



softMC Add-On Instructions
for Studio 5000 Logix Designer®
User Guide

Rev. 0.2 Preliminary

ORIGINAL INSTRUCTIONS

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Technical Support

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Revision History

Doc. Rev.	Date	Remarks
0.2	1 Feb. 2021	Preliminary release
0.1	28 Jan. 2021	Final draft

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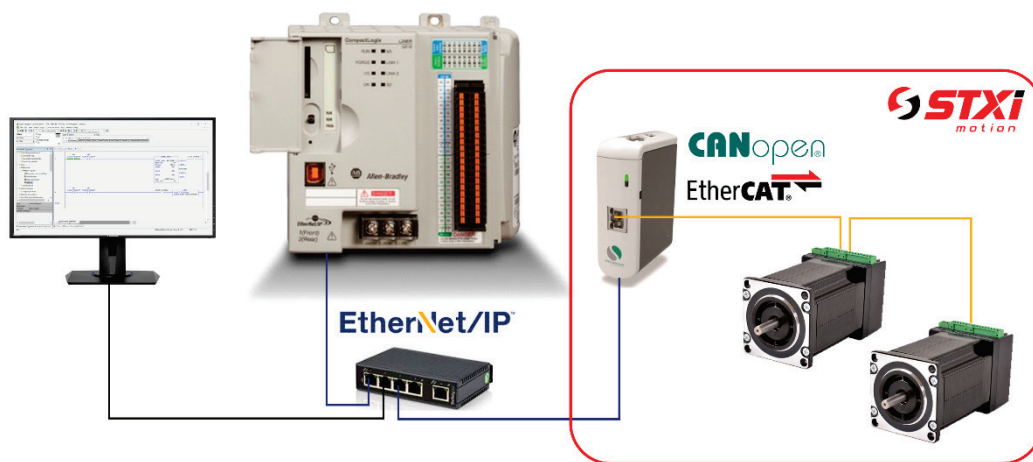
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1 Introduction

The softMC multi-axis robotic motion controller and the Studio 5000® software exchange messages directly using EtherNet/IP communication protocol.

The Rockwell Automation machine controllers and Studio 5000 software manage and monitor the workcell performance, and the softMC motion controller controls auxiliary axes and electromechanical motion systems, by sending EtherNet/IP motion messages over CANopen or EtherCAT networks.



Rockwell Automation

GUI

Studio 5000®

Add-on instructions (AOI)

Allen-Bradley PLC

ControlLogix®

CompactLogix™

Micro800™ control system

STXI Motion

Stepper motors

BLDC rotary and linear motors

Servo drives

Gantry systems

Robotic systems up to 6 axes

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2 Add-On Instructions

The Add-On Instructions developed by STXI Motion give integrators a simple way to interface the control systems with the robotic and motion devices. The name format is similar to other Rockwell AOIs.

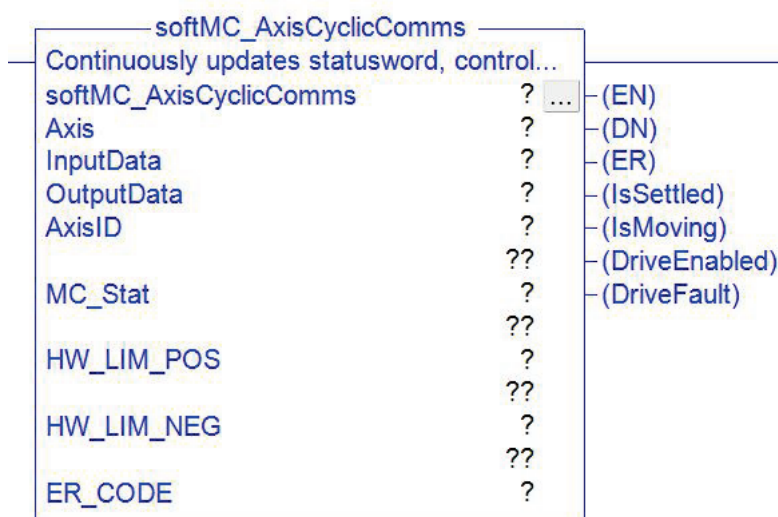
For more information, refer to the Rockwell online Help and to *Logix 5000 Controllers Add On Instructions* (Rockwell publication 1756-PM010_).

2.1 softMC_AxisCyclicComms

Continuously updates statusword, controlword, and other axis data.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_AxisCyclicComms	softMC_AxisCyclicComms	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	Axis	udtAxis_SoftMC	InOut	Axis object
x	InputData	DINT[89]	InOut	softMC assembly input structure
x	OutputData	DINT[65]	InOut	softMC assembly output structure
x	AxisID	INT	Input	Axis ID number (1 to 6)
x	MC_Stat	INT	Input	Module status

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Req	Name	Data Type	Usage	Description
x	HW_LIM_POS	BOOL	Input	State of the hardware limit switch in the positive direction. 0=Limit reached
x	HW_LIM_NEG	BOOL	Input	State of the hardware limit switch in the negative direction. 0=Limit reached
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set.
	DN	BOOL	Output	Instruction completed
	ER	BOOL	Output	Error during execution
	IsSettled	BOOL	Output	1=Axis is position 0=Axis not in position
	IsMoving	BOOL	Output	1=Axis in motion 0=Axis not in motion
	DriveEnabled	BOOL	Output	1=Axis drive is enabled 0=Axis drive is disabled
	DriveFault	BOOL	Output	1=Axis fault
	ER_CODE	INT	Output	Error code (0=No error)

Extended Description

softMC_AxisCyclicComms continuously reads and writes the statusword, controlword, position command, velocity command, feedback, and other values for each axis. Must be activated for each axis at runtime.

MC_Stat: module status is called by the instruction **GSV**:

Get System Value

Class Name Module

Instance Name softMC_IO

Attribute Name softMC_Stat

For an example of use, refer to the Main Routine ladder diagram in the Appendix of this guide.

For more information about parameters, refer to the following:

IsSettled: <http://softmc.servotronix.com/wiki/MC-Basic:element.ISSETTLED>

IsMoving: <http://softmc.servotronix.com/wiki/MC-Basic:element.ISMOVING>

DriveEnabled: <http://softmc.servotronix.com/wiki/MC-Basic:element.ENABLE>

Drive Fault

– To be added

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Execution

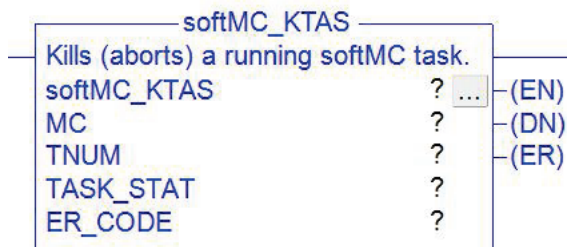
Condition	Description
EnableIn is true	Reads axis InputData and writes axis OutputData. Changes IsSettled, IsMoving, DriveEnabled, and DriveFault bits according to the state of the axis drive. If an error occurs, sets the ER bit and shows the error number in ER_CODE.
Prescan	Clears the EN, DN, and ER bits, and all axis output data.

2.2 softMC_KTAS

Kills (aborts) a running softMC task.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_KTAS	softMC_KTAS	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	MC	udtMC_SoftMC	InOut	Name of the softMC object
	TNUM	SINT	Input	ID number of task to be killed (range 1 to 10)
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set.
	DN	BOOL	Output	Instruction completed. Task state remains until next trigger.
	ER	BOOL	Output	Error during execution. Task state remains until next trigger.
	TASK_STAT	SINT	Output	0=Idle. 1=Running. 2=Killed. 4=Error. 7=Ready.
	ER_CODE	INT	Output	Error code (0=No error)

Extended Description

softMC_KTAS aborts the execution of a task. The program pointer stays on the line at which the task was stopped. All motion being controlled by the specified task is stopped, all attached devices are detached, and all events are cancelled. The task can be restarted using the instruction softMC_STAS (Start Task).

For more information about parameters, refer to the following:

<http://softmc.servotronix.com/wiki/MC-Basic:KILLTASK>

Execution

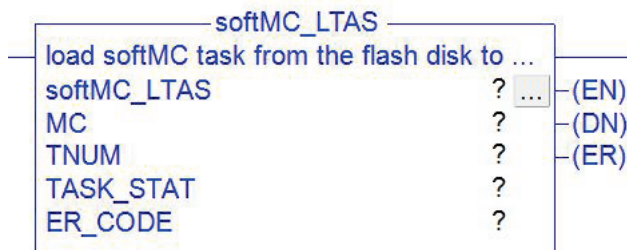
Condition	Description
EnableIn is true	Sets the EN bit, which sends the Abort command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the execution is completed. Updates TASK_STAT according to the state of TNUM. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	Clears the EN bit. TASK_STAT continues to show the state of TNUM.

2.3 softMC_LTAS

Loads a task to softMC RAM.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_LTAS	softMC_LTAS	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	MC	udtMC_SoftMC	InOut	Name of the softMC object
	TNUM	SINT	Input	ID number of task to be loaded (range 1 to 10)
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set.
	DN	BOOL	Output	Instruction completed. Task state remains until next trigger.
	ER	BOOL	Output	Error during execution. Task state remains until next trigger.
	TASK_STAT	SINT	Output	0=Idle. 1=Running. 2=Killed. 4=Error. 7=Ready.
	ER_CODE	INT	Output	Error code (0=No error)

Extended Description

softMC_LTAS loads a task from flash memory into softMC RAM, which allows it to be executed.

During loading, the task is checked for syntax errors. If syntax error is detected, ER_CODE will be set to **7039**.

For more information about parameters, refer to the following:

<http://softmc.servotronix.com/wiki/MC-Basic:LOAD>

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Execution

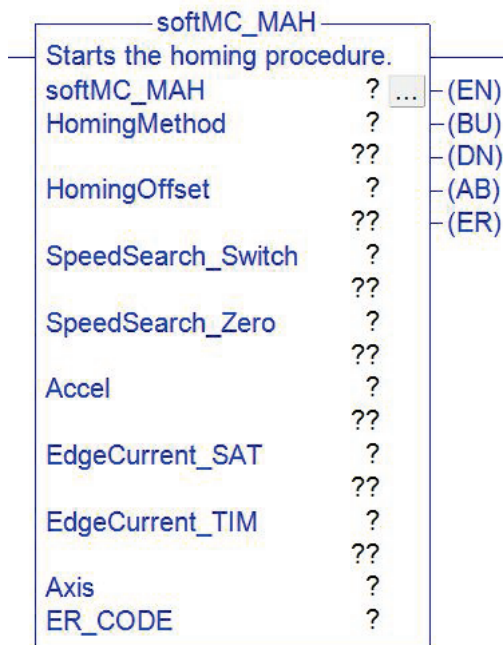
Condition	Description
EnableIn is true	Sets the EN bit, which sends the Load Task command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the execution is completed. Updates TASK_STAT according to the state of TNUM. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	Clears the EN bit. TASK_STAT continues to show the state of TNUM.

2.4 softMC_MAH

Starts the homing procedure.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_MAH	softMC_MAH	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	HomingMethod	DINT	Input	Homing method to be used (valid values: -4 to 36. 0=not defined)
x	HomingOffset	DINT	Input	Distance from the home trigger position
x	SpeedSearch_Switch	REAL	Input	Velocity during search for limit switches, home switches, and hard stops. deg/s (local unit)
x	SpeedSearch_Zero	REAL	Input	Velocity during search for the home trigger. deg/s (local unit)
x	Accel	REAL	Input	Acceleration/deceleration during homing. deg/s^2 (local unit)
x	EdgeCurrent_SAT	INT	Input	Current saturation for Homing-on-Edge method (applicable only to stepIM homing methods -1, -2, -3, -4)

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Req	Name	Data Type	Usage	Description
x	EdgeCurrent_TIM	INT	Input	Minimum wait time in stall position before setting home, for Homing-on-Edge method (applicable only to stepIM homing methods -1, -2, -3, -4)
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set. EN remains 1 until end of motion.
	BU	BOOL	Output	Busy (motor running)
	DN	BOOL	Output	Instruction completed
	AB	BOOL	Output	Aborted (EN switched to 0 during motion)
	ER	BOOL	Output	Error during execution
x	Axis	udtAxis_SoftMC	InOut	Name of the axis to home
	ER_CODE	INT	Output	Error code (0=no error)

Extended Description

softMC_MAH corresponds to the MAH (Motion Axis Home) instruction in Rockwell drives.

The instruction starts the home procedure in the drive. It puts the axis into following mode and starts the homing move.

HomingOffset: An offset from the homing trigger position. The trigger may be an index mark, a transition of a limit switch or the home switch, or another source (as defined by HomingMethod). Used when the position at which the homing trigger is detected is not considered the home position.

SpeedSearch_Switch: A fast velocity, used first in the homing process, while searching for limit switches, home switches, and hard stops.

SpeedSearch_Zero: A slow velocity, used next in the homing process, while searching for the homing trigger.

For more information about the homing parameters, refer to the documentation provided with the drive.

Execution

Condition	Description
EnableIn is true	Sets the EN bit, which sends the Homing command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the execution is completed. BU bit is set while axis homing is in progress. AB bit is set if the axis stops without completing the homing procedure. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, BU, AB, and ER bits.
EnableIn is false	If EN is set, continues executing the homing as for EnableIn is true condition. Otherwise, clears the BU bit.

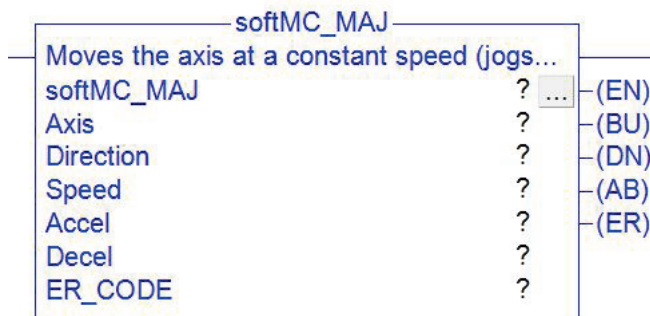
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2.5 softMC_MAJ

Moves the axis at a constant speed (jogs).

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_MAJ	softMC_MAJ	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	Axis	udtAxis_SoftMC	InOut	Name of the axis to be jogged
	Direction	BOOL	Input	0=Positive (CW) direction. 1=Negative (CWW) direction.
	Speed	REAL	Input	mm/s, deg/s (engineering unit)
	Accel	REAL	Input	mm/s^2, deg/s^2 (engineering unit)
	Decel	REAL	Input	mm/s^2, deg/s^2 (engineering unit)
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set. EN remains 1 until end of motion.
	BU	BOOL	Output	Busy (motor running)
	DN	BOOL	Output	Completed
	AB	BOOL	Output	Aborted (EN switched to 0 during motion)
	ER	BOOL	Output	Error during execution
	ER_CODE	INT	Output	Error code (0=No error)

Extended Description

softMC_MAJ corresponds to the MAJ (Motion Axis Jog) instruction in Rockwell drives.

This instruction moves an axis at a constant speed until it is stopped.

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The jogged axis moves as long as the EnableIn bit is set (to 1). It is recommended to stop the jog by clearing the EnableIn bit.

However, the motion can be stopped by the instruction softMC_MAS, which sets the AB bit.

For more information about this parameter, refer to the following:

<http://softmc.servotronics.com/wiki/MC-Basic:JOG>

Execution

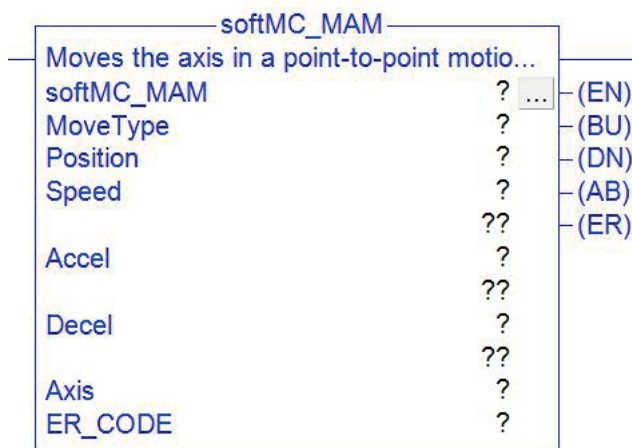
Condition	Description
EnableIn is true	Sets the EN bit, which sends the Jog command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the execution is completed. The BU bit is set while axis jogging is in progress. The AB bit is set if the axis stops without completing the jog. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	Calls the softMC_MAS instruction to stop the jogging. Clears the EN, DN, BU, AB, and ER bits. Sets the ER bit if an error occurs with softMC_MAS.

2.6 softMC_MAM

Moves the axis in a point-to-point motion.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_MAM	softMC_MAM	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
	MoveType	DINT	Input	1=Absolute 0=Relative
	Position	REAL	Input	mm, deg (engineering unit)
x	Speed	REAL	Input	mm/s, deg/s (engineering unit)
x	Accel	REAL	Input	mm/s ² , deg/s ² (engineering unit)
x	Decel	REAL	Input	mm/s ² , deg/s ² (engineering unit)
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set. EN remains 1 until end of motion.
	BU	BOOL	Output	Busy (motor running)
	DN	BOOL	Output	Instruction completed
	AB	BOOL	Output	Aborted (EN switched to 0 during motion)
	ER	BOOL	Output	Error during execution
x	Axis	udtAxis_SoftMC	InOut	Name of the axis to be moved
	ER_CODE	INT	Output	Error code (0=No error)

Extended Description

softMC_MAM corresponds to the MAM (Motion Axis Move) instruction in Rockwell drives.

This instruction executes a point-to-point movement of an axis, from its current position to a target position.

For more information about this parameter, refer to the following:

<http://softmc.servotronix.com/wiki/MC-Basic:MOVE>

Execution

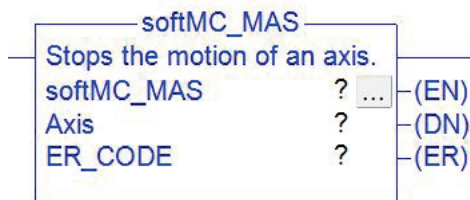
Condition	Description
EnableIn is true	Sets the EN bit, which sends the Move command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the execution is completed. The BU bit is set while the axis movement is in progress. The AB bit is set if the axis stops without completing the movement. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	If EN is set, continues executing the motion as for EnableIn is true condition. Otherwise, clears the BU bit.

2.7 softMC_MAS

Stops the motion of an axis.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_MAS	softMC_MAS	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	Axis	udtAxis_SoftMC	InOut	Name of the axis to be stopped
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set. EN remains 1 until end of motion.
	DN	BOOL	Output	Instruction completed
	ER	BOOL	Output	Error during execution
	ER_CODE	INT	Output	Error code (0 = no error)

Extended Description

softMC_MAS corresponds to the MAS (Motion Axis Stop) instruction in Rockwell drives.

This instruction stops the motion of an axis.

For more information about this parameter, refer to the following:

<http://softmc.servotronix.com/wiki/MC-Basic:STOP>

Execution

Condition	Description
EnableIn is true	Sets the EN bit, which sends the Stop command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the execution is completed. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	If EN is set, continues executing the stop as for EnableIn is true condition. Otherwise, clears the BU bit.

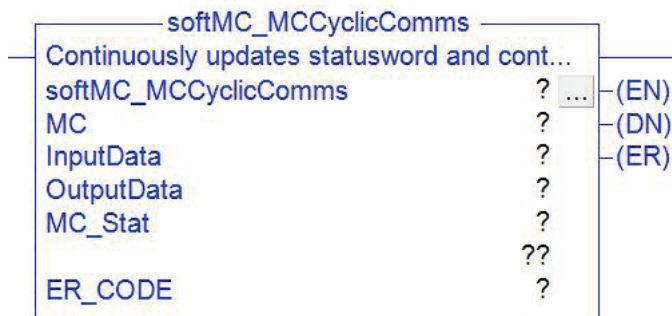
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2.8 softMC_MCCyclicComms

Continuously updates statusword and controlword for softMC tasks.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_MCCyclicComms	softMC_MCCyclicComms	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	MC	udtMC_SoftMC	InOut	Name of the softMC object
x	InputData	DINT[89]	InOut	softMC assembly input structure
x	OutputData	DINT[65]	InOut	softMC assembly output structure
x	MC_Stat	INT	Input	Module status
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set.
	DN	BOOL	Output	Instruction completed successfully (keeps value until next trigger)
	ER	BOOL	Output	Error during execution
	ER_CODE	INT	Output	Error code (0=No error)

Extended Description

softMC_MCCyclicComms continuously updates the statusword and controlword of up to ten tasks simultaneously. It is designed for applications performed by synchronized axes and robots. This instruction must be activated at runtime.

MC_Stat: module status is called by the instruction **GSV**:

Get System Value

Class Name Module

Instance Name softMC_IO

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Attribute Name softMC_Stat

For an example of use, refer to the Main Routine ladder diagram in the Appendix of this guide.

Execution

Condition	Description
EnableIn is true	Reads task InputData and writes task OutputData. If an error occurs, sets the ER bit.
Prescan	Clears the EN, DN, and ER bits, and all task data.

2.9 softMC_MSF

Disables the axis and deactivates the axis servo loop.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_MSF	softMC_MSF	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	Axis	udtAxis_SoftMC	InOut	Name of the axis to be disabled
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set.
	DN	BOOL	Output	Instruction completed
	ER	BOOL	Output	Error during execution

Extended Description

softMC_MSF corresponds to the MSF instruction in Rockwell drives.

This instruction disables the axis and deactivates the configured servo control loops associated with a physical servo drive.

To enable the axis, use the softMC_MSO instruction.

For more information about this parameter, refer to the following:

<http://softmc.servotronix.com/wiki/MC-Basic:element.ENABLE>

Execution

Condition	Description
EnableIn is true	Sets the EN bit, which sends the Disable command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the axis is disabled. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	Clears the EN bit. The DN bit remains set while the axis is disabled. Clears the DN bit when the axis is enabled.

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2.10 softMC_MSO

Enables the axis and activates the axis servo loop.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_MSO	softMC_MSO	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	Axis	udtAxis_SoftMC	InOut	Name of the axis to be enabled
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set.
	DN	BOOL	Output	Instruction completed
	ER	BOOL	Output	Error during execution

Extended Description

softMC_MSO corresponds to the MSO instruction in Rockwell drives.

This instruction enables the axis and activates the configured servo control loops associated with a physical servo drive.

To disable the axis, use the softMC_MSF instruction.

For more information about this parameter, refer to the following:

<http://softmc.servotronix.com/wiki/MC-Basic:element.ENABLE>

Execution

Condition	Description
EnableIn is true	Sets the EN bit, which sends the Enable command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the axis is enabled. Sets the ER bit if a timeout or a fault occurs. The DN bit remains set while the axis is enabled.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	Clears the EN bit. The DN bit remains set while the axis is enabled. Clears the DN bit when the axis is disabled.

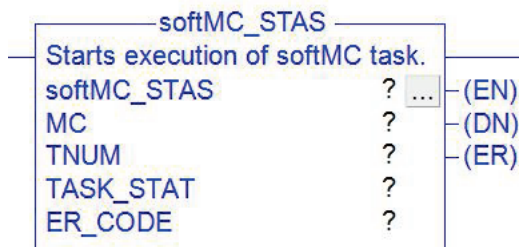
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2.11 softMC_STAS

Starts execution of softMC task.

Available Languages

Relay Ladder



Parameters

Req	Name	Data Type	Usage	Description
x	softMC_STAS	softMC_STAS	InOut	Instruction instance
	EnableIn	BOOL	Input	When set to 1, the instruction is executed. Remains set until the instruction is completed, and then is cleared.
	EnableOut	BOOL	Output	Follows the state of EnableIn.
x	MC	udtMC_SoftMC	InOut	Name of the softMC object
	TNUM	SINT	Input	ID number of task to be executed
	EN	BOOL	Output	Switches to 1 when EnableIn bit is set. Switches to 0 when DN bit or ER bit is set.
	DN	BOOL	Output	Instruction completed. Task state remains until next trigger.
	ER	BOOL	Output	Error during execution. Task state remains until next trigger.
	TASK_STAT	SINT	Output	0=Idle. 1=Running. 2=Killed. 4=Error. 7=Ready.
	ER_CODE	INT	Output	Error code (0=No error)

Extended Description

softMC_STAS starts execution of a softMC task from the beginning of the task.

If a task is killed, it can be restarted with this command.

For more information about this parameter, refer to the following:

<http://softmc.servotronix.com/wiki/MC-Basic:STARTTASK>

Execution

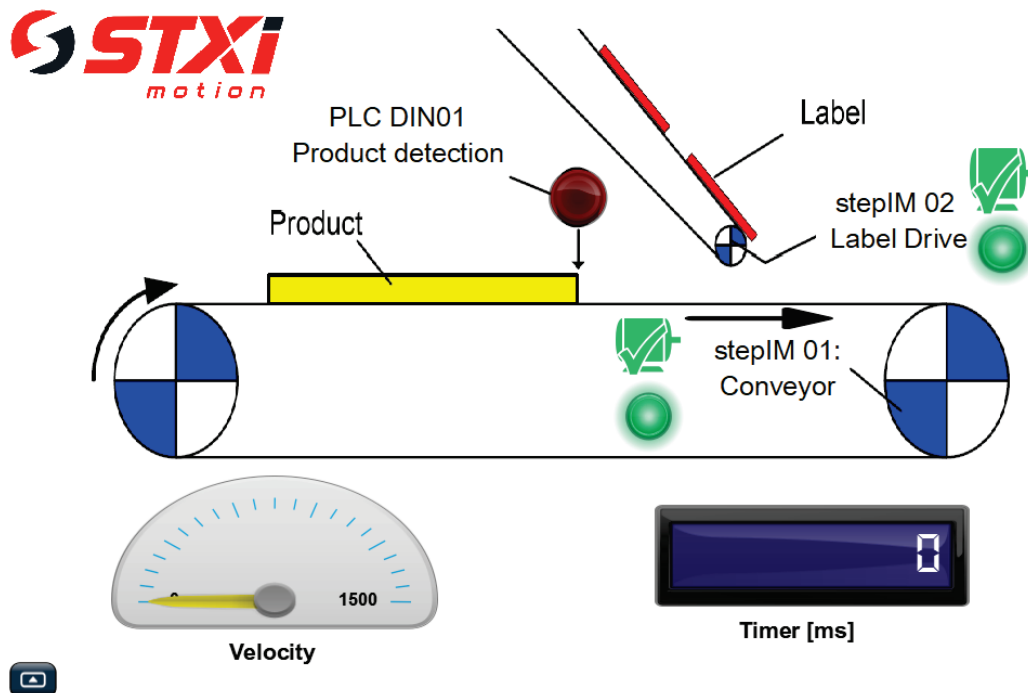
Condition	Description
EnableIn is true	Sets the EN bit, which sends the Start Task command to the softMC for execution. Waits for a response from the softMC, and sets the DN bit when the execution is completed. Updates TASK_STAT according to the state of TNUM. Sets the ER bit if a timeout or a fault occurs.
Prescan	Clears the EN, DN, and ER bits.
EnableIn is false	Clears the EN bit. TASK_STAT continues to show the state of TNUM.

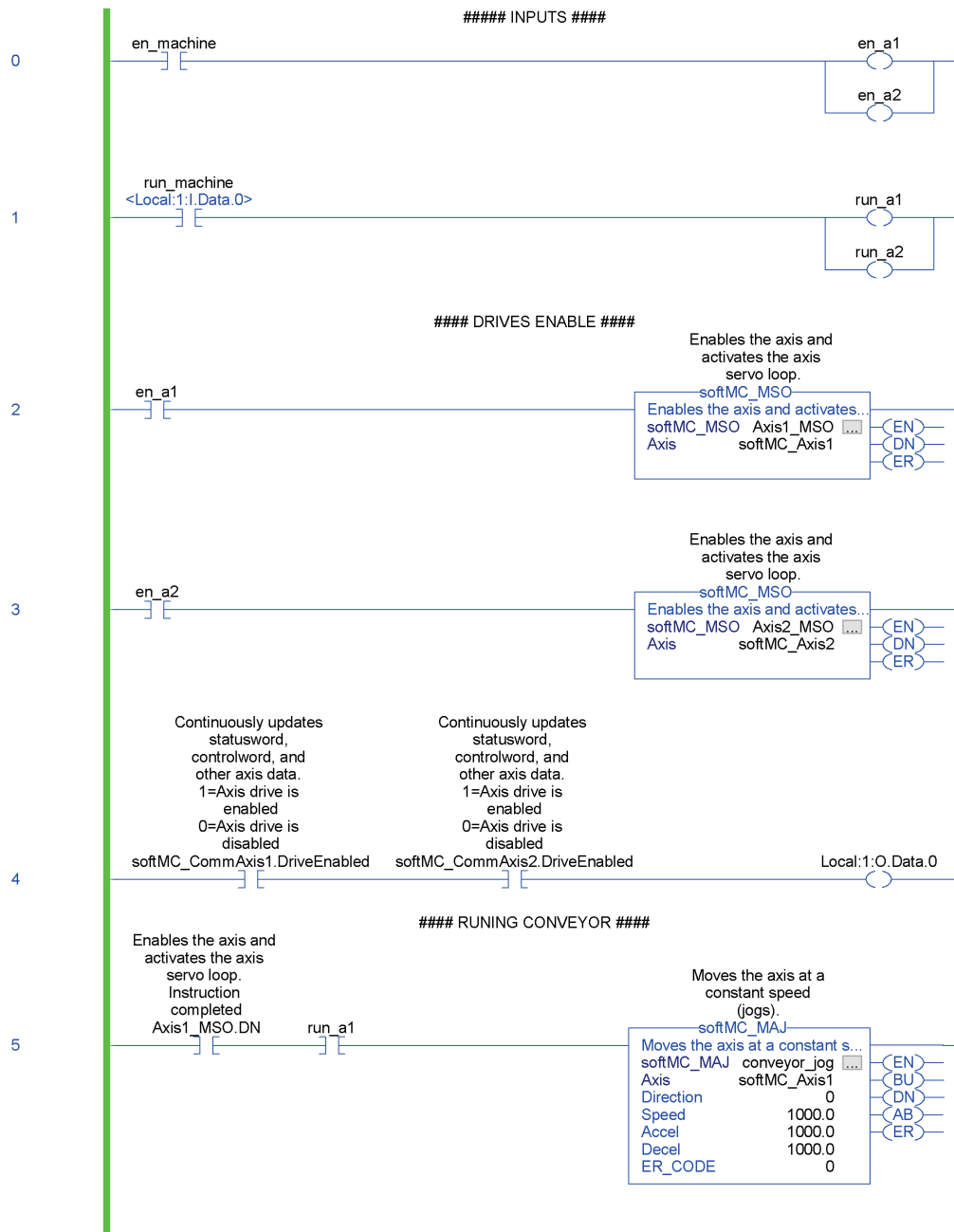
Appendix. Application Examples

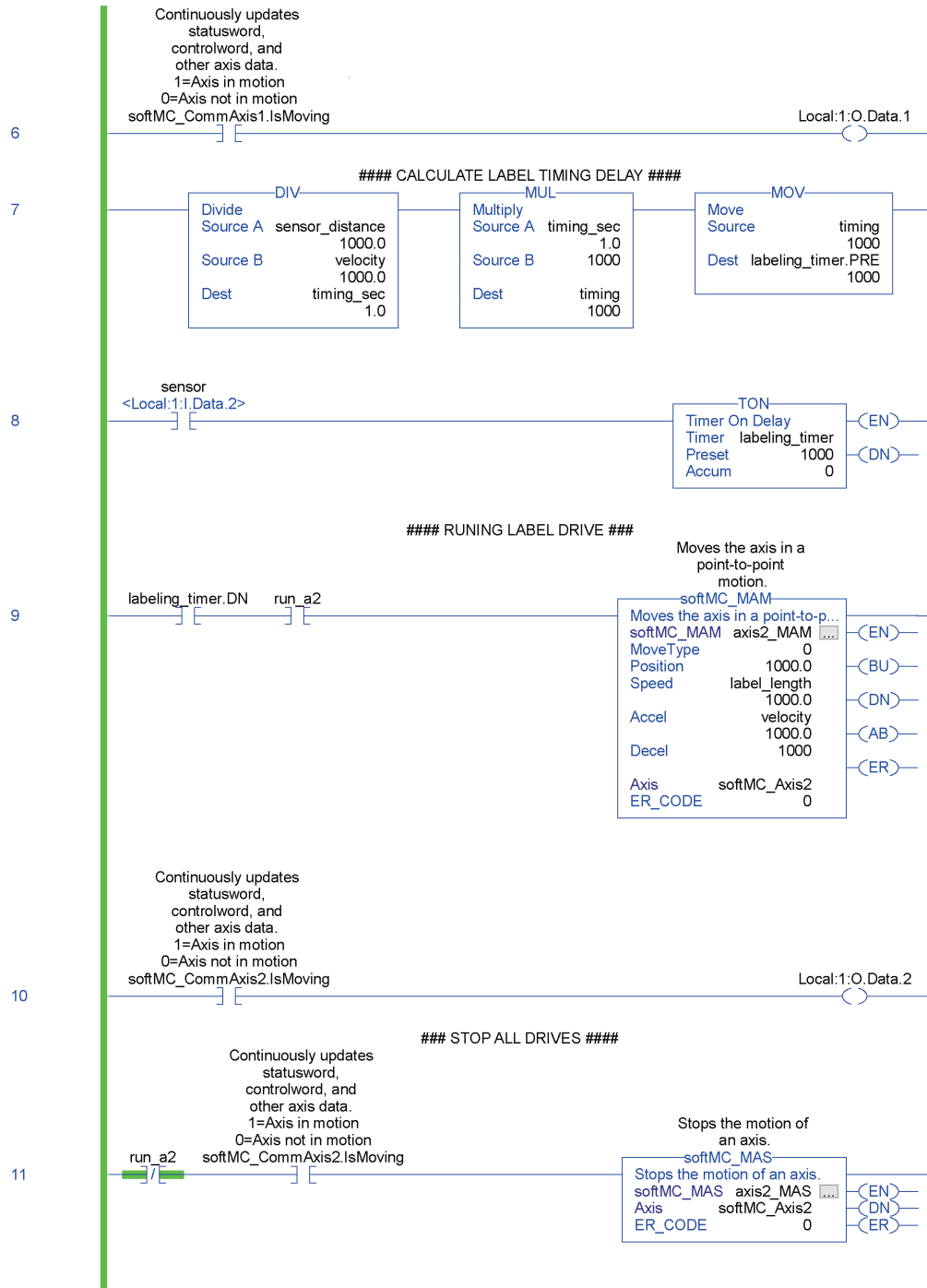
Labeling Machine

The following HMI emulation, included in Studio 5000 View Designer, shows a labeling machine using two stepIM drives and Allen-Bradley PLC.

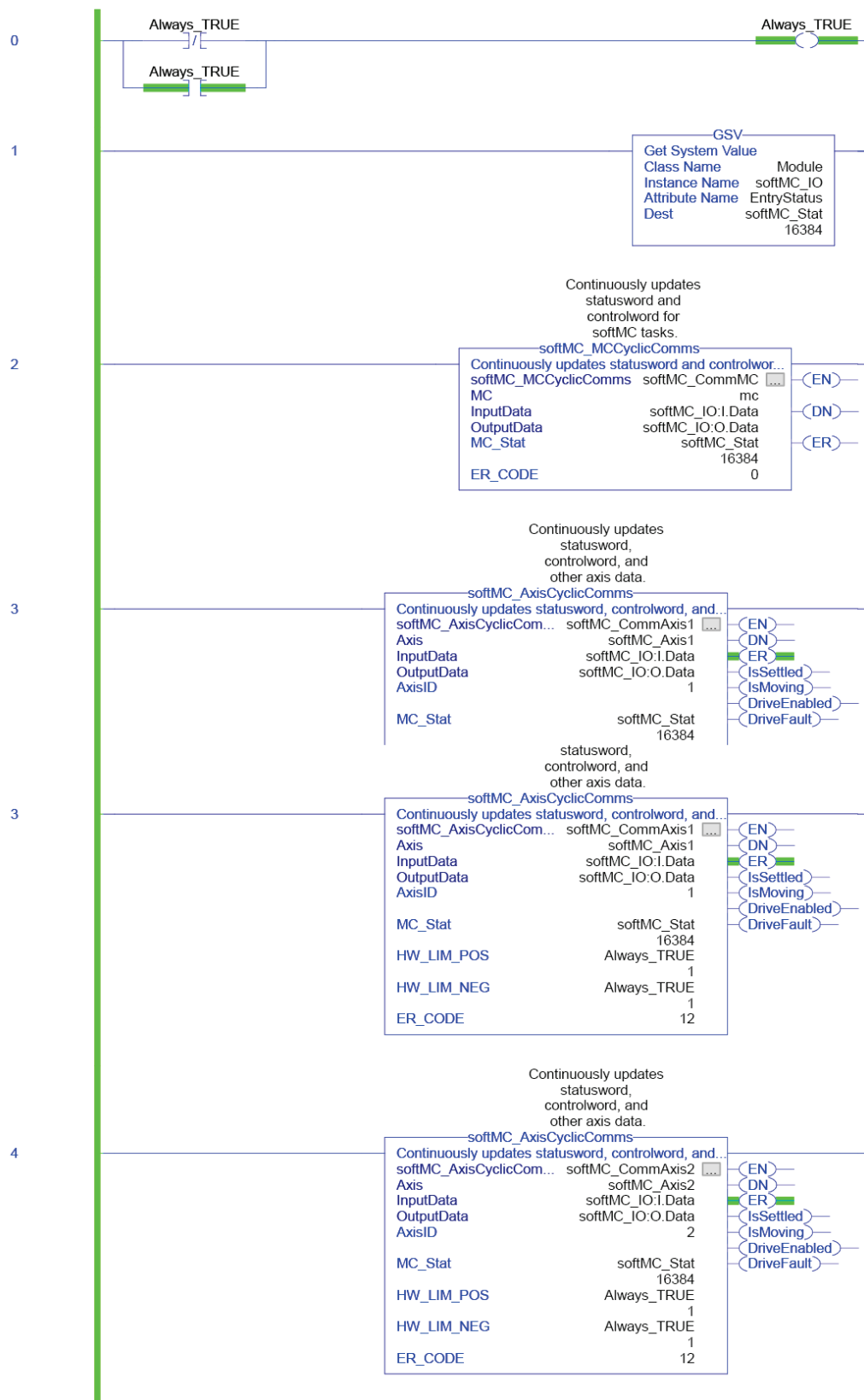
Its operation is configured by the ladder diagram that follows.







Main Routine



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