# Motion Change Dynamics (MCD)

This information applies to the CompactLogix 5370, ControlLogix 5570, Compact GuardLogix 5370, GuardLogix 5570, Compact GuardLogix 5380, CompactLogix 5380, CompactLogix 5480, ControlLogix 5580, and GuardLogix 5580 controllers. Controller differences are noted where applicable.

Use the Motion Change Dynamics (MCD) instruction to selectively change the speed, acceleration rate, or deceleration rate of a move profile or a jog profile in process.

Available Languages

Ladder Diagram
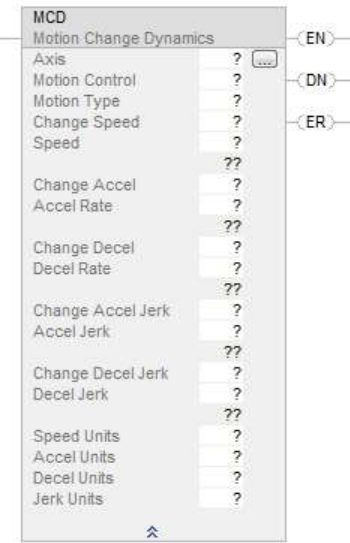
Function Block

This instruction is not available in function block.

Structured Text

MCD(Axis, MotionControl, MotionType, ChangeSpeed, Speed, ChangeAccel, AccelRate, ChangeAccelJerk, AccelJerk, ChangeDecelJerk, ChangeDecel, DecelRate, SpeedUnits, AccelUnits, DecelUnits, JerkUnits);

Operands

There are data conversion rules for mixed data types within an instruction. See Data Conversion.

Ladder Diagram and Structured Text

Operand	Type	Type	Format	Description
	CompactLogix 5370, Compact GuardLogix 5370, Compact GuardLogix 5380, CompactLogix 5380, CompactLogix 5480	**ControlLogix 5570, GuardLogix 5570, ControlLogix 5580, and GuardLogix 5580 controllers**		
Axis	AXIS_CIP_DRIVE AXIS_VIRTUAL	AXIS_CIP_DRIVE AXIS_VIRTUAL AXIS_SERVO AXIS_SERVO_DRIVE AXIS_GENERIC_DRIVE	Tag	Name of the axis to perform operation on.
Motion Control	MOTION_INSTRUCTION	MOTION_INSTRUCTION	Tag	Structure used to access instruction status parameters.
Motion Type	UDINT	UDINT	Immediate	Motion profile (jog or move) to change. Select either: 0 = jog 1 = move
Change Speed	BOOLEAN	BOOLEAN	Immediate	Set to enable a change of speed. Select either: 0 = no 1 = yes
Speed	REAL	REAL	Immediate or Tag	The new Speed to move the axis in % or Speed Units.

Change Accel	BOOLEAN	BOOLEAN	Immediate	Set to enable an acceleration change. Select either: 0 = no 1 = yes
Accel Rate	REAL	REAL	Immediate or Tag	The acceleration rate of the axis in % or Acceleration units.
Change Decel	BOOLEAN	BOOLEAN	Immediate	Set to enable a deceleration change. Select either: 0 = no 1 = yes
Decel Rate	REAL	REAL	Immediate or Tag	The deceleration rate of the axis in % or Deceleration units. The axis could overshoot its target position if you reduce the deceleration while a move is in process.
Change Accel Jerk	SINT, INT, or DINT	SINT, INT, or DINT	Immediate	0 = No 1 = Yes
Accel Jerk	SINT, INT, DINT, or REAL	SINT, INT, DINT, or REAL	Immediate or Tag	You must always enter a value for the Accel Jerk operand. This instruction only uses the value if the Profile is configured as S-curve. Accel Jerk is the acceleration jerk rate for the axis. Use this value to get started. Accel Jerk = 100 (% of Time) Jerk Units = 2
Change Decel Jerk	SINT, INT, or DINT	SINT, INT, or DINT	Immediate	0 = No 1 = Yes
Decel Jerk	SINT, INT, DINT, or REAL	SINT, INT, DINT, or REAL	Immediate or Tag	You must always enter a value for the Decel Jerk operand. This instruction only uses the value if the Profile is configured as S-curve. Decel Jerk is the deceleration jerk rate for the coordinate system. Use these values to get started. Decel Jerk = 100 (% of Time) Jerk Units = 2
Speed Units	BOOLEAN	BOOLEAN	Immediate	Units used to display the Speed value. Select either: 0 = units per sec 1 = % of maximum speed 4 = units per master unit
Accel Units	BOOLEAN	BOOLEAN	Immediate	Units used to display the Acceleration value. Select either: 0 = units per sec^2 1 = % of maximum acceleration 4 = units per master $unit^2$

Decel Units	BOOLEAN	BOOLEAN	Immediate	Units used to display the Deceleration value. Select either: 0 = units per sec^2 1 = % of maximum deceleration 4 = units per master unit^2
Jerk Units	SINT, INT, or DINT	SINT, INT, or DINT	Immediate	0 = Units per sec^3 1 = % of Maximum 2 = % of Time 4 = units per master unit^3 6 = % of Time Master Driven

Structured Text

See *Structured Text Syntax* for more information on the syntax of expressions within structured text.

Enter your selection for the operands that require you to select your available options.

This Operand	Has These Options Which You	
	Enter as Text	**Or Enter as a Number**
Axis	No enumeration	Tag
MotionControl	No enumeration	Tag
MotionType	jog move	0 1
ChangeSpeed	no yes	0 1
Speed	No enumeration	Immediate or Tag
ChangeAccel	no yes	0 1
AccelRate	No enumeration	Immediate or Tag
ChageDecel	no yes	0 1
DecelRate	No enumeration	Immediate or Tag
ChangeAccelJerk	No enumeration	0 = No 1 = Yes
AccelJerk	No enumeration	Immediate or tag You must always enter a value for the Accel operand. This instruction only uses the value if the Profile is configured as S-curve. Use this value to get started. Accel Jerk = 100
ChangeDecelJerk	No enumeration	0 = No 1 = Yes
DecelJerk	No enumeration	Immediate or tag You must always enter a value Decel Jerk operand. This instruction only uses the value if the Profile is configured as S-curve. Use this value to get started. Decel Jerk = 100

SpeedUnits	unitspersec	0
	%ofmaximum	1
	unitspermasterunit	4
AccelUnits	$unitspersec^2$	0
	%ofmaximum	1
	$unitspermasterunit^2$	4
DecelUnits	$unitspersec^2$	0
	%ofmaximum	1
	$unitspermasterunit^2$	4
JerkUnits	$unitspersec^3$	0
	%ofmaximum	1
	%oftime	2
	$unitspermasterunit^3$	4
	%oftimemasterdriven	6

MOTION_INSTRUCTION Structure

Mnemonic	Description
.EN (Enable) Bit 31	It is set when the rung makes a false-to-true transition and remains set until the servo message transaction is completed and the rung goes false.
.DN (Done) Bit 29	It is set when axis change dynamics has been successfully initiated. The instruction execution completes in a single scan, and the DN bit is set immediately.
.ER (Error) Bit 28	It is set to indicate that the instruction detected an error, such as if you specified an unconfigured axis.

Description

The MCD instruction changes the speed of profile moves on-the-fly and the speed, acceleration, and deceleration of trapezoidal profile jogs on-the-fly. Choose the desired physical axis and type of motion and enter values or tag variables for the Speed, Accel, and Decel. Speed, acceleration, and deceleration values can be entered as percentages of the current maximum configured value or directly in the configured speed or acceleration units of the axis.

If the targeted axis does not appear in the list of available axes, the axis has not been configured for servo operation. Use the Tag Editor to create and configure a new axis.

Programming Guidelines

Important: Risk of Velocity and/or End Position Overshoot

If you change move parameters dynamically by any method, that is by changing move dynamics [Motion Change Dynamics (MCD) instruction or Motion Coordinated Change Dynamics (MCCD)] or by starting a new instruction before the last one has completed, be aware of the risk of velocity and/or end position overshoot.

A Trapezoidal velocity profile can overshoot if maximum deceleration is decreased while the move is decelerating or is close to the deceleration point.

An S-curve velocity profile can overshoot if:

maximum deceleration is decreased while the move is decelerating or close to the deceleration point; or

maximum acceleration jerk is decreased and the axis is accelerating. Keep in mind, however, that jerk can be changed indirectly if it is specified in % of time.

For more information, see Troubleshoot Axis Motion.

In this transitional instruction, the relay ladder, toggle the Rung-condition-in from cleared to set each time the instruction should execute.

Changing Move Dynamics

When a Motion type of Move is entered or chosen, the speed, acceleration, and/or deceleration of a Move in progress may be changed to the specified value. The speed change occurs at the specified acceleration rate if the new speed is higher than the current speed or at the specified deceleration rate if the new speed is lower than the current speed.

Pausing Moves

The MCD instruction may be used to temporarily pause a move in progress by changing its speed to zero. Use another MCD instruction with a non-zero speed value to complete the move as originally specified.

Changing Jog Dynamics

When a Motion type of Jog is entered or chosen, the speed, acceleration, and/or deceleration of a Jog in progress may be changed to the specified value. The speed change occurs at the specified acceleration rate if the new speed is higher than the current speed or at the specified deceleration rate if the new speed is lower than the current speed.

Supporting Motion Drive Start (MDS) Instruction

The MCD instruction supports the Motion Drive Start (MDS) instruction. However, the MCD instruction has no affect on the DirectVelocityControlStatus Command feature because the Motion Planner only takes the value from the Direct Command Velocity Attribute and sums it into the axis output before sending the total command to the drive. After all acceleration and deceleration have been planned, the MCD instruction has no affect on the feature.

Changing Between MDSC and Time Driven Modes in Master Driven Speed Control (MDSC)

You cannot change from Master Driven Mode to Time Driven Mode or vice versa with an MCD instruction. You receive a runtime error if you attempt to change modes.

Affects Math Status Flags

No

Major/Minor Faults

None specific to this instruction. See Common Attributes for operand-related faults.

Execution

Ladder Diagram

Condition/State	Action Taken
Prescan	The .EN, .DN, .ER, and .IP bits are cleared to false.
Rung-condition-in is false	The .EN bit is cleared to false if either the .DN or .ER bit is true.
Rung-condition-in is true	The .EN bit is set to true and the instruction executes.
Postscan	N/A

Structured Text

Condition/State	Action Taken
Prescan	See Prescan in the Ladder Diagram table
Normal execution	See Rung-condition-in is false, followed by rung-condition-in is true in the Ladder Diagram table.
Postscan	See Postscan in the Ladder Diagram table.

Error Codes

See *Motion Error Codes (.ERR)* for Motion Instructions.

Runtime Error Condition

For the Master Driven Speed Control (MDSC) function, an error will occur at runtime if you attempt to change the mode of the system from Master Driven to Time Driven or from Time Driven to Master Driven.

Extended Error Codes

Extended Error Codes provide additional instruction specific information for the Error Codes that are generic to many instructions. See *Motion Error Codes (.ERR)* for Motion Instructions.

Extended Error codes for the Parameter Out of Range (13) error code lists a number that refers to the number of the operand as they are listed in the faceplate from top to bottom with the first operand being counted as zero. Therefore for the MCD instruction, an extended error code of 4 would refer to the Speed operand's value. You would then have to check your value with the accepted range of values for the instruction.

For the Error Code 54 – Maximum Deceleration Value is Zero, if the Extended Error returns a positive number (0-n) it is referring to the offending axis in the coordinate system. Go to the Coordinate System Properties General Tab and look under the Brackets ([ ])column of the Axis Grid to determine which axis has a Maximum Deceleration value of 0. Click on the ellipsis button next to the offending axis to access the Axis Properties screen. Go to the Dynamics tab and make the appropriate

change to the Maximum Deceleration Value. If the Extended Error number is -1, this means the Coordinate System has a Maximum Deceleration Value of 0. Go to the Coordinate System Properties Dynamics Tab to correct the Maximum Deceleration value.

MCD Changes to Status Bits

For the Master Driven Speed Control (MDSC) function, when the MCD is executed (goes IP), the status bit (CalculatedDataAvailable (CDA)) is cleared in an MAM instruction, which indicates that the Event Distances has been computed. After the MCD is complete and the Event Distances have been recomputed, the CalculatedDataAvailable status bit is set again. Therefore, look at the CalculatedDataAvailable status bit after the MCD instruction has been completed to determine when to use the recomputed Event Distances.

If a MCD is executed, the CDA bit is cleared. The Calculated Data for the move is recomputed using the new dynamics parameters. The CDA bit is set again when computations are complete. The Calculated Data that is recomputed is measured from the original Motion Start Point (MSP) to the Event Distance point using the new dynamics parameters as changed by the MCD instruction - not from the point of the MCD.

Note that if the MCD changes the speed to 0, the Event Distance is not recomputed; the CDA bit is not set. The Event Distance is however recomputed if a second MCD is issued to restart the motion. The recomputed Calculated Data includes the duration of the stopped motion.

If the Event Distance is set to 0, the Calculated Data is set to equal the position that equals the length of the move. This may be one or two coarse update periods before the PC bit is set because of an internal delay. The end position is typically achieved in the middle of a coarse update period, which adds up to one additional coarse update period to the delay. Therefore, if the master is moved a distance equal to the Calculated Data, you must wait up to 2 iterations more for the PC bit of the slave move to be set.

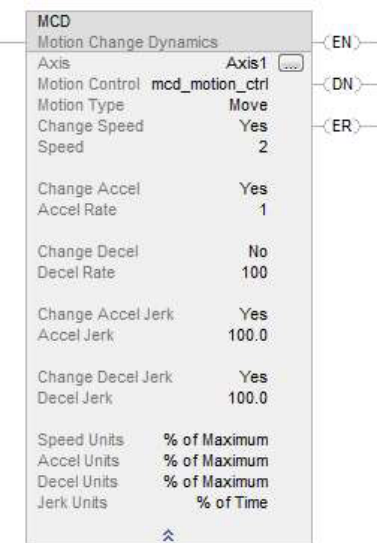## Examples

Example 1

Ladder Diagram
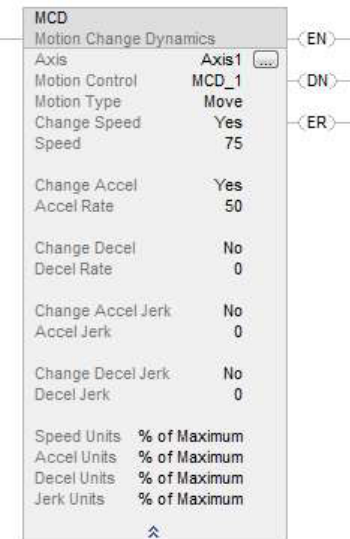
Structured Text

MCD(Axis1,MCD_1,Move,Yes,75,Yes,50,No,0,No,0,No,0,%ofMaximum,%ofMaximum,%ofMaximum,%ofMaximum);

Example 2

Ladder Diagram

Structured Text

MCD(Axis1,mcd_motion_ctrl,Move,Yes,2,Yes,1,No,100,Yes,100.0,Yes,100.0,%ofMaximum,%ofMaximum,%ofMaximum,%ofTime);

See also

[Structured Text Syntax](#)

[MCD Flow Chart (True)](#)

Motion Error Codes (.ERR)

Motion Move Instructions

Common Attributes

How are we doing?

Motion Error Codes (.ERR)

Motion Move Instructions

Common Attributes

How are we doing?