Motion State Instructions

Motion state control instructions directly control or change the operating states of an axis. These are the motion state instructions.

Available Instructions

Ladder Diagram and Structured Text

MSO	MSF	MASD	MASR	MDO	MDF	MDS	MAFR

Function Block

Not available

Important:	Tags used for the motion control attribute of instructions should only be used once. Re-use of the motion control tag in other instructions can cause unintended operation. This may result in damage to equipment or personal injury.

Motion state control instructions directly control or change the operating states of an axis. The motion state instructions are:

If you want to:	Use this instruction:
Enable the servo drive and activate the axis servo loop.	MSO
Disable the servo drive and deactivate the axis servo loop.	MSF
Force an axis into the shutdown operating state. Once the axis is in the shutdown operating state, the controller will block any instructions that initiate axis motion.	MASD
Change an axis from an existing shutdown operating state to an axis ready operating state. If all of the axes of a servo module are removed from the shutdown state as a result of this instruction, the OK relay contacts for the module will close.	MASR
Enable the servo drive and set the servo output voltage of an axis.	MDO
Deactivate the servo drive and set the servo output voltage to the output offset voltage.	MDF
Activate the drive control loops for the specified axis and run the motor at the specified speed.	MDS
Clear all motion faults for an axis.	MAFR

The five operating states of a non-CIP axis are:

Operating State	Description

Axis Ready	This is the normal power-up state of the axis. In this state: • The servo module drive enable output is inactive. • Servo action is disabled. • No servo faults are present.
Direct Drive Control	This operating state allows the servo module DAC to directly control an external drive. In this state: • The servo module drive enable output is active. • Position servo action is disabled.
Servo Control	This operating state allows the servo module to perform closed loop motion. In this state: • The servo module drive enable output is active. • Servo action is enabled. • The axis is forced to maintain the commanded servo position.
Axis Faulted	In this operating state, a servo fault is present, and the status of the drive enable output, the action of the servo, and the condition of the OK contact depend on the faults and fault actions that are present.
Shutdown	This operating state allows the OK relay contacts to open a set of contacts in the E- string of the drive power supply. In this state: • The servo module drive enable output is inactive. • Servo action is disabled. • The OK contact is open.

The 16 operating states of a CIP axis are:

Operating State	As Shown in the Logix Designer Programming Application	Description
Initializing	0	During the Initializing State, the drive first initializes all attributes to their factory default values, that is, resets all active faults. The drive then waits for the controller to establish connections to it. Once connections are established, the controller sets configuration attributes in the drive to values stored in the controller. If the drive supports synchronous operation, the controller then synchronizes with the drive. Once this process has been completed successfully, the drive and all its associated axis instances transition to the Pre-charge state. If a problem is found during the initializing process, an Initialization Fault is generated. An Initialization Fault is an unrecoverable fault. You can only clear the fault can via a power cycle or a drive reset. If the connection to the drive closes for any reason during operation, the drive returns to the Initializing State

Pre-Charge	1	The drive is waiting for the DC Bus to fully charge, that is, the DC Bus Up status bit is cleared. Once the DC Bus reaches an operational voltage level, that is, DC Bus Up status bit is set, the axis transitions to the Stopped state. The drive's power structure is always disabled in this state, that is, the Power Structure Enabled status bit is cleared. Any attempt to enable the drive via the Axis Control mechanism while in this state is reported back to the controller as an error in the Response Status and the axis remains in the Pre-charge state.
Stopped	2	In the Stopped state, the drive's inverter power structure should either be disabled and free of torque, that is, the Power Structure Enabled status bit is cleared, or held in a static condition via an active control loop, that is, Power Structure Enabled status bit is set. The drive cannot initiate motion in the Stopped state nor can the drive respond to a planner generated command reference, that is, the Tracking Command status bit is cleared. In general, the axis should be at rest. However, if you apply an external force or torque to the load, a brake may be needed to maintain the rest condition. In the Stopped state, main power is applied to the drive and the DC Bus are at an operational voltage level. If there are any Start Inhibited conditions detected while in this state, the axis transitions to the Start Inhibited state. If an Enable request or one of the Run Test service requests is applied to an axis in the Stopped state, the motion axis transitions to the Starting state.
Starting	3	When an Enable request is given to an axis in the Stopped or Stopping state while it is performing a Flying Start, the axis immediately transitions to the Starting state. In this state, the drive checks the following conditions before transitioning to the Running state. • Brake Release delay time • Induction Motor flux level The drive control and power structures are activated during the Starting state, that is, the Power Structure Enabled status bit is set. But the command reference is set to a local static value and does not track the command reference derived from the motion planner, that is, the Tracking Command status bit is cleared. If all the starting conditions are met, the axis state transitions to either the Running state or the Testing state.
Running	4	The drive's power structure is active, that is, the Power Structure Enabled status bit is set. Additionally, the selected Control Mode is enabled and actively tracking command data from the controller-based or drive-based motion planner output to affect axis motion, that is, the Tracking Command status bit is set.

| Testing | 5 | When any one of the Run Test request services is sent to the motion axis while in the Stopped state, that is, services that require an active power structure to execute, the axis immediately transitions to the Starting state, that is, the Power Structure Enabled status bit is set. Then once the Starting state conditions are met, the axis transitions to the Testing state. Like the Running state, in the Testing state, the drive's power structure is active.

The motion axis remains in this state for the duration of the requested test procedure and then returns to the Stopped state. The motion axis can also exit the Testing state by either a fault or an explicit Axis Control request. |
| --- | --- | --- |
| Stopping | 6 | When a Disable request is issued to an axis in the Running or Testing state, the axis immediately transitions to the Stopping state. In this state, the axis is in the process of stopping and no longer tracks command data from the motion planner, that is, the Tracking Command status bit is cleared.

Once the selected Stopping Mode procedure has completed, the axis transitions to the Stopped state. |
| Aborting | 7 | When a Major Fault occurs in the drive while the axis is in either the Running or Testing states, the motion axis immediately transitions to the Aborting state. In this state, the axis is in the process of stopping and no longer tracks command data from the motion planner, that is, the Tracking Command status bit is cleared. The Aborting state executes the appropriate stopping action as specified by the drive. As with the Stopping state, in the Aborting state the power structure remains active, that is, the Power Structure Enabled status bit is set, for as long as the stopping action takes to complete. Once the stopping procedure is complete the axis transitions to the Faulted state.

When faults conditions are detected in the controller that are not visible to the drive, or when the drive reports a Minor Fault condition, the controller brings the axis to a stop, either directly via an Axis Control state change request or motion planner stop, or indirectly via a fault handler in the user program. If the Axis State reported by the driv e is Stopping, the controller sets the CIP Axis State to Aborting based on the presence of the fault condition. |

Faulted	8	The faulted state is identical to the Stopped state or the Shutdown state with the exception that there are one or more faults active. Faults are latched conditions. Therefore, a Fault Reset is required to clear the faults and, assuming the original fault condition has been removed, the axis transitions to the Axis State of the drive.
		There are many different sources of faults:
		• CIP Initialization Faults - Faults that occur when the drive transitions out of the Initializing state. These faults can apply to a specific axis or the entire drive.
		• CIP Axis Faults - Faults that apply to a specific axis and are the direct result of Axis Exceptions configured to generate a Fault response. Axis exceptions are run-time conditions that are related to Motor, Inverter, Converter, Bus Regulator, and Feedback components.
		• Safety Fault: Faults that apply to a specific axis and are generated by a fault condition detected in the drive's safety monitor functionality. A Safety Fault always results in the axis transitioning to the Stopped state.
		• Motion Fault: Faults generally associated with fault conditions generated by the motion planner function. These faults can include conditions related to the input, for example, actual position, or output, for example, command position, signals.
		• Module Fault: Faults that apply to the entire drive and affect all axes associated with that drive. Module faults include all node faults reported by the drive and also communication fault conditions detected on the controller side of the motion connection.
		• Group Fault: Faults related to the motion group object function and affect all axes associated with the motion group. Group Fault conditions are detected by controller and are associated with the time synchronization function common to all axes in the motion group.
		• Configuration Fault: Fault generated anytime there is an error when sending configuration data to the drive.
Start Inhibited	9	This state is the same as the Stopped state with the exception that the axis has one or more 'start inhibit' conditions that prevent it from successfully transitioning to the Starting state. Once corrected, the axis state automatically transitions back to the Stopped state.

Shutdown	10	When a Shutdown request is issued to the drive or a Shutdown fault action is executed by the drive, the targeted axis immediately transitions to the Shutdown state. The Shutdown state has the same basic characteristics of the Stopped state except that it can be configured via the Shutdown Action attribute to drop the DC Bus power to the drive's power structure.
		Regardless of whether DC Bus power is disconnected, this state requires an explicit Shutdown Reset request from the controller to transition to the Pre-charge state. If the drive is configured to keep DC Bus power active while in the Shutdown state, then the motion axis transitions through the Pre-charge state to the Stopped state.
		In the case where a Shutdown fault action is initiated by the drive in response to an exception condition that is configured to be a major fault, the drive executes the Shutdown action. However, the axis goes to the Faulted state, not the Shutdown state. Similarly, when the axis is in the Shutdown state and a major fault condition occurs, the axis transitions to the Faulted state. A Fault Reset request from the controller clears the fault and, assuming the original fault condition has been removed, the axis transitions to the Shutdown state. A Shutdown Reset request from the controller, however, both clears the fault and performs a shutdown reset so, assuming the original fault condition has been removed, the axis transitions to the Pre-charge state.
Axis Inhibited	11	If you inhibit the axis, the associated instance in the CIP Motion connection is eliminated and the axis state transitions to the Axis Inhibited state. If this is the only instance supported by the CIP Motion connection, the connection itself is closed. The Axis Inhibited state is a controller-only sub state of the Self-test state[1]. The Axis Inhibited condition is checked during the controller Self-test state as qualification for transition to the Initializing state. If currently Axis Inhibited, you must execute an Un-Inhibit operation to transition to the Initializing state and restore axis function.
Not Grouped	12	If a CIP Motion axis is created and not associated with a Motion Group, the axis state is set to the Not Grouped state. A CIP Motion axis must be assigned to a Motion Group for the axis to be updated by the periodic Motion Task and carry out its function. This condition is checked during the controller Self-test state as qualification for transition to the Initializing state. For this reason, the Not Grouped state is considered a controller-only sub state of the Self-test state.
No Device	13	If the CIP Motion axis in the controller is created, but not currently associated with a drive, the axis state indicates the No Device state. A CIP Motion axis must be associated with a physical drive to function. This condition is checked during the controller Self-test state as qualification for transition to the Initializing state. For this reason, the No Device state is considered a controller-only sub state of the Self Test state.

(1) The Self-test state is a drive state. This state does not appear in the Logix Designer programming application as an operating state of a CIP axis. Instead, self-test is

represented as the Initializing state for a CIP axis.

See also

[Motion Configuration Instructions](#)

[Motion Move Instructions](#)

[Multi-Axis Coordinated Motion Instructions](#)

[Motion Event Instructions](#)

[Motion Group Instructions](#)

[How are we doing?](#)