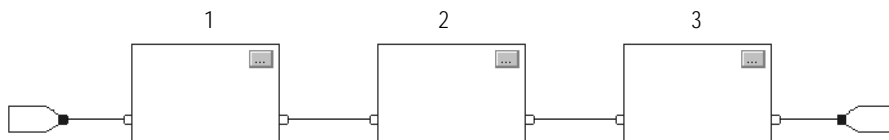
The RSLogix 5000 programming software automatically determines the order of execution for the function blocks in a routine when you:

- verify a function block routine
- verify a project that contains a function block routine
- download a project that contains a function block routine

You define execution order by wiring function blocks together and indicating the data flow of any feedback wires, if necessary.

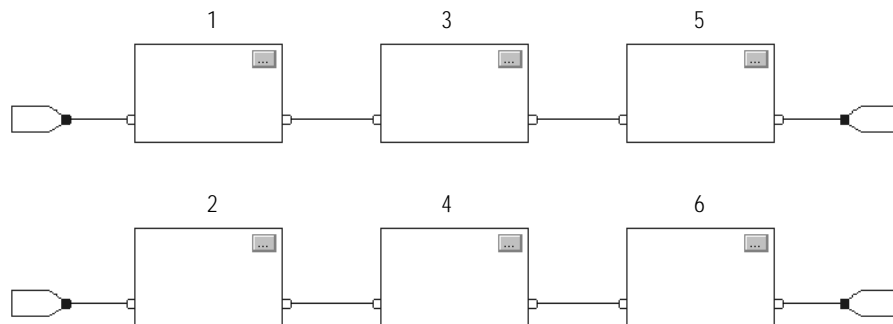
If function blocks are not wired together, it does not matter which block executes first. There is no data flow between the blocks.

If you wire the blocks sequentially, the execution order moves from input to output. The inputs of a block require data to be available before the controller can execute that block. For example, block 2 has to execute before block 3 because the outputs of block 2 feed the inputs of block 3.



4 - 6 Function Block Diagram

Execution order is only relative to the blocks that are wired together. The following example is fine because the two groups of blocks are not wired together. The blocks within a specific group execute in the appropriate order in relation to the blocks in that group.

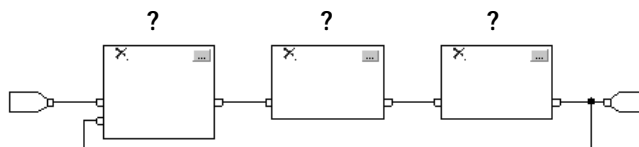


Resolve a Loop

To create a feedback loop around a block, wire an output pin of the block to an input pin of the same block. The following example is OK. The loop contains only a single block, so execution order does not matter.

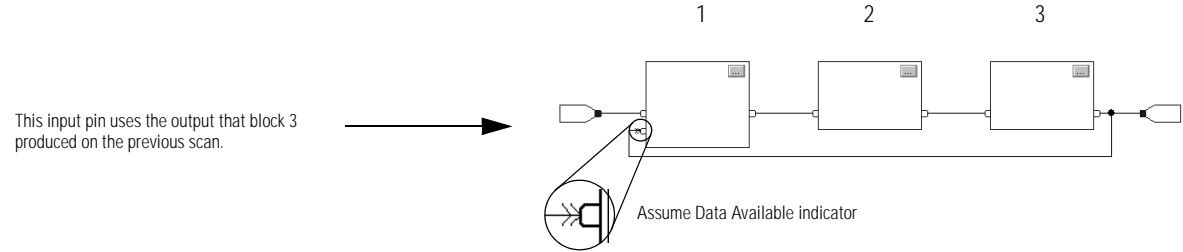


If a group of blocks are in a loop, the controller cannot determine which block to execute first. In other words, it cannot resolve the loop.



4 - 8 Function Block Diagram

To identify which block to execute first, mark the input wire that creates the loop (the feedback wire) with the *Assume Data Available* indicator. In the following example, block 1 uses the output from block 3 that was produced in the previous execution of the routine.

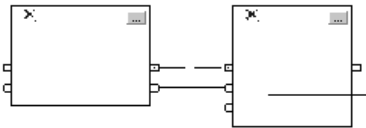
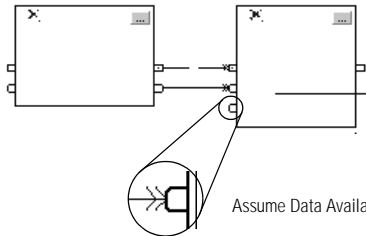
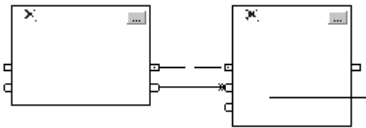


The *Assume Data Available* indicator defines the data flow within the loop. The arrow indicates that the data serves as input to the first block in the loop. *Do not* mark all the wires of a loop with the *Assume Data Available* indicator.

This is OK	This is NOT OK
<p>Assume Data Available indicator</p>	<p>The controller cannot resolve the loop because all the wires use the <i>Assume Data Available</i> indicator.</p>

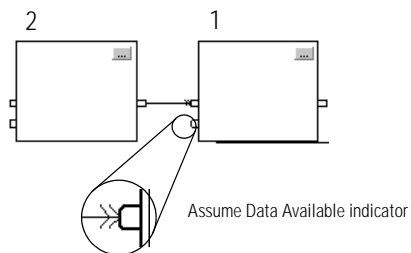
Resolve Data Flow Between Two Blocks

If you use two or more wires to connect two blocks, use the same data flow indicators for all of the wires between the two blocks.

This is OK	This is NOT OK
 <p>Neither wire uses the <i>Assume Data Available</i> indicator.</p>  <p>Both wires use the <i>Assume Data Available</i> indicator.</p>	 <p>One wire uses the <i>Assume Data Available</i> indicator while the other wire does not.</p>

Create a One Scan Delay

To produce a one scan delay between blocks, use the *Assume Data Available* indicator. In the following example, block 1 executes first. It uses the output from block 2 that was produced in the previous scan of the routine.



Summary

In summary, a function block routine executes in this order:

1. The controller latches all data values in IREFs.
2. The controller executes the other function blocks in the order determined by how they are wired.
3. The controller writes outputs in OREFs.

Define Program/Operator Control

Several instructions support the concept of Program/Operator control. These instructions include:

- Enhanced Select (ESEL)
- Totalizer (TOT)
- Enhanced PID (PIDE)
- Ramp/Soak (RMPS)
- Discrete 2-State Device (D2SD)
- Discrete 3-State Device (D3SD)

Program/Operator control lets you control these instructions simultaneously from both your user program and from an operator interface device. When in Program control, the instruction is controlled by the Program inputs to the instruction; when in Operator control, the instruction is controlled by the Operator inputs to the instruction.

Program or Operator control is determined by using these inputs:

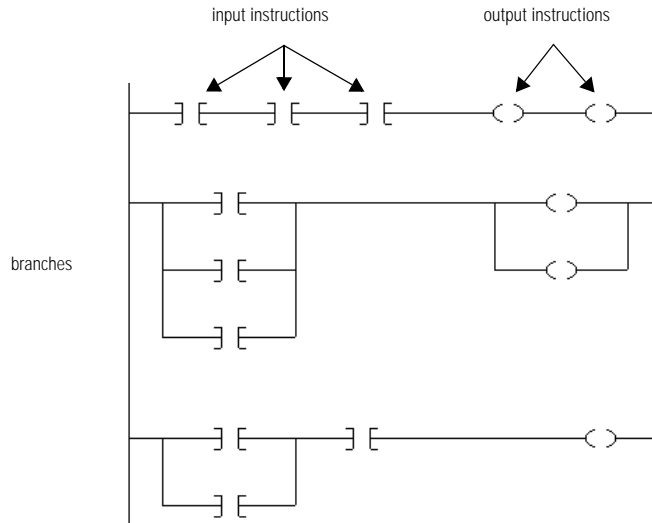
Input:	Description:
.ProgProgReq	A program request to go to Program control.
.ProgOperReq	A program request to go to Operator control.
.OperProgReq	An operator request to go to Program control.
.OperOperReq	An operator request to go to Operator control.

To determine whether an instruction is in Program or Control control, examine the ProgOper output. If ProgOper is set, the instruction is in Program control; if ProgOper is cleared, the instruction is in Operator control.

Control:	Description:
program	<p>The Program request inputs take precedence over the Operator request inputs. This provides the capability to use the ProgProgReq and ProgOperReq inputs to “lock” an instruction in a desired control.</p> <p>Constantly setting the ProgProgReq can “lock” the instruction into Program control. This is useful for automatic startup sequences when you want the program to control the action of the instruction without worrying about an operator inadvertently taking control of the instruction. In this example, you have the program set the ProgProgReq input during the startup, and then clear the ProgProgReq input once the startup was complete. Once the ProgProgReq input is cleared, the instruction remains in Program control until it receives a request to change. For example, the operator could set the OperOperReq input from a faceplate to take over control of that instruction.</p> <p>Program request inputs are not normally cleared by the instruction because these are normally wired as inputs into the instruction. If the instruction clears these inputs, the input would just get set again by the wired input. There might be situations where you want to use other logic to set the Program requests in such a manner that you want the Program requests to be cleared by the instruction. In this case, you can set the ProgValueReset input and the instruction will always clear the Program mode request inputs when it executes.</p>
operator	<p>Operator request inputs to an instruction are always cleared by the instruction when it executes. This allows operator interfaces to work with these instructions by merely setting the desired mode request bit. You don’t have to program the operator interface to reset the request bits.</p> <p>Operator control takes precedence over Program control if both input request bits are set. For example, if ProgProgReq and ProgOperReq are both set, the instruction goes to Operator control.</p>

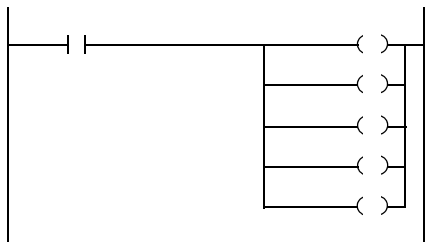
Relay Ladder Logic

Relay ladder logic places input and output instructions on rungs.

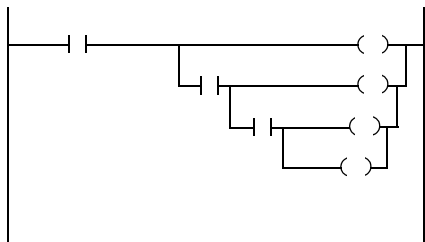


5 - 2 Relay Ladder

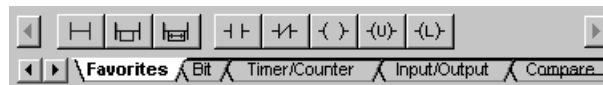
There is no limit to the number of parallel branch levels that you can enter. The following figure shows a parallel branch with five levels. The main rung is the first branch level, followed by four additional branches.







You can nest branches to as many as 6 levels. The following figure shows a nested branch. The bottom output instruction is on a nested branch that is three levels deep.



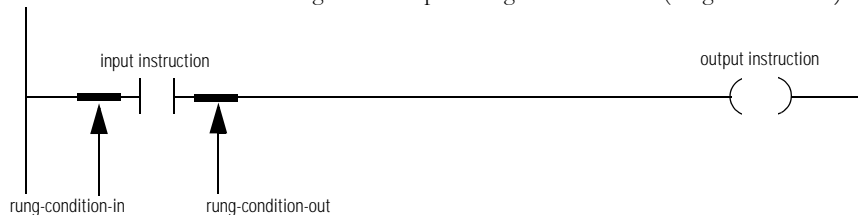
Editing Relay Ladder



This toolbar button:	Creates this ladder element:	Description:
	ladder rung	A rung determines the execution order of input and output instructions.
	branch	A branch is two or more instructions in parallel.
	a branch level	There is no limit to the number of parallel branch levels that you can enter. You can nest branches to as many as 6 levels.
	instruction	<p>Input instruction: An instruction that checks, compares, or examines specific conditions in your machine or process.</p> <p>Output instruction: An instruction that takes some action, such as turn on a device, turn off a device, copy data, or calculate a value.</p> <p>Use the tabs on the bottom of the toolbar to display other available instructions.</p>

Rung Condition

The controller evaluates ladder instructions based on the rung condition preceding the instruction (rung-condition-in).



Only input instructions affect the rung-condition-in of subsequent instructions on the rung:

- If the rung-condition-in to an input instruction is true, the controller evaluates the instruction and sets the rung-condition-out to match the results of the evaluation.
 - If the instruction evaluates to true, the rung-condition-out is true.
 - If the instruction evaluates to false, the rung-condition-out is false.
- An output instruction does not change the rung-condition-out.
 - If the rung-condition-in to an output instruction is true, the rung-condition-out is set to true.
 - If the rung-condition-in to an output instruction is false, the rung-condition-out is set to false.

System Values Stored by the Controller

The controller automatically stored different status information:

If you want to:	See page:
use specific key words in logic to monitor specific status conditions	6-2
get or set system data (status information)	6-3
available status information - GSV/SSV objects	6-5
get information about controller memory	6-26

Monitor Status Flags

The controller supports status keywords you can use in your logic to monitor specific events:

To determine if:	Use:
the value you are storing cannot fit into the destination because it is either: <ul style="list-style-type: none">greater than the maximum value for the destinationless than the minimum value for the destination	S:V
Important: Each time S:V goes from cleared to set, it generates a minor fault (type 4, code 4)	
the instruction's destination value is 0	S:Z
the instruction's destination value is negative	S:N
an arithmetic operation causes a carry or borrow that tries to use bits that are outside of the data type	S:C
this is the first, normal scan of the routines in the current program	S:FS
at least one minor fault has been generated: <ul style="list-style-type: none">The controller sets this bit when a minor fault occurs due to program execution.The controller does not set this bit for minor faults that are not related to program execution, such as battery low.	S:MINOR

The status keywords are not case sensitive. Because the status flags can change so quickly, RSLogix 5000 software does *not* display the status of the flags. You *cannot* define a tag alias to a keyword.

Get and Set System Data (Status Information)

The controller stores system data in objects. There is no status file, as in the PLC-5 controller. Use the GSV/SSV instructions get and set controller system data that is stored in objects. To get or set a system value:

1. Select the system object you want.

To get or set:	Select:	To get or set:	Select:
axis of a servo module	AXIS	status, faults, and mode of a module	MODULE
system overhead timeslice	CONTROLLER	group of axes	MOTIONGROUP
physical hardware of a controller	CONTROLLERDEVICE	fault information or scan time for a program	PROGRAM
coordinated system time for the devices in one chassis	CST	instance number of a routine	ROUTINE
DF1 communication driver for the serial port	DF1	configuration of the serial port	SERIALPORT
fault history for a controller	FAULTLOG	properties or elapsed time of a task	TASK
attributes of a message instruction	MESSAGE	wall clock time of a controller	WALLCLOCKTIME

2. In the list of attributes for the object, identify the attribute that you want to access.

3. Create a tag for the value of the attribute:

If the data type of the attribute is:	Then:
one element (e.g., DINT)	Create a tag for the attribute.
more than one element (e.g., DINT[7])	A. Create a user-defined data type that matches the organization of data for the attribute. B. Create a tag for the attribute.

4. In your logic, use a GSV instruction to get the value of an attribute or an SSV instruction to set the value of an attribute.

5. Assign the required operands to the instruction:

For this operand:	Select:
Class name	name of the object
Instance name	name of the specific object (e.g., name of the required I/O module, task, message) Not all objects require this entry. To specify the current task, program, or routine, select <i>THIS</i> .
Attribute Name	name of the attribute
Dest (GSV)	tag that will store the retrieved value If the tag is a user-defined data type or an array, select the first member or element.
Source (SSV)	tag that stores the value to be set If the tag is a user-defined data type or an array, select the first member or element.

Available Status Information - GSV/SSV Objects

CONTROLLER attributes

Attribute:	Data Type:	Instruction:	Description:
TimeSlice	INT	GSV SSV	Percentage of available CPU that is assigned to communications. Valid values are 10-90. This value cannot be changed when the keyswitch is in the run position.

CONTROLLERDEVICE attributes

Attribute:	Data Type:	Instruction:	Description:																		
DeviceName	SINT[33]	GSV	ASCII string that identifies the catalog number of the controller and memory board. The first byte contains a count of the number of ASCII characters returned in the array string.																		
ProductCode	INT	GSV	Identifies the type of controller: <table><thead><tr><th>Value:</th><th>Meaning:</th></tr></thead><tbody><tr><td>3</td><td>ControlLogix5550</td></tr><tr><td>15</td><td>SoftLogix5860</td></tr><tr><td>41</td><td>FlexLogix5433</td></tr><tr><td>43</td><td>FlexLogix5434</td></tr><tr><td>48</td><td>PowerFlex 700S with DriveLogix5720</td></tr><tr><td>50</td><td>CompactLogix5320</td></tr><tr><td>51</td><td>ControlLogix5555</td></tr><tr><td>52</td><td>PowerFlex 700S with DriveLogix5730</td></tr></tbody></table>	Value:	Meaning:	3	ControlLogix5550	15	SoftLogix5860	41	FlexLogix5433	43	FlexLogix5434	48	PowerFlex 700S with DriveLogix5720	50	CompactLogix5320	51	ControlLogix5555	52	PowerFlex 700S with DriveLogix5730
Value:	Meaning:																				
3	ControlLogix5550																				
15	SoftLogix5860																				
41	FlexLogix5433																				
43	FlexLogix5434																				
48	PowerFlex 700S with DriveLogix5720																				
50	CompactLogix5320																				
51	ControlLogix5555																				
52	PowerFlex 700S with DriveLogix5730																				

Attribute:	Data Type:	Instruction:	Description:
ProductRev	INT	GSV	Identifies the current product revision. Display should be hexadecimal. The low byte contains the major revision; the high byte contains the minor revision.
SerialNumber	DINT	GSV	Serial number of the device. The serial number is assigned when the device is built.
Status	INT	GSV	<div><div>Device Status Bits Bits 7-4: Meaning: 0000 reserved 0001 flash update in progress 0010 reserved 0011 reserved 0100 flash is bad 0101 faulted 0110 run 0111 program</div><div>Controller Status Bits Bits 13-12: Meaning: 01 keyswitch in run 10 keyswitch in program 11 keyswitch in remote Bits 15-14 Meaning 01 controller is changing modes 10 debug mode if controller is in run mode</div><div>Fault Status Bits Bits 11-8: Meaning: 0001 recoverable minor fault 0010 unrecoverable minor fault 0100 recoverable major fault 1000 unrecoverable major fault</div></div>
Type	INT	GSV	Identifies the device as a controller. Controller = 14
Vendor	INT	GSV	Identifies the vendor of the device. Allen-Bradley = 0001

CST attributes

Attribute:	Data Type:	Instruction:	Description:
CurrentStatus	INT	GSV	<p>Current status of the coordinated system time.</p> <p>Bit:</p> <p>0 timer hardware faulted: the device's internal timer hardware is in a faulted state</p> <p>1 ramping enabled: the current value of the timer's lower 16+ bits ramp up to the requested value, rather than snap to the lower value.</p> <p>2 system time master: the CST object is a master time source in the ControllLogix system</p> <p>3 synchronized: the CST object's 64-bit CurrentValue is synchronized by a master CST object via a system time update</p> <p>4 local network master: the CST object is the local network master time source</p> <p>5 in relay mode: the CST object is acting in a time relay mode</p> <p>6 duplicate master detected: a duplicate local network time master has been detected. This bit is always 0 for time-dependent nodes.</p> <p>7 unused</p> <p>8-9 00 = time dependent node 01 = time master node 10 = time relay node 11 = unused</p> <p>10-15 unused</p>
CurrentValue	DINT[2]	GSV	<p>Current value of the timer. DINT[0] contains the lower 32; DINT[1] contains the upper 32 bits. The timer source is adjusted to match the value supplied in update services and from local communication network synchronization. The adjustment is either a ramping to the requested value or an immediate setting to the request value, as reported in the CurrentStatus attribute.</p>

DF1 attributes

Attribute:		Data Type:	Instruction:	Description:
ACKTimeout		DINT	GSV	The amount of time to wait for an acknowledgment to a message transmission (point-to-point and master only). Valid value 0-32,767. Delay in counts of 20 msec periods. Default is 50 (1 second).
DiagnosticCounters		INT[19]	GSV	Array of diagnostic counters for the DF1 communication driver.
word offset	DF1 point-to-point	DF1 slave	master	
0	signature (0x0043)	signature (0x0042)	signature (0x0044)	
1	modem bits	modem bits	modem bits	
2	packets sent	packets sent	packets sent	
3	packets received	packets received	packets received	
4	undelivered packets	undelivered packets	undelivered packets	
5	unused	messages retried	messages retried	
6	NAKs received	NAKs received	unused	
7	ENQs received	poll packets received	unused	
8	bad packets NAKed	bad packets not ACKed	bad packets not ACKed	
9	no memory sent NAK	no memory not ACKed	unused	
10	duplicate packets received	duplicate packets received	duplicate packets received	
11	bad characters received	unused	unused	
12	DCD recoveries count	DCD recoveries count	DCD recoveries count	
13	lost modem count	lost modem count	lost modem count	
14	unused	unused	priority scan time maximum	
15	unused	unused	priority scan time last	
16	unused	unused	normal scan time maximum	
17	unused	unused	normal scan time last	
18	ENQs sent	unused	unused	

Attribute:	Data Type:	Instruction:	Description:
DuplicateDetection	SINT	GSV	<p>Enables duplicate message detection.</p> <p>Value: 0 non zero</p> <p>Meaning: duplicate message detection disabled duplicate message detection enabled</p>
EmbeddedResponseEnable	SINT	GSV	<p>Enables embedded response functionality (point-to-point only).</p> <p>Value: 0 1</p> <p>Meaning: initiated only after one is received (default) enabled unconditionally</p>
ENQTransmitLimit	SINT	GSV	<p>The number of inquiries (ENQs) to send after an ACK timeout (point-to-point only). Valid value 0-127. Default setting is 3.</p>
EOTSuppression	SINT	GSV	<p>Enable suppressing EOT transmissions in response to poll packets (slave only).</p> <p>Value: 0 non zero</p> <p>Meaning: EOT suppression disabled (disabled) EOT suppression enabled</p>
ErrorDetection	SINT	GSV	<p>Specifies the error-detection scheme.</p> <p>Value: 0 1</p> <p>Meaning: BCC (default) CRC</p>
MasterMessageTransmit	SINT	GSV	<p>Current value of the master message transmission (master only).</p> <p>Value: 0 1</p> <p>Meaning: between station polls (default) in poll sequence (in place of master's station number)</p>
NAKReceiveLimit	SINT	GSV	<p>The number of NAKs received in response to a message before stopping transmission (point-to-point communication only). Valid value 0-127. Default is 3.</p>

Attribute:	Data Type:	Instruction:	Description:
NormalPollGroupSize	INT	GSV	Number of stations to poll in the normal poll node array after polling all the stations in the priority poll node array (master only). Valid value 0-255. Default is 0.
PollingMode	SINT	GSV	Current polling mode (master only). Default setting is 1. Value: 0 1 2 3 Meaning: message-based, but don't allow slaves to initiate messages message-based, but allow slaves to initiate messages (default) standard, single-message transfer per node scan standard, multiple-message transfer per node scan
ReplyMessageWait	DINT	GSV	The time (acting as a master) to wait after receiving an ACK before polling the slave for a response (master only). Valid value 0-65,535. Delay in counts of 20 msec periods. The default is 5 periods (100 msec).
StationAddress	INT	GSV	Current station address of the serial port. Valid value 0-254. Default is 0.
SlavePollTimeout	DINT	GSV	The amount of time in msec that the slave waits for the master to poll before the slave declares that it is unable to transmit because the master is inactive (slave only). Valid value 0-32,767. Delay in counts of 20 msec periods. The default is 3000 periods (1 minute).
TransmitRetries	SINT	GSV	Number of times to resend a message without getting an acknowledgment (master and slave only). Valid value 0-127. Default is 3.
PendingACKTimeout	DINT	SSV	Pending value for the ACKTimeout attribute.
PendingDuplicateDetection	SINT	SSV	Pending value for the DuplicateDetection attribute.
PendingEmbeddedResponseEnable	SINT	SSV	Pending value for the EmbeddedResponse attribute.
PendingENQTransmitLimit	SINT	SSV	Pending value for the ENQTransmitLimit attribute.
PendingEOTSuppression	SINT	SSV	Pending value for the EOTSuppression attribute.

Attribute:	Data Type:	Instruction:	Description:
PendingErrorDetection	SINT	SSV	Pending value for the ErrorDetection attribute.
PendingNormalPollGroupSize	INT	SSV	Pending value for the NormalPollGroupSize attribute.
PendingMasterMessageTransmit	SINT	SSV	Pending value for the MasterMessageTransmit attribute.
PendingNAKReceiveLimit	SINT	SSV	Pending value for the NAKReceiveLimit attribute.
PendingPollingMode	SINT	SSV	Pending value for the PollingMode attribute.
PendingReplyMessageWait	DINT	SSV	Pending value for the ReplyMessageWait attribute.
PendingStationAddress	INT	SSV	Pending value for the StationAddress attribute.
PendingSlavePollTimeout	DINT	SSV	Pending value for the SlavePollTimeout attribute.
PendingTransmitRetries	SINT	SSV	Pending value for the TransmitRetries attribute.

FAULTLOG attributes

Attribute:	Data Type:	Instruction:	Description:
MajorEvents	INT	GSV SSV	How many major faults have occurred since the last time this counter was reset.
MinorEvents	INT	GSV SSV	How many minor faults have occurred since the last time this counter was reset.

Attribute:	Data Type:	Instruction:	Description:
MajorFaultBits	DINT	GSV SSV	Individual bits indicate the reason for the current major fault. Bit: 1 power loss 3 I/O 4 instruction execution (program) 5 fault handler 6 watchdog 7 stack 8 mode change 11 motion
MinorFaultBits	DINT	GSV SSV	Individual bits indicate the reason for the current minor fault. Bit: 4 instruction execution (program) 6 watchdog 9 serial port 10 battery

MESSAGE attributes

Attribute:	Data Type:	Instruction:	Description:
ConnectionPath	SINT[130]	GSV SSV	Data to setup the connection path. The first two bytes (low byte and high byte) are the length in bytes of the connection path.
ConnectionRate	DINT	GSV SSV	Requested packet rate of the connection.

Attribute:	Data Type:	Instruction:	Description:
MessageType	SINT	GSV SSV	Specifies the type of message. Value: 0 Meaning: not initialized
Port	SINT	GSV SSV	Indicates which port the message should be sent on. Value: 1 2 Meaning: backplane serial port
TimeoutMultiplier	SINT	GSV SSV	Determines when a connection should be considered timed out and closed. Value: 0 1 2 Meaning: connection will timeout in 4 times the update rate default) connection will timeout in 8 times the update rate connection will timeout in 16 times the update rate
UnconnectedTimeout	DINT	GSV SSV	Timeout in microseconds for all unconnected messages. The default is 30,000,000 microseconds (30 sec).

MODULE attributes

Attribute:	Data Type:	Instruction:	Description:
EntryStatus	INT	GSV	<p>Specifies the current state of the specified map entry. The lower 12 bits should be masked when performing a comparison operation. Only bits 12-15 are valid.</p> <p>Value: 16#0000 16#1000 16#2000 16#3000 16#4000 16#5000 16#6000 16#7000</p> <p>Meaning: Standby: the controller is powering up. Faulted: any of the MODULE object's connections to the associated module fail. This value should not be used to determine if the module failed because the MODULE object leaves this state periodically when trying to reconnect to the module. Instead, test for Running state (16#4000). Check for FaultCode not equal to 0 to determine if a module is faulted. When Faulted, the FaultCode and FaultInfo attributes are valid until the fault condition is corrected. Validating: the MODULE object is verifying MODULE object integrity prior to establishing connections to the module. Connecting: the MODULE object is initiating connections to the module. Running: all connections to the module are established and data is transferring. Shutting down: the MODULE object is in the process of shutting down all connections to the module. Inhibited: the MODULE object is inhibited (the inhibit bit in the Mode attribute is set). Waiting: the parent object upon which this MODULE object depends is not running.</p>
FaultCode	INT	GSV	A number which identifies a module fault, if one occurs.
FaultInfo	DINT	GSV	Provides specific information about the MODULE object fault code.
ForceStatus	INT	GSV	<p>Specifies the status of forces.</p> <p>Bit: 0 1</p> <p>Meaning: forces installed (1=yes, 0=no) forces enabled (1=yes, 0=no)</p>
Instance	DINT	GSV	Provides the instance number of this MODULE object.

Attribute:	Data Type:	Instruction:	Description:
LEDStatus	INT	GSV	<p>Specifies the current state of the I/O LED on the front of the controller.</p> <p>Value: Meaning:</p> <p>0 LED off: No MODULE objects are configured for the controller (there are no modules in the I/O Configuration section of the controller organizer).</p> <p>1 Flashing red: None of the MODULE objects are Running.</p> <p>2 Flashing green: At least one MODULE object is not Running.</p> <p>3 Solid green: All the Module objects are Running.</p> <p>Note: You do not enter an object name with this attribute because this attribute applies to the entire collection of modules.</p>
Mode	INT	GSV SSV	<p>Specifies the current mode of the MODULE object.</p> <p>Bit: Meaning:</p> <p>0 If set, causes a major fault to be generated if any of the MODULE object connections fault while the controller is in Run mode.</p> <p>2 If set, causes the MODULE object to enter Inhibited state after shutting down all the connections to the module.</p>

PROGRAM attributes

Attribute:	Data Type:	Instruction:	Description:
DisableFlag	SINT	GSV SSV	<p>Controls this program's execution.</p> <p>Value: Meaning:</p> <p>0 execution enabled</p> <p>1 execution disabled</p>
Instance	DINT	GSV	Provides the instance number of this PROGRAM object.

Attribute:	Data Type:	Instruction:	Description:
LastScanTime	DINT	GSV SSV	Time it took to execute this program the last time it was executed. Time is in microseconds.
MajorFaultRecord	DINT[11]	GSV SSV	Records major faults for this program We recommend that you create a user-defined structure to simplify access to the MajorFaultRecord attribute:
Name: TimeLow TimeHigh Type Code Info	Data Type: DINT DINT INT INT DINT[8]	Style: Decimal Decimal Decimal Decimal Hexadecimal	Description: lower 32 bits of fault timestamp value upper 32 bits of fault timestamp value fault type (program, I/O, etc.) unique code for the fault (depends on fault type) fault specific information (depends on fault type and code)
MaxScanTime	DINT	GSV SSV	Maximum recorded execution time for this program. Time is in microseconds.
MinorFaultRecord	DINT[11]	GSV SSV	Records minor faults for this program We recommend that you create a user-defined structure to simplify access to the MinorFaultRecord attribute:
Name: TimeLow TimeHigh Type Code Info	Data Type: DINT DINT INT INT DINT[8]	Style: Decimal Decimal Decimal Decimal Hexadecimal	Description: lower 32 bits of fault timestamp value upper 32 bits of fault timestamp value fault type (program, I/O, etc.) unique code for the fault (depends on fault type) fault specific information (depends on fault type and code)
SFCRestart	INT	GSV SSV	unused - reserved for future use

REDUNDANCY attributes

Attribute:	Data Type:	Instruction:	Description:
ChassisRedundancyState	INT	GSV	<p>Redundancy status of the entire chassis.</p> <p>Value: 16#1 16#2 16#3 16#4</p> <p>Meaning: power-up or undetermined primary with qualified secondary primary with disqualified secondary primary with no secondary</p>
CompatibilityResults	INT	GSV	<p>The results of the compatibility checks with the partner controller.</p> <p>Value: 0 1 2</p> <p>Meaning: undetermined no compatible partner fully compatible partner</p>
KeyswitchAlarm	DINT	GSV	<p>The keyswitch settings of the controller and its partner match or do not match.</p> <p>Value: 0 1</p> <p>Meaning: the keyswitches match or no partner is present keyswitches do not match</p>
ModuleRedundancyState	INT	GSV	<p>Redundancy status of the controller.</p> <p>Value: 16#1 16#2 16#3 16#4 16#6</p> <p>Meaning: power-up or undetermined primary with qualified secondary primary with disqualified secondary primary with no secondary primary with qualifying secondary</p>

Attribute:	Data Type:	Instruction:	Description:
PartnerChassisRedundancyState	INT	GSV	Redundancy state of the partner chassis. Value: 16#8 Meaning: qualified secondary 16#9 disqualified secondary with primary
PartnerKeyswitch	DINT	GSV	Position of the keyswitch of the partner. Value: 0 Meaning: unknown 1 RUN 2 PROG 3 REM
PartnerMinorFaults	DINT	GSV	Minor faults of the partner (if the ModuleRedundancyState indicates that a partner is present). Value: 4 Meaning: problem with an instruction (program) 6 periodic task overlap (watchdog) 9 problem with the serial port 10 low battery

Attribute:	Data Type:	Instruction:	Description:
PartnerMode	DINT	GSV	<p>Mode of the partner.</p> <p>Value: 16#0 power up 16#1 program 16#2 run 16#3 test 16#4 faulted 16#5 run-to-program 16#6 test-to-program 16#7 program-to-run 16#8 test-to-run 16#9 run-to-test 16#A program-to-test into faulted 16#B into faulted 16#C faulted-to-program</p> <p>Meaning:</p>
PartnerModuleRedundancyState	INT	GSV	<p>Redundancy state of the partner.</p> <p>Value: 16#7 qualifying secondary 16#8 qualified secondary 16#9 disqualified secondary with primary</p> <p>Meaning:</p>
PhysicalChassisID	INT	GSV	<p>In a pair of redundant chassis, identifies a specific chassis without regard to the state of the chassis.</p> <p>Value: 0 unknown 1 Chassis A 2 Chassis B</p> <p>Meaning:</p>

Attribute:	Data Type:	Instruction:	Description:
QualificationInProgress	INT	GSV	Status of the qualification process. Value: -1 qualification is not in progress 0 unsupported 1 - 99 for modules that can measure their completion percentage, the percent of qualification that is complete; for modules that cannot measure their completion percentage, 50 = qualification is in progress and 100 = qualification is complete.
SRMSlotNumber	INT	GSV	Slot number of the 1757-SRM module in this chassis
LastDataTransferSize	DINT	GSV	This attribute is only valid on a primary controller that is configured for redundancy. If: a synchronized partner is present Then this value is the: amount of data that was last transferred to the partner, specified in DINTs no partner is present or a disqualified partner is specified in DINTs amount of data that would have been last transferred to a synchronized partner, a disqualified partner is specified in DINTs present
MaxDataTransferSize	DINT	GSV SSV	Maximum value of the LastDataTransferSize attribute. This attribute is only valid on a primary controller that is configured for redundancy. To reset this value, use an SSV instruction with a Source value of 0.

ROUTINE attributes

Attribute:	Data Type:	Instruction:	Description:
Instance	DINT	GSV	Provides the instance number of this ROUTINE object. Valid values are 0-65,535.

SERIALPORT attribute

Attribute:	Data Type:	Instruction:	Description:
BaudRate	DINT	GSV	Specifies the baud rate. Valid values are 110, 300, 600, 1200, 2400, 4800, 9600, and 19200 (default).
DataBits	SINT	GSV	Specifies the number of bits of data per character. Value: 7 Meaning: 7 data bits (ASCII only) 8 8 data bits (default)
Parity	SINT	GSV	Specifies the parity. Value: 0 Meaning: no parity (no default) 1 odd parity (ASCII only) 2 even parity
RTSOffDelay	INT	GSV	Amount of time to delay turning off the RTS line after the last character has been transmitted. Valid value 0-32,767. Delay in counts of 20 msec periods. The default is 0 msec.
RTSSendDelay	INT	GSV	Amount of time to delay transmitting the first character of a message after turning on the RTS line. Valid value 0-32,767. Delay in counts of 20 msec periods. The default is 0 msec.
StopBits	SINT	GSV	Specifies the number of stop bits. Value: 1 Meaning: 1 stop bit (default) 2 2 stop bits (ASCII only)
PendingBaudRate	DINT	SSV	Pending value for the BaudRate attribute.
PendingDataBits	SINT	SSV	Pending value for the DataBits attribute.
PendingParity	SINT	SSV	Pending value for the Parity attribute.

Attribute:	Data Type:	Instruction:	Description:
PendingRTSOffDelay	INT	SSV	Pending value for the RTSOffDelay attribute.
PendingRTSSendDelay	INT	SSV	Pending value for the RTSSendDelay attribute.
PendingStopBits	SINT	SSV	Pending value for the StopBits attribute.

TASK attributes

Attribute:	Data Type:	Instruction:	Description:
DisableUpdateOutputs	DINT	GSV SSV	Enables or disables the processing of outputs at the end of a task. Value: Meaning: 0 enable the processing of outputs at the end of the task non zero disable the processing of outputs at the end of the task
InhibitTask	DINT	GSV SSV	Prevents the task from executing. If a task is inhibited, the controller still prescans the task when the controller transitions from program to run or test mode. Value: Meaning: 0 enable the task 0 (default) non zero inhibit (disable) the task
Instance	DINT	GSV	Provides the instance number of this TASK object. Valid values are 0-31.
LastScanTime	DINT	GSV SSV	Time it took to execute this task the last time it was executed. Time is in microseconds.
MaxInterval	DINT[2]	GSV SSV	The maximum time interval between successive executions of the task. DINT[0] contains the lower 32 bits of the value; DINT[1] contains the upper 32 bits of the value. A value of 0 indicates 1 or less executions of the task.

Attribute:	Data Type:	Instruction:	Description:
MaxScanTime	DINT	GSV SSV	Maximum recorded execution time for this program. Time is in microseconds.
MinInterval	DINT[2]	GSV SSV	The minimum time interval between successive executions of the task. DINT[0] contains the lower 32 bits of the value; DINT[1] contains the upper 32 bits of the value. A value of 0 indicates 1 or less executions of the task.
OverlapCount	DINT	GSV SSV	Number of times that the task was triggered while it was still executing. Valid for an event or a periodic task. To clear the count, set the attribute to 0.
Priority	INT	GSV	Relative priority of this task as compared to the other tasks. Valid values 0-15.
Rate	DINT	GSV	The time interval between executions of the task. Time is in microseconds.
StartTime	DINT[2]	GSV SSV	Value of WALLCLOCKTIME when the last execution of the task was started. DINT[0] contains the lower 32 bits of the value; DINT[1] contains the upper 32 bits of the value.
Status	DINT	GSV SSV	Status information about the task. Once the controller sets one of these bits, you must manually clear the bit. <div> Bit: 0 1 2 </div> <div> Meaning: an EVNT instruction triggered the task (event task only) a timeout triggered the task (event task only) an overlap occurred for this task </div>

Attribute:	Data Type:	Instruction:	Description:
Timeout	DINT	GSV SSV	The timeout value for an event task. Time is in microseconds.
EnableTimeOut	DINT	GSV SSV	Enables or disables the timeout function of an event task. Value: 0 non zero Meaning: disable the timeout function enable the timeout function
Watchdog	DINT	GSV SSV	Time limit for execution of all programs associated with this task. Time is in microseconds. If you enter 0, these values are assigned: Time: 0.5 sec 5.0 sec Task Type: periodic continuous

WALLCLOCKTIME attributes

Attribute:	Data Type:	Instruction:	Description:
CSTOffset	DINT[2]	GSV SSV	Positive offset from the CurrentValue of the CST object (coordinated system time, see page 6-7). DINT[0] contains the lower 32 bits of the value; DINT[1] contains the upper 32 bits of the value. Value in μ secs. The default is 0.
CurrentValue	DINT[2]	GSV SSV	Current value of the wall clock time. DINT[0] contains the lower 32 bits of the value; DINT[1] contains the upper 32 bits of the value. The value is the number of microseconds that have elapsed since 0000 hours 1 January 1972. The CST and WALLCLOCKTIME objects are mathematically related in the controller. For example, if you add the CST CurrentValue and the WALLCLOCKTIME CSTOffset, the result is the WALLCLOCKTIME CurrentValue.
DateTime	DINT[7]	GSV SSV	The date and time in a readable format. DINT[0] year DINT[1] integer representation of month (1-12) DINT[2] integer representation of day (1-31) DINT[3] hour (0-23) DINT[4] minute (0-59) DINT[5] seconds (0-59) DINT[6] microseconds (0-999,999)

Determine Controller Memory Information

Depending on your type of controller, the memory of the controller may be divided into several areas:

If you have this controller:	Then it stores this:	In this memory:
ControlLogix	I/O tags	I/O memory
	produced tags	
	consumed tags	
	communication via Message (MSG) instructions	
	communication with workstations	
	communication with polled (OPC/DDE) tags that use RSLinx software ⁽¹⁾	
	tags other than I/O, produced, or consumed tags	data and logic memory ⁽²⁾
	logic routines	
	communication with polled (OPC/DDE) tags that use RSLinx software ⁽¹⁾	
CompactLogix FlexLogix PowerFlex 700S with DriveLogix SoftLogix	These controllers do not divide their memory. They store all elements in one common memory area. When you use the following procedure to get the memory values for these controllers, the values show up as I/O memory.	

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

⁽²⁾ 1756-L55M16 controllers have an additional memory section for logic.

To get memory information from the controller, use a MSG instruction:

MSG Configuration Tab

For this item:	Type or select:	Which means:
Message Type	CIP Generic	Execute a Control and Information Protocol command.
Service Type	Custom	Create a CIP Generic message that is not available in the drop-down list.
Service Code	3	Use the GetAttributeList service. This lets you read specific information about the controller.
Class	72	Get information from the user memory object.
Instance	1	This object contains only 1 instance.
Attribute	0	Null value

For this item:	Type or select:	Which means:	
Source Element	<i>source_array</i> of type SINT[12]		
	In this element:	Enter:	Which means:
	<i>source_array</i> [0]	5	Get 5 attributes
	<i>source_array</i> [1]	0	Null value
	<i>source_array</i> [2]	1	Get free memory
	<i>source_array</i> [3]	0	Null value
	<i>source_array</i> [4]	2	Get total memory
	<i>source_array</i> [5]	0	Null value
	<i>source_array</i> [6]	5	Get largest contiguous block of additional free logic memory
	<i>source_array</i> [7]	0	Null value
	<i>source_array</i> [8]	6	Get largest contiguous block of free I/O memory
	<i>source_array</i> [9]	0	Null value
	<i>source_array</i> [10]	7	Get largest contiguous block of free data and logic memory
	<i>source_array</i> [11]	0	Null value
Source Length	12	Write 12 bytes (12 SINTs).	
Destination	<i>INT_array</i> of type INT[29]		

MSG Communication Tab

For this item:	Type:
Path	1, <i>slot_number_of_controller</i>

The MSG instruction returns the following information to *INT_array* (destination tag of the MSG):

If you want the:	Then copy these array elements:	Description:
amount of free I/O memory (32-bit words)	<i>INT_array</i> [3]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [4]	upper 16 bits of the 32 bit value
amount of free data and logic memory (32-bit words)	<i>INT_array</i> [5]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [6]	upper 16 bits of the 32 bit value
1756-L55M16 controllers only—amount of additional free logic memory (32-bit words)	<i>INT_array</i> [7]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [8]	upper 16 bits of the 32 bit value
total size of I/O memory (32-bit words)	<i>INT_array</i> [11]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [12]	upper 16 bits of the 32 bit value
total size of data and logic memory (32-bit words)	<i>INT_array</i> [13]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [14]	upper 16 bits of the 32 bit value
1756-L55M16 controllers only—additional logic memory (32-bit words)	<i>INT_array</i> [15]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [16]	upper 16 bits of the 32 bit value

If you want the:	Then copy these array elements:	Description:
1756-L55M16 controllers only—largest contiguous block of additional free logic memory (32-bit words)	<i>INT_array</i> [19]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [20]	upper 16 bits of the 32 bit value
largest contiguous block of free I/O memory (32-bit words)	<i>INT_array</i> [23]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [24]	upper 16 bits of the 32 bit value
largest contiguous block of free data and logic memory (32-bit words)	<i>INT_array</i> [27]	lower 16 bits of the 32 bit value
	<i>INT_array</i> [28]	upper 16 bits of the 32 bit value

The MSG instruction returns each memory value as two separate INTs.

- The first INT represents the lower 16 bits of the value.
- The second INT represents the upper 16 bits of the value.

To convert the separate INTs into one usable value, use a Copy (COP) instruction, where:

In this operand:	Specify:	Which means:
Source	first INT of the 2 element pair (lower 16 bits)	Start with the lower 16 bits
Destination	DINT tag in which to store the 32-bit value	Copy the value to the DINT tag.
Length	1	Copy 1 times the number of bytes in the Destination data type. In this case, the instruction copies 4 bytes (32 bits), which combines the lower and upper 16 bits into one 32-bit value.

Communication Options

Select a method for transferring data between controllers:

If the data:	Then:	See page:
needs regular delivery at a rate that you specify (i.e., deterministic)	produce and consume a tag	7-2
is sent when a specific condition occurs in your application	send a message	7-9
is transmitted between Logix controllers and PLC or SLC processors	map PLC/SLC addresses	7-13
is gathered from multiple controllers (and consumed tags are not an option or not desired)	send a message to multiple controllers	7-13

Produce and Consume a Tag

You can use produced and consumed tags with the following controller and network combinations.

This controller:	Can produce and consume tags over this network:		
	Logix Backplane	ControlNet	EtherNet/IP
SLC 500		X	
PLC-5		X	
ControlLogix	X	X	X
1769-L35E CompactLogix			X
FlexLogix		X	X
PowerFlex 700S with DriveLogix		X	X
SoftLogix		X	

Produced and consumed tags work as follows:

- A connection transfers the data between controllers:
 - Multiple controllers can consume (receive) the data.
 - The data updates at the requested packet interval (RPI), as configured by the consuming tags.

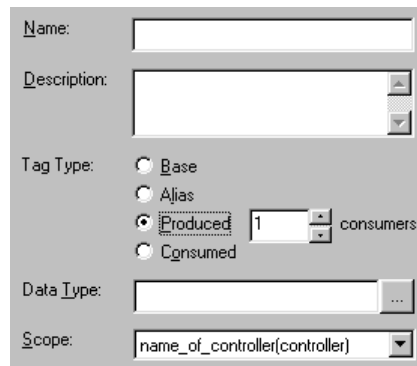
- Each produced or consumed tag uses the following number of connections:

Each:	Uses this many connections at the local controller:	Uses this many connections at the communication device:
produced tag	<i>number_of_consumers + 1</i>	<i>number_of_consumers</i>
consumed tag	1	1

Follow these guidelines:

- Create the tags at the controller scope. You can only share controller-scoped tags.
- Use one of these data types:
 - DINT
 - REAL
 - array of DINTs or REALs
 - user-defined
- Use the same data type for the produced tag and corresponding consumed tag (s).
- To share tags with a PLC-5C controller, use a user-defined data type.
- Limit the size of the tag to less than or equal to 500 bytes. If you must transfer more than 500 bytes, transfer the data in packets.
- If you are producing several tags for the same controller:
 - Group the data into one or more user-defined data types. (This uses less connections than producing each tag separately.)
 - Group the data according to similar update rates. (To conserve network bandwidth, use a greater RPI for less critical data.)

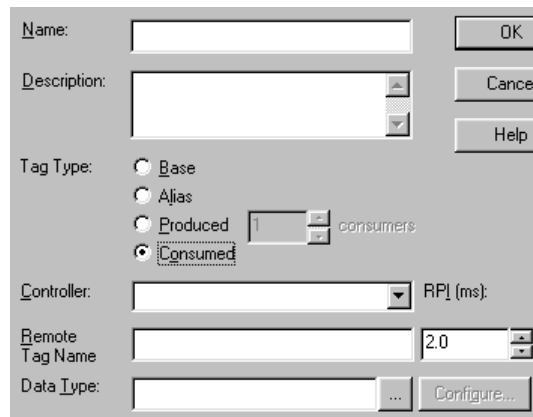
Produce a tag



The 'Produce a tag' dialog box contains the following fields and controls:

- Name:** A text input field.
- Description:** A text input field with a vertical scrollbar.
- Tag Type:** Three radio buttons: ☐ Base, ☐ Alias, and ☒ Produced. To the right of the 'Produced' radio button is a spinner box showing the value '1' and the text 'consumers'.
- Data Type:** A text input field followed by an ellipsis button (...).
- Scope:** A dropdown menu with the text 'name_of_controller(controller)'.

Consume a tag



The 'Consume a tag' dialog box contains the following fields and controls:

- Name:** A text input field.
- Description:** A text input field with a vertical scrollbar.
- Tag Type:** Three radio buttons: ☐ Base, ☐ Alias, ☐ Produced, and ☒ Consumed. To the right of the 'Consumed' radio button is a spinner box showing the value '1' and the text 'consumers'.
- Controller:** A dropdown menu.
- Remote Tag Name:** A text input field.
- RPI (ms):** A spinner box showing the value '2.0'.
- Data Type:** A text input field followed by an ellipsis button (...).
- Buttons:** 'OK', 'Cancel', 'Help', and 'Configure...'.

IMPORTANT

If a consumed-tag connection fails, all of the other tags being consumed from that remote controller stop receiving new data.

Produce tags for a PLC-5C controller

1. Create a user-defined data type that contains an array of INTs with an even number of elements, such as INT[2]. (When you produce INTs, you must produce two or more.)
2. Create a produced tag and select the user-defined data type.
3. In the ControlNet configuration for the target PLC-5C controller:
 - Insert a Receive Scheduled Message.
 - In the Message size, enter the number of integers in the produced tag.
4. In RSNetWorx for ControlNet software, schedule the network.

Produce REALs for a PLC-5C controller

1. How many values do you want to produce?

If you are producing:	Then:
Only one REAL value	Create a produced tag and select the REAL data type.
More than one REAL value	A. Create a user-defined data type that contains an array of REALs. B. Create a produced tag and select the user-defined data type from Step A.

2. In the ControlNet configuration for the target PLC-5C controller:
- Insert a Receive Scheduled Message.
 - In the Message size, enter two times the number of REALs in the produced tag. For example, if the produced tag contains 10 REALs, enter 20 for the Message size.

When a PLC-5C controller consumes a tag that is produced by a Logix5000 controller, it stores the data in consecutive 16-bit integers. The PLC-5C stores floating-point data, which requires 32-bits regardless of the type of controller, as follows:

- The first integer contains the upper (left-most) bits of the value.
 - The second integer contains the lower (right-most) bits of the value.
 - This pattern continues for each floating-point value.
3. In the PLC-5C controller, re-construct the floating point data, as depicted in the following example:
4. In RSNetWorx for ControlNet software, schedule the network.

Consume Integers from a PLC-5C Controller

- 1. In the ControlNet configuration of the PLC-5C controller, insert a Send Scheduled Message.
- 2. In the controller organizer, add the PLC-5C controller to the I/O configuration.
- 3. Create a user-defined data type that contains the following members:

Data type:	Description:
DINT	Status
INT[x], where "x" is the output size of the data from the PLC-5C controller. (If you are consuming only one INT, no dimension is required.)	Data produced by a PLC-5C controller

- 4. Create a consumed tag with the following properties:

For this tag property:	Type or select:
Tag Type	Consumed
Controller	The PLC-5C that is producing the data
Remote Instance	The message number from the ControlNet configuration of the PLC-5C controller
RPI	A power of two times the NUT of the ControlNet network. For example, if the NUT is 5ms, select an RPI of 5, 10, 20, 40, etc.
Data Type	The user-defined data type that you created.

- 5. In RSNetWorx for ControlNet software, schedule the network.

Adjust for bandwidth limitations

When you share a tag over a ControlNet network, the tag must fit within the bandwidth of the network:

- As the number of connections increases, several connections may need to share a network update time (NUT).
- Since a ControlNet network can only pass 500 bytes in one NUT, the data of each connection must be less than 500 bytes.

Depending on the size of your system, you may not have enough bandwidth. You can make these adjustments:

- Reduce your NUT. At a faster NUT, less connections have to share an update slot.
- Increase the RPI of your connections. At higher RPIs, connections can take turns sending data during an update slot.
- For a ControlNet bridge module in a remote chassis, select the most efficient communication format for that chassis:

Are most of the modules in the chassis non-diagnostic, digital I/O modules?	Then select this communication format for the remote CNB module:
Yes	Rack Optimization
No	None

The Rack Optimization format uses an additional 8 bytes for each slot in its chassis. Analog modules or modules that are sending or getting diagnostic, fuse, timestamp, or schedule data require direct connections and cannot take advantage of the rack optimized form. Selecting “None” frees up the 8 bytes per slot for other uses, such as produced or consumed tags.

- Separate the tag into two or more smaller tags:
 - Group the data according to similar update rates.
 - Assign a different RPI to each tag.
- Create logic to transfer the data in smaller sections (packets).

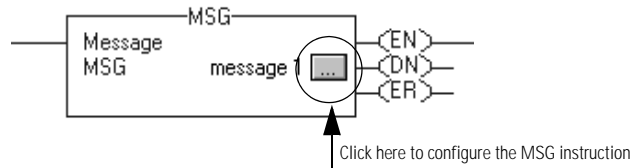
Send a Message

For each message, create a tag to control the message:

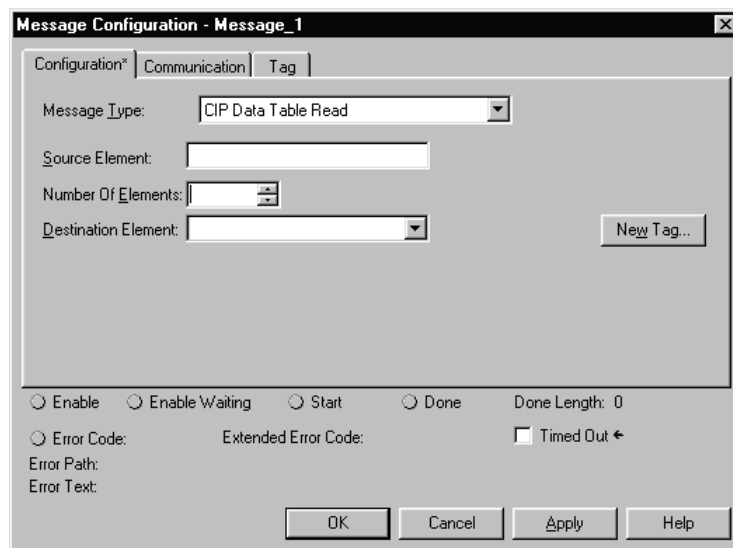
- Create the tag at the controller scope.
- Use the MESSAGE data type.
- In the Logix5000 controller, use the **DINT** data type for integers whenever possible. Logix5000 controllers execute more efficiently and use less memory when working with 32-bit integers (DINTs).
- If your message is to or from a PLC-5[®] or SLC 500[™] controller *and* it transfers integers (not REALs), use a buffer of **INT**s:
 - Create a buffer for the data (controller scope) using the *INT[x]* data type.
 - Use an FAL instruction to move the data between the buffer and your application.

To send the same message to multiple controllers, reconfigure the MSG instruction during runtime, write new values to the members of the MESSAGE data type.

After you enter the MSG instruction and specify the MESSAGE structure, use the Message Configuration dialog box to specify the details of the message.



The details you configure depend on the message type you select.



The image shows a dialog box titled "Message Configuration - Message_1". It has three tabs: "Configuration*", "Communication", and "Tag". The "Configuration*" tab is active. Inside the dialog, there are several fields and controls:

- Message Type:** A dropdown menu with "CIP Data Table Read" selected.
- Source Element:** A text input field.
- Number Of Elements:** A spinner control.
- Destination Element:** A dropdown menu.
- New Tag...** A button to the right of the Destination Element dropdown.
- Enable:** A radio button.
- Enable Waiting:** A radio button.
- Start:** A radio button.
- Done:** A radio button.
- Done Length:** A text field with the value "0".
- Error Code:** A radio button.
- Extended Error Code:** A text field.
- Timed Out:** A checkbox.
- Error Path:** A text field.
- Error Text:** A text field.
- Buttons:** "OK", "Cancel", "Apply", and "Help" at the bottom.

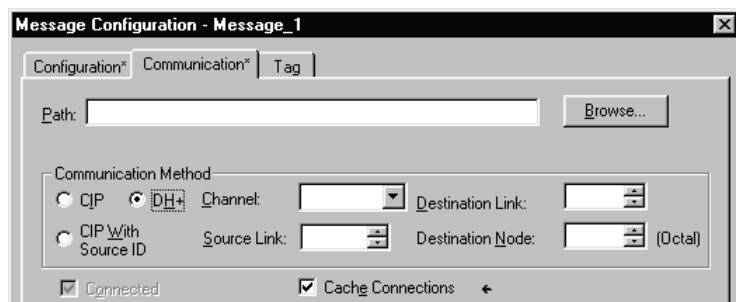
Specify the message type:

If the target device is a:	Select one of these message types:
Logix controller	CIP Data Table Read/Write
I/O module that you configure using RSLogix 5000 software	Module Reconfigure
	CIP Generic
PLC-5 controller	PLC5 Typed Read/Write
	PLC5 Word Range Read/Write
SLC controller MicroLogix controller	SLC Typed Read/Write
Block-transfer module	Block-Transfer Read/Write
PLC-3 processor	PLC3 Typed Read/write
	PLC3 Word Range Read/write
PLC-2 processor	PLC2 Unprotected Read/write

Then, specify this configuration information:

For this property:	Specify:
Source Element	<ul style="list-style-type: none"> If you select a read message type, the Source Element is the address of the data you want to read in the target device. Use the addressing syntax of the target device. If you select a write message type, the Source Tag is the first element of the tag that you want to send to the target device.
Number of Elements	The number of elements you read/write depends on the type of data you are using. An element refers to one “chunk” of related data. For example, tag <i>timer1</i> is one element that consists of one timer control structure.
Destination Element	<ul style="list-style-type: none"> If you select a read message type, the Destination Element is the first element of the tag in the Logix5000 controller where you want to store the data you read from the target device. If you select a write message type, the Destination Element is the address of the location in the target device where you want to write the data.

When you configure a MSG instruction, specify these details on the Communication tab.



Map PLC/SLC Addresses

You only map PLC/SLC addresses if you send a message from a PLC or SLC 500 processor to a Logix controller and the PLC/SLC processor does not support logical ASCII addressing. To use a logical address (e.g., N7:0) to specify a value (tag) in a Logix controller, you must map files to tags:

- You only have to map the file numbers that are used in messages; the other file numbers do not need to be mapped.
- The mapping table is loaded into the controller and is used whenever a “logical” address accesses data.
- You can only access controller-scoped tags (global data).

For each file that is referenced in a PLC or SLC command, make a map entry:



- Type the file number of the logical address.
- Type or select the controller-scoped (global) tag that supplies or receives data for the file number. (You can map multiple files to the same tag.)
- For PLC-2 commands, specify the tag that supplies or receives the data.

Send a Message to Multiple Devices

To send a message to multiple devices:

- Define source and destination elements
- Create the MESSAGE_CONFIGURATION data type
- Create the configuration array
- Get the size of the local array
- Load the message properties for a device
- Configure the message
- Step to the next device

Define source and destination elements

An array stores the data that is read from or written to each remote controller. Each element in the array corresponds to a different remote device.

Create the *local_array* tag, which stores the data in this controller.

Tag Name	Type
local_array	<i>data_type</i> [<i>length</i>] where: <i>data_type</i> is the data type of the data that the message sends or receives, such as DINT, REAL, or STRING. <i>length</i> is the number of elements in the local array.

Create the MESSAGE_CONFIGURATION data type

Create a user-defined data type to store the configuration variables for the message to each device.

- Some of the required members of the data type use a string data type.
- The default STRING data type stores 82 characters.
- If your paths or remote tag names or addresses use less than 82 characters, you have the option of creating a new string type that stores fewer characters. This lets you conserve memory.
- To create a new string type, choose *File* ⇒ *New Component* ⇒ *String Type...*
- If you create a new string type, use it in place of the STRING data type in this procedure.

To store the configuration variables for the message to each controller, create the following user-defined data type.

Data Type: MESSAGE_CONFIGURATION				
Name		MESSAGE_CONFIGURATION		
Description		Configuration properties for a message to another controller		
Members				
	Name	Data Type	Style	Description
	<div><div></div>Path</div>	STRING		
	<div><div></div>RemoteElement</div>	STRING		

Create the configuration array





Store the configuration properties for each device in an array. Before each execution of the MSG instruction, your logic loads new properties into the instruction. This sends the message to a different controller.

1. Create this array:

Tag Name	Type	Scope
message_config	MESSAGE_CONFIGURATION[<i>number</i>]	any

where *number* is the number of devices to which to send the message.

2. Into the *message_config* array, enter the **path** to the first controller that receives the message.

Tag Name	Value
 message_config	{...}
 message_config[0]	{...}
 message_config[0].Path	
 message_config[0].RemoteElement	

Right-click and choose *Go to Message Path Editor*.



Type the **path** to the remote controller.



or

Browse to the remote controller.



Message Path Browser


Path:

peer_controller

I/O Configuration

3. Into the *message_config* array, enter the tag name or address of the data in the first controller to receive the message.

Tag Name	Value
<input type="checkbox"/> message_config	{...}
<input type="checkbox"/> message_config[0]	{...}
<input type="checkbox"/> message_config[0].Path	
<input type="checkbox"/> message_config[0].RemoteElement	...
<input type="checkbox"/> message_config[1]	{...}
<input type="checkbox"/> message_config[1].Path	
<input type="checkbox"/> message_config[1].RemoteElement	



Type the tag name or address of the data in the other controller.

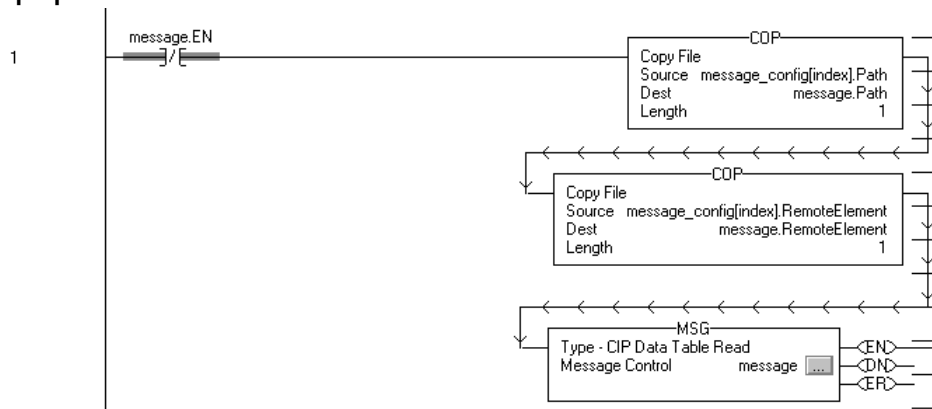
4. Enter the path and remote element for each additional controller:

Tag Name	Value
<input type="checkbox"/> message_config	{...}
<input type="checkbox"/> message_config[0]	{...}
<input type="checkbox"/> message_config[0].Path	
<input type="checkbox"/> message_config[0].RemoteElement	
<input type="checkbox"/> message_config[1]	{...}
<input type="checkbox"/> message_config[1].Path	←
<input type="checkbox"/> message_config[1].RemoteElement	←

Get the size of the local array

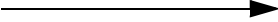


Load the message properties for a device

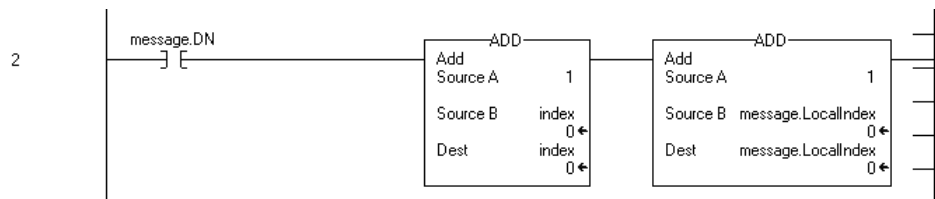


Configure the message

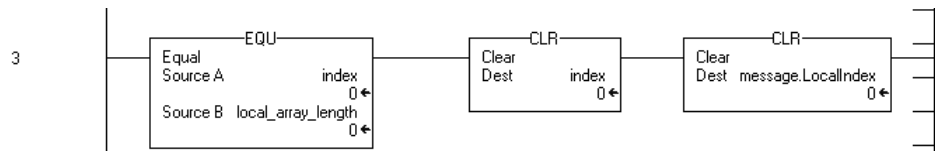
Although your logic controls the remote element and path for the message, the Message Properties dialog box requires an initial configuration. Make sure to clear the Cache Connections option.

On this tab:	If you want to:	For this item:	Type or select:
Configuration	read (receive) data from the other controllers	Message Type	the read-type that corresponds to the other controllers
		Source Element	tag or address that contains the data in the first controller
		Number Of Elements	1
		Destination Tag	local_array[*]
		Index	0
	write (send) data to the other controllers	Message Type	the write-type that corresponds to other controllers
		Source Tag	local_array[*]
		Index	0
		Number Of Elements	1
		Destination Element	tag or address that contains the data in the first controller
Communication		Path	path to the first controller
		Cache Connections	Clear the <i>Cache Connection</i> check box. Since this procedure continuously changes the path of the message, it is more efficient to clear this check box.

Step to the next controller



Restart the sequence



Notes:

What You Can Force

Use a force to override data that your logic either uses or produces. For example, use forces in the following situations:

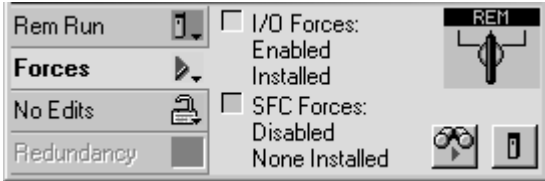
- test and debug your logic
- check wiring to an output device
- temporarily keep your process functioning when an input device has failed

Use forces only as a temporary measure. They are *not* intended to be a permanent part of your application.

You can force the following elements:

If you want to:	Then:
override an input value, output value, produced tag, or consumed tag	add an I/O force
override the conditions of a transition one time to go from an active step to the next step	step through a transition or a force of a path
override one time the force of a simultaneous path and execute the steps of the path	
override the conditions of a transition in a sequential function chart	add an SFC force
execute some but not all the paths of a simultaneous branch of a sequential function chart	

Before you use a force, determine the status of forces for the controller:

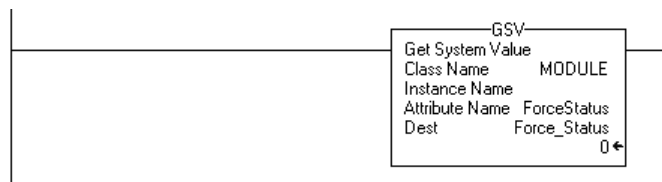
Use this method:	To determine the status of:	Description:								
online toolbar	I/O forces SFC forces	<div>Forces tab → </div>								
FORCE LED	I/O forces	<table><tr><th>If the FORCE LED is:</th><th>Then:</th></tr><tr><td>off</td><td><ul style="list-style-type: none">No tags contain force values.I/O forces are inactive (disabled).</td></tr><tr><td>flashing</td><td><ul style="list-style-type: none">At least one tag contains a force value.I/O forces are inactive (disabled).</td></tr><tr><td>solid</td><td><ul style="list-style-type: none">I/O forces are active (enabled).Force values may or may not exist.</td></tr></table>	If the FORCE LED is:	Then:	off	<ul style="list-style-type: none">No tags contain force values.I/O forces are inactive (disabled).	flashing	<ul style="list-style-type: none">At least one tag contains a force value.I/O forces are inactive (disabled).	solid	<ul style="list-style-type: none">I/O forces are active (enabled).Force values may or may not exist.
If the FORCE LED is:	Then:									
off	<ul style="list-style-type: none">No tags contain force values.I/O forces are inactive (disabled).									
flashing	<ul style="list-style-type: none">At least one tag contains a force value.I/O forces are inactive (disabled).									
solid	<ul style="list-style-type: none">I/O forces are active (enabled).Force values may or may not exist.									

continued

Use this method: **To determine the status of:** **Description:**

GSV instruction

I/O forces



Force_Status is a DINT tag.

To determine if:	Examine this bit:	For this value:
forces are installed	0	1
<i>no</i> forces are installed	0	0
forces are enabled	1	1
forces are disabled	1	0

Force I/O

Use an I/O force to accomplish the following:

- override an input value from another controller (i.e., a consumed tag)
- override an input value from an input device
- override your logic and specify an output value for another controller (i.e., a produced tag)
- override your logic and specify the state of an output device

IMPORTANT

Forcing increases logic execution time. The more values you force, the longer it takes to execute the logic.

IMPORTANT

I/O forces are held by the controller and not by the programming workstation. Forces remain even if the programming workstation is disconnected.

When you force an I/O value:

- You can force all I/O data, except for configuration data.
- If the tag is an array or structure, such as an I/O tag, force a BOOL, SINT, INT, DINT, or REAL element or member.
- If the data value is a SINT, INT, or DINT, you can force the entire value or you can force individual bits within the value.
- You can also force an alias to an I/O structure member, produced tag, or consumed tag. An alias tag shares the same data value as its base tag, so forcing an alias tag also forces the associated base tag.

Forcing an input or consumed tag:

- overrides the value regardless of the value of the physical device or produced tag
- does not affect the value received by other controllers monitoring that input or produced tag

Forcing an output or produced tag overrides the logic for the physical device or other controller (s). Other controllers monitoring that output module in a listen-only capacity will also see the forced value.

To force I/O:

1. What is the state of the I/O Forces indicator?

If:	Then note the following:
off	No I/O forces currently exist.
flashing	No I/O forces are active. But at least one force already exists in your project. When you enable I/O forces, <i>all</i> existing I/O forces will also take effect.
solid	I/O forces are enabled (active). When you install (add) a force, it immediately takes effect.

- 2. Open the routine that contains the tag that you want to force.
- 3. Right-click the tag and choose *Monitor...* If necessary, expand the tag to show the value that you want to force.
- 4. Install the force value:

To force a:	Do this:
BOOL value	Right-click the tag and choose <i>Force ON</i> or <i>Force OFF</i> .
non-BOOL value	In the <i>Force Mask</i> column for the tag, type the value to which you want to force the tag. Then press the <i>Enter</i> key.

- 5. Are I/O forces enabled? (See **step 1.**)

If:	Then:
no	From the <i>Logic</i> menu, choose <i>I/O Forcing</i> ⇒ <i>Enable All I/O Forces</i> . Then choose <i>Yes</i> to confirm.
yes	Stop.

Step Through a Transition

To override a false transition one time and go from an active step to the next step, use the *Step Through* option.

With the *Step Through* option:

- You *do not* have to add, enable, disable, or remove forces.
- The next time the SFC reaches the transition, it executes according to the conditions of the transition.

To step through the transition of an active step or a force of a simultaneous path:

1. Open the SFC routine.
2. Right-click the transition or the path that is forced and choose *Step Through*.

Force an SFC

To override the logic of an SFC, you have the following options:

If you want to:	Then:
override the conditions of a transition each time the SFC reaches the transition	Force a Transition
prevent the execution of one or more paths of a simultaneous branch	Force a Simultaneous Path

Force a Transition

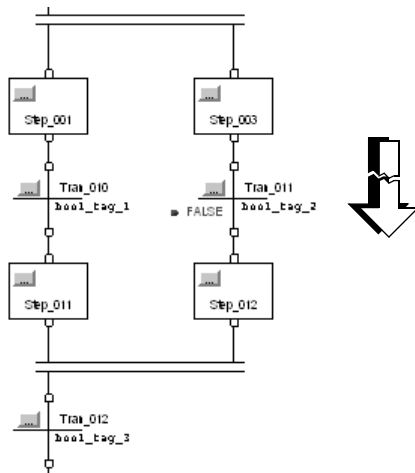
To override the conditions of a transition through repeated executions of an SFC, force the transition. The force remains until you remove it or disable forces

If you want to:	Then:
prevent the SFC from going to the next step	force the transition false
cause the SFC go to the next step regardless of transition conditions	force the transition true

If you force a transition within a simultaneous branch to be false, the SFC stays in the simultaneous branch as long as the force is active (installed and enabled).

- To leave a simultaneous branch, the last step of each path must execute at least one time and the transition below the branch must be true.
- Forcing a transition false prevents the SFC from reaching the last step of a path.

- When you remove or disable the force, the SFC can execute the rest of the steps in the path.

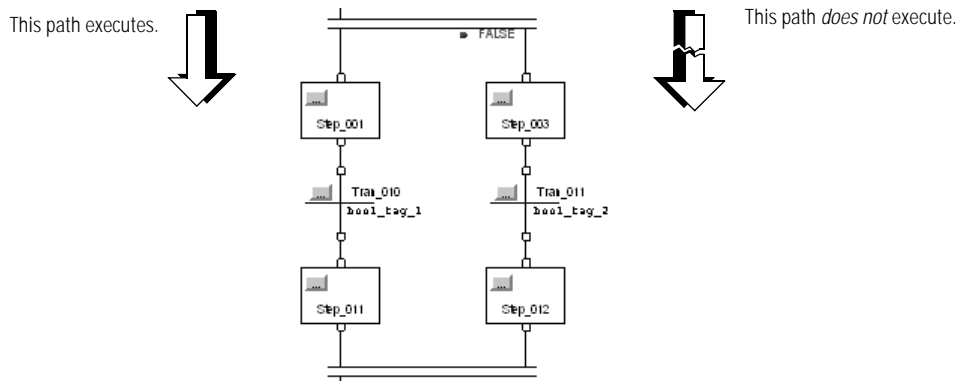


For example, to exit this branch, the SFC must be able to:

- execute *Step_011* at least once
- get past *Tran_011* and execute *Step_012* at least once
- determine that *Tran_012* is true

Force a Simultaneous Path

To prevent the execution of a path of a simultaneous branch, force the path false. When the SFC reaches the branch, it executes only the un-forced paths.



If you force a path of a simultaneous branch to be false, the SFC stays in the simultaneous branch as long as the force is active (installed and enabled).

- To leave a simultaneous branch, the last step of each path must execute at least one time and the transition below the branch must be true.
- Forcing a path false prevents the SFC from entering a path and executing its steps.
- When you remove or disable the force, the SFC can execute the steps in the path.

To force an SFC:

1. What is the state of the SFC Forces indicator?

If:	Then note the following:
off	No SFC forces currently exist.
flashing	No SFC forces are active. But at least one force already exists in your project. When you enable SFC forces, <i>all</i> existing SFC forces will also take effect.
solid	SFC forces are enabled (active). When you install (add) a force, it immediately takes effect.

2. Open the SFC routine.
3. Right-click the transition or start of a simultaneous path that you want to force, and choose either *Force TRUE* (only for a transition) or *Force FALSE*.
4. Are SFC forces enabled?

If:	Then:
no	From the <i>Logic</i> menu, choose <i>SFC Forcing</i> \Rightarrow <i>Enable All SFC Forces</i> . Then choose <i>Yes</i> to confirm.
yes	Stop.

Notes:

Controller Faults

The controller stored different fault information:

Fault type:	Description:	See page:
major fault	<p>A fault condition that is severe enough for the controller to shut down, unless the condition is cleared.</p> <p>When a major fault occurs, the controller:</p> <ol style="list-style-type: none"> 1. Sets a major fault bit 2. Runs user-supplied fault logic, if it exists 3. If the user-supplied fault logic cannot clear the fault, the controller goes to faulted mode 4. Sets outputs according to their output state during program mode 5. OK LED flashes red 	9-2
minor fault	A fault condition that is <i>not</i> severe enough for the controller to shut down.	9-10
user-defined faults	<p>If you want to suspend (shut down) the controller based on conditions in your application, create a user-defined major fault. With a user-defined major fault:</p> <ul style="list-style-type: none"> • You define a value for the fault code. • The controller handles the fault the same as other major faults: <ul style="list-style-type: none"> – The controller changes to the faulted mode (major fault) and stops executing the logic. – Outputs are set to their configured state or value for faulted mode. 	9-14

Major Faults

If a fault condition occurs that is severe enough for the controller to shut down, the controller generates a major fault and stops the execution of logic.

- 1. Create the following user-defined data type. It stores information about the fault.

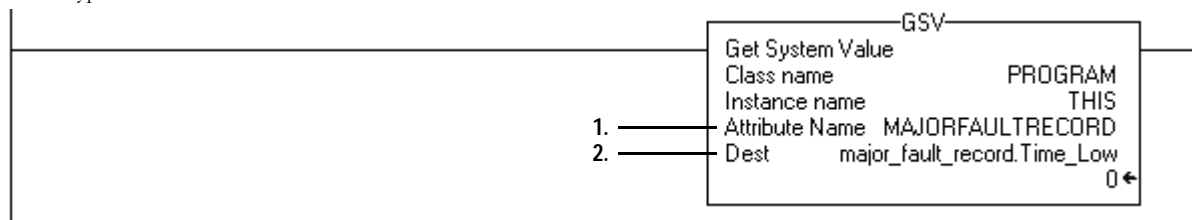
Data Type: FAULTRECORD					
Name		FAULTRECORD			
Description		Stores the MajorFaultRecord attribute or MinorFaultRecord attribute of the PROGRAM object.			
Members					
	Name	Data Type	Style	Description	
	Time_Low	DINT	Decimal	lower 32 bits of the fault timestamp value	
	Time_High	DINT	Decimal	upper 32 bits of the fault timestamp value	
	Type	INT	Decimal	fault type (program, I/O, etc.)	
	Code	INT	Decimal	unique code for the fault	
	Info	DINT[8]	Hex	fault specific information	

2. Create a fault routine to clear specific faults and let the controller resume execution. Where you place the routine depends on the type of fault that you want to clear:

For a fault due to:	Do this:
execution of an instruction	Create a fault routine for the program: <ul style="list-style-type: none"> • In the controller organizer, right-click the program and select New Routine. <ol style="list-style-type: none"> a. In the name box, type a name for the fault routine. b. From the Type drop-down list, select Ladder. • Right-click the program and select Properties. <ol style="list-style-type: none"> a. Click the Configuration tab. b. From the Fault drop-down list, select the fault routine
power loss	Create a program and main routine for the Controller Fault Handler: <ul style="list-style-type: none"> • In the controller organizer, right-click Controller Fault Handler and select New Program. <ol style="list-style-type: none"> a. Enter the name of the program and a description. • Click the + sign next to Controller Fault Handler. • Right-click the program and select the New Routine <ol style="list-style-type: none"> a. Enter the name of the routine and a description. b. From the Type drop-down list, select the programming language for the routine. c. Right-click the program and select Properties. d. Click the Configuration tab. e. From the Main drop-down list, select the routine
I/O	
task watchdog	
mode change	
motion axis	

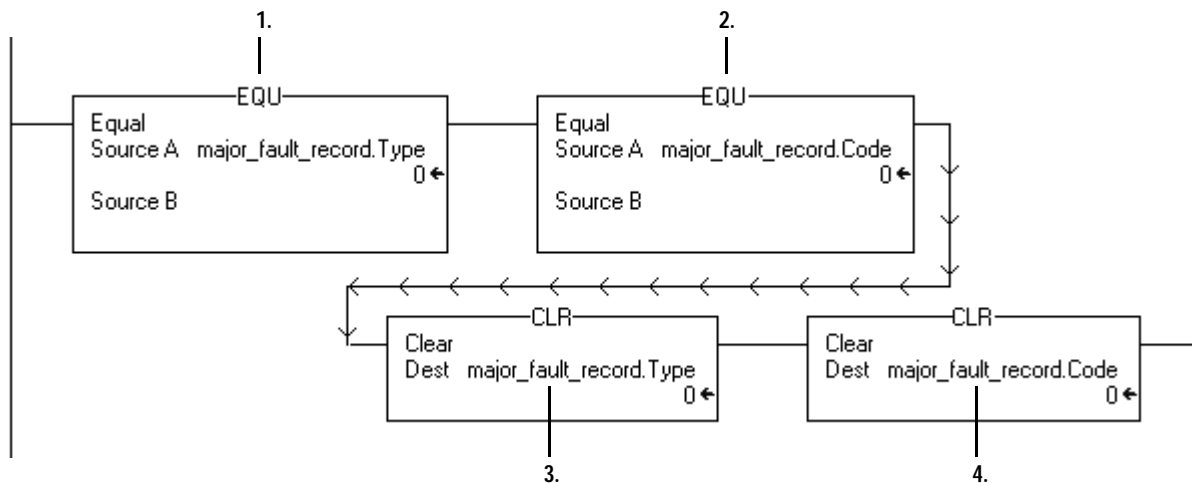
3. To clear a major fault that occurs during the execution of your project, use the following logic to:

- Get the fault type and code



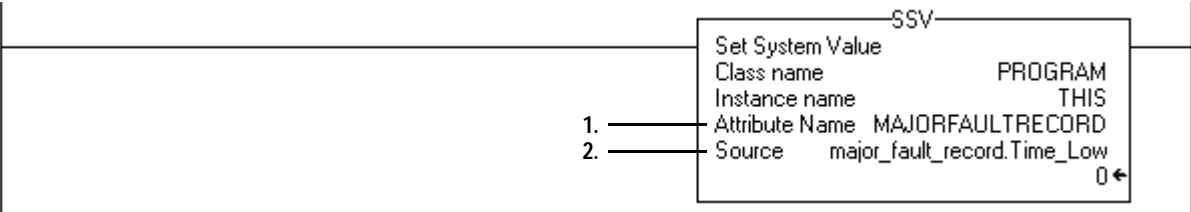
1. The GSV instruction accesses the MAJORFAULTRECORD attribute of this program.
2. The GSV instruction stores the fault information in the major_fault_record tag.

- Check for a specific fault



1. This EQU instruction checks for a specific type of fault, such as program, I/O. In Source B, enter the value for the type of fault that you want to clear.
2. This EQU instruction checks for a specific fault code. In Source B, enter the value for the code that you want to clear.
3. This CLR instruction sets to zero the value of the fault type in the major_fault_record tag.
4. This CLR instruction sets to zero the value of the fault code in the major_fault_record tag.

- Clear the fault



1. The SSV instruction writes new values to the MAJORFAULTRECORD attribute of this program.
2. The SSV instruction writes the values contained in the *major_fault_record* tag. Since the *Type* and *Code* member are set to zero, the fault clears and the controller resumes execution.

Major Fault Codes

Type:	Code:	Cause:	Recovery Method:
1	1	The controller powered on in Run mode.	Execute the power-loss handler.
3	16	A required I/O module connection failed.	Check that the I/O module is in the chassis. Check electronic keying requirements. View the controller properties Major Fault tab and the module properties Connection tab for more information about the fault.
3	20	Possible problem with the ControlBus chassis.	Not recoverable - replace the chassis.
3	23	At least one required connection was not established before going to Run mode.	Wait for the controller I/O light to turn green before changing to Run mode.
4	16	Unknown instruction encountered.	Remove the unknown instruction. This probably happened due to a program conversion process.
4	20	Array subscript too big, control structure .POS or .LEN is invalid.	Adjust the value to be within the valid range. Don't exceed the array size or go beyond dimensions defined.
4	21	Control structure .LEN or .POS < 0.	Adjust the value so it is > 0.
4	31	The parameters of the JSR instruction do not match those of the associated SBR or RET instruction.	Pass the appropriate number of parameters. If too many parameters are passed, the extra ones are ignored without any error.
4	34	A timer instruction has a negative preset or accumulated value.	Fix the program to not load a negative value into timer preset or accumulated value.
4	42	JMP to a label that did not exist or was deleted.	Correct the JMP target or add the missing label.

9 - 8 System Faults

Type:	Code:	Cause:	Recovery Method:
4	82	A sequential function chart (SFC) called a subroutine and the subroutine tried to jump back to the calling SFC. Occurs when the SFC uses either a JSR or FOR instruction to call the subroutine.	Remove the jump back to the calling SFC.
4	83	The data tested was not inside the required limits.	Modify value to be within limits.
4	84	Stack overflow.	Reduce the subroutine nesting levels or the number of parameters passed.
4	89	In a SFR instruction, the target routine does not contain the target step.	Correct the SFR target or add the missing step.
4	user defined	A user-defined fault.	
6	1	Task watchdog expired. User task has not completed in specified period of time. A program error caused an infinite loop, or the program is too complex to execute as quickly as specified, or a higher priority task is keeping this task from finishing.	Increase the task watchdog, shorten the execution time, make the priority of this task "higher," simplify higher priority tasks, or move some code to another controller.
7	40	Store to nonvolatile memory failed.	<ol style="list-style-type: none"> 1. Try again to store the project to nonvolatile memory. 2. If the project fails to store to nonvolatile memory, replace the memory board.
7	42	Load from nonvolatile memory failed because the firmware revision of the project in nonvolatile memory does not match the firmware revision of the controller.	Update the controller firmware to the same revision level as the project that is in nonvolatile memory.
8	1	Attempted to place controller in Run mode with keyswitch during download.	Wait for the download to complete and clear fault.

Type:	Code:	Cause:	Recovery Method:
11	1	Actual position has exceeded positive overtravel limit.	Move axis in negative direction until position is within overtravel limit and then execute Motion Axis Fault Reset.
11	2	Actual position has exceeded negative overtravel limit.	Move axis in positive direction until position is within overtravel limit and then execute Motion Axis Fault Reset.
11	3	Actual position has exceeded position error tolerance.	Move the position within tolerance and then execute Motion Axis Fault Reset.
11	4	Encoder channel A, B, or Z connection is broken.	Reconnect the encoder channel then execute Motion Axis Fault Reset.
11	5	Encoder noise event detected or the encoder signals are not in quadrature.	Fix encoder cabling then execute Motion Axis Fault Reset.
11	6	Drive Fault input was activated.	Clear Drive Fault then execute Motion Axis Fault Reset.
11	7	Synchronous connection incurred a failure.	First execute Motion Axis Fault Reset. If that doesn't work, pull servo module out and plug back in. If all else fails replace servo module.
11	8	Servo module has detected a serious hardware fault.	Replace the module.
11	9	Asynchronous Connection has incurred a failure.	First execute Motion Axis Fault Reset. If that doesn't work, pull servo module out and plug back in. If all else fails replace servo module.
11	32	The motion task has experienced an overlap.	The group's course update rate is too high to maintain correct operation. Clear the group fault tag, raise the group's update rate, and then clear the major fault.

Minor Faults

If a fault condition occurs that is *not* severe enough for the controller to shut down, the controller generates a **minor fault**.

- The controller continues to execute.
- You do not need to clear a minor fault.
- To optimize execution time and ensure program accuracy, you should monitor and correct minor faults.

To use ladder logic to capture information about a minor fault:

To check for a:	Do this:
periodic task overlap	1. Enter a GSV instructions that gets the FAULTLOG object, MinorFaultBits attribute. 2. Monitor bit 6.
load from nonvolatile memory	1. Enter a GSV instructions that gets the FAULTLOG object, MinorFaultBits attribute. 2. Monitor bit 7.
problem with the serial port	1. Enter a GSV instructions that gets the FAULTLOG object, MinorFaultBits attribute. 2. Monitor bit 9.
low battery	1. Enter a GSV instructions that gets the FAULTLOG object, MinorFaultBits attribute. 2. Monitor bit 10.

To check for a:**Do this:**

problem with an instruction

1. Create a user-defined data type that stores the fault information. Name the data type *FaultRecord* and assign the following members:

Name:	Data Type:	Style:
TimeLow	DINT	Decimal
TimeHigh	DINT	Decimal
Type	INT	Decimal
Code	INT	Decimal
Info	DINT[8]	Hex

2. Create a tag that will store the values of the MinorFaultRecord attribute.
 3. Monitor S:MINOR.
 4. If S:MINOR is on, use a GSV instruction to get the values of the MinorFaultRecord attribute.
 5. To detect a minor fault that is caused by another instruction, reset S:MINOR. (S:MINOR remains set until the end of the scan.)
-

Minor Fault Codes

Type:	Code:	Cause:	Recovery Method:
4	4	An arithmetic overflow occurred in an instruction.	Fix program by examining arithmetic operations (order) or adjusting values.
4	7	The GSV/SSV destination tag was too small to hold all of the data.	Fix the destination so it has enough space.
4	35	PID delta time ≤ 0 .	Adjust the PID delta time so that it is > 0 .
4	36	PID setpoint out of range	Adjust the setpoint so that it is within range.
4	51	The LEN value of the string tag is greater than the DATA size of the string tag.	<ol style="list-style-type: none"> 1. Check that no instruction is writing to the LEN member of the string tag. 2. In the LEN value, enter the number of characters that the string contains.
4	52	The output string is larger than the destination.	Create a new string data type that is large enough for the output string. Use the new string data type as the data type for the destination.
4	53	The output number is beyond the limits of the destination data type.	Either: <ul style="list-style-type: none"> • Reduce the size of the ASCII value. • Use a larger data type for the destination.
4	56	The Start or Quantity value is invalid.	<ol style="list-style-type: none"> 1. Check that the Start value is between 1 and the DATA size of the Source. 2. Check that the Start value plus the Quantity value is less than or equal to the DATA size of the Source.
4	57	The AHL instruction failed to execute because the serial port is set to no handshaking.	Either: <ul style="list-style-type: none"> • Change the Control Line setting of the serial port. • Delete the AHL instruction.
6	2	Periodic task overlap. Periodic task has not completed before it is time to execute again.	Simplify program(s), or lengthen period, or raise relative priority, etc.

Type:	Code:	Cause:	Recovery Method:
7	49	Project loaded from nonvolatile memory.	
9	0	Unknown error while servicing the serial port.	Contact Technical Support group.
9	1	The CTS line is not correct for the current configuration.	Disconnect and reconnect the serial port cable to the controller. Make sure the cable is wired correctly
9	2	Poll list error. A problem was detected with the DF1 master's poll list, such as specifying more stations than the size of the file, specifying more than 255 stations, trying to index past the end of the list, or polling the broadcast address (STN #255).	Check for the following errors in the poll list: <ul style="list-style-type: none"> • total number of stations is greater than the space in the poll list tag • total number of stations is greater than 255 • current station pointer is greater than the end of the poll list tag • a station number greater than 254 was encountered
9	5	DF1 slave poll timeout. The poll watchdog has timed out for slave. The master has not polled this controller in the specified amount of time.	Determine and correct delay for polling.
9	9	Modem contact was lost. DCD and/or DSR control lines are not being received in proper sequence and/or state.	Correct modem connection to the controller.
10	10	Battery not detected or needs to be replaced.	Install new battery.

User-Defined Faults

If you want to suspend (shut down) the controller based on conditions in your application, create a user-defined major fault. With a user-defined major fault:

- The fault type is always 4.
- You define a value for the fault code. Make sure it isn't a code that is already used by the predefined major faults.

If you use a fault code that is already a predefined fault code, a major fault occurs.

- The controller handles the fault the same as other major faults:
 - The controller changes to the faulted mode (major fault) and stops executing the logic.
 - Outputs are set to their configured state or value for faulted mode.

In the main routine of the program, enter the following rung:



Common Structures

The following structures are common structures used by several relay ladder instructions. Function block instructions also use structures, but they are more unique to individual types of instructions.

COMPARE Structure

Mnemonic:	Data Type:	Description:
.EN	BOOL	The enable bit indicates that the instruction is enabled.
.DN	BOOL	The done bit is set when the instruction has operated on the last element (.POS = .LEN).
.FD	BOOL	The found bit is set each time the instruction records a mismatch (one-at-a-time operation) or after recording all mismatches (all-per-scan operation).
.IN	BOOL	The inhibit bit indicates the search mode. 0 = all mode 1 = one mismatch at a time mode
.ER	BOOL	The error bit is set if .POS < 0 or .LEN < 0. The instruction stops executing until the program clears the .ER bit.
.LEN	DINT	The length specifies the number of elements in the array.
.POS	DINT	The position contains the position of the current element.

CONTROL Structure

Mnemonic:	Data Type:	Description:
.EN	BOOL	The enable bit indicates that the instruction is enabled.
.DN	BOOL	The done bit is set when the instruction has operated on the last element (.POS = .LEN).
.ER	BOOL	The error bit is set if the expression generates an overflow (S:V is set). The instruction stops executing until the program clears the .ER bit. The .POS value contains the position of the element that caused the overflow.
.LEN	DINT	The length specifies the number of elements in the array.
.POS	DINT	The position contains the position of the current element.

COUNTER Structure

Mnemonic:	Data Type:	Description:
.CD	BOOL	The count down enable bit indicates that the CTD instruction is enabled.
.CU	BOOL	The count up enable bit indicates that the CTU instruction is enabled.
.DN	BOOL	The done bit indicates that $.ACC \geq .PRE$.
.OV	BOOL	The overflow bit indicates that the counter exceeded the upper limit of 2,147,483,647. The counter then rolls over to -2,147,483,648 and begins counting up again.
.UN	BOOL	The underflow bit indicates that the counter exceeded the lower limit of -2,147,483,648. The counter then rolls over to 2,147,483,647 and begins counting down again.
.PRE	DINT	The preset value specifies the value which the accumulated value must reach before the instruction sets the .DN bit.
.ACC	DINT	The accumulated value specifies the number of transitions the instruction has counted.

EXT_ROUTINE_CONTROL Structure *(SoftLogix5800 controller only)*

Mnemonic:	Data Type:	Description:
ErrorCode	SINT	If an error occurs, this value identifies the error. Valid values are from 0-255.
NumParams	SINT	This value indicates the number of parameters associated with this instruction.
ParameterDefs	EXT_ROUTINE_PARAMETERS[10]	This array contains definitions of the parameters to pass to the external routine. The instruction can pass as many as 10 parameters.

Mnemonic:	Data Type:	Description:
ReturnParamDef	EXT_ROUTIN_PARAMETERS	This value contains definitions of the return parameter from the external routine. There is only one return parameter.
EN	BOOL	When set, the enable bit indicates that the JXR instruction is enabled.
ReturnsValue	BOOL	If set, this bit indicates that a return parameter was entered for the instruction. If cleared, this bit indicates that no return parameter was entered for the instruction.
DN	BOOL	The done bit is set when the external routine has executed once to completion.
ER	BOOL	The error bit is set if an error occurs. The instruction stops executing until the program clears the error bit.
FirstScan	BOOL	This bit identifies whether this is the first scan after switching the controller to Run mode. Use FirstScan to initialize the external routine, if needed.
EnableOut	BOOL	Enable output.
EnableIn	BOOL	Enable input.
User1	BOOL	These bits are available for the user. The controller does not initialize these bits.
User0	BOOL	
ScanType1	BOOL	These bits identify the current scan type: Bit Values: 00 01 10
ScanType0	BOOL	
		Scan Type: Normal Pre Scan Post Scan (not applicable to relay ladder programs)

MESSAGE Structure

Mnemonic:	Data Type:	Description:
.FLAGS	INT	The .FLAGS member provides access to the status members (bits) in one, 16-bit word.
		This bit: Is this member:
		2 .EW
		4 .ER
		5 .DN
		6 .ST
		7 .EN
		8 .TO
		9 .EN_CC
Important: Resetting any MSG status bits while a MSG is enabled can disrupt communications.		
.ERR	INT	If the .ER bit is set, the error code word identifies error codes for the MSG instruction.
.EXERR	INT	The extended error code word specifies additional error code information for some error codes.
.REQ_LEN	INT	The requested length specifies how many words the message instruction will attempt to transfer.
.DN_LEN	INT	The done length identifies how many words actually transferred.
.EW	BOOL	The enable waiting bit is set when the controller detects that a message request has entered the queue. The controller resets the.EW bit when the .ST bit is set.

Mnemonic:	Data Type:	Description:
.ER	BOOL	The error bit is set when the controller detects that a transfer failed. The .ER bit is reset the next time the rung-condition-in goes from false to true.
.DN	BOOL	The done bit is set when the last packet of the message is successfully transferred. The .DN bit is reset the next time the rung-condition-in goes from false to true.
.ST	BOOL	The start bit is set when the controller begins executing the MSG instruction. The .ST bit is reset when the .DN bit or the .ER bit is set.
.EN	BOOL	The enable bit is set when the rung-condition-in goes true and remains set until either the .DN bit or the .ER bit is set and the rung-condition-in is false. If the rung-condition-in goes false, but the .DN bit and the .ER bit are cleared, the .EN bit remains set.
.TO	BOOL	If you manually set the .TO bit, the controller stops processing the message and sets the .ER bit.
.EN_CC	BOOL	The enable cache bit determines how to manage the MSG connection. Connections for MSG instructions going out the serial port are not cached, even if the .EN_CC bit is set.
.ERR_SRC	SINT	Used by RSLogix 5000 software to show the error path on the Message Configuration dialog box
.DestinationLink	INT	To change the Destination Link of a DH+ or CIP with Source ID message, set this member to the required value.
.DestinationNode	INT	To change the Destination Node of a DH+ or CIP with Source ID message, set this member to the required value.
.SourceLink	INT	To change the Source Link of a DH+ or CIP with Source ID message, set this member to the required value.
.Class	INT	To change the Class parameter of a CIP Generic message, set this member to the required value.
.Attribute	INT	To change the Attribute parameter of a CIP Generic message, set this member to the required value.
.Instance	DINT	To change the Instance parameter of a CIP Generic message, set this member to the required value.

Mnemonic:	Data Type:	Description:	
.LocalIndex	DINT	If you use an asterisk [*] to designate the element number of the local array, the LocalIndex provides the element number. To change the element number, set this member to the required value.	
		If the message:	Then the local array is the:
		reads data	Destination element
		writes data	Source element
.Channel	SINT	To send the message out a different channel of the 1756-DHRIO module, set this member to the required value. Use either the ASCII character A or B.	
.Rack	SINT	To change the rack number for a block transfer message, set this member to the required rack number (octal).	
.Group	SINT	To change the group number for a block transfer message, set this member to the required group number (octal).	
.Slot	SINT	To change the slot number for a block transfer message, set this member to the required slot number.	
		If the network is:	Then specify the slot number in:
		universal remote I/O	octal
		ControlNet	decimal (0-15)
.Path	STRING	To send the message to a different controller, set this member to the new path. <ul style="list-style-type: none">enter the path as hexadecimal valuesomit commas [,]	

Mnemonic:	Data Type:	Description:	
.RemoteIndex	DINT	If you use an asterisk [*] to designate the element number of the remote array, the RemoteIndex provides the element number. To change the element number, set this member to the required value.	
		If the message:	Then the remote array is the:
		reads data	Source element
		writes data	Destination element
.RemoteElement	STRING	To specify a different tag or address in the controller to which the message is sent, set this member to the required value. Enter the tag or address as ASCII characters.	
		If the message:	Then the remote array is the:
		reads data	Source element
		writes data	Destination element
.UnconnectedTimeout	DINT	The time out for unconnected messages. The default value is 30 seconds.	
.ConnectionRate	DINT	The ConnectionRate times the TimeoutMultiplier produces the time out for connected messages. <ul style="list-style-type: none">the default ConnectionRate is 7.5 secondsthe default TimeoutMultiplier is 0 (which equates to a multiplication factor of 4)the default time out for connected messages is 30 seconds (7.5 seconds x 4 = 30 seconds)to change the time out, change the ConnectionRate and leave the TimeoutMultiplier at the default value	
.TimeoutMultiplier	SINT		

RESULT Structure

Mnemonic:	Data Type:	Description:
.DN	BOOL	The done bit is set when the Result array is full.
.LEN	DINT	The length value identifies the number of storage locations in the Result array.
.POS	DINT	The position value identifies the current position in the Result array.

SERIAL_PORT_CONTROL Structure

Mnemonic:	Data Type:	Description:
.EN	BOOL	The enable bit indicates that the instruction is enabled.
.EU	BOOL	The queue bit indicates that the instruction entered the ASCII queue.
.DN	BOOL	The done bit indicates when the instruction is done, but it is asynchronous to the logic scan.
.RN	BOOL	The run bit indicates that the instruction is executing.
.EM	BOOL	The empty bit indicates that the instruction is done, but it is synchronous to the logic scan.
.ER	BOOL	The error bit indicates when the instruction fails (errors).
.FD	BOOL	The found bit indicates that the instruction found the termination character or characters.
.POS	DINT	The position determines the number of characters in the buffer, up to and including the first set of termination characters. The instruction only returns this number after it finds the termination character or characters.
.ERROR	DINT	The error contains a hexadecimal value that identifies the cause of an error.

STRING Structure

Every string data type includes these members:

Name:	Data Type:	Description:	Notes:
LEN	DINT	number of characters in the string	<p>The LEN automatically updates to the new count of characters whenever you:</p> <ul style="list-style-type: none"> • use the String Browser dialog box to enter characters • use instructions that read, convert, or manipulate a string <p>The LEN shows the length of the current string. The DATA member may contain additional, old characters, which are not included in the LEN count.</p>
DATA	SINT array	ASCII characters of the string	To access the characters of the string, address the name of the tag. Each element of the DATA array contains one character. You can create new string data types that store less or more characters.

You store ASCII characters in tags that use a string data type.

- You can use the default STRING data type. It stores up to 82 characters.
- You can create a new string data type that stores less or more characters.

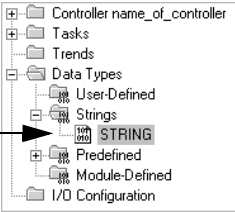
IMPORTANT

Use caution when you create a new string data type. If you later decide to change the size of the string data type, you may lose data in any tags that currently use that data type.

If you:	Then:
make a string data type smaller	<ul style="list-style-type: none"> • The data is truncated. • The LEN is unchanged.
make a string data type larger	The data and LEN is reset to zero.

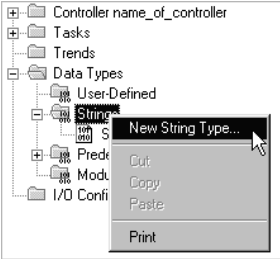
To create a string data type:

Use the default STRING data type. It stores as many as 82 characters.

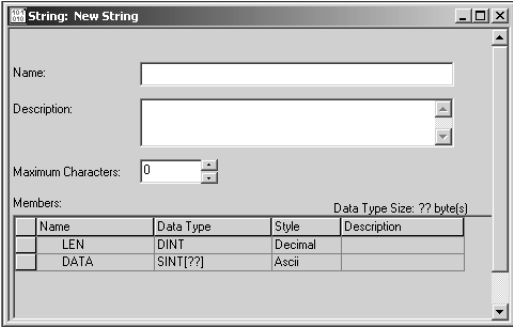


OR

Create a new string data type to store the number of characters that you define.



If you create a new string data type, define the number of characters in the string:



TIMER Structure

Mnemonic:	Data Type:	Description:
.EN	BOOL	The enable bit indicates that the instruction is enabled.
.TT	BOOL	The timing bit indicates that a timing operation is in process
.DN	BOOL	The done bit is set when $.ACC \geq .PRE$.
.PRE	DINT	The preset value specifies the value (1 msec units) which the accumulated value must reach before the instruction sets the .DN bit.
.ACC	DINT	The accumulated value specifies the number of milliseconds that have elapsed since the instruction was enabled.

User-Defined Structure

You can also create your own structures, called a user-defined data type. A user-defined data type groups different types of data into a single named entity.

- Within a user-defined data type, you define the members.
- Like tags, members have a name and data type.
- You can include arrays and structures.
- Once you create a user-defined data type, you can create one or more tags using that data type.
- Minimize the use of these data type because they typically increase the memory requirements and execution time of your logic:
 - INT
 - SINT

- If you include members that represent I/O devices, you must use ladder logic to copy the data between the members in the structure and the corresponding I/O tags.
- When you use the BOOL, SINT, or INT data types, place members that use the same data type in sequence:

more efficient

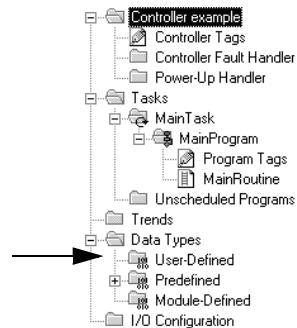
BOOL
BOOL
BOOL
DINT
DINT

less efficient

BOOL
DINT
BOOL
DINT
BOOL

- You can use single dimension arrays.
- You can create, edit, and delete user-defined data types only when programming offline.
- If you modify a user-defined data type and change its size, the existing values of any tags that use the data type are set to zero (0).
- To copy data to a structure, use the COP instruction.

To create a user-defined data type:

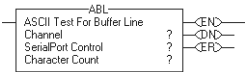


The dialog box is titled 'Data Type: New UDT2'. It contains the following fields and sections:

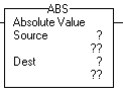

- Name:** A text input field.
- Size:** A dropdown menu showing '??' and the unit 'byte(s)'.
- Description:** A text area with up and down arrow buttons.
- Members:** A section containing a table with the following columns: Name, Data Type, Style, and Description.

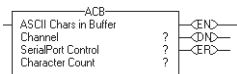
	Name	Data Type	Style	Description
*				

Notes:

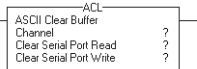
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ABL ASCII Test for Buffer Line		not available	ABL(Channel SerialPortControl);	The ABL instruction counts the characters in the buffer up to and including the first termination character.
Operand:	Type:	Format:	Description:	
Channel	DINT	immediate tag	0	
Serial Port Control	SERIAL_PORT_ CONTROL	tag	tag that controls the operation	
Character Count	DINT	immediate	displays the number of characters in the buffer, including the first set of termination characters (relay ladder only)	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

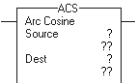

11 - 2 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:		
ABS Absolute Value			<code>dest := ABS(source);</code>	The ABS instruction takes the absolute value of the Source and places the result in the Destination.		
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:		
	Source	SINT INT	DINT REAL	immediate tag	value of which to take the absolute value	
	Destination	SINT INT	DINT REAL	tag	tag to store the result	
Function Block	Operand:	Type:	Format:	Description:		
	ABS tag	FBD_MATH_ ADVANCED	structure	ABS structure (default parameters):		
				Parameter:	Type:	Description:
				Source	REAL	value of which to take the absolute value
	Dest	REAL	result of the math instruction			
	Arithmetic Status Flags:		Major Faults:			
affected		none				

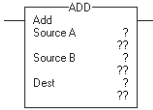

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ACB ASCII Characters in Buffer		not available	ACB(Channel SerialPortControl)	The ACB instruction counts the characters in the buffer.
Operand:	Type:	Format:	Description:	
Channel	DINT	immediate tag	0	
Serial Port Control	SERIAL_PORT_CONTROL	tag	tag that controls the operation	
Character Count	DINT	immediate	displays the number of characters in the buffer (relay ladder only)	
Arithmetic Status Flags:		Major Faults:		
not affected		none		


11 - 4 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ACL ASCII Clear Buffer		not available	ACL(Channel, ClearSerialPortRead, ClearSerialPortWrite);	The ACL instruction immediately clears the buffer and ASCII queue.
Operand:	Type:	Format:	Description:	
Channel	DINT	immediate tag	0	
Clear Serial Port Read	BOOL	immediate tag	to empty the buffer and remove ARD and ARL instructions from the queue, enter Yes.	
Clear Serial Port Write	BOOL	immediate tag	to remove AWA and AWT instructions from the queue, enter Yes.	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

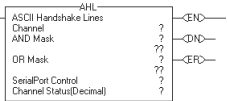
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:		
ACS Arc Cosine			dest := ACOS(source);	The ACS instruction takes the arc cosine of the Source value (in radians) and stores the result in the Destination.		
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:		
	Source	SINT INT	DINT REAL	immediate tag	find the arc cosine of this value	
	Destination	SINT INT	DINT REAL	tag	tag to store the result	
Function Block	Operand:	Type:	Format:	Description:		
	ACS tag	FBD_MATH_ ADVANCED	structure	ACS structure (default parameters):		
				Parameter:	Type:	Description:
				Source	REAL	input to the math instruction
				Dest	REAL	result of the math instruction
	Arithmetic Status Flags:		Major Faults:			
affected		none				

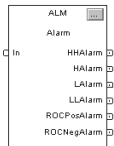
11 - 6 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ADD Add			dest := sourceA + sourceB;	The ADD instruction adds Source A to Source B and places the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source A	SINT INT	DINT REAL	immediate tag value to add to Source B
	Source B	SINT INT	DINT REAL	immediate tag value to add to Source A
	Destination	SINT INT	DINT REAL	tag tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	ADD tag	FBD_MATH	structure	ADD structure (default parameters):
	Parameter:	Type:	Description:	
	SourceA	REAL	value to add to SourceB	
	SourceB	REAL	value to add to SourceA	
	Dest	REAL	result of the math instruction	
	Arithmetic Status Flags:	Major Faults:		
	affected	none		

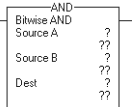

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
AFI Always False		not available	not available	The AFI instruction sets its rung-condition-out to false.
Arithmetic Status Flags:		Major Faults:		
not affected		none		

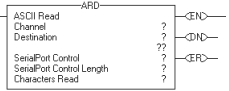
11 - 8 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:																																																								
AHL ASCII Handshake Lines		not available	AHL (Channel,ANDMask ORMask, SerialPortControl) ;	The AHL instruction obtains the status of control lines and turns on or off the DTR and RTS signals.																																																								
Operand:	Type:	Format:	Description:																																																									
Channel	DINT	immediate tag	0																																																									
ANDMask	DINT	immediate tag	<table><tr><th>To turn DTR:</th><th>And turn RTS:</th><th>ANDMask value:</th><th>ORMask value:</th><th>To turn DTR:</th><th>And turn RTS:</th><th>ANDMask value:</th><th>ORMask value:</th></tr><tr><td>off</td><td>off</td><td>3</td><td>0</td><td>unchanged</td><td>off</td><td>2</td><td>0</td></tr><tr><td></td><td>on</td><td>1</td><td>2</td><td></td><td>on</td><td>0</td><td>2</td></tr><tr><td></td><td>unchanged</td><td>1</td><td>0</td><td></td><td>unchanged</td><td>0</td><td>0</td></tr><tr><td>on</td><td>off</td><td>2</td><td>1</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td>on</td><td>0</td><td>3</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td>unchanged</td><td>0</td><td>1</td><td></td><td></td><td></td><td></td></tr></table>		To turn DTR:	And turn RTS:	ANDMask value:	ORMask value:	To turn DTR:	And turn RTS:	ANDMask value:	ORMask value:	off	off	3	0	unchanged	off	2	0		on	1	2		on	0	2		unchanged	1	0		unchanged	0	0	on	off	2	1						on	0	3						unchanged	0	1				
To turn DTR:	And turn RTS:	ANDMask value:			ORMask value:	To turn DTR:	And turn RTS:	ANDMask value:	ORMask value:																																																			
off	off	3			0	unchanged	off	2	0																																																			
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	unchanged	1			0		unchanged	0	0																																																			
on	off	2			1																																																							
	on	0	3																																																									
	unchanged	0	1																																																									
ORMask	DINT	immediate tag																																																										
Serial Port Control	SERIAL_PORT_ CONTROL	tag	tag that controls the operation																																																									
Channel Status	DINT	immediate	displays the status of the control lines (relay ladder only)																																																									
Arithmetic Status Flags:		Major Faults:																																																										
affected		Type 4	Code 57	The AHL instruction failed to execute because the serial port is set to no handshaking. Either change the Control Line setting of the serial port or delete the AHL instruction.																																																								

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ALM Alarm	not available		ALM (ALM_tag) ;	The ALM instruction provides alarming for any analog signal.
Operand:	Type:	Format:	Description:	
ALM tag	ALARM	structure	ALM structure (default parameters):	
Parameter:	Type:	Description:		
In	REAL	analog signal input		
HHAAlarm	BOOL	high-high alarm indicator		
HAlarm	BOOL	high alarm indicator		
LAlarm	BOOL	low alarm indicator		
LLAlarm	BOOL	low-low alarm indicator		
ROCPosAlarm	BOOL	rate-of-change positive alarm indicator		
ROCNegAlarm	BOOL	rate-of-change negative alarm indicator		
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

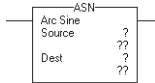
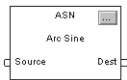
11 - 10 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
AND Bitwise AND			dest := sourceA AND sourceB	The AND instruction performs a bitwise AND operation using the bits in Source A and Source B and places the result in the Destination.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source A	SINT INT	DINT	immediate tag	value to AND with Source B
	Source B	SINT INT	DINT	immediate tag	value to AND with Source A
	Destination	SINT INT	DINT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:	
	AND tag	FBD_LOGICAL	structure	AND structure (default parameters):	
			Parameter:	Type:	Description:
			SourceA	DINT	value to AND with Source B
			SourceB	DINT	value to AND with Source A
			Dest	DINT	result of the instruction
	Arithmetic Status Flags:		Major Faults:		
	affected		none		

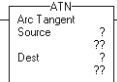
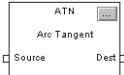
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ARD ASCII Read		not available	<pre>ARD(Channel, Destination, SerialPortControl);</pre>	The ARD instruction removes characters from the buffer and stores them in the Destination.
Operand:	Type:	Format:	Description:	
Channel	DINT	immediate tag	0	
Destination	string SINT DINT INT	tag	tag into which the characters are moved (read): <ul style="list-style-type: none"> for a string data type, enter the name of the tag for a SINT, INT, or DINT array, enter the first element of the array 	
Serial Port Control	SERIAL_PORT_CONTROL	tag	tag that controls the operation	
Serial Port Control Length	DINT	immediate	displays the number of characters to move to the destination (relay ladder only)	
Characters Read	DINT	immediate	during execution, displays the number of characters that were read (relay ladder only)	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

11 - 12 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ARL ASCII Read Line		not available	<pre>ARL(Channel, Destination, SerialPortControl);</pre>	The ARL instruction removes specified characters from the buffer and stores them in the Destination.
Operand:	Type:	Format:	Description:	
Channel	DINT	immediate tag	0	
Destination	string SINT INT	tag	tag into which the characters are moved (read): <ul style="list-style-type: none"> for a string data type, enter the name of the tag for a SINT, INT, or DINT array, enter the first element of the array 	
Serial Port Control	SERIAL_PORT_CONTROL	tag	tag that controls the operation	
Serial Port Control Length	DINT	immediate	displays the maximum number of characters to read if no termination characters are found (relay ladder only)	
Characters Read	DINT	immediate	during execution, displays the number of characters that were read (relay ladder only)	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

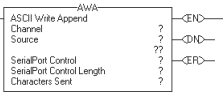
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ASN Arc Sine			dest := ASIN(source);	The ASN instruction takes the arc sine of the Source value (in radians) and stores the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	SINT INT	immediate tag	find the arc sine of this value
	Destination	SINT INT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	ASN tag	FBD_MATH_ ADVANCED	structure	ASN structure (default parameters):
			</	

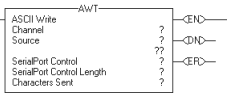
11 - 14 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ATN Arc Tangent			dest := ATAN(source);	The ATN instruction takes the arc tangent of the Source value (in radians) and stores the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	SINT INT	immediate tag	find the arc tangent of this value
	Destination	SINT INT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	ATN tag	FBD_MATH_ ADVANCED	structure	ATN structure (default parameters):
	Parameter:	Type:	Description:	
	Source	REAL	input to the math instruction	
	Dest	REAL	result of the math instruction	
	Arithmetic Status Flags:		Major Faults:	
	affected		none	

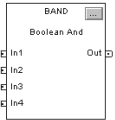
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
AVE Average		not available	<pre> SIZE(array,0,length); sum := 0; FOR position = 0 TO length-1 DO sum := sum + array[position]; END_FOR; destination := sum / length; </pre>	The AVE instruction calculates the average of a set of values.
Operand:	Type:	Format:	Description:	
Array	SINT INT	DINT REAL	array tag	find the average of the values in this array; specify the first element of the group of elements to average do not use CONTROL.POS in the subscript
Dimension to vary	DINT	immediate (0, 1, 2)		which dimension to use the order is: array[dim_0,dim_1,dim_2] then array[dim_0,dim_1] then array[dim_0]
Destination	SINT INT	DINT REAL	tag	result of the operation
Control	CONTROL	tag		control structure for the operation
Length	DINT	immediate		number of elements of the array to average
Position	DINT	immediate		current element in the array; initial value is typically 0
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	Dimension to vary does not exist for the specified array
		Type 4	Code 21	.POS < 0 or .LEN < 0


11 - 16 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
AWA ASCII Write Append		not available	AWA(Channel,Source, SerialPortControl);	The AWA instruction sends a specified number of characters of the Source tag to a serial device and appends either one or two predefined characters.
Operand:	Type:	Format:	Description:	
Channel	DINT	immediate tag	0	
Source	string SINT INT	tag	tag that contains the characters to send: <ul style="list-style-type: none">for a string data type, enter the name of the tag.for a SINT, INT, or DINT array, enter the first element of the array.	
Serial Port Control	SERIAL_PORT_ CONTROL	tag	tag that controls the operation	
Serial Port Control Length	DINT	immediate	displays the number of characters to send (relay ladder only)	
Characters Sent	DINT	immediate	displays the number of characters that were sent (relay ladder only)	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

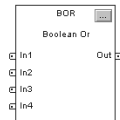
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
AWT ASCII Write		not available	AWT(Channel, Source, SerialPortControl);	The AWT instruction sends a specified number of characters of the Source tag to a serial device.
Operand:	Type:	Format:	Description:	
Channel	DINT	immediate tag	0	
Source	SINT INT DINT string	tag	tag that contains the characters to send: <ul style="list-style-type: none"> • for a string data type, enter the name of the tag • for a SINT, INT, or DINT array, enter the first element of the array 	
Serial Port Control	SERIAL_PORT_ CONTROL	tag	tag that controls the operation	
Serial Port Control Length	DINT	immediate	number of characters to send (relay ladder only)	
Characters Sent	DINT	immediate	displays the number of characters that were sent (relay ladder only)	
Arithmetic Status Flags:		Major Faults:		
not affected		none		


11 - 18 Instruction Set

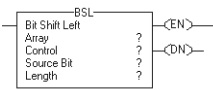
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
BAND Boolean AND	see AND		IF operandA AND operandB THEN <statement>; END_IF;	The BAND instruction logically ANDs as many as 8 boolean inputs.
Operand:	Type:	Format:	Description:	
BAND tag	FBD_BOOLEAN_ AND	structure	BAND structure (default parameters):	
			Parameter:	Description:
			Inx	boolean input; where x = 1-8
			Out	result of the instruction
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
BNOT Boolean NOT	see NOT		IF NOT operand THEN <statement>; END_IF;	The BNOT instruction complements a boolean input.	
Operand:	Type:	Format:	Description:		
BNOT tag	FBD_BOOLEAN_B NOT	structure	BNOT structure (default parameters):		
			Parameter:	Type:	Description:
			In	BOOL	boolean input
			Out	BOOL	result of the instruction
Arithmetic Status Flags:		Major Faults:			
not affected		none			


11 - 20 Instruction Set

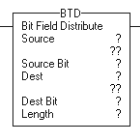
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
BOR Boolean OR	see OR		IF operandA OR operandB THEN <statement>; END_IF;	The BOR instruction logically ORs as many as 8 boolean inputs.	
Operand:	Type:	Format:	Description:		
BOR tag	FBD_BOOLEAN_OR	structure	BOR structure (default parameters):		
			Parameter:	Type:	Description:
			Inx	BOOL	boolean input; where x = 1-8
			Out	BOOL	result of the instruction
Arithmetic Status Flags:		Major Faults:			
not affected		none			

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
BRK Break		not available	EXIT;	The BRK instruction interrupts the execution of a routine that was called by a FOR instruction.
Arithmetic Status Flags:		Major Faults:		
not affected		none		

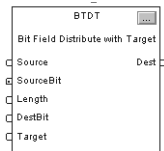
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
BSL Bit Shift Left		not available	not available	The BSL instruction shifts the specified bits within the Array one position left.
Operand:	Type:	Format:	Description:	
Array	DINT	array tag	array to modify; specify the first element of the group of elements do not use CONTROL.POS in the subscript	
Control	CONTROL	tag	control structure for the operation	
Source bit	BOOL	tag	bit to shift	
Length	DINT	immediate	number of bits in the array to shift	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

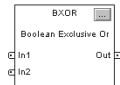
11 - 22 Instruction Set


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
BSL Bit Shift Right		not available	not available	The BSR instruction shifts the specified bits within the Array one position right.
Operand:	Type:	Format:	Description:	
Array	DINT	array tag	array to modify; specify the first element of the group of elements do not use CONTROL.POS in the subscript	
Control	CONTROL	tag	control structure for the operation	
Source bit	BOOL	tag	bit to shift	
Length	DINT	immediate	number of bits in the array to shift	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
BTD Bit Field Distribute		see BTDI	see BTDI	The BTD instruction copies the specified bits from the Source, shifts the bits to the appropriate position, and writes the bits into the Destination.
Operand:	Type:	Format:	Description:	
Source	SINT INT	immediate tag	tag that contains the bits to move	
Source Bit	DINT	immediate	number of the bit (lowest bit number) from where to start the move must be within the valid range for the Source data type (0-31 DINT, 0-15 INT, 0-7 SINT)	
Destination	SINT INT	immediate tag	tag where to move the bits	
Destination bit	DINT	immediate	the number of the bit (lowest bit number) where to start copying bits from the Source must be within the valid range for the Destination data type (0-31 DINT, 0-15 INT, 0-7 SINT)	
Length	DINT	tag	number of bits to move (1-32)	
Arithmetic Status Flags:		Major Faults:		
affected		none		


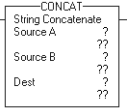
11 - 24 Instruction Set

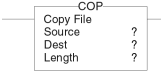
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
BTDT Bit Field Distribute with Target	see BTD		BTDT (BTDT_tag) ;	The BTDT instruction first copies the Target to the Destination. Then the instruction copies the specified bits from the Source, shifts the bits to the appropriate position and writes the bits into the Destination. The Target and Source remain unchanged.
Operand:	Type:	Format:	Description:	
BTDT tag	FBD_BIT_FIELD_ DISTRIBUTE	structure	BTDT structure (default parameters):	
Parameter:	Type:	Description:		
Source	DINT	input value containing the bits to move to Destination		
SourceBit	DINT	the bit position in Source (lowest bit number where to start the move)		
Length	DINT	number of bits to move (1-32)		
DestBit	DINT	the bit position in Dest (lowest bit number to start copying bits into)		
Target	DINT	input value to move to Dest prior to moving bits from the Source		
Dest	DINT	result of the bit move operation		
Arithmetic Status Flags:		Major Faults:		
affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
BXOR Boolean Exclusive XOR	see XOR		IF operandA XOR operandB THEN <statement>; END_IF;	The BXOR performs an exclusive OR on two boolean inputs.
Operand:	Type:	Format:	Description:	
BXOR tag	FBD_BOOLEAN_X OR	structure	BXOR structure (default parameters):	
Parameter:	Type:	Description:		
In1	BOOL	boolean input		
In2	BOOL	boolean input		
Out	BOOL	result of the instruction		
Arithmetic Status Flags:		Major Faults:		
not affected		none		

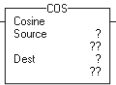
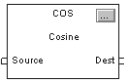
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CLR Clear		not available	dest := 0;	The CLR instruction clears all the bits of the Destination.
Operand:	Type:	Format:	Description:	
Destination	SINT INT REAL	tag	tag to clear	
Arithmetic Status Flags:		Major Faults:		
affected		none		

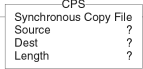
11 - 26 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CMP Compare		not available	IF <i>BOOL_expression</i> THEN < <i>statement</i> >; END_IF;	The CMP instruction performs a comparison on the arithmetic operations you specify in the expression.
Operand:	Type:	Format:	Description:	
Expression	SINT INT DINT	REAL string tag	immediate tag	an expression consisting of tags and/or immediate values separated by operators
Arithmetic Status Flags:		Major Faults:		
affected if expressions uses operators that affect arithmetic status flags		none		
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CONCAT String Concatenate		not available	CONCAT (SourceA, SourceB, Dest);	The CONCAT instruction adds ASCII characters to the end of a string.
Operand:	Type:	Format:	Description:	
Source A	string	tag	tag that contains the initial characters	
Source B	string	tag	tag that contains the end characters	
Destination	string	tag	tag to store the result	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 51	The LEN value of the string tag is greater than the DATA size of the string tag. Check that no instruction is writing to the LEN member of the string tag and that in the LEN value, you entered the number of characters that the string contains.

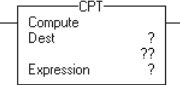
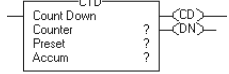
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
COP Copy File		not available	COP (Source, Dest Length);	<p>The COP instruction copies the value(s) in the Source to the Destination. The Source remains unchanged.</p> <p>The data can change during the copy operation</p>
Operand:	Type:	Format:	Description:	
Source	SINT INT DINT	REAL string structure	tag	initial element to copy the Source and Destination operands should be the same data type, or unexpected results may occur
Destination	SINT INT DINT	REAL string structure	tag	initial element to be overwritten by the Source the Source and Destination operands should be the same data type, or unexpected results may occur
Length	DINT	immediate tag		number of Destination elements to copy
Arithmetic Status Flags:		Major Faults:		
not affected		none		

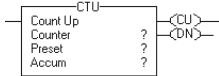
11 - 28 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
COS Cosine			dest := COS(source);	The COS instruction takes the cosine of the Source value (in radians) and stores the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	SINT INT REAL	immediate tag	find the cosine of this value
	Destination	SINT INT REAL	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	COS tag	FBD_MATH_ ADVANCED	structure	COS structure (default parameters):
			Parameter:	Type: Description:
			Source	REAL input to the math instruction
			Dest	REAL result of the math instruction
	Arithmetic Status Flags:	Major Faults:		
	affected	none		

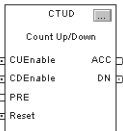
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CPS Synchronous Copy File		not available	CPS (Source, Dest Length) ;	The CPS instruction copies the value(s) in the Source to the Destination. The Source remains unchanged. The data cannot change during the copy operation.
Operand:	Type:	Format:	Description:	
Source	SINT INT DINT	REAL string structure	tag	initial element to copy the Source and Destination operands should be the same data type, or unexpected results may occur
Destination	SINT INT DINT	REAL string structure	tag	initial element to be overwritten by the Source the Source and Destination operands should be the same data type, or unexpected results may occur
Length	DINT	immediate tag		number of Destination elements to copy
Arithmetic Status Flags:		Major Faults:		
not affected		none		

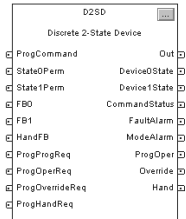
11 - 30 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CPT Compute		not available	<pre>destination := numeric_expression;</pre>	The CPT instruction performs the arithmetic operations you define in the expression.
Operand:	Type:	Format:	Description:	
Destination	SINT INT	DINT REAL	immediate tag	tag to store the result
Expression	SINT INT	DINT REAL	immediate tag	an expression consisting of tags and/or immediate values separated by operators
Arithmetic Status Flags:		Major Faults:		
affected		none		
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CTD Counter Down		see CTUD	see CTUD	The CTD instruction counts downward.
Operand:	Type:	Format:	Description:	
Counter	COUNTER	tag	counter structure	
Preset	DINT	immediate	how low to count	
Accum	DINT	immediate	number of times the counter has counted; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CTU Counter Up		see CTUD	see CTUD	The CTU instruction counts upward.
Operand:	Type:	Format:	Description:	
Counter	COUNTER	tag	counter structure	
Preset	DINT	immediate	how high to count	
Accum	DINT	immediate	number of times the counter has counted; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

11 - 32 Instruction Set

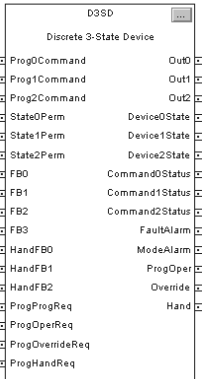
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
CTUD Count Up/Down	see CTU and CTD		CTUD (CTUD_tag) ;	The CTUD instruction counts up by one when CUEnable transitions from clear to set. The instruction counts down by one when CDEnable transitions from clear to set.
Operand:	Type:	Format:	Description:	
CTUD tag	FBD_COUNTER	structure	CTUD structure (default parameters):	
Parameter:	Type:	Description:		
CUEnable	BOOL	enable up count When input toggles from clear to set, accumulator counts up by one.		
CDEnable	BOOL	enable down count When input toggles from clear to set, accumulator counts down by one.		
PRE	DINT	counter preset value		
Reset	BOOL	request to reset the timer		
ACC	DINT	accumulated value		
DN	BOOL	counting done		
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
D2SD Discrete 2-State Device	not available		D2SD (D2SD_tag) ;	The D2SD instruction controls a discrete device which has only two possible states such as on/off, open/closed, etc.
Operand:	Type:	Format:	Description:	
D2SD tag	DISCRETE_2STATE	structure	D2SD structure (default parameters):	
Parameter:	Type:	Description:		
ProgCommand	BOOL	program state command		
State x Perm	BOOL	state x permissive, where $x = 0$ or 1 unless in Hand or Override mode, this input must be set for the device to enter the state		
FB x	BOOL	feedback input, where $x = 0$ or 1		
HandFB	BOOL	hand feedback input when set, the field device is being requested to enter the 1 state; when cleared, the field device is being requested to enter the 0 state		
ProgProgReq	BOOL	program program request		
ProgOperReq	BOOL	program operator request		
ProgOverrideReq	BOOL	program override request		

continued

11 - 34 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
D2SD Discrete 2-State Device (continued)			Parameter:	Type:	Description:
		ProgHandReq	BOOL	program hand request	
		Out	BOOL	output of the instruction	
		DeviceXState	BOOL	device x state output, where x = 0 or 1	
		CommandStatus	BOOL	command status output	
		FaultAlarm	BOOL	fault alarm output	
		ModeAlarm	BOOL	mode alarm output	
		ProgOper	BOOL	program/operator control indicator	
		Override	BOOL	override mode indicator	
		Hand	BOOL	hand mode indicator	
Arithmetic Status Flags:		Major Faults:			
not affected		none			

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
D3SD Discrete 3-State Device	not available		D3SD (D3SD_tag) ;	The D3SD instruction controls a discrete device having three possible states such as fast/slow/off, forward/stop/reverse, etc.

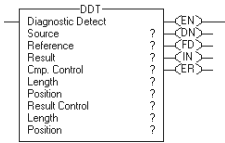
Operand:	Type:	Format:	Description:
D3SD tag	DISCRETE_3STATE	structure	D3SD structure (default parameters):
Parameter:	Type:	Description:	
ProgxCmd	BOOL	program state x command, where x = 0, 1, or 2	
StatexPerm	BOOL	state x permissive, where x = 0, 1, or 2 unless in Hand or Override mode, this input must be set for the device to enter the state	
FBx	BOOL	feedback input; where x = 0,1, 2, or 3	

continued


continued

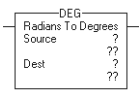

11 - 36 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
D3SD Discrete 3-State Device (continued)			Parameter:	Type:	Description:
			HandFBx	BOOL	hand feedback input, where $x = 0, 1, \text{ or } 2$ when set, the field device is being requested to enter the 1 state; when cleared, the field device is being requested to enter some other state
			ProgProgReq	BOOL	program program request
			ProgOperReq	BOOL	program operator request
			ProgOverrideReq	BOOL	program override request
			ProgHandReq	BOOL	program hand request
			Outx	BOOL	output of the instruction, where $x = 0, 1, \text{ or } 2$
			DevicexState	BOOL	device x state output, where $x = 0, 1, \text{ or } 2$
			CommandxStatus	BOOL	command status output, where $x = 0, 1, \text{ or } 2$
			FaultAlarm	BOOL	fault alarm output
			ModeAlarm	BOOL	mode alarm output
			ProgOper	BOOL	program/operator control indicator
			Override	BOOL	override mode indicator
			Hand	BOOL	hand mode indicator
Arithmetic Status Flags:		Major Faults:			
not affected		none			

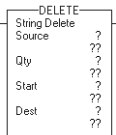
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
DDT Diagnostic Detect		not available	not available	The DDT instruction compares bits in a Source array with bits in a Reference array to determine changes of state.
Operand:	Type:	Format:	Description:	
Source	DINT	array tag	array to compare to the reference; do not use CONTROL.POS in the subscript	
Reference	DINT	array tag	array to compare to the source; do not use CONTROL.POS in the subscript	
Result	DINT	array tag	array to store the results; do not use CONTROL.POS in the subscript	
Cmp control	CONTROL	structure	control structure for the compare	
Length	DINT	immediate	number of bits to compare	
Position	DINT	immediate	current position in the source; initial value typically 0	
Result control	CONTROL	structure	control structure for the results	
Length	DINT	immediate	number of storage locations in the result	
Position	DINT	immediate	current position in the result; initial value typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	Result.POS > size of Result array

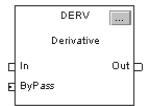
11 - 38 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
DEDT Deadtime	not available		DEDT (DEDT_tag, storage);	The DEDT instruction performs a delay of a single input. You select the amount of deadtime delay.	
Operand:	Type:	Format:	Description:		
DEDT tag	DEADTIME	structure	DEDT structure (default parameters):		
			Parameter:	Type:	Description:
			In	REAL	analog signal input to the instruction
			Out	REAL	calculated output of the algorithm
storage	REAL	array	deadtime buffer		
Arithmetic Status Flags:		Major Faults:			
set for the Out parameter		none			


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
DEG Degrees			dest := DEG(source);	The DEG instruction converts the Source (in radians) to degrees and stores the result in the Destination.
<i>Relay Ladder and Structured Text</i>	Operand:	Type:	Format:	Description:
	Source	SINT INT	immediate tag	value to convert to degrees
	Destination	SINT INT	tag	tag to store the result
<i>Function Block</i>	Operand:	Type:	Format:	Description:
	DEG tag	FBD_MATH_ ADVANCED	structure	DEG structure (default parameters):
			Parameter:	Type:
			Source	REAL
			Dest	REAL
Arithmetic Status Flags:		Major Faults:		
affected		none		

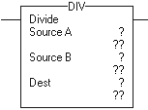
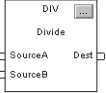
11 - 40 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
DELETE String Delete		not available	DELETE (Source, Qty, Start, Dest) ;	The DELETE instruction removes ASCII characters from a string.
Operand:	Type:	Format:	Description:	
Source	string	tag	tag that contains the string from which you want to delete characters	
Quantity	SINT INT	DINT tag	immediate tag	number of characters to delete; the Start plus the Quantity must be less than or equal to the DATA size of the Source
Start	SINT INT	DINT tag	immediate tag	position of the first character to delete; enter a number between 1 and the DATA size of the Source
Destination	string	tag	tag to store the result	
Arithmetic Status Flags:		Major Faults:		
not affected		4	51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none"> that no instruction is writing to the LEN member of the string tag. in the LEN value, you entered the number of characters that the string contains.
		4	56	The Start or Quantity value is invalid. Check that: <ul style="list-style-type: none"> the Start value is between 1 and the DATA size of the Source. the Start value plus the Quantity value is less than or equal to the DATA size of the Source.

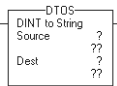
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
DERV Derivative	not available		DERV (DERV_tag) ;	The DERV instruction calculates the amount of change of a signal over time in per-second units.
Operand:	Type:	Format:	Description:	
DERV tag	DERIVATIVE	structure	DERV structure (default parameters):	
Parameter:	Type:	Description:		
In	REAL	input to the instruction		
ByPass	BOOL	request to bypass the algorithm; when set, the instruction sets Out = In		
Out	REAL	calculated output of the algorithm		
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

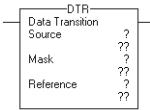
11 - 42 Instruction Set


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
DFF D FLip-Flop	not available		DFF (DFF_tag) ;	The DFF instruction sets the Q output to the state of the D input on a cleared to set transition of the Clock input. The QNot output is set to the opposite state of the Q output.
Operand:	Type:	Format:	Description:	
DFF tag	FLIP_FLOP_D	structure	DFF structure (default parameters):	
Parameter:	Type:	Description:		
D	BOOL	input to the instruction		
Clear	BOOL	clear input to the instruction; if set, the instruction clears Q and sets QNot		
Clock	BOOL	Clock input to the instruction		
Q	BOOL	output of the instruction		
QNot	BOOL	complement of the Q output		
Arithmetic Status Flags:		Major Faults:		
not affected		none		

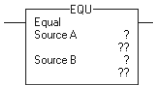
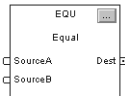
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
DIV Divide			dest := sourceA / sourceB;	The DIV instruction divides Source A by Source B and places the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source A	SINT INT	immediate tag	value of the dividend
	Source B	SINT INT	immediate tag	value of the divisor
	Destination	SINT INT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	DIV tag	FBD_MATH	structure	DIV structure (default parameters):
			Parameter:	Type:
			SourceA	REAL
			SourceB	REAL
			Dest	REAL
	Arithmetic Status Flags:		Major Faults:	
	affected	Type 4	Code 4	the divisor is 0

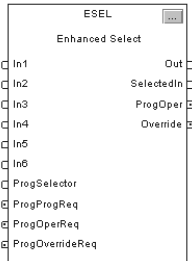
11 - 44 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
DTOS DINT to String		not available	DTOS (Source, Dest) ;	The DTOS instruction produces the ASCII representation of a value.
Operand:	Type:	Format:	Description:	
Source	SINT INT	tag	tag that contains the value; if the Source is a REAL, the instruction converts it to a DINT value	
Destination	string	tag	tag to store the ASCII value	
Arithmetic Status Flags:		Major Faults:		
not affected		4	51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none">that no instruction is writing to the LEN member of the string tag.in the LEN value, you entered the number of characters that the string contains.
		4	52	The output string is larger than the destination. Create a new string data type that is large enough for the output string. Use the new string data type as the data type for the destination.

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:																
DTR Data Transitional		not available	not available	The DTR instruction passes the Source value through a Mask and compares the result with the Reference value.																
	<table><tr><th>Operand:</th><th>Type:</th><th>Format:</th><th>Description:</th></tr><tr><td>Source</td><td>DINT</td><td>immediate tag</td><td>array to compare to the reference</td></tr><tr><td>Mask</td><td>DINT</td><td>immediate tag</td><td>which bits to block or pass</td></tr><tr><td>Reference</td><td>DINT</td><td>tag</td><td>array to compare to the source</td></tr></table>	Operand:	Type:	Format:	Description:	Source	DINT	immediate tag	array to compare to the reference	Mask	DINT	immediate tag	which bits to block or pass	Reference	DINT	tag	array to compare to the source			
Operand:	Type:	Format:	Description:																	
Source	DINT	immediate tag	array to compare to the reference																	
Mask	DINT	immediate tag	which bits to block or pass																	
Reference	DINT	tag	array to compare to the source																	
		Arithmetic Status Flags:	Major Faults:																	
		not affected	none																	

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:								
EOT End of Transition		not available	EOT (data_bit);	The EOT instruction returns a boolean state to an SFC transition.								
	<table><tr><th>Operand:</th><th>Type:</th><th>Format:</th><th>Description:</th></tr><tr><td>data bit</td><td>BOOL</td><td>tag</td><td>state of the transition (0=executing, 1=completed)</td></tr></table>	Operand:	Type:	Format:	Description:	data bit	BOOL	tag	state of the transition (0=executing, 1=completed)			
Operand:	Type:	Format:	Description:									
data bit	BOOL	tag	state of the transition (0=executing, 1=completed)									
		Arithmetic Status Flags:	Major Faults:									
		not affected	none									


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
EQU Equal To			IF sourceA = sourceB THEN <statements>;	The EQU instruction tests whether Source A is equal to Source B.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source A	SINT INT DINT	REAL string tag	immediate value to test against Source B
Function Block	Operand:	Type:	Format:	Description:
	Source B	SINT INT DINT	REAL string tag	immediate value to test against Source A
Function Block	Operand:	Type:	Format:	Description:
	EQU tag	FBD_COMPARE	structure	EQU structure (default parameters):
Function Block	Parameter:	Type:	Description:	
	SourceA	REAL	value to test against SourceB	
Function Block	SourceB	REAL	value to test against SourceA	
	Dest	BOOL	result of the instruction	
Function Block	Arithmetic Status Flags:	Major Faults:		
	not affected	none		

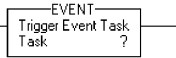
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ESEL Enhanced Select	not available		ESEL (ESEL_tag) ;	<p>The ESEL instruction lets you select one of as many as six inputs. Selection options include:</p> <ul style="list-style-type: none">• manual select (either by operator or by program)• high select• low select• median select• average (mean) select
Operand:	Type:	Format:	Description:	
ESEL tag	SELECT_ ENHANCED	structure	ESEL structure (default parameters):	
Parameter:	Type:	Description:		
Inx	REAL	analog signal inputs to the instruction, where x = 1-6		
ProgSelector	DINT	program selector input		
ProgProgReq	BOOL	program program request		
ProgOperReq	BOOL	program operator request		
ProgOverrideReq	BOOL	program override request		

continued

continued

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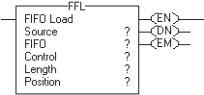
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ESEL Enhanced Select (continued)			Parameter:	Type:
			Out	REAL
			SelectedIn	DINT
			ProgOper	BOOL
			Override	BOOL
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
EVENT Trigger Event Task		not available	EVENT (Task) ;	The EVENT instruction triggers one execution of an event task.
Operand:	Type:	Format:	Description:	
Task	na	task name	event task to execute	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

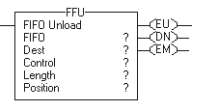
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FAL File Arithmetic and Logic		not available	<pre> SIZE(destination,0 length-1); FOR position = 0 TO length DO destination[position] := numeric_expression; END_FOR; </pre>	The FAL instruction performs copy, arithmetic, logic, and function operations on data stored in an array.
Operand:	Type:	Format:	Description:	
Control	CONTROL	tag	control structure for the operation	
Length	DINT	immediate	number of elements in the array to be manipulated	
Position	DINT	immediate	current element in array; initial value is typically 0	
Mode	DINT	immediate	how to distribute the operation; select INC, ALL, or enter a number	
Destination	SINT INT	DINT REAL	tag	tag to store the result
Expression	SINT INT	DINT REAL	immediate tag	an expression consisting of tags and/or immediate values separated by operators
Arithmetic Status Flags:		Major Faults:		
affected		Type 4	Code 20	subscript is out of range
		Type 4	Code 21	.POS < 0 or .LEN < 0

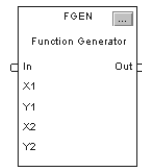
11 - 50 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FBC File Bit Compare		not available	not available	The FBC instruction compares bits in a Source array with bits in a Reference array.
Operand:	Type:	Format:	Description:	
Source	DINT	array tag	array to compare to the reference; do not use CONTROL.POS in the subscript	
Reference	DINT	array tag	array to compare to the source; do not use CONTROL.POS in the subscript	
Result	DINT	array tag	array to store the result; do not use CONTROL.POS in the subscripts	
Cmp control	CONTROL	structure	control structure for the compare	
Length	DINT	immediate	number of bits to compare	
Position	DINT	immediate	current position in the source; initial value is typically 0	
Result control	CONTROL	structure	control structure for the results	
Length	DINT	immediate	number of storage locations in the result	
Position	DINT	immediate	current position in the result initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	Result.POS > size of Result array

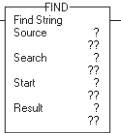
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FFL FIFO Load		not available	not available	The FFL instruction copies the Source value to the FIFO.
Operand:	Type:	Format:	Description:	
Source	SINT INT REAL string structure	immediate tag	data to be stored in the FIFO	
FIFO	SINT INT REAL string structure	array tag	FIFO to modify; specify the first element of the FIFO do not use CONTROL.POS in the subscript	
Control	CONTROL	tag	control structure for the operation; typically use the same CONTROL as the associated FFU	
Length	DINT	immediate	maximum number of elements the FIFO can hold at one time	
Position	DINT	immediate	next location in the FIFO where the instruction loads data; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	(starting element + .POS) > FIFO array size


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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FFU FIFO Unload		not available	not available	The FFU instruction unloads the value from position 0 (first position) of the FIFO and stores that value in the Destination. The remaining data in the FIFO shifts down one position.
Operand:	Type:	Format:	Description:	
FIFO	SINT INT string structure	DINT REAL array tag	FIFO to modify; specify the first element of the FIFO do not use CONTROL.POS in the subscript	
Destination	SINT INT string structure	DINT REAL tag	value that exits the FIFO	
Control	CONTROL	tag	control structure for the operation; typically use the same CONTROL as the associated FFL	
Length	DINT	immediate	maximum number of elements the FIFO can hold at one time	
Position	DINT	immediate	next location in the FIFO where the instruction unloads data; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	Length > FIFO array size

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
FGEN Function Generator	not available		FGEN (FGEN_tag, X1, Y1, X2, Y2) ;	The FGEN instruction converts an input based on a piece-wise linear function.	
Operand:	Type:	Format:	Description:		
FGEN tag	FUNCTION_GENERATOR	structure	FGEN structure (default parameters):		
			Parameter:	Type:	Description:
			In	REAL	analog signal input to the instruction
			Out	REAL	calculated output of the algorithm
X1	REAL	array	X-axis array, table one combine with the Y-axis array, table one to define the points of the first piece-wise linear curve		
Y1	REAL	array	Y-axis array, table one combine with the X-axis array, table one to define the points of the first piece-wise linear curve		
X2	REAL	array	(optional) X-axis array, table two combine with the Y-axis array, table two to define the points of the second piece-wise linear curve		
Y2	REAL	array	(optional) Y-axis array, table two combine with the X-axis array, table two to define the points of the second piece-wise linear curve		
Arithmetic Status Flags:		Major Faults:			
set for the Out parameter		none			


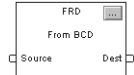
11 - 54 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FIND Find String		not available	FIND (Source, Search, Start, Result);	The FIND instruction locates the starting position of a specified string within another string
Operand:	Type:	Format:	Description:	
Source	string	tag	string to search in	
Search	string	tag	string to find	
Start	SINT INT	DINT tag	immediate	position in Source to start the search; enter a number between 1 and the DATA size of the Source.
Result	SINT INT	DINT tag	tag	tag that stores the starting position of the string to find
Arithmetic Status Flags:		Major Faults:		
not affected		4	51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none">that no instruction is writing to the LEN member of the string tag.in the LEN value, you entered the number of characters that the string contains.
		4	56	The Start value is invalid. Check that the Start value is between 1 and the DATA size of the Source.

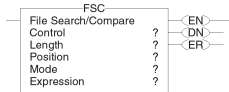
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FLL File Fill		not available	<pre> SIZE (destination, 0 length); FOR position = 0 TO length-1 DO destination[position] := source; END_FOR; </pre>	The FLL instruction fills elements of an array with the Source value. The Source remains unchanged.
Operand:	Type:	Format:	Description:	
Source	SINT INT	DINT REAL	immediate tag	element to copy the Source and Destination operands should be the same data type, or unexpected results may occur
Destination	SINT INT	DINT REAL	tag	initial element to be overwritten by the Source the Source and Destination operands should be the same data type, or unexpected results may occur the preferred way to initialize a structure is to use the COP instruction
Length	DINT		immediate	number of elements to fill
Arithmetic Status Flags:		Major Faults:		
not affected		none		

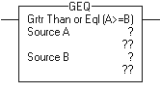
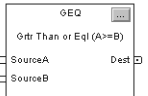
11 - 56 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FOR For	<div><div>FOR</div><div><div>For</div><div>Routine name</div><div>Index</div><div>Initial value</div><div>Terminal value</div><div>Step size</div></div><div><div>?</div><div>?</div><div>??</div><div>?</div><div>?</div><div>?</div></div></div>	not available	<pre>FOR count:= initial_value TO final_value BY increment DO <statement>; END_FOR;</pre>	The FOR instruction executes a routine repeatedly.
Operand:	Type:	Format:	Description:	
Routine name	ROUTINE	routine name	routine to execute	
Index	DINT	tag	counts how many times the routine has been executed	
Initial value	SINT INT	DINT tag	value at which to start the index	
Terminal value	SINT INT	DINT tag	value at which to stop executing the routine	
Step size	SINT INT	immediate tag	amount to add to the index each time the FOR instruction executes the routine	
Arithmetic Status Flags:		Major Faults:		
not affected		4	31	main routine contains a RET instruction

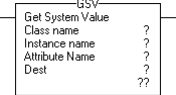
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
FRD Convert to Integer			not available	The FRD instruction converts a BCD value (Source) to an integer value and stores the result in the Destination.	
Relay Ladder	Operand:	Type:	Format:	Description:	
	Source	SINT INT	DINT	immediate tag	value to convert
	Destination	SINT INT	DINT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:	
	FRD tag	FBD_CONVERT	structure	FRD structure (default parameters):	
			Parameter:	Type:	Description:
			Source	DINT	input to the conversion instruction.
			Dest	DINT	result of the math instruction.
			Arithmetic Status Flags:	Major Faults:	
			affected	none	

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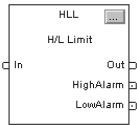
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
FSC File Search and Compare		not available	not available	The FSC instruction compares values in an array, element by element.
Operand:	Type:	Format:	Description:	
Control	CONTROL	tag	control structure for the operation	
Length	DINT	immediate	number of elements in the array to be manipulated	
Position	DINT	immediate	offset into array; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
affected		4	21	.POS < 0 or .LEN < 0


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
GEQ Greater Than or Equal To			IF sourceA >= sourceB THEN <statements>;	The GEQ instruction tests whether Source A is greater than or equal to Source B.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source A	SINT INT DINT	REAL string immediate tag	value to test against Source B	
	Source B	SINT INT DINT	REAL string immediate tag	value to test against Source A	
Function Block	Operand:	Type:	Format:	Description:	
	GEQ tag	FBD_COMPARE	structure	GEQ structure (default parameters):	
			Parameter:	Type:	Description:
			SourceA	REAL	value to test against SourceB
			SourceB	REAL	value to test against SourceA
			Dest	BOOL	result of the instruction
	Arithmetic Status Flags:	Major Faults:			
not affected		none			

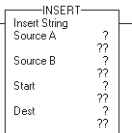
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
GRT Greater Than			IF sourceA > sourceB THEN <statements>;	The GRT instruction tests whether Source A is greater than Source B.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source A	SINT INT DINT	REAL string	immediate tag	value to test against Source B
	Source B	SINT INT DINT	REAL string	immediate tag	value to test against Source A
Function Block	Operand:	Type:	Format:	Description:	
	GRT tag	FBD_COMPARE	structure	GRT structure (default parameters):	
				Parameter: Type: Description:	
				SourceA REAL value to test against SourceB	
				SourceB REAL value to test against SourceA	
				Dest BOOL result of the instruction	
Arithmetic Status Flags:		Major Faults:			
not affected		none			


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
GSV Get System Value		not available	GSV (ClassName, InstanceName, AttributeName, Dest);	The GSV instructions get s controller system data that is stored in objects.
Operand:	Type:	Format:	Description:	
Class name	na	name	name of object	
Instance name	na	name	name of specific object, when object requires name	
Attribute Name	na	name	attribute of object; data type depends on the attribute you select	
Destination	SINT INT REAL	tag	destination for attribute data	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 5	invalid object address
		Type 4	Code 6	<ul style="list-style-type: none">specified an object that does not support GSV/SSVinvalid attributedid not supply enough information for an SSV instruction
		Type 4	Code 7	the GSV destination was not large enough to hold the requested data

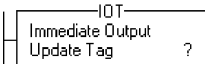
11 - 62 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
HLL High/Low Limit	not available	 <p>The diagram shows a function block labeled 'HLL' with a 'H/L Limit' title. It has four ports on the right side: 'In' (input), 'Out' (output), 'HighAlarm' (alarm output), and 'LowAlarm' (alarm output). The 'In' port is connected to a line from the left.</p>	HLL(HLL_tag);	The HLL instruction limits an analog input between two values. You can select high/low, high, or low limits.
Operand:	Type:	Format:	Description:	
HLL tag	HL_LIMIT	structure	HLL structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	analog signal input to the instruction
		Out	REAL	calculated output of the algorithm
		HighAlarm	BOOL	high alarm indicator; set when $In \geq HighLimit$
		LowAlarm	BOOL	low alarm indicator; set when $In \leq LowLimit$
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		



Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
HPF High Pass Filter	not available		HPF (HPF_tag) ;	The HPF instruction provides a filter to attenuate input frequencies that are below the cutoff frequency.
Operand:	Type:	Format:	Description:	
HPF tag	FILTER_HIGH_PASS	structure	HPF structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	analog signal input to the instruction
		Out	REAL	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

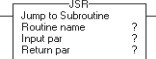
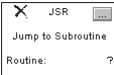
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
INSERT Insert String		not available	INSERT (SourceA, SourceB, Start, Dest) ;	The INSERT instruction adds ASCII characters to a specified location within a string.
Operand:	Type:	Format:	Description:	
Source A	string	tag	string to add the characters to	
Source B	string	tag	string containing the characters to add	
Start	SINT INT	DINT immediate tag	position in Source A to add the characters; enter a number between 1 and the DATA size of the Source.	
Result	string	tag	string to store the result	
Arithmetic Status Flags:		Major Faults:		
not affected		4	51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none">that no instruction is writing to the LEN member of the string tag.in the LEN value, you entered the number of characters that the string contains.
		4	56	The Start value is invalid. Check that the Start value is between 1 and the DATA size of the Source.

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
INTG Integrator	not available		INTG (INTG_tag) ;	The INTG instruction implements an integral operation. This instruction is designed to execute in a task where the scan rate remains constant.
Operand:	Type:	Format:	Description:	
INTG tag	INTEGRATOR	structure	INTG structure (default parameters):	
Parameter:	Type:	Description:		
In	REAL	analog signal input to the instruction		
Out	REAL	calculated output of the algorithm		
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
IOT Immediate Output		not available	IOT (output_tag) ;	The IOT instruction immediately updates the specified output data (output tag or produced tag).
Operand:	Type:	Format:	Description:	
Output tag	tag name	tag	tag that you want to update, either an output tag of an I/O module or a produced tag do not choose a member or element of a tag	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

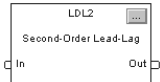
11 - 66 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
JKFF JK Flip-Flop	not available		JKFF (JKFF_tag) ;	The JKFF instruction complements the Q and QNot outputs when the Clock input transitions from cleared to set.
Operand:	Type:	Format:	Description:	
JKFF tag	FLIP_FLOP_JK	structure	JKFF structure (default parameters):	
Parameter:	Type:	Description:		
Clear	BOOL	clear input to the instruction; if set, the instruction clears Q and sets QNot		
Clock	BOOL	Clock input to the instruction		
Q	BOOL	output of the instruction		
QNot	BOOL	complement of the Q output		
Arithmetic Status Flags:	Major Faults:			
not affected	none			
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
JMP Jump		not available	not available	The JMP and LBL instructions skip portions of ladder logic.
Operand:	Type:	Format:	Description:	
Label name	na	name	name of associated LBL instruction	
Arithmetic Status Flags:	Major Faults:			
not affected	Type 4	Code 42	label does not exist	


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
JSR Jump to Subroutine			JSR (RoutineName InputCount, InputPar, ReturnPar);	The JSR instruction jumps execution to a different routine.
Operand:	Type:	Format:	Description:	
Routine name	ROUTINE	name	routine to execute	
Input parameter	BOOL SINT DINT REAL INT structure	immediate tag array tag	data from this routine that you want to copy to a tag in the subroutine <ul style="list-style-type: none"> parameters are optional enter multiple parameters, if needed 	
Return parameter	BOOL SINT DINT REAL INT structure	tag array tag	tag in this routine to which you want to copy a result of the subroutine <ul style="list-style-type: none"> parameters are optional enter multiple parameters, if needed 	
Input count	SINT INT	DINT REAL	immediate	number of input parameters (structured text only)
Arithmetic Status Flags:		Major Faults:		
affected		4	31	<ul style="list-style-type: none"> JSR instruction has fewer input parameters than SBR instruction RET instruction has fewer return parameters than JSR instruction main routine contains a RET instruction
		4	0	JSR instruction jumps to a fault routine

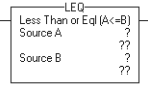
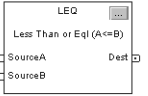
11 - 68 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
JXR Jump to External Routine		not available	not available	The JXR instruction executes an external routine. This instruction is only supported by the SoftLogix5800 controllers.
Operand:	Type:	Format:	Description:	
External routine name	ROUTINE	name	external routine to execute	
External routine control	EXT_ROUTINE_CONTROL	tag	control structure	
Parameter	BOOL SINT DINT REAL INT structure	immediate tag array tag	data from this routine that you want to copy to a variable in the external routine <ul style="list-style-type: none"> parameters are optional enter multiple parameters, if needed you can have as many as 10 parameters 	
Return parameter	BOOL SINT DINT REAL INT	tag	tag in this routine to which you want to copy a result of the external routine <ul style="list-style-type: none"> the return parameter is optional. you can have only one return parameter 	
Arithmetic Status Flags:		Major Faults:		
not affected		none		
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LBL Label		not available	not available	The JMP and LBL instructions skip portions of ladder logic.
Operand:	Type:	Format:	Description:	
Label name	na	name	execution jumps to LBL instruction with referenced label name	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 42	label does not exist

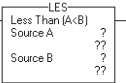

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
LDL2 Second-Order Lead Lag	not available		LDL2 (LDL2_tag) ;	The LDL2 instruction provides a filter with a pole pair and a zero pair. The frequency and damping of the pole and zero pairs are adjustable. The pole or zero pairs can be either complex (damping less than unity) or real (damping greater than or equal to unity).	
Operand:	Type:	Format:	Description:		
LDL2 tag	LEAD_LAG_SEC_ORDER	structure	LDL2 structure (default parameters):		
			Parameter:	Type:	Description:
			In	REAL	analog signal input to the instruction
			Out	REAL	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:			
set for the Out parameter		none			

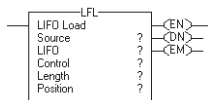
11 - 70 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LDLG Lead Lag	not available		LDLG (LDLG_tag) ;	The LDLG instruction provides a phase lead-lag compensation for an input signal. This instruction is typically used for feedforward PID control or for process simulations.
Operand:	Type:	Format:	Description:	
LDLG tag	LEAD_LAG	structure	LDLG structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	analog signal input to the instruction
		Out	REAL	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

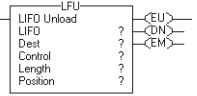
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LEQ Less Than or Equal To			IF sourceA <= sourceB THEN <statements>;	The LEQ instruction tests whether Source A is less than or equal to Source B.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source A	SINT INT DINT	REAL string	immediate tag value to test against Source B
	Source B	SINT INT DINT	REAL string	immediate tag value to test against Source A
Function Block	Operand:	Type:	Format:	Description:
	LEQ tag	FBD_COMPARE	structure	LEQ structure (default parameters):
			Parameter:	Type: Description:
			SourceA	REAL value to test against SourceB
			SourceB	REAL value to test against SourceA
			Dest	BOOL result of the instruction
	Arithmetic Status Flags:	Major Faults:		
	not affected	none		

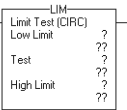
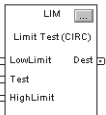
11 - 72 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LES Less Than			IF sourceA < sourceB THEN <statements>;	The LES instruction tests whether Source A is less than Source B.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source A	SINT INT DINT	REAL string immediate tag	value to test against Source B
Function Block	Source B	SINT INT DINT	immediate tag	value to test against Source A
	Operand:	Type:	Format:	Description:
	LES tag	FBD_COMPARE	structure	LES structure (default parameters):
			Parameter:	Type: Description:
			SourceA	REAL value to test against SourceB
			SourceB	REAL value to test against SourceA
			Dest	BOOL result of the instruction
	Arithmetic Status Flags:		Major Faults:	
	not affected		none	

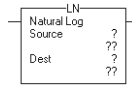

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LFL LIFO Load		not available	not available	The LFL instruction copies the Source value to the LIFO.
Operand:	Type:	Format:	Description:	
Source	SINT INT REAL string structure	immediate tag	data to be stored in the LIFO	
LIFO	SINT INT REAL string structure	array tag	LIFO to modify; specify the first element of the LIFO do not use CONTROL.POS in the subscript	
Control	CONTROL	tag	control structure for the operation; typically use the same CONTROL as the associated LFL	
Length	DINT	immediate	maximum number of elements the LIFO can hold at one time	
Position	DINT	immediate	next location in the LIFO where the instruction loads data; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	(starting element + .POS) > LIFO array size

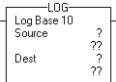
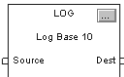
11 - 74 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LFU LIFO Unload		not available	not available	The LFU instruction unloads the value at .POS of the LIFO and stores 0 in that location.
Operand:	Type:	Format:	Description:	
LIFO	SINT INT string structure	DINT REAL array tag	LIFO to modify: specify the first element of the LIFO do not use CONTROL.POS in the subscript	
Destination	SINT INT string structure	DINT REAL tag	value that exits the LIFO	
Control	CONTROL	tag	control structure for the operation; typically use the same CONTROL as the associated LFL	
Length	DINT	immediate	maximum number of elements the LIFO can hold at one time	
Position	DINT	immediate	next location in the LIFO where the instruction unloads data; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	Length > LIFO array size

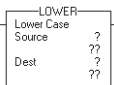
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LIM Limit			<pre> IF (LowLimit <= HighLimit AND (Test >= LowLimit AND Test <= HighLimit)) OR (LowLimit >= HighLimit AND (Test <= LowLimit OR Test >= HighLimit)) THEN <statement>; END_IF; </pre>	The LIM instruction tests whether the Test value is within the range of the Low Limit to the High Limit.
<i>Relay Ladder and Structured Text</i>	Operand:	Type:	Format:	Description:
	Low Limit	SINT INT REAL	immediate tag	value of lower limit
	Test	SINT INT REAL	immediate tag	value to test
<i>Function Block</i>	High Limit	SINT INT REAL	immediate tag	value of upper limit
	Operand:	Type:	Format:	Description:
	LIM tag	FBD_LIMIT	structure	LIM structure (default parameters):
		Parameter:	Type:	Description:
		LowLimit	REAL	value of lower limit
		Test	REAL	value to test against limits
		HighLimit	REAL	value of upper limit
		Dest	BOOL	result of the instruction
Arithmetic Status Flags:		Major Faults:		
not affected		none		

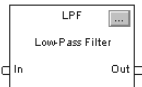
11 - 76 Instruction Set

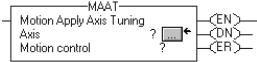
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:		
LN Natural Log			dest := LN(source);	The LN instruction takes the natural log of the Source and stores the result in the Destination.		
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:		
	Source	SINT INT	immediate tag	find the natural log of this value		
	Destination	SINT INT	tag	tag to store the result		
Function Block	Operand:	Type:	Format:	Description:		
	LN tag	FBD_MATH_ ADVANCED	structure	LN structure (default parameters):		
				Parameter:	Type:	Description:
				Source	REAL	input to the math instruction
				Dest	REAL	result of the math instruction
	Arithmetic Status Flags:		Major Faults:			
affected		none				

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LOG Log Base 10			dest := LOG(source);	The LOG instruction takes the log base 10 of the Source and stores the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	SINT INT DINT REAL	immediate tag	find the log of this value
	Destination	SINT INT DINT REAL	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	LOG tag	FBD_MATH_ ADVANCED	structure	LOG structure (default parameters):
			Parameter:	Type: Description:
			Source	REAL input to the math instruction
			Dest	REAL result of the math instruction
Arithmetic Status Flags:		Major Faults:		
affected		none		

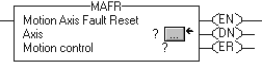
11 - 78 Instruction Set

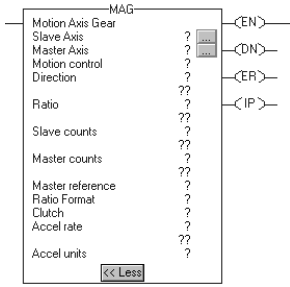
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LOWER Lower Case		not available	LOWER (Source, Dest) ;	The LOWER instruction converts the alphabetical characters in a string to lower case characters.
Operand:	Type:	Format:	Description:	
Source	string	tag	tag that contains the characters that you want to convert to lower case	
Destination	string	tag	tag to store the characters in lower case	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
LPF Low Pass Filter	not available		LPF (LPF_tag) ;	The LPF instruction provides a filter to attenuate input frequencies that are above the cutoff frequency.
Operand:	Type:	Format:	Description:	
LPF tag	FILTER_LOW_PASS	structure	LPF structure (default parameters):	
Parameter:	Type:	Description:		
In	REAL	analog signal input to the instruction		
Out	REAL	calculated output of the algorithm		
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAAT Motion Apply Axis Tuning		not available	MAAT (Axis, MotionControl);	The MAAT computes a complete set of servo gains and dynamic limits based on the results of a previously run MRAT instruction and updates the motion module with these new gain parameters.
Operand:	Type:	Format:	Description:	
Axis	AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

11 - 80 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAFR Motion Axis Fault Reset		not available	MAFR (Axis, MotionControl) ;	The MAFR instruction clears all motion faults for an axis. This is the only method for clearing axis motion faults.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

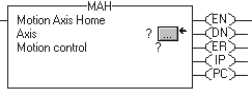
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAG Motion Axis Gear		not available	MAG (SlaveAxis, MasterAxis, MotionControl, Direction, Ratio, SlaveCounts, MasterCounts, MasterReference, RatioFormat, Clutch, AccelRate, AccelUnits) ;	The MAG instruction provides electronic gearing between any two axes in a specified direction and at a specified ratio
Operand:	Type:	Format:	Description:	
Slave axis	AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Master axis	AXIS_FEEDBACK AXIS_CONSUMED AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	axis that the slave axis follows	
Motion control	MOTION_INSTRUCTION	tag	motion structure	

continued

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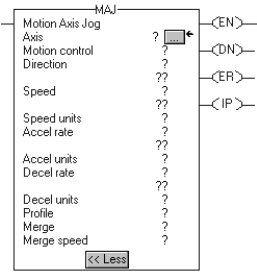
11 - 82 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAG Motion Axis Gear (continued)	Direction	UINT32	immediate tag	relative direction that the Slave axis tracks the Master Axis: <ul style="list-style-type: none"> • 0 = slave axis moves in the same direction as the master axis • 1 = slave axis moves in the opposite direction of its current direction • 2 = slave axis reverses from current or previous • 3 = slave axis to continue its current or previous direction
	Ratio	REAL	immediate tag	signed Real value establishing the gear ratio in Slave User Units per Master User Unit
	Slave counts	UINT32	immediate tag	slave counts
	Master counts	UINT32	immediate tag	master counts
	Master reference	BOOL	immediate	master position reference: 0 = actual position, 1 = command position
	Ratio format	BOOL	immediate	ratio format: <ul style="list-style-type: none"> • 0 = real gear ratio • 1 = integer fraction of slave encoder counts to master encoder counts
	Clutch	BOOL	immediate	whether Clutch is enabled or disabled
	Accel rate	BOOL	immediate tag	acceleration rate of the Slave Axis in% or Acceleration Units
	Accel units	DINT	immediate	units used to display the Acceleration value: 0 = units per sec ² ; 1 = % of maximum acceleration
	Arithmetic Status Flags:		Major Faults:	
	not affected		none	

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAH Motion Axis Home		not available	MAH(Axis,MotionControl);	The MAH instruction homes an axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

11 - 84 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAHD Motion Apply Hookup Diagnostics		not available	MAHD (Axis, MotionControl, DiagnosticTest, ObservedDirection);	The MAHD instruction applies the results of a previously run MRHD instruction to generate a new set of encoder and servo polarities based on the observed direction of motion during the test.
Operand:	Type:	Format:	Description:	
Axis	AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Diagnostic test	UDINT	immediate	test for the motion module to run: <ul style="list-style-type: none"> 0 = motor/encoder hookup test 1 = encoder hookup test 2 = encoder marker test 	
Observed direction	BOOL	immediate	direction of the test motion: 0 = forward; 1 = reverse	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAJ Motion Axis Jog		not available	<pre>MAJ(Axis, MotionControl, Direction, Speed, SpeedUnits, AccelRate, AccelUnits, DecelRate, DecelUnits, Profile, Merge, MergeSpeed);</pre>	The MAJ instruction initiates a jog motion profile for the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Direction	UDINT	immediate tag	direction of jog: 0 = forward jog; 1 = reverse jog	
Speed	REAL	immediate tag	speed to move the axis in% or Speed Units	
Speed units	UDINT	immediate	engineering units for the Speed value: 0 = units per sec; 1 = % of maximum speed	

continued

11 - 86 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAJ Motion Axis Jog (continued)	Accel units	UDINT	immediate	engineering units for the Acceleration value: 0 = units per sec ² ; 1 = % of maximum acceleration
	Accel rate	REAL	immediate tag	acceleration rate of the axis in% or Acceleration Units
	Decel rate	REAL	immediate or tag	deceleration rate of the axis in% or Deceleration Units
	Decel units	UDINT	immediate	engineering units for the Deceleration value: 0 = units per sec ² ; 1 = % of maximum deceleration
	Profile	UDINT	immediate	select the velocity profile to run the jog: 0 = trapezoidal; 1 = S-curve
	Merge	UDINT	immediate	instructs the motion control to turn all current axis motion
	Merge speed	UDINT	immediate	determines whether the speed is the specified Speed value of this instruction or the Current axis speed: <ul style="list-style-type: none"> 0 = programmed value in the speed field 1 = current axis speed
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAM Motion Axis Move		not available	<pre>MAM(Axis, MotionControl, MoveType, Position, Speed, SpeedUnits, AccelRate, AccelUnits, DecelRate, DecelUnits, Profile, Merge, MergeSpeed);</pre>	The MAM instruction initiates a move profile for the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Move type	UDINT	immediate or tag	type of move operation: 0 = Absolute Move; 1 = Incremental Move; 2 = Rotary Shortest Path Move; 3 = Rotary Positive Move; 4 = Rotary Negative Move; 5 = Absolute Master Offset; 6 = Incremental Master Offset	
Position /Distance	REAL	immediate tag	value of the absolute command position to move to, or for incremental movement, the value of the distance to move from the current command position.	
Speed	REAL	immediate tag	speed to move the axis in either% or Speed units.	

continued

11 - 88 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAM Motion Axis Move (continued)	Speed Units	BOOL	immediate	units for the Speed value: 0 = units per sec; 1 = % of maximum speed
	Accel rate	REAL	immediate or tag	acceleration rate of the axis in% or Acceleration units
	Accel units	BOOL	immediate	units for the Accel value: 0 = units per sec ² ; 1 = % of maximum acceleration
	Decel rate	REAL	immediate or tag	deceleration rate of the axis in% or Deceleration units
	Decel units	BOOLEAN	immediate	units for the Deceleration value: 0 = units per sec ² ; 1 = % of maximum acceleration
	Profile	UDINT	immediate	velocity profile to run for the move: 0 = Trapezoidal; 1 = S-curve
	Merge	BOOL	immediate	instructs the motion control to turn all current axis motion, regardless of the motion instructions currently in process, into a pure move governed by this instruction
	Merge speed	DINT	immediate	determines whether the speed of the move profile is going to be the specified Speed value of this instruction or the Current axis speed: <ul style="list-style-type: none"> • 0 = programmed value in the speed field • 1 = current axis speed
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAOC Motion Arm Output Cam		not available	<pre>MAOC (Axis, ExecutionTarget, MotionControl, Output, Input, OutputCam, CamStartPosition, CamEndPosition, OutputCompensation, ExecutionMode, ExecutionSchedule, AxisArmPosition, CamArmPosition, Reference);</pre>	The MAOC instruction sets and resets output bits based on an axis position.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_CONSUME D AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRI VE	tag	name of the axis	
Execution Target	UNIT32	immediate tag	defines the specific output cam: <ul style="list-style-type: none"> 0...8 – Output Cams executed in the Logix controller. 9...31 – Reserved for future use. 	
Motion Control	MOTION_INSTRUCTION	tag	motion structure	

continued

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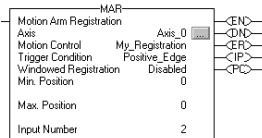
Instruction:	Relay Ladder:		Function Block:	Structured Text:	Description:
MAOC Motion Arm Output Cam (continued)	Output	DINT	tag	32 output bits that are set or reset based on the specified output cam	
	Input	DINT	tag	32 input bits that can be used as enable bits depending on the specified output cam	
	Output Cam	OUTPUT_CAM	array tag	array of OUTPUT_CAM elements	
	Cam Start Position	SINT INT	DINT REAL	immediate tag	cam start position with the cam end position define the left and right boundaries of the output cam range
	Cam End Position	SINT INT	DINT REAL	immediate tag	cam end position with the cam start position define the left and right boundaries of the output cam range
	Output Compensation	OUTPUT_COMPENSATION	array tag	array of 1 to 32 OUTPUT_COMPENSATION elements	
	Execution Mode	UINT32	immediate	execution mode: once (0); continuous (1); persistent (2)	
	Execution Schedule	UINT32	immediate	when to arm the output cam: 0 = immediate; 1 = pending; 2 = forward only; 3 = reverse only; 4 = bi-directional	
	Axis Arm Position	SINT INT	DINT REAL	immediate tag	axis position where the output cam is armed when the execution schedule is set to forward only, reverse only, or bi-directional and the axis moves in the specified direction
	Cam Arm Position	SINT INT	DINT REAL	immediate tag	cam position associated with the axis arm position when the output cam is armed
	Reference	UINT32	immediate	whether the output cam is connected to either 0 = actual position, 1 = command position	
Arithmetic Status Flags:			Major Faults:		
not affected			none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAPC Motion Axis Position Cam		not available	<pre>MAPC (SlaveAxis, MasterAxis, MotionControl, Direction, CamProfile, SlaveScaling, MasterScaling, ExecutionMode, ExecutionSchedule, MasterLockPosition, CamLockPosition, MasterReference, MasterDirection);</pre>	The MAPC instruction provides electronic camming between any two axes according to the specified cam profile.
Operand:	Type:	Format:	Description:	
Slave Axis	AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Master Axis	AXIS_FEEDBACK AXIS_CONSUMED AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	axis that the slave axis follows according to the cam profile	
Motion Control	MOTION_INSTRUCTION	tag	motion structure	

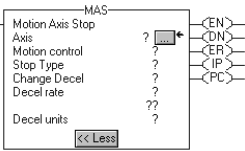
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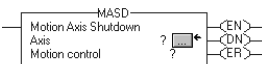
11 - 92 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAPC Motion Axis Position Cam (continued)	Direction	UINT32	immediate tag	relative direction of the slave axis: same, opposite, revers, or unchanged
	Cam Profile	CAM_PROFILE	array	calculated cam profile array used to establish the master/slave position relationship
	Slave Scaling	REAL	immediate tag	scales the total distance covered by the slave axis through the cam profile
	Master Scaling	REAL	immediate tag	scales the total distance covered by the master axis through the cam profile
	Execution Mode	UINT32	immediate	determines if the cam profile is executed: 0 = once, 1 = continuous, 2 = persistent
	Execution Schedule	UINT32	immediate	method to execute the cam profile: 0 = immediate, 1 = pending, 2 = forward only, 3 = reverse only, 4 = bi-directional
	Master Lock Position	REAL	immediate tag	master axis absolute position where the slave axis locks to the master axis
	Cam Lock Position	REAL	immediate tag	starting location in the cam profile
	Master Reference	UINT32	immediate	master position reference: 0 = actual position, 1 = command position
	Master Direction	UINT32	immediate	direction of the master axis that generates slave motion according to the cam profile: bi-directional (0), forward only (1), reverse only (2)
Arithmetic Status Flags:		Major Faults:		
	not affected		none	

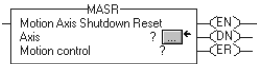
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAR Motion Arm Registration		not available	MAR (Axis,MotionControl, TriggerCondition, WindowedRegistration, MinimumPosition, MaximumPosition, InputNumber);	The MAR instruction arms servo-module registration event-checking for the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Trigger condition	BOOL	immediate	registration input transition trigger: 0 = on positive edge, 1 = on negative edge	
Windowed registration	BOOL	immediate	whether registration is to be windowed, meaning that the computed registration position must fall within the specified minimum and maximum position limits	
Minimum position	REAL	immediate or tag	registration position must be greater than minimum position limit	
Maximum position	REAL	immediate or tag	registration position must be less than maximum position limit	
Input Number	UINT32	1 or 2	registration input: 1 = Registration 1 Position, 2 = Registration 2 Position	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

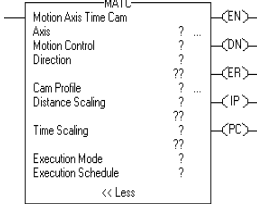
11 - 94 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAS Motion Axis Stop		not available	MAS(Axis,MotionControl, StopType,ChangeDecel, DecelRate,DecelUnits);	The MAS instruction initiates a controlled stop of any motion process on the designated axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Stop type	UNIT32	immediate	determines motion process: 0 = stop all motion; 1 = stop jogging; 2 = stop moving; 3 = stop gearing; 4 = stop homing; 5 = stop tuning; 6 = stop test; 7 = stop position camming; 8 = stop time camming; 9 = stop a Master Offset Move	
Change Decel	BOOL	immediate	set to enable use of Decel value rather than the current configured Max Deceleration rate	
Decel rate	REAL	immediate tag	deceleration rate of the axis in% or Deceleration Units	
Decel units	BOOL	immediate	engineering units for Decel value: 0 = units per sec ² ; 1 =% of maximum	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MASD Motion Axis Shutdown		not available	MASD (Axis, MotionControl);	The MASD instruction forces a specified axis into the Shutdown state. The Shutdown state of an axis is when the drive output is disabled, servo loop deactivated, and any available or associated OK solid-state relay contacts are open. The axis remains in the Shutdown state until either an Axis or Group Shutdown Reset is executed.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

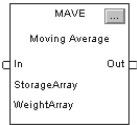
11 - 96 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MASR Motion Axis Shutdown Reset		not available	MASR(Axis,MotionControl);	The MASR instruction transitions an axis from an existing Shutdown state to an Axis Ready state.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

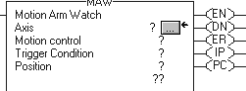
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MATC Motion Axis Time Cam		not available	MATC(Axis,MotionControl, Direction,CamProfile, DistanceScaling, TimeScaling, ExecutionMode, ExecutionSchedule);	The MATC instruction provides electronic camming of an axis as a function of time, according to the specified Cam Profile.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion Control	MOTION_INSTRUCTION	tag	motion structure	
Direction	UINT32	immediate tag	relative direction of the slave axis to the master axis: same, opposite, reverse, unchanged	
Cam Profile	CAM_PROFILE	array	calculated cam profile array	
Distance Scaling	REAL	immediate tag	scales the total distance covered by the axis through the cam profile	
continued				

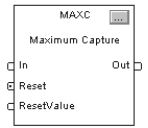
11 - 98 Instruction Set

Instruction:	Relay Ladder:		Function Block:	Structured Text:	Description:
MATC Motion Axis Time Cam (continued)	Time Scaling	REAL	immediate tag	scales the time interval covered by the cam profile	
	Execution Mode	UINT32	immediate	how the cam motion behaves when the time moves beyond the end point of the cam profile: once (0), continuous (1)	
	Execution Schedule	UNIT32	immediate	method to execute the cam profile: 0 = immediate, 1 = pending	
	Arithmetic Status Flags:		Major Faults:		
	not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
MAVE Moving Average	not available		MAVE (MAVE_tag, storage, weight);	The MAVE instruction calculates a time average value for the In signal. This instruction optionally supports user-specified weights.	
Operand:	Type:	Format:	Description:		
MAVE tag	MOVING_AVERAGE	structure	MAVE structure (default parameters):		
			Parameter:	Type:	Description:
			In	REAL	analog signal input to the instruction
			Out	REAL	calculated output of the algorithm
storage	REAL	array	holds the moving average samples; this array must be at least as large as NumberOfSamples		
weight	REAL	array	(optional) used for weighted averages; this array must be at least as large as NumberOfSamples element [0] is used for the newest sample; element [n] is used for the oldest sample		
Arithmetic Status Flags:		Major Faults:			
set for the Out parameter		none			

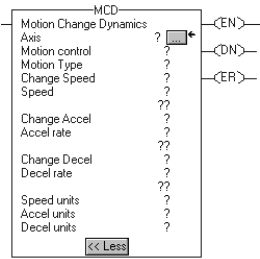
11 - 100 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAW Motion Arm Watch		not available	MAW(Axis, MotionControl, TriggerCondition, Position);	The MAW instruction arms watch-position event-checking for the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Trigger condition	BOOL	immediate	watch-event trigger condition: 0 = forward; 1 = reverse	
Position	REAL	immediate tag	new value for the watch position	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MAXC Maximum Capture	not available	 <p>The diagram shows a function block labeled 'MAXC' with a 'MAXC' tag. It has four inputs: 'In', 'Reset', and 'ResetValue' (all with checkboxes), and one output 'Out' (with a checkbox). The block is labeled 'Maximum Capture'.</p>	MAXC (MAXC_tag) ;	The MAXC instruction finds the maximum of the input signal over time.
Operand:	Type:	Format:	Description:	
MAXC tag	MAXIMUM_CAPTURE	structure	MAXC structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	analog signal input to the instruction
		Reset	BOOL	request to reset control algorithm the instruction sets Out = ResetValue as long as Reset is set
		ResetValue	REAL	reset value for instruction the instruction sets Out = ResetValue as long as Reset is set
		Out	REAL	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

11 - 102 Instruction Set


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MCCP Motion Calculate Cam Profile		not available	MCCP (MotionControl, Cam, Length, StartSlope, EndSlope, CamProfile);	The MCCP instruction calculates a cam profile based on an array of cam points.
Operand:	Type:	Format:	Description:	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Cam	CAM	array	cam array	
Length	UINT	immediate tag	number of cam elements in the array	
Start Slope	REAL	immediate tag	boundary condition for the initial slope of the profile	
End Slope	REAL	immediate tag	boundary condition for the ending slope of the profile	
Cam Profile	CAM_PROFILE	array	calculated cam profile array	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

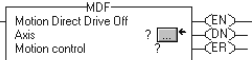
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MCD Motion Change Dynamics		not available	<pre>MCD(Axis, MotionControl, MotionType, ChangeSpeed, Speed, ChangeAccel, AccelRate, ChangeDecel, DecelRate, SpeedUnits, DecelUnits, AccelUnits);</pre>	The MCD instruction selectively changes the speed, acceleration rate, or deceleration rate of a move profile or a jog profile in process
Operand:	Type:	Format:	Description:	
Axis	AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Motion type	UDINT	immediate	motion profile to change: 0 = jog; 1 = move	
Change speed	BOOL	immediate	whether to enable a change of speed	
Speed	REAL	immediate tag	new Speed to move the axis in% or Speed Units	

continued


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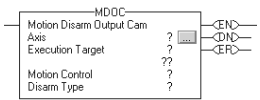
11 - 104 Instruction Set

Instruction:	Relay Ladder:		Function Block:	Structured Text:	Description:
MCD Motion Change Dynamics (continued)	Change accel	BOOL	immediate	whether to enable an acceleration change	
	Accel rate	REAL	immediate tag	acceleration rate of the axis in% or Acceleration units	
	Change decel	BOOL	immediate	whether to enable a deceleration change	
	Decel rate	REAL	immediate tag	deceleration rate of the axis in% or Deceleration units	
	Speed units	BOOL	immediate	units used to display the Speed value: 0 = units per sec; 1 =% of maximum speed	
	Accel units	BOOL	immediate	units used to display the Acceleration value: 0 = units per sec ² ; 1 =% of maximum acceleration	
	Decel units	BOOL	immediate	units used to display the Deceleration value: 0 = units per sec ² ; 1 =% of maximum acceleration	
	Arithmetic Status Flags:		Major Faults:		
not affected		none			
Instruction:	Relay Ladder:		Function Block:	Structured Text:	Description:
MCR Master Control Reset			not available	not available	The MCR instruction, used in pairs, creates a program zone that can disable all rungs within the MCR instructions.
	Arithmetic Status Flags:		Major Faults:		
not affected		none			


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MDF Motion Direct Drive Off		not available	<code>MDF(Axis, MotionControl);</code>	The MDF instruction deactivates the servo drive and sets the servo output voltage to the output offset voltage.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_SERVO	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MDO Motion Direct Drive On		not available	<pre>MDO(Axis, MotionControl, DriveOutput, DriveUnits);</pre>	The MDO instruction works in conjunction with motion modules that support an external analog servo drive interface. The MDO instruction activates the module's Drive Enable, enabling the external servo drive, and also sets the servo module's output voltage of the drive to the specified voltage level.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_SERVO	tag	name of the axis	
Motion control	MOTION_ INSTRUCTION	tag	motion structure	
Drive Output	REAL	tag	voltage to output in% of servo output limit or in volts	
Drive Units	BOOL	tag	units for drive output value: 0 = volts, 1 = %	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

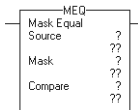
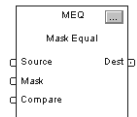
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MDOC Motion Disarm Output Cam		not available	MDOC (Axis, ExecutionTarget, MotionControl, DisarmType);	The MDOC instruction initiates the disarming of one or more output cams connected to the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_CONSUME D AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Execution Target	SINT DINT INT	immediate tag	output cam from the set connected to the named axis: <ul style="list-style-type: none">• 0...8 – Output Cams executed in the Logix controller.• 9...31 – Reserved for future use.	
Motion Control	MOTION_INSTRUCTION	tag	motion structure	
Disarm Type	DINT	immediate	output cam(s) to be disarmed: 0 = all, 1 = specific	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

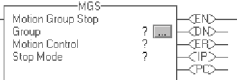
11 - 108 Instruction Set

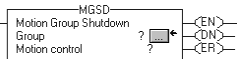
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MDR Motion Disarm Registration		not available	MDR(Axis,MotionControl, InputNumber);	The MDR instruction disarms the registration input event-checking for the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Input Number	UINT32	1 or 2	registration input: 1 = Registration 1 Position, 2 = Registration 2 Position	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MDW Motion Disarm Watch		not available	MDW(Axis, MotionControl);	The MDW instruction disarms watch-position event-checking for an axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

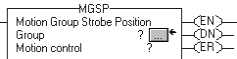
11 - 110 Instruction Set

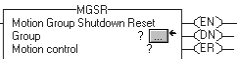
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
MEQ Masked Equal To			<pre>IF (Source AND Mask) = (Compare AND Mask) THEN <statement>; END_IF;</pre>	The MEQ instruction passes the Source and Compare values through a Mask and compares the results.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source	SINT INT	DINT	immediate tag value to test against Compare	
	Mask	SINT INT	DINT	immediate tag defines which bits to block or pass	
	Compare	SINT INT	DINT	immediate tag value to test against Source	
Function Block	Operand:	Type:	Format:	Description:	
	MEQ tag	FBD_MASK_EQUAL	structure	MEQ structure (default parameters):	
			Parameter:	Type:	Description:
			Source	DINT	value to test against Compare
			Mask	DINT	defines which bits to block (mask)
			Compare	DINT	compare value
			Dest	BOOL	result of the instruction
	Arithmetic Status Flags:		Major Faults:		
	not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MGS Motion Group Stop		not available	MGS(Group,MotionControl, StopMode);	The MGS instruction initiates a stop of all motion in progress on all axes in the specified group by a method configured individually for each axis or as a group via the stop mode of the MGS instruction.
Operand:	Type:	Format:	Description:	
Group	MOTION_GROUP	tag	group of axes	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Stop Mode	UDINT	immediate	how the axes in the group are stopped: 0 = programmed, 1 = fast stop, 2 = fast disable	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MGSD Motion Group Shutdown		not available	MGSD(Group,MotionControl);	The MGSD instruction forces all axes in the designated group into a Shutdown state.
Operand:	Type:	Format:	Description:	
Group	MOTION_GROUP	tag	group of axes	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		


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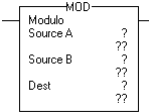
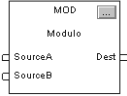
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MGSP Motion Group Strobe Position		not available	MGSP (Group, MotionControl) ;	The MGSP instruction latches the current command and actual position of all axes in the specified group at a single point in time.
Operand:	Type:	Format:	Description:	
Group	MOTION_GROUP	tag	group of axes	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MGSR Motion Group Shutdown Reset		not available	MGSR (Group, MotionControl) ;	The MGSR instruction transitions a group of axes from the shutdown operating state to the axis ready operating state.
Operand:	Type:	Format:	Description:	
Group	MOTION_GROUP	tag	group of axes	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

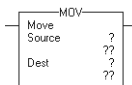
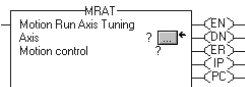
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MID Middle String		not available	MID (Source, Qty, Start, Dest) ;	The MID instruction copies a specified number of ASCII characters from a string and stores them in another string.
Operand:	Type:	Format:	Description:	
Source	string	tag	string to copy characters from	
Quantity	SINT INT	DINT tag	immediate tag	number of characters to copy; the Start plus the Quantity must be less than or equal to the DATA size of the Source
Start	SINT INT	DINT tag	immediate tag	position of the first character to copy; enter a number between 1 and the DATA size of the Source
Destination	string	tag	string to copy the characters to	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none"> that no instruction is writing to the LEN member of the string tag in the LEN value, you entered the number of characters that the string contains
		Type 4	Code 56	The Start or Quantity value is invalid. Check that the: <ul style="list-style-type: none"> Start value is between 1 and the DATA size of the Source Start value plus the Quantity value is less than or equal to the DATA size of the Source

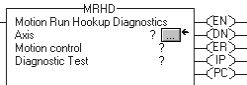
11 - 114 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MINC Minimum Capture	not available		MINC (MINC_tag) ;	The MINC instruction finds the minimum of the Input signal over time.
Operand:	Type:	Format:	Description:	
MINC tag	MINIMUM_CAPTURE	structure	MINC structure (default parameters):	
			Parameter:	Description:
			In	analog signal input to the instruction
			Reset	request to reset control algorithm the instruction sets Out = ResetValue as long as Reset is set
			ResetValue	reset value for instruction the instruction sets Out = ResetValue as long as Reset is set.
			Out	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MOD Modulo			dest := sourceA MOD sourceB;	The MOD instruction divides Source A by Source B and places the remainder in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source A	SINT INT	immediate tag	value of the dividend
	Source B	SINT INT	immediate tag	value of the divisor
	Destination	SINT INT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	MOD tag	FBD_MATH	structure	MOD structure (default parameters):
	Parameter:	Type:	Description:	
	SourceA	REAL	value of the dividend	
	SourceB	REAL	value of the divisor	
	Dest	REAL	result of the math instruction	
	Arithmetic Status Flags:	Major Faults:		
	affected	Type 4	Code 4	the divisor is 0

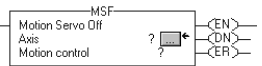
11 - 116 Instruction Set


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MOV Move		not available	dest := source;	The MOV instruction copies the Source to the Destination. The Source remains unchanged.
Operand:	Type:	Format:	Description:	
Source	SINT INT	DINT REAL	immediate tag	value to move (copy)
Destination	SINT INT	DINT REAL	tag	an expression consisting of tags and/or immediate values separated by operators
Arithmetic Status Flags:		Major Faults:		
affected		none		
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MRAT Motion Run Axis Tuning		not available	MRAT(Axis,MotionControl);	The MRAT instruction commands the motion module to run a tuning profile for the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MRHD Motion Run Hookup Diagnostics		not available	MRHD (Axis, MotionControl, DiagnosticTest);	The MRHD instruction commands the motion module to run any one of three different diagnostics on the specified axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Diagnostic test	DINT	immediate	test for the motion module to run: <ul style="list-style-type: none">• 0 = motor/encoder hookup test• 1 = encoder hookup test• 2 = encoder marker test	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

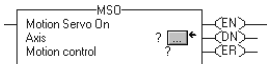
11 - 118 Instruction Set

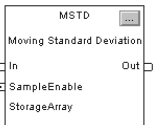
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MRP Motion Redefine Position		not available	MRP(Axis,MotionControl, Type,PositionSelect, Position);	The MRP instruction changes the command or actual position of an axis.
Operand:	Type:	Format:	Description:	
Axis	AXIS_FEEDBACK AXIS_VIRTUAL AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Type	BOOL	immediate	how the redefinition operation should work: 0 = absolute, 1 = relative	
Position select	BOOL	immediate	what position to perform the redefinition operation on: 0 = actual position, 1 = command position	
Position	REAL	immediate tag	value to use to change the axis position to or offset to current position	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

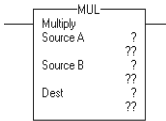
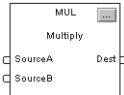
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MSF Motion Servo Off		not available	MSF(Axis, MotionControl);	The MSF instruction deactivates the drive output for the specified axis and to deactivate the axis' servo loop. If you execute an MSF instruction while the axis is moving, the axis coasts to an uncontrolled stop.
Operand:	Type:	Format:	Description:	
Axis	AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

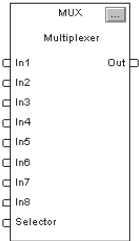
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MSG Message		not available	MSG(MessageControl);	The MSG instruction asynchronously reads or writes a block of data to another module on a network.
Operand:	Type:	Format:	Description:	
message control	MESSAGE	tag	message structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

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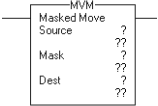
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MSO Motion Servo On		not available	MSO(Axis,MotionControl);	The MSO instruction activates the drive amplifier for the specified axis and to activate the axis' servo control loop.
Operand:	Type:	Format:	Description:	
Axis	AXIS_GENERIC AXIS_SERVO AXIS_SERVO_DRIVE	tag	name of the axis	
Motion control	MOTION_INSTRUCTION	tag	motion structure	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

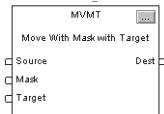
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MSTD Moving Standard Deviation	not available		MSTD (MSTD_tag, storage) ;	The MSTD instruction calculates a moving standard deviation and average for the In signal.
Operand:	Type:	Format:	Description:	
MSTD tag	MOVING_STD_DEV	structure	MSTD structure (default parameters):	
Parameter:	Type:	Description:		
In	REAL	analog signal input to the instruction		
SampleEnable	BOOL	enable for taking a sample of In When set, the instruction enters the value of In into the storage array and calculates a new Out and Average value. When cleared and Initialize is cleared, the instruction holds Out and Average at their current values.		
Out	REAL	calculated output of the algorithm		
storage	REAL	array	holds the In samples; this array must be at least as large as NumberOfSamples	
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

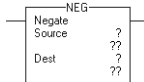
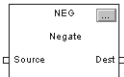
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
MUL Multiply			dest := sourceA * sourceB;	The MUL instruction multiplies Source A with Source B and places the result in the Destination.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source A	SINT INT	immediate tag	value of the multiplicand	
	Source B	SINT INT	immediate tag	value of the multiplier	
	Destination	SINT INT	tag	tag to store the result	
Function Block	Operand:	Type:	Format:	Description:	
	MUL tag	FBD_MATH	structure	MUL structure (default parameters):	
			Parameter:	Type:	Description:
			SourceA	REAL	value of the multiplicand
			SourceB	REAL	value of the multiplier
			Dest	REAL	result of the math instruction
	Arithmetic Status Flags:		Major Faults:		
	affected		none		

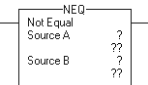
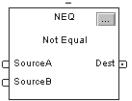
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MUX Multiplexer	not available		not available	The MUX instruction selects one of eight inputs based on the selector input.
Operand:	Type:	Format:	Description:	
MUX tag	MULTIPLEXER	structure	MUX structure (default parameters):	
		Parameter:	Type:	Description:
		Inx	REAL	analog signal input to the instruction where $x = 1-8$
		Selector	DINT	selector input to the instruction
		Out	REAL	selected output of the algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MVM Masked Move		see MVMT	<pre>dest := (Dest AND NOT (Mask)) OR (Source AND Mask);</pre>	The MVM instruction copies the Source to a Destination and allows portions of the data to be masked.
Operand:	Type:		Format:	Description:
Source	SINT INT	DINT	immediate tag	value to move
Mask	SINT INT	DINT	immediate tag	which bits to block or pass
Destination	SINT INT	DINT	tag	an expression consisting of tags and/or immediate values separated by operators
Arithmetic Status Flags:		Major Faults:		
affected		none		

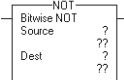
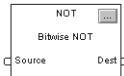
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
MVMT Masked Move with Target	see MVM		MVMT (MVMT_tag) ;	The MVMT instruction first copies the Target to the Destination. Then the instruction compares the masked Source to the Destination and makes any required changes to the Destination. The Target and the Source remain unchanged.
Operand:	Type:	Format:	Description:	
MVMT tag	FBD_MASKED_MOVE	structure	MVMT structure (default parameters):	
Parameter:	Type:	Description:		
Source	DINT	input value to move to Destination based on value of Mask		
Mask	DINT	mask of bits to move from Source to Dest. All bits set to one cause the corresponding bits to move from Source to Dest. All bits that are set to zero cause the corresponding bits not to move from Source to Dest		
Target	DINT	input value to move to Dest prior to moving Source bits through the Mask		
Dest	DINT	result of masked move instruction		
Arithmetic Status Flags:		Major Faults:		
affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
NEG Negate			dest := -source;	The NEG instruction changes the sign of the Source and places the result in the Destination.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source	SINT INT DINT REAL	immediate tag	value to negate	
	Destination	SINT INT DINT REAL	tag	tag to store the result	
Function Block	Operand:	Type:	Format:	Description:	
	NEG tag	FBD_MATH_ ADVANCED	structure	NEG structure (default parameters):	
	Parameter:	Type:	Description:		
	Source	REAL	value to negate		
	Dest	REAL	result of the math instruction		
	Arithmetic Status Flags:		Major Faults:		
	affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
NEQ Not Equal To			IF sourceA <> sourceB THEN <statements>;	The NEQ instruction tests whether Source A is not equal to Source B.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source A	SINT INT DINT	REAL string tag	value to test against Source B
Function Block	Source B	SINT INT DINT	REAL string tag	value to test against Source A
	NEQ tag	FBD_COMPARE	structure	NEQ structure (default parameters):
		Parameter:	Type:	Description:
		SourceA	REAL	value to test against SourceB
		SourceB	REAL	value to test against SourceA
		Dest	BOOL	result of the instruction
Arithmetic Status Flags:		Major Faults:		
not affected		none		

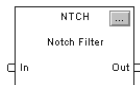
11 - 128 Instruction Set


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
NOP No Operation		not available	not available	The NOP instruction functions as a placeholder
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
NOT Bitwise NOT			dest := NOT source	The NOT instruction performs a bitwise NOT operation using the bits in the Source and places the result in the Destination.

Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	SINT DINT	immediate tag	value to NOT
	Destination	SINT DINT	tag	tag to store the result


Function Block	Operand:	Type:	Format:	Description:
	NOT tag	FBD_LOGICAL	structure	NOT structure (default parameters):
	Parameter:	Type:	Description:	
	Source	DINT	value to NOT	
	Dest	DINT	result of the instruction	
	Arithmetic Status Flags:		Major Faults:	
	affected		none	


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
NTCH Notch Filter	not available		NTCH (NTCH_tag) ;	The NTCH instruction provides a filter to attenuate input frequencies that are at the notch frequency.
Operand:	Type:	Format:	Description:	
NTCH tag	FILTER_NOTCH	structure	NTCH structure (default parameters):	
Parameter:	Type:	Description:		
In	REAL	analog signal input to the instruction		
Out	REAL	calculated output of the algorithm		
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
ONS One Shot		not available	<pre>IF BOOL_expression AND NOT storage_bit THEN <statement>; END_IF; storage_bit := BOOL_expression;</pre>	The ONS instruction enables or disables the remainder of the rung, depending on the status of the storage bit.
Operand:	Type:	Format:	Description:	
storage bit	BOOL	tag	internal storage bit stores the rung-condition-in from the last time the instruction was executed	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
OR Bitwise OR			dest := sourceA OR sourceB	The OR instruction performs a bitwise OR operation using the bits in Source A and Source B and places the result in the Destination.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source A	SINT INT	DINT	immediate tag	value to OR with Source B
	Source B	SINT INT	DINT	immediate tag	value to OR with Source A
	Destination	SINT INT	DINT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:	
	OR tag	FBD_LOGICAL	structure	OR structure (default parameters):	
		Parameter:	Type:	Description:	
		SourceA	DINT	value to OR with Source B	
		SourceB	DINT	value to OR with Source A	
		Dest	DINT	result of the instruction	
	Arithmetic Status Flags:		Major Faults:		
	affected		none		




Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
OSF One Shot Falling		see OSFI	see OSFI	The OSF instruction sets or clears the output bit depending on the status of the storage bit.
Operand:	Type:	Format:	Description:	
storage bit	BOOL	tag	internal storage bit stores the rung-condition-in from the last time the instruction was executed	
output bit	BOOL	tag	bit to be set	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
OSFI One Shot Falling with Input	see OSF		OSFI (OSFI_tag) ;	The OSFI instruction sets the OutputBit for one execution cycle when the InputBit toggles from set to cleared.
Operand:	Type:	Format:	Description:	
OSFI tag	FBD_ONESHOT	structure	OSFI structure (default parameters):	
Parameter:	Type:	Description:		
InputBit	BOOL	input bit		
OutputBit	BOOL	output bit		
Arithmetic Status Flags:		Major Faults:		
not affected		none		

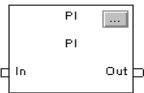
11 - 132 Instruction Set

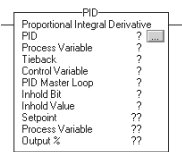
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
OSR One Shot Rising		see OSRI	see OSRI	The OSR instruction sets or clears the output bit, depending on the status of the storage bit.
Operand:	Type:	Format:	Description:	
storage bit	BOOL	tag	internal storage bit stores the rung-condition-in from the last time the instruction was executed	
output bit	BOOL	tag	bit to be set	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
OSRI One Shot Rising with Input	see OSR		OSRI (OSRI_tag) ;	The OSRI instruction sets the output bit for one execution cycle when the input bit toggles from cleared to set.
Operand:	Type:	Format:	Description:	
OSRI tag	FBD_ONESHOT	structure	OSRI structure (default parameters):	
		Parameter:	Type:	Description:
		InputBit	BOOL	input bit
		OutputBit	BOOL	output bit
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
OTE Output Energize		not available	<code>data_bit [:=] BOOL_expression;</code>	The OTE instruction sets or clears the data bit.
	Operand:	Type:	Format:	Description:
	data bit	BOOL	tag	bit to be set or cleared
	Arithmetic Status Flags:		Major Faults:	
	not affected		none	
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
OTL Output Latch		not available	<code>IF BOOL_expression THEN data_bit := 1; END_IF;</code>	The OTL instruction sets (latches) the data bit.
	Operand:	Type:	Format:	Description:
	data bit	BOOL	tag	bit to be set
	Arithmetic Status Flags:		Major Faults:	
	not affected		none	
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
OTU Output Unlatch		not available	<code>IF BOOL_expression THEN data_bit := 0; END_IF;</code>	The OTU instruction clears (unlatches) the data bit.
	Operand:	Type:	Format:	Description:
	data bit	BOOL	tag	bit to be cleared
	Arithmetic Status Flags:		Major Faults:	
	not affected		none	

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
PI Proportional + Integral	not available		PI (PI_tag);	The PI instruction provides two methods of operation. The first method follows the conventional PI algorithm in that the proportional and integral gains remain constant over the range of the input signal (error). The second method uses a non-linear algorithm where the proportional and integral gains vary over the range of the input signal. The input signal is the deviation between the setpoint and feedback of the process.
Operand:	Type:	Format:	Description:	
PI tag	PROP_INT	structure	PI structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	process error signal input
		Out	REAL	calculated output of the PI algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

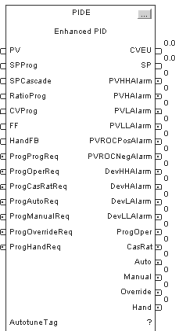
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
PID Proportional, Integral, Derivative		not available	PID (PID, ProcessVariable, Tieback, ControlVariable, PIDMasterLoop, InholdBit, InholdValue) ;	The PID instruction controls a process variable such as flow, pressure, temperature, or level.
Operand:	Type:	Format:	Description:	
PID	PID	structure	PID structure	
Process variable	SINT INT	DINT REAL	tag value you want to control	
Tieback	SINT INT	DINT REAL	immediate tag (<i>optional</i>) output of a hardware hand/auto station which is bypassing the output of the controller Enter 0 if you don't want to use this parameter.	
Control variable	SINT INT	DINT REAL	tag value which goes to the final control device (valve, damper, etc.) If you are using the deadband, the Control variable must be REAL or it will be forced to 0 when the error is within the deadband.	
PID master loop	PID	structure	(<i>optional</i>) PID tag for the master PID Enter 0 if you don't want to use this parameter.	
Inhold bit	BOOL	tag	(<i>optional</i>) current status of the inhold bit from a 1756 analog output channel to support bumpless restart Enter 0 if you don't want to use this parameter.	
Inhold value	SINT INT	DINT REAL	tag (<i>optional</i>) data readback value from a 1756 analog output channel to support bumpless restart Enter 0 if you don't want to use this parameter.	

continued

continued

11 - 136 Instruction Set

Instruction:	Relay Ladder:		Function Block:	Structured Text:		Description:
PID Proportional, Integral, Derivative (continued)	Setpoint	na	na	displays current value of the setpoint		
	Process variable	na	na	displays current value of the scaled process variable		
	Output %	na	na	displays current output percentage value		
	Arithmetic Status Flags:		Major Faults:			
	not affected		Type 4	Code 35	.UPD =0	
			Type 4	Code 36	setpoint out of range	

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
PIDE Enhanced PID	not available		PIDE (PIDE_tag) ;	The PIDE instruction provides enhanced capabilities over the standard PID instruction. The instruction uses the velocity form of the PID algorithm. The gain terms are applied to the change in the value of error or PV, not the value of error or PV.

Operand:	Type:	Format:	Description:																		
PIDE tag	PIDE_ENHANCED	structure	PIDE structure (default parameters):																		
			<table><tr><th>Parameter:</th><th>Type:</th><th>Description:</th></tr><tr><td>PV</td><td>REAL</td><td>scaled process variable input</td></tr><tr><td>SPProg</td><td>REAL</td><td>SP program value, scaled in PV units</td></tr><tr><td>SPCascade</td><td>REAL</td><td>SP Cascade value, scaled in PV units</td></tr><tr><td>RatioProg</td><td>REAL</td><td>ratio program multiplier.</td></tr><tr><td>CVProg</td><td>REAL</td><td>CV program manual value</td></tr></table>	Parameter:	Type:	Description:	PV	REAL	scaled process variable input	SPProg	REAL	SP program value, scaled in PV units	SPCascade	REAL	SP Cascade value, scaled in PV units	RatioProg	REAL	ratio program multiplier.	CVProg	REAL	CV program manual value
Parameter:	Type:	Description:																			
PV	REAL	scaled process variable input																			
SPProg	REAL	SP program value, scaled in PV units																			
SPCascade	REAL	SP Cascade value, scaled in PV units																			
RatioProg	REAL	ratio program multiplier.																			
CVProg	REAL	CV program manual value																			

continued

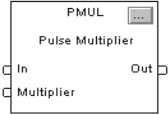
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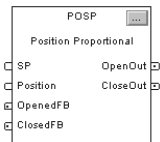
11 - 138 Instruction Set

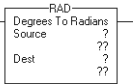

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
PIDE Enhanced PID (continued)			Parameter:	Type:	Description:
			FF	REAL	feed forward value
			HandFB	REAL	CV hand feedback value
			ProgProgReq	BOOL	program program request
			ProgOperReq	BOOL	program operator request
			ProgCasRatReq	BOOL	program cascade/ratio mode request
			ProgAutoReq	BOOL	program auto mode request
			ProgManualReq	BOOL	program manual mode request
			ProgOverrideReq	BOOL	program override mode request
			ProgHandReq	BOOL	program hand mode request
			CVEU	REAL	scaled control variable output
			SP	REAL	current setpoint value
			PVHHAlarm	BOOL	PV high-high alarm indicator
			PVHAlarm	BOOL	PV high alarm indicator
			PVLowAlarm	BOOL	PV low alarm indicator
			PVLLAlarm	BOOL	PV low-low alarm indicator
			PVROCPosAlarm	BOOL	PV rate-of-change positive alarm indicator
			PVROCNegAlarm	BOOL	PV rate-of-change negative alarm indicator
continued					


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
PIDE Enhanced PID (continued)			Parameter:	Type:	Description:
			DevHHAlarm	BOOL	deviation high-high alarm indicator
			DevHAlarm	BOOL	deviation high alarm indicator
			DevLAlarm	BOOL	deviation low alarm indicator
			DevLLAlarm	BOOL	deviation low-low alarm indicator
			ProgOper	BOOL	program/operator control indicator set when in program mode; cleared when in operator mode
			CasRat	BOOL	cascade ration mode indicator
			Auto	BOOL	auto mode indicator
			Manual	BOOL	manual mode indicator
			Override	BOOL	override mode indicator
			Hand	BOOL	hand mode indicator
autotune	PIDE_AUTOTUNE	structure	(optional) autotune structure (function block only)		
Arithmetic Status Flags:		Major Faults:			
set for the CVEU parameter		none			

11 - 140 Instruction Set

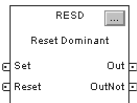
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
PMUL Pulse Multiplier	not available		PMUL (PMUL_tag) ;	The PMUL instruction provides an interface from a position input module, such as a resolver or encoder feedback module, to the digital system by computing the change in input from one scan to the next. By selecting a specific word size, you configure the PMUL instruction to differentiate through the rollover boundary in a continuous and linear fashion.
Operand:	Type:	Format:	Description:	
PMUL tag	PULSE MULTIPLIER	structure	PMUL structure (default parameters):	
Parameter:	Type:	Description:		
In	DINT	analog signal input to the instruction		
Multiplier	DINT	multiplier; divide this value by 100,000 to control the ratio of In to Out		
Out	REAL	output of the instruction		
Arithmetic Status Flags:	Major Faults:			
set for the Out parameter	none			

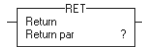

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
POSP Position Proportional	not available		POSP (POSP_tag) ;	The POSP instruction opens or closes a device by pulsing open or close contacts at a user defined cycle time with a pulse width proportional to the difference between the desired and actual positions.
Operand:	Type:	Format:	Description:	
POSP tag	POSITION_PROP	structure	POSP structure (default parameters):	
Parameter:	Type:	Description:		
SP	REAL	setpoint value; must use the same engineering units as Position		
Position	REAL	position feedback		
OpenedFB	BOOL	opened feedback; when set, the open output is not allowed to turn on		
ClosedFB	BOOL	closed feedback; when set, the close output is not allowed to turn on		
OpenOut	BOOL	output is pulsed to open the device		
CloseOut	BOOL	output is pulsed to close the device		
Arithmetic Status Flags:		Major Faults:		
set for the PositionPercent parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:		
RAD Radians			dest := RAD(source);	The RAD instruction converts the Source (in degrees) to radians and stores the result in the Destination.		
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:		
	Source	SINT INT	DINT REAL	immediate tag	value to convert to radians	
	Destination	SINT INT	DINT REAL	tag	tag to store the result	
Function Block	Operand:	Type:	Format:	Description:		
	RAD tag	FBD_MATH_ ADVANCED	structure	RAD structure (default parameters):		
				Parameter:	Type:	Description:
				Source	REAL	input to the conversion instruction
				Dest	REAL	result of the conversion instruction
	Arithmetic Status Flags:		Major Faults:			
affected		none				

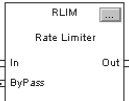
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RES Reset		not available	not available	The RES instruction resets a TIMER, COUNTER, or CONTROL structure.
	Operand:	Type:	Format:	Description:
	structure	TIMER CONTROL COUNTER	tag	structure to reset
	Arithmetic Status Flags:		Major Faults:	
	not affected		none	

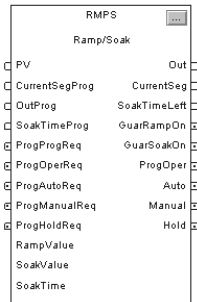
11 - 144 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
RESD Reset Dominant	not available		RESD (RESD_tag) ;	The RESD instruction uses Set and Reset inputs to control latched outputs. The Reset input has precedence over the Set input.	
Operand:	Type:	Format:	Description:		
RESD tag	DOMINANT_ RESET	structure	RESD structure (default parameters):		
			Parameter:	Type:	Description:
			Set	BOOL	set input to the instruction
			Reset	BOOL	reset input to the instruction
			Out	BOOL	output of the instruction
OutNot	BOOL	inverted output of the instruction			
Arithmetic Status Flags:		Major Faults:			
not affected		none			

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RET Return			RET (ReturnPar);	The RET instruction is an optional instruction that exchanges data with the JSR instruction.
Operand:	Type:	Format:	Description:	
Return parameter	BOOL SINT INT structure	immediate tag array tag	data from this routine that you want to copy to the corresponding return parameter in the JSR instruction	
Arithmetic Status Flags:		Major Faults:		
affected		4	31	<ul style="list-style-type: none">JSR instruction has fewer input parameters than SBR instructionRET instruction has fewer return parameters than JSR instructionmain routine contains a RET instruction
		4	0	JSR instruction jumps to a fault routine

11 - 146 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RLIM Rate Limiter	not available		RLIM(RLIM_tag);	The RLIM instruction limits the amount of change of a signal over time.
Operand:	Type:	Format:	Description:	
RLIM tag	RATE_LIMITER	structure	RLIM structure (default parameters):	
			Parameter:	Type: Description:
			In	REAL analog signal input to the instruction
			ByPass	BOOL request to bypass the algorithm; when set, Out = In
			Out	REAL calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

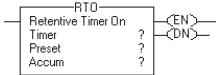
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RMPS Ramp/Soak	not available		RMPS (RMPS_tag,RampValue, SoakValue,SoakTime) ;	The RMPS instruction provides for a number of segments of alternating ramp and soak periods.
Operand:	Type:	Format:	Description:	
RMPS tag	RAMP_SOAK	structure	RMPS structure (default parameters):	
Parameter:	Type:	Description:		
PV	REAL	scaled analog temperature signal input to the instruction		
CurrentSegProg	DINT	current segment program value		
OutProg	REAL	output program value		
SoakTimeProg	REAL	soak time program value		
ProgProgReq	BOOL	program program request		
ProgOperReq	BOOL	program operator request		

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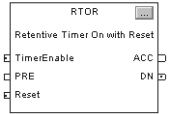
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
11 - 148 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RMPS Ramp/Soak (continued)			Parameter:	Type:
			Description:	
			ProgAutoReq	BOOL
			ProgManualReq	BOOL
			ProgHoldReq	BOOL
			Out	REAL
			CurrentSeg	DINT
			SoakTimeLeft	REAL
			GuarRampOn	BOOL
			GuarSoakOn	BOOL
			ProgOper	BOOL
			Auto	BOOL
			Manual	BOOL
			Hold	BOOL
	RampValue	REAL	array	ramp value array; enter a ramp value (time in minutes) for each segment (0 to NumberOfSegs-1)
	SoakValue	REAL	array	soak value array; enter a soak value for each segment (0 to NumberOfSegs-1); the array must be at least as large as NumberOfSegs
	SoakTime	REAL	array	soak time array; enter a soak time (time in minutes) for each segment (0 to NumberOfSegs-1)
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

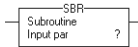

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RTO Retentive Timer On		see RTOR	see RTOR	The RTO instruction is a retentive timer that accumulates time when the instruction is enabled.
Operand:	Type:	Format:	Description:	
Timer	TIMER	tag	timer structure	
Preset	DINT	immediate	how long to delay (accumulate time)	
Accum	DINT	immediate	number of msec the timer has counted; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 34	<ul style="list-style-type: none">.PRE < 0.ACC < 0

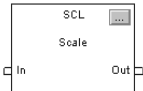
11 - 150 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RTOR Retentive Timer On with Reset	see RTO		RTOR (RTOR_tag) ;	The RTOR instruction is a retentive timer that accumulates time when TimerEnable is set.
Operand:	Type:	Format:	Description:	
RTOR tag	FBD_TIMER	structure	RTOR structure (default parameters):	
		Parameter:	Type:	Description:
		TimerEnable	BOOL	if cleared, enables the timer to run and accumulate time
		PRE	DINT	timer preset value in 1msec units
		Reset	BOOL	request to reset the timer
		ACC	BOOL	accumulated time in milliseconds
		DN	BOOL	timing done output. Indicates when the ACC ≥ PRE
Arithmetic Status Flags:		Major Faults:		
not affected		none		


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
RTOS REAL to String		not available	RTOS (Source, Dest) ;	The RTOS instruction produces the ASCII representation of a REAL value.
Operand:	Type:	Format:	Description:	
Source	REAL	tag	tag that contains the REAL value	
Destination	string	tag	tag to store the ASCII value	
Arithmetic Status Flags:		Major Faults:		
not affected		4	51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none">that no instruction is writing to the LEN member of the string tag.in the LEN value, you entered the number of characters that the string contains.
		4	52	The output string is larger than the destination. Create a new string data type that is large enough for the output string. Use the new string data type as the data type for the destination.


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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SBR Subroutine			SBR (InputPar) ;	The SBR instruction is an optional instruction that exchanges data with the JSR instruction.
Operand:	Type:	Format:	Description:	
Input parameter	BOOL SINT INT structure	tag array tag	tag in this routine into which you want to copy the corresponding input parameter from the JSR instruction	
Arithmetic Status Flags:		Major Faults:		
affected		4	31	<ul style="list-style-type: none">• JSR instruction has fewer input parameters than SBR instruction• RET instruction has fewer return parameters than JSR instruction• main routine contains a RET instruction
		4	0	JSR instruction jumps to a fault routine


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SCL Scale	not available	 <p>The diagram shows a function block labeled 'SCL Scale'. It has an 'In' input on the left and an 'Out' output on the right. There is a small 'Scale' label inside the block.</p>	SCL(SCL_tag);	The SCL instruction converts an unscaled input value to a floating point value in engineering units.
Operand:	Type:	Format:	Description:	
SCL tag	SCALE	structure	SCL structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	analog signal input to the instruction
		Out	REAL	output that represents the scaled value of the analog input
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

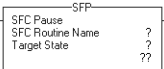
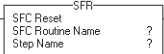
11 - 154 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SCRV S-Curve	not available		SCRV (SCRV_tag) ;	The SCR instruction performs a ramp function with an added jerk rate. The jerk rate is the maximum rate of change of the rate used to ramp output to input.
Operand:	Type:	Format:	Description:	
SCRV tag	S_CURVE	structure	SCRV structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	analog signal input to the instruction
		Out	REAL	output of the instruction
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SEL Selector	not available		not available	The SEL instruction uses a digital input to select one of two inputs.
Operand:	Type:	Format:	Description:	
SEL tag	SELECT	structure	SEL structure (default parameters):	
		Parameter:	Type:	Description:
		In1	REAL	first analog signal input to the instruction
		In2	REAL	second analog signal input to the instruction
		SelectorIn	BOOL	input that selects between In1 and In2
		Out	REAL	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

11 - 156 Instruction Set

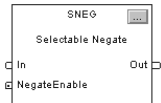
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SETD Set Dominant	not available		SETD (SETD_tag) ;	The SETD instruction uses Set and Reset inputs to control latched outputs. The Set input has precedence over the Reset input.
Operand:	Type:	Format:	Description:	
SETD tag	DOMINANT_SET	structure	SETD structure (default parameters):	
		Parameter:	Type:	Description:
		Set	BOOL	Set input to the instruction
		Reset	BOOL	Reset input to the instruction
		Out	BOOL	output of the instruction
		OutNot	BOOL	inverted output of the instruction
Arithmetic Status Flags:		Major Faults:		
not affected		none		

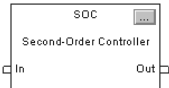
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SFP Pause SFC		not available	<code>SFP(SFCRoutineName, TargetState);</code>	The SFP instruction pauses an SFC routine.
Operand:	Type:	Format:	Description:	
SFCRoutine Name	ROUTINE	name	SFC routine to pause	
TargetState	DINT	immediate tag	select executing (enter 0) or paused (enter 1)	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 85	the routine type is not an SFC routine
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SFR Reset SFC		not available	<code>SFR(SFCRoutineName StepName);</code>	The SFR instruction resets the execution of a SFC routine at a specified step.
Operand:	Type:	Format:	Description:	
SFCRoutine Name	ROUTINE	name	SFC routine to reset	
Step Name	SFC_STEP	tag	target step where to resume execution	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 85	the routine type is not an SFC routine
		Type 4	Code 89	specified target step does not exist in the SFC routine

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SIN Sine			dest := SIN(source);	The SIN instruction takes the sine of the Source value (in radians) and stores the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	SINT INT DINT REAL	immediate tag	find the sine of this value
	Destination	SINT INT DINT REAL	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	SIN tag	FBD_MATH_ ADVANCED	structure	SIN structure (default parameters):
			Parameter:	Type: Description:
			Source	REAL input to the math instruction
			Dest	REAL result of the math instruction
	Arithmetic Status Flags:		Major Faults:	
	affected		none	

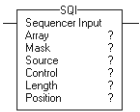
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SIZE Size in Elements		not available	not available	The SIZE instruction finds the size of a dimension of an array.
Operand:	Type:	Format:	Description:	
Source	SINT INT REAL structure string	array tag	array on which the instruction is to operate	
Dimension to vary	DINT	immediate (0, 1, 2)	which dimension to use enter 0 (first dimension), 1 (second dimension), or 2 (third dimension)	
Size	SINT INT REAL	tag	tag to store the number of elements in the specified dimension of the array	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
SNEG Selected Negate	not available		SNEG (SNEG_tag) ;	The SNEG instruction uses a digital input to select between the input value and the negative of the input value.	
Operand:	Type:	Format:	Description:		
SNEG tag	SELECTABLE_ NEGATE	structure	SNEG structure (default parameters):		
			Parameter:	Type:	Description:
			In	REAL	analog signal input to the instruction
			NegateEnable	BOOL	when NegateEnable is set, the instruction sets Out to the negative value of In
			Out	REAL	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:			
set for the Out parameter		none			

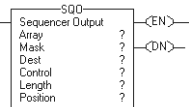
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
SOC Second-Order Controller	not available		SOC (SOC_tag) ;	The SOC instruction is designed for use in closed loop control systems in a similar manner to the PI instruction. The SOC instruction provides a gain term, a first order lag, and a second order lead.	
Operand:	Type:	Format:	Description:		
SOC tag	SEC_ORDER_CONTROLLER	structure	SOC structure (default parameters):		
			Parameter:	Type:	Description:
			In	REAL	analog signal input to the instruction
			Out	REAL	calculated output of the algorithm
Arithmetic Status Flags:		Major Faults:			
set for the Out parameter		none			

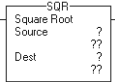
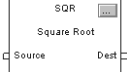
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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SQI Sequencer Input		not available	not available	The SQI instruction detects when a step is complete in a sequence pair of SQO/SQI instructions.
Operand:	Type:	Format:	Description:	
Array	DINT	array tag	sequencer array; specify the first element of the sequencer array do not use CONTROL.POS in the subscript	
Mask	SINT INT	tag immediate	which bits to block or pass	
Source	SINT INT	tag	input data for the sequencer array	
Control	CONTROL	tag	control structure for the operation; typically use the same CONTROL as the SQO and SQL instructions	
Length	DINT	immediate	number of elements in the Array (sequencer table) to compare	
Position	DINT	immediate	current position in the array; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

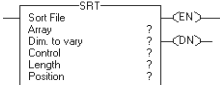
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SQL Sequencer Load		not available	not available	The SQL instruction loads reference conditions into a sequencer array.
Operand:	Type:	Format:	Description:	
Array	DINT	array tag	sequencer array; specify the first element of the sequencer array do not use CONTROL.POS in the subscript	
Source	SINT INT	tag immediate	input data to load into the sequencer array	
Control	CONTROL	tag	control structure for the operation; typically use the same CONTROL as the SQI and SQO instructions	
Length	DINT	immediate	number of elements in the Array (sequencer table) to load	
Position	DINT	immediate	current position in the array; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 20	Length > size of Array

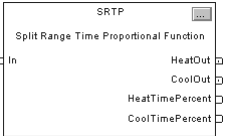
11 - 164 Instruction Set

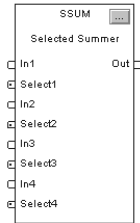
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SQO Sequencer Output		not available	not available	The SQO instruction sets output conditions for the next step of a sequence pair of SQO/SQI instructions.
Operand:	Type:	Format:	Description:	
Array	DINT	array tag	sequencer array; specify the first element of the sequencer array do not use CONTROL.POS in the subscript	
Mask	SINT INT	tag immediate	which bits to block or pass	
Destination	DINT	tag	output data from the sequencer array	
Control	CONTROL	tag	control structure for the operation; typically use the same CONTROL as the SQI and SQL instructions	
Length	DINT	immediate	number of elements in the Array (sequencer table) to output	
Position	DINT	immediate	current position in the array; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

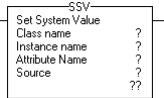
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:		
SQR Square Root			dest := SQR(source);	The SQR instruction computes the square root of the Source and places the result in the Destination.		
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:		
	Source	SINT INT	DINT REAL	immediate tag	find the square root of this value	
	Destination	SINT INT	DINT REAL	tag	tag to store the result	
Function Block	Operand:	Type:	Format:	Description:		
	SQR tag	FBD_MATH_ ADVANCED	structure	SQR structure (default parameters):		
				Parameter:	Type:	Description:
				Source	REAL	find the square root of this value
				Dest	REAL	result of the math instruction
	Arithmetic Status Flags:		Major Faults:			
	affected		none			

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SRT File Sort		not available	SRT (Array,Dimtovary, Control);	The SRT instruction sorts a set of values in one dimension (Dim to vary) of the Array into ascending order.
Operand:	Type:	Format:	Description:	
Array	SINT INT REAL	array tag	array to sort; specify the first element of the group of elements to sort do not use CONTROL.POS in the subscript	
Dimension to vary	DINT	immediate (0, 1, 2)	which dimension to use the order is: array[dim_0,dim_1,dim_2] then array[dim_0,dim_1] then array[dim_0]	
Control	CONTROL	tag	control structure for the operation	
Length	DINT	immediate	number of elements of the array to sort	
Position	DINT	immediate	current element in the array; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
affected		Type 4	Code 20	<ul style="list-style-type: none">instruction tries to access data outside of the array boundariesdimension to vary does not exist for the specified array
		Type 4	Code 21	.POS < 0 or .LEN < 0

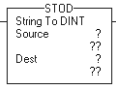
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SRTP Split Range Proportional	not available		SRTP (SRTP_tag) ;	The SRTP instruction takes the 0-100% output of a PID loop and drives heating and cooling digital output contacts with a periodic pulse. This instruction controls applications such as barrel temperature control on extrusion machines.
Operand:	Type:	Format:	Description:	
SRTP tag	SPLIT_RANGE	structure	SRTP structure (default parameters):	
		Parameter:	Type:	Description:
		In	REAL	analog signal input asking for heating or cooling
		HeatOut	BOOL	heating output pulse
		CoolOut	BOOL	cooling output pulse
		HeatTimePercent	REAL	calculated percent of the current cycle that the HeatOut will be on
		CoolTimePercent	REAL	calculated percent of the current cycle that the CoolOut will be on
Arithmetic Status Flags:		Major Faults:		
set for the HeatTimePercent and CoolTimePercent parameters		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SSUM Selected Summer	not available		SSUM (SSUM_tag) ;	The SSUM instruction uses boolean inputs to select real inputs to be algebraically summed.
Operand:	Type:	Format:	Description:	
SSUM tag	SELECTABLE_ SUMMER	structure	SSUM structure (default parameters):	
Parameter:	Type:	Description:		
Inx	REAL	input, where $x = 1-4$		
Selectx	BOOL	selector signal for associated input, where $x = 1-4$		
Out	REAL	calculated output of the algorithm		
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

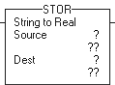
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SSV Set System Value		not available	SSV (ClassName, InstanceName, AttributeName, Source) ;	The GSV/SSV instructions get and set controller system data that is stored in objects.
Operand:	Type:	Format:	Description:	
Class name	na	name	name of object	
Instance name	na	name	name of specific object, when object requires name	
Attribute Name	na	name	attribute of object; data type depends on the attribute you select	
Source	SINT INT DINT REAL	tag	tag that contains data you want to copy to the attribute	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 5	invalid object address
		Type 4	Code 6	<ul style="list-style-type: none">specified an object that does not support GSV/SSVinvalid attributedid not supply enough information for an SSV instruction
		Type 4	Code 7	the GSV destination was not large enough to hold the requested data

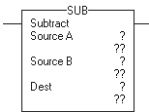
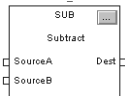
11 - 170 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
STD Standard Deviation		not available	not available	The STD instruction calculates the standard deviation of a set of values in one dimension of the Array and stores the result in the Destination.
Operand:	Type:	Format:	Description:	
Array	SINT INT REAL	array tag	find the standard deviation of the values in this array specify the first element of the group of elements to use in calculating the standard deviation do not use CONTROL.POS in the subscript	
Dimension to vary	DINT	immediate (0, 1, 2)	which dimension to use the order is: array[dim_0,dim_1,dim_2] then array[dim_0,dim_1] then array[dim_0]	
Destination	REAL	tag	result of the operation	
Control	CONTROL	tag	control structure for the operation	
Length	DINT	immediate	number of elements of the array to use in calculating the standard deviation	
Position	DINT	immediate	current element in the array; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
affected		Type 4	Code 20	dimension to vary does not exist for the specified array
		Type 4	Code 21	.POS < 0 or .LEN < 0

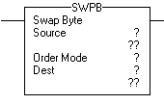
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
STOD String to DINT		not available	STOD(Source, Dest) ;	The STOD instruction converts the ASCII representation of an integer to an integer or REAL value.
Operand:	Type:	Format:	Description:	
Source	string	tag	tag that contains the value in ASCII	
Destination	SINT INT	DINT REAL	tag	tag to store the integer value; if the Source value is a floating-point number, the instruction converts only the non-fractional part of the number (regardless of the destination data type).
Arithmetic Status Flags:		Major Faults:		
affected		Type 4	Code 51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none"> that no instruction is writing to the LEN member of the string tag. in the LEN value, you entered the number of characters that the string contains.
		Type 4	Code 53	The output number is beyond the limits of the destination data type. Either: <ul style="list-style-type: none"> reduce the size of the ASCII value use a larger data type for the destination

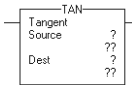
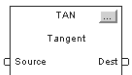

11 - 172 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
STOR String to REAL		not available	STOR (Source, Dest) ;	The STOR instruction converts the ASCII representation of a floating-point value to a REAL value.
Operand:	Type:	Format:	Description:	
Source	string	tag	tag that contains the value in ASCII	
Destination	REAL	tag	tag to store the REAL value	
Arithmetic Status Flags:		Major Faults:		
affected		Type 4	Code 51	The LEN value of the string tag is greater than the DATA size of the string tag. Check: <ul style="list-style-type: none">that no instruction is writing to the LEN member of the string tag.in the LEN value, you entered the number of characters that the string contains.
		Type 4	Code 53	The output number is beyond the limits of the destination data type. Either: <ul style="list-style-type: none">reduce the size of the ASCII valueuse a larger data type for the destination

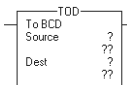
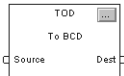
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
SUB Subtract			dest := sourceA - sourceB;	The SUB instruction subtracts Source B from Source A and places the result in the Destination.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source A	SINT INT	immediate tag	value from which to subtract Source B	
	Source B	SINT INT	immediate tag	value to subtract from Source A	
	Destination	SINT INT	tag	tag to store the result	
Function Block	Operand:	Type:	Format:	Description:	
	SUB tag	FBD_MATH	structure	SUB structure (default parameters):	
			Parameter:	Type:	Description:
			SourceA	REAL	value from which to subtract Source B
			SourceB	REAL	value to subtract from Source A
			Dest	REAL	result of the math instruction
	Arithmetic Status Flags:		Major Faults:		
	affected		none		

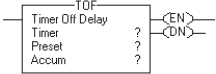
11 - 174 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
SWPB Swap Byte		not available	SWPB (Source, OrderMode, Dest) ;	The SWPB instruction rearranges the bytes of a value.
Operand:	Type:		Format:	Description:
Source	INT DINT	REAL	tag	tag that contains the bytes that you want to rearrange
Order Mode	na		REVERSE WORD HIGH/LOW	how you want to change the order of the bytes
Destination	INT DINT	REAL	tag	tag to store the bytes in the new order
Arithmetic Status Flags:		Major Faults:		
not affected		none		

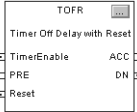
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TAN Tangent			dest := TAN(source);	The TAN instruction takes the tangent of the Source value (in radians) and stores the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	SINT INT REAL	immediate tag	find the tangent of this value
	Destination	SINT INT REAL	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:
	TAN tag	FBD_MATH_ ADVANCED	structure	TAN structure (default parameters):
			Parameter:	Type: Description:
			Source	REAL input to the math instruction
			Dest	REAL result of the math instruction
	Arithmetic Status Flags:	Major Faults:		
	affected	none		
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TND Temporary End		not available	TND () ;	The TND instruction acts as a boundary.
	Arithmetic Status Flags:	Major Faults:		
	not affected	none		

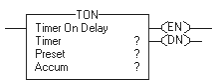
11 - 176 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
TOD Convert to BCD			not available	The TOD instruction converts a decimal value ($0 \leq \text{Source} \leq 99,999,999$) to a BCD value and stores the result in the Destination.	
Relay Ladder	Operand:	Type:	Format:	Description:	
	Source	SINT INT	DINT	immediate tag	value to convert
	Destination	SINT INT	DINT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:	
	TOD tag	FBD_CONVERT	structure	TOD structure (default parameters):	
	Parameter:	Type:	Description:		
	Source	DINT	input to the conversion instruction		
	Dest	DINT	result of the conversion instruction		
	Arithmetic Status Flags:		Major Faults:		
	affected		Type 4	Code 4	Source < 0

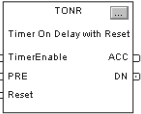
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TOF Timer Off Delay		see TOFR	see TOFR	The TOF instruction is a non-retentive timer that accumulates time when the instruction is enabled (rung-condition-in is false).
Operand:	Type:	Format:	Description:	
Timer	TIMER	tag	timer structure	
Preset	DINT	immediate	how long to delay (accumulate time)	
Accum	DINT	immediate	number of msec the timer has counted; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 34	<ul style="list-style-type: none"> .PRE < 0 .ACC < 0

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TOFR Timer Off Delay with Reset	see TOF		TOFR (TOFR_tag) ;	The TOFR instruction is a non-retentive timer that accumulates time when TimerEnable is cleared.
Operand:	Type:	Format:	Description:	
TOFR tag	FBD_TIMER	structure	TOFR structure (default parameters):	
		Parameter:	Type:	Description:
		TimerEnable	BOOL	if cleared, enables the timer to run and accumulate time
		PRE	DINT	timer preset value in 1msec units
		Reset	BOOL	request to reset the timer
		ACC	BOOL	accumulated time in milliseconds
		DN	BOOL	timing done output. Indicates when the ACC ≥ PRE
Arithmetic Status Flags:		Major Faults:		
not affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TON Timer On Delay		see TONR	see TONR	The TON instruction is a non-retentive timer that accumulates time when the instruction is enabled (rung-condition-in is true).
Operand:	Type:	Format:	Description:	
Timer	TIMER	tag	timer structure	
Preset	DINT	immediate	how long to delay (accumulate time)	
Accum	DINT	immediate	number of msec the timer has counted; initial value is typically 0	
Arithmetic Status Flags:		Major Faults:		
not affected		Type 4	Code 34	<ul style="list-style-type: none">• .PRE < 0• .ACC < 0

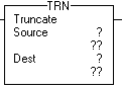
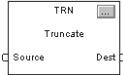

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Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TONR Timer On Delay with Reset	see TON		TONR (TONR_tag) ;	The TONR instruction is a non-retentive timer that accumulates time when TimerEnable is set.
Operand:	Type:	Format:	Description:	
TONR tag	FBD_TIMER	structure	TONR structure (default parameters):	
		Parameter:	Type:	Description:
		TimerEnable	BOOL	if cleared, enables the timer to run and accumulate time
		PRE	DINT	timer preset value in 1msec units
		reset	BOOL	request to reset the timer
		ACC	BOOL	accumulated time in milliseconds
		DN	BOOL	timing done output. Indicates when the ACC ≥ PRE
Arithmetic Status Flags:		Major Faults:		
not affected		none		

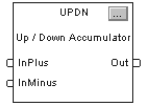
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TOT Totalizer	not available	<div><div>TOT</div><div>Totalizer</div><div><div><div><div></div></div><div>In</div></div><div><div><div></div></div><div>ProgProgReq</div></div><div><div><div></div></div><div>ProgOperReq</div></div><div><div><div></div></div><div>ProgStartReq</div></div><div><div><div></div></div><div>ProgStopReq</div></div><div><div><div></div></div><div>ProgResetReq</div></div></div><div><div><div></div></div><div>Total</div></div><div><div><div></div></div><div>OldTotal</div></div><div><div><div></div></div><div>ProgOper</div></div><div><div><div></div></div><div>RunStop</div></div><div><div><div></div></div><div>ProgResetDone</div></div><div><div><div></div></div><div>TargetFlag</div></div><div><div><div></div></div><div>TargetDev1Flag</div></div><div><div><div></div></div><div>TargetDev2Flag</div></div></div>	TOT (TOT_tag) ;	The TOT instruction provides a time-scaled accumulation of an analog input value.
Operand:	Type:	Format:	Description:	
TOT tag	TOTALIZER	structure	TOT structure (default parameters):	
Parameter:	Type:	Description:		
In	REAL	analog signal input to the instruction		
ProgProgReq	BOOL	program program request		
ProgOperReq	BOOL	program operator request		
ProgStartReq	BOOL	program start request		
ProgStopRequest	BOOL	program stop request		
ProgResetReq	BOOL	program reset request		

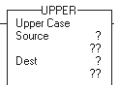

continued

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
TOT Totalizer (continued)			Parameter:	Type:	Description:
			Total	REAL	the totalized value if In
			OldTotal	REAL	the value of the total before a reset occurred
			ProgOper	BOOL	program/operator control indicator
			RunStop	BOOL	the indicator of the operational state of the totalizer
			ProgResetDone	BOOL	the indicator that the TOT instruction has completed a program reset request
			TargetFlag	BOOL	the flag for Total; set when Total ≥ Target.
			TargetDev1Flag	BOOL	the flag for TargetDev1; set when Total ≥ Target - TargetDev1
			TargetDev2Flag	BOOL	the flag for TargetDev2; set when Total ≥ Target - TargetDev2
Arithmetic Status Flags:		Major Faults:			
set for the Total parameter		none			


Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
TRN Truncate			dest := TRUNC(source);	The TRN instruction removes (truncates) the fractional part of the Source and stores the result in the Destination.
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:
	Source	REAL	immediate tag	value to truncate
Function Block	Destination	SINT INT DINT REAL	tag	tag to store the result
	Operand:	Type:	Format:	Description:
	TRN tag	FBD_ TRUNCATE	structure	TRN structure (default parameters):
			Parameter:	Type:
			Source	REAL
			Dest	DINT
				Description:
				input to the conversion instruction.
				result of the math instruction.
	Arithmetic Status Flags:	Major Faults:		
	affected	none		
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
UID User Interrupt Disable		not available	UID();	The UID instruction and the UIE instruction work together to prevent a small number of critical rungs from being interrupted by other tasks.
			UIE();	
UIE User Interrupt Enable		Arithmetic Status Flags:	Major Faults:	
		not affected	none	

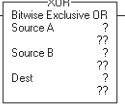

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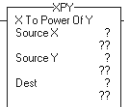
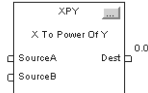
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
UPDN Up/Down Accumulator	not available		UPDN (UPDN_tag) ;	The UPDN instruction adds and subtracts two inputs into an accumulated value.
Operand:	Type:	Format:	Description:	
UPDN tag	UP_DOWN_ ACCUM	structure	UPDN structure (default parameters):	
		Parameter:	Type:	Description:
		InPlus	REAL	input added to the accumulator
		InMinus	REAL	input subtracted from the accumulator
		Out	REAL	output of the instruction
Arithmetic Status Flags:		Major Faults:		
set for the Out parameter		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
UPPER Upper Case		not available	UPPER(Source, Dest) ;	The UPPER instruction converts the alphabetical characters in a string to upper case characters.
Operand:	Type:	Format:	Description:	
Source	string	tag	tag that contains the characters that you want to convert to upper case	
Destination	string	tag	tag to store the characters in upper case	
Arithmetic Status Flags:		Major Faults:		
not affected		none		
Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
XIC Examine If Closed		not available	IF data_bit THEN <statement>; END_IF;	The XIC instruction examines the data bit to see if it is set.
Operand:	Type:	Format:	Description:	
data bit	BOOL	tag	bit to be tested	
Arithmetic Status Flags:		Major Faults:		
not affected		none		

11 - 186 Instruction Set

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:
XIO Examine If Open		not available	IF NOT data_bit THEN <statement>; END_IF;	The XIO instruction examines the data bit to see if it is cleared.
	Operand:	Type:	Format:	Description:
	data bit	BOOL	tag	bit to be tested
	Arithmetic Status Flags:		Major Faults:	
	not affected		none	

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
XOR Bitwise Exclusive OR			dest := sourceA XOR sourceB	The XOR instruction performs a bitwise XOR operation using the bits in Source A and Source B and places the result in the Destination.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source A	SINT INT	DINT	immediate tag	value to XOR with Source B
	Source B	SINT INT	DINT	immediate tag	value to XOR with Source A
	Destination	SINT INT	DINT	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:	
	XOR tag	FBD_LOGICAL	structure	XOR structure (default parameters):	
			Parameter:	Type:	Description:
			SourceA	DINT	value to XOR with Source B
			SourceB	DINT	value to XOR with Source A
			Dest	DINT	result of the instruction
	Arithmetic Status Flags:		Major Faults:		
	affected		none		

Instruction:	Relay Ladder:	Function Block:	Structured Text:	Description:	
XPY X to the Power of Y			dest := sourceX ** sourceY;	The XPY instruction takes Source A (X) to the power of Source B (Y) and stores the result in the Destination.	
Relay Ladder and Structured Text	Operand:	Type:	Format:	Description:	
	Source X	SINT INT	DINT REAL	immediate tag	base value
	Source Y	SINT INT	DINT REAL	immediate tag	exponent
	Destination	SINT INT	DINT REAL	tag	tag to store the result
Function Block	Operand:	Type:	Format:	Description:	
	XPY tag	FBD_MATH	structure	LOXPY structure (default parameters):	
	Parameter:	Type:	Description:		
	Source X	REAL	immediate tag	base value	
	Source Y	REAL	immediate tag	exponent	
	Dest	REAL	tag	tag to store the result	
	Arithmetic Status Flags:		Major Faults:		
affected		Type 4	Code 4	Source X is negative and Source Y is not an integer value	

Rockwell Automation Support

Rockwell Automation provides technical information on the web to assist you in using our products. At <http://support.rockwellautomation.com>, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

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