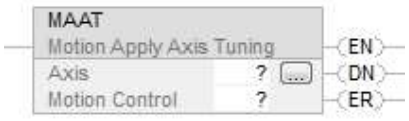
Motion Apply Axis Tuning (MAAT)

This information applies to the CompactLogix 5370, ControlLogix 5570, Compact GuardLogix 5370, GuardLogix 5570, and ControlLogix 5580 controllers.

The Motion Apply Axis Tuning (MAAT) instruction is used to compute a complete set of servo gains and dynamic limits based on the results of a previously run Motion Run Axis Tuning (MRAT) instruction and update the motion module with these new gain parameters. While this instruction takes no explicit parameters, input is derived from the Axis Tuning Configuration parameters as described in Tune Status Parameter. After execution of the MAAT instruction, the corresponding axis should be ready for servo activation.

Available Languages

Ladder Diagram



Function Block

This instruction is not available in function block.

Structured Text

MAAT(Axis,MotionControl);

Operands

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

Ladder Diagram and Structured Text

Operand	Type	Format	Description
Axis	AXIS_SERV0 AXIS_SERV0_DRIVE	Tag	Name of the axis to perform operation on
Motion Control	MOTION_INSTRUCTION	Tag	Structure used to access instruction status parameters.

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

MOTION_INSTRUCTION Structure

Mnemonic	Description
.EN (Enable) Bit 31	The enable bit indicates when the instruction is enabled. It remains set until servo messaging completes and the Rung-condition-in goes false.
.DN (Done) Bit 29	The done bit indicates when the instruction completes an apply axis-tuning process.
.ER (Error) Bit 28	The error bit indicates when the instruction detects an error, such as if the axis is not configured.

Description

The MAAT instruction is used to execute a series of computations resulting in values for gain and dynamic configuration parameters on the specified axis. As part of the work performed by MAAT, these resultant configuration parameters are applied so that the axis is ready for full servo operation. This instruction is designed to follow execution of the Motion Run Axis Tuning (MRAT) which generates axis input configuration values for the MAAT instruction. See the Motion Run Axis Tuning (MRAT) description for more information. MAAT requires no explicit input parameters; simply enter or select the desired physical axis.

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

The MAAT instruction uses axis configuration parameters as input and output. The input configuration parameters that MAAT uses are shown in the table below. Refer to the Motion Axis Object specification for a detailed description of these parameters.

The axis configuration parameters that MAAT uses as input depends on the External Drive configuration. If the External Vel Servo Drive configuration bit parameter is TRUE, indicating interface to an external velocity servo drive, the following input parameters are required.

Axis Parameter	Data Type	Units	Meaning
Tuning Velocity	Real	pos units/sec	Top Speed of Tuning Profile.
Tune Accel	Real	pos units/sec^2	Calculated Acceleration Time of Tuning Profile.
Tune Decel	Real	pos units/sec^2	Calculated Deceleration Time of Tuning Profile.
Tune Velocity Scaling	Real	mV/KCPS	Measured Velocity Scaling factor of axis Drive/Motor/Encoder system.
Tune Velocity Bandwidth	Real	Hertz	Bandwidth of External Velocity Servo Drive.

If the External Vel Servo Drive configuration bit parameter is FALSE, indicating interface to an external torque servo drive, the following input parameters are required.

Axis Parameter	Data Type	Units	Meaning
Damping Factor	Real	-	Damping Factor used to calculate the gains.
Tuning Velocity	Real	pos units/sec	Top Speed of Tuning Profile.
Tune Accel	Real	pos units/sec^2	Calculated Acceleration Time of Tuning Profile.

Tune Decel	Real	pos units/sec^2	Calculated Deceleration Time of Tuning Profile.
Effective Inertia	Real	mV/KCPS^2	Computed Effective Inertia of Drive/Motor system.
Position Servo Bandwidth	Real	Hertz	Maximum Position Servo Loop Bandwidth.

The axis configuration parameters that MAAT generates as output depend on the External Drive configuration. If the External Vel Servo Drive configuration bit parameter is TRUE, indicating interface to an external velocity servo drive, the following output parameters are generated.

Axis Parameter	Data Type	Units	Meaning
Pos Proportional Gain	Real	1/msec	Position Servo Loop Proportional Gain.
Pos Integral Gain	Real	1/msec^2	Position Servo Loop Integral Gain -- Set to Zero.
Velocity Feedforward	Real	-	Position Servo Loop Proportional Gain.
Acceleration Feedforward	Real	-	Velocity Command Feedforward -- Set to Zero.
Max Speed	Real	pos units/sec	Maximum Speed for Motion Profiles – Set to Tuning Velocity
Max Acceleration	Real	pos units/sec^2	Maximum Acceleration for Motion Profiles
Max Deceleration	Real	pos units/sec^2	Maximum Deceleration for Motion Profiles
Output Filter Bandwidth	Real	Hertz	Bandwidth of Low Pass Servo Output Filter
Output Scaling	Real	mV/ KCPS	Scale Factor applied to output of the Position Servo Loop to the DAC.
Position Error Tolerance	Real	pos units	Maximum Servo Loop Position Error allowed without Fault.

If the External Vel Servo Drive configuration bit parameter is FALSE, indicating interface to an external torque servo drive, the following output parameters are generated.

Axis Parameter	Data Type	Units	Meaning
Pos Proportional Gain	Real	1/msec	Position Servo Loop Proportional Gain.

Pos Integral Gain	Real	1/msec^2	Position Servo Loop Integral Gain.
Vel Proportional Gain	Real	1/msec	Velocity Servo Loop Proportional Gain.
Vel Integral Gain	Real	1/msec^2	Velocity Servo Loop Integral Gain.
Velocity Feedforward	Real	-	Position Servo Loop Proportional Gain.
Acceleration Feedforward	Real	-	Velocity Command Feedforward.
Max Speed	Real	pos units/sec	Maximum Speed for Motion Profiles – Set to Tuning Velocity
Max Acceleration	Real	pos units/sec^2	Maximum Acceleration for Motion Profiles.
Maximum Deceleration	Real	pos units/sec^2	Maximum Deceleration for Motion Profiles.
Output Filter Bandwidth	Real	Hertz	Bandwidth of Low Pass Servo Output Filter.
Output Scaling	Real	mV/KCPS^2	Scale Factor applied to output of the Velocity Servo Loop to the DAC.
Position Error Tolerance	Real	pos units	Maximum Servo Loop Position Error allowed without Fault.

The output parameters generated by the MAAT instruction are immediately applied to the specified axis so that subsequent motion can be performed.

For more information about tuning configuration parameters see Tune Status Parameter.

To successfully execute a MAAT instruction, the targeted axis must be configured as a Servo axis and be in the Axis Ready state, with servo action off. If these conditions are not met, the instruction errors.

Important: The instruction execution may take multiple scans to execute because it requires multiple coarse updates to complete the request. The Done (.DN) bit is only set after the request is completed.

This is a transitional instruction:

- In relay ladder, toggle Rung-condition-in from false to true each time the instruction should execute.
- In structured text, condition the instruction so that it only executes on a transition.

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 the .DN or .ER bit is set to true. Otherwise, the .EN bit is not affected. The .DN,.ER ,.IP and .PC bits are not affected.
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 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.

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. The following Extended Error codes help to pinpoint the problem when the MAAT instruction receives a Servo Message Failure (12) error message.

Associated Error Code (decimal)	Extended Error Code (decimal)	Meaning
SERVO_MESSAGE_FAILURE (12)	No resource (2)	Not enough memory resources to complete request. (SERCOS)
SERVO_MESSAGE_FAILURE (12)	Object Mode conflict (12)	Axis is in shutdown.
SERVO_MESSAGE_FAILURE (12)	Permission denied (15)	Enable input switch error. (SERCOS)
SERVO_MESSAGE_FAILURE (12)	Device in wrong	Redefine Position, Home, and Registration 2 are mutually exclusive (SERCOS), device state

	state (16)	not correct for action. (SERCOS)

Status Bits

MAAT Changes to Status Bits

The MAAT instruction does not make any changes to the status bits.

Examples

When the input conditions are true, the controller computes a complete set of servo gains and dynamic limits for axis1 based on the results of the previously executed Motion Run Axis Tuning (MRAT) instruction.

Ladder Diagram

See also

MAAT Flow Chart (True)

Motion Error Codes (.ERR)

Motion Configuration Instructions

Common Attributes

Data Conversions

How are we doing?