Rockwell Automation Application Content

Rockwell Automation Robotics Libraries

Reference Manual

Configure Frame - Robot

raM_Robot_Opr_ConfigureFrame **v2.1**

April, 2024

Rockwell Automation

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING 	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION 	Identifies information about practices or circumstances or death, property damage, or economic loss. Attentions avoid a hazard, and recognize the consequence.
SHOCK HAZARD 	Labels may be on or inside the equipment, that dangerous voltage may be present.
BURN HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

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1 Overview

raM_Robot_Opr_ConfigureFrame:

Instruction to assign a frame to the application. This can consist of robot, user, and tool frames.

Use when:

- Using a Device Handler for Robot Management

Do NOT use when:

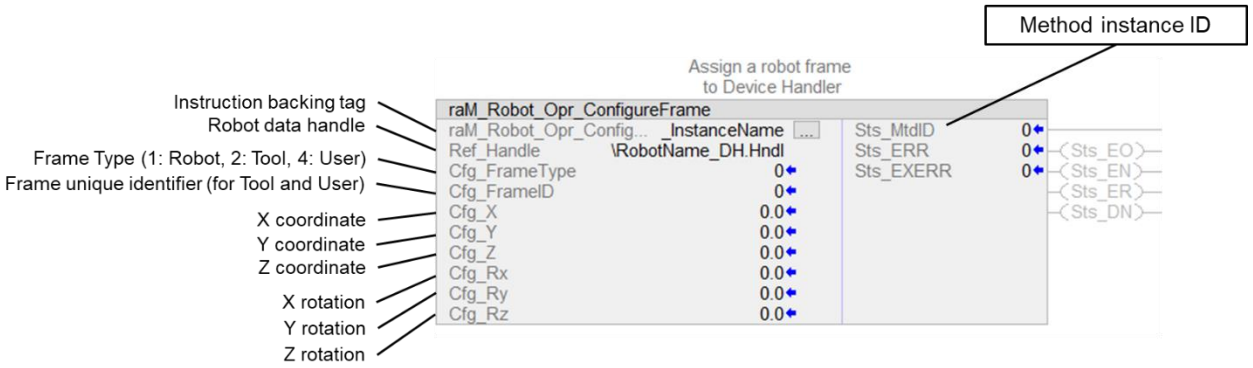
- Not using a Device Handler for Robot Management

1.1 Prerequisites

- Device Handler for Robot
  - Rockwell Automation Robotics Libraries v2.2 →
- Studio 5000 – Logix Designer
  - v35.0 →
- Studio 5000 – Application Code Manager
  - v4.03.00 →

1.2 Functional Description

Configure a Frame for the robotic application. There are 3 types of frames: Robot, Tool, and User. There is only one Robot frame but there can be multiple Tool and User Frames, and each Tool and User Frame requires a unique Frame ID to be assigned to it.



The Robot Device Handler has the capability by default to add 1 Robot frame, up to 15 User frames, and up to 15 Tool frames. It is not required to use all frames but a frame must be configure before it can be used in a move or zone instruction. Inputs X, Y, Z represent Cartesian offsets whereas input Rx, Ry, and Rz represent angular offsets in degrees and are solved in

To configure a Robot frame, the inputs represent an offset from the World frame. By default, (when the Robot frame is configured for all 0.0s) the World frame and Robot frame are coincident and exactly overlap. To adjust the Robot frame away from the World, change the instruction pose inputs to represent the new position of the Robot with respect to the World.

User frames are considered fixed frames in that they do not move with respect to the robot and are defined in absolute terms. The inputs to the instruction will represent an offset from the World frame.

Tool frames are considered mobile frames in that they move with respect to the world when the robot flange moves. The inputs to the instruction will represent an incremental offset from the center of the robot flange.

Tool and User frames may be reconfigured provided there is a not an active zone, active move, or pending move that references its particular ID.

To check if a frame has been configured, locate the stFrames structure in the robot Hndl tag. Each frame type (Robot, User, Tool) has a dedicated structure within the stFrames tag. Each frame has a corresponding Configured bit that will indicate if a frame has been properly configured and is available for use in the application.

Once a frame has been configured and Sts_DN bit is set, the instruction no longer needs to be held true.

Please refer to the RM-raM_Robot_Tec_CalculatePose manual for more information regarding frames.

General Status Bit Behavior:

Note: Status bits not shown on the output side of the instruction are not used and will not exist in the instruction backing tag.

Status Bit	Description / Behavior
*.Sts_EO	• Enable Out indicated the status of the output line of the instruction. • If false (logically LO) any instruction on the ladder rung between the instruction and the neutral rail will not be energized. • If the instruction is removed from ladder scan either in a conditional subroutine, MCR zone, JMP/LBL etc., the bit will remain in its last evaluated state.
*.Sts_EN	• The rung-in condition of the ladder rung is true and the instruction is being evaluated. • If the instruction is removed from ladder scan either in a conditional subroutine, MCR zone, JMP/LBL etc., the bit will remain in its last evaluated state.
*.Sts_ER	• If the instruction experiences an internal error, the *. Sts_ER bit will be set. Error codes / Extended codes can be found by monitoring the backing tag *.Sts_ERR / *.Sts_EXERR members respectively. • If the instruction is removed from ladder scan either in a conditional subroutine, MCR zone, JMP/LBL etc., the bit will remain in its last evaluated state.
*.Sts_DN	• Used when the execution of the instruction completes within a single scan. • If the instruction is removed from ladder scan either in a conditional subroutine, MCR zone, JMP/LBL etc., the bit will remain in its last evaluated state.
*.Sts_IP	• Used to identify the instruction is In-Process • If the instruction is removed from ladder scan either in a conditional subroutine, MCR zone, JMP/LBL etc., the bit will remain in its last evaluated state.
*.Sts_PC	• Used when the execution of the instruction requires more than a single scan to complete, and indicates the ‘process’ carried out by the instruction has successfully completed; Process Complete. • If the instruction is removed from ladder scan either in a conditional subroutine, MCR zone, JMP/LBL etc., the bit will remain in its last evaluated state.

1.3 Execution

- Edge

1.3.1 Overview

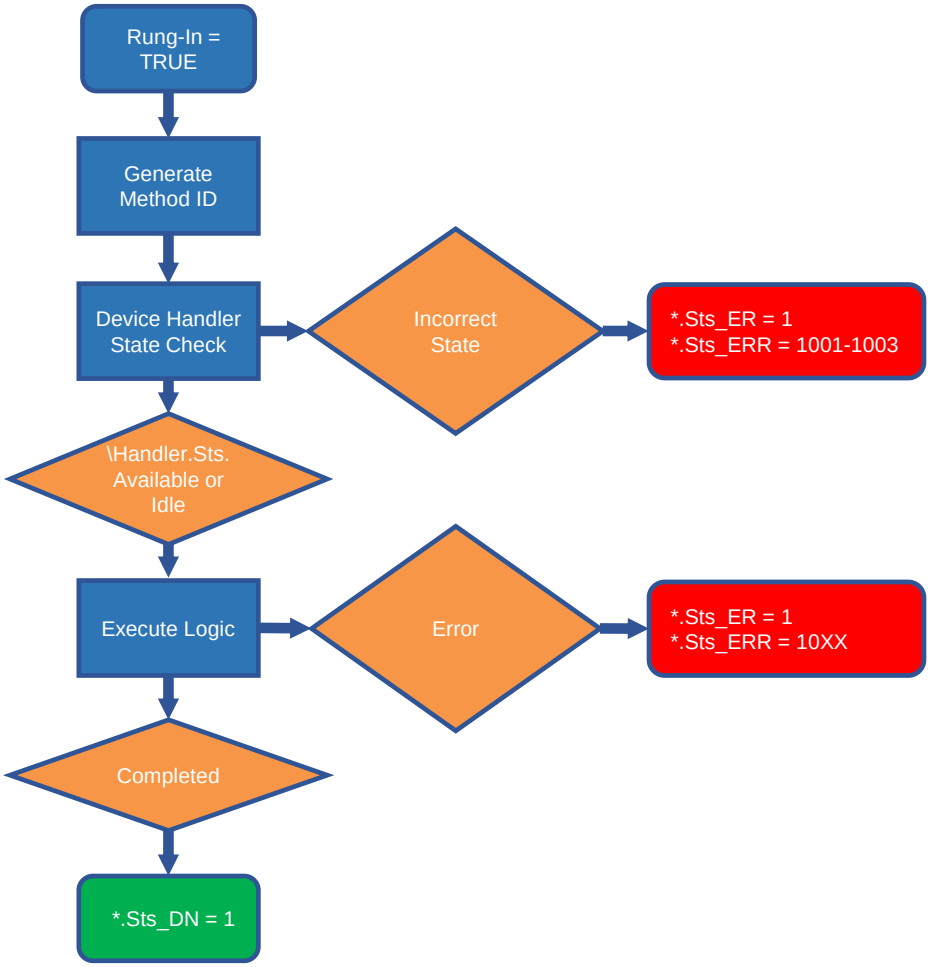
Rung in condition transition response:

- False → True
  - Initialization
    - *.Sts_EO = 0
    - *.Sts_ER = 0
    - *.Sts_PC = 0
    - *.Sts_IP = 0
  - Running
    - *.Sts_EO = 1
    - *.Sts_EN = 1
      - *Operation*
      - IF: *Method completes*
        - THEN: *.Sts_DN = 1
      - IF: Error
        - THEN: *.Sts_DN = 0 and *.Sts_ER = 1
- True → False
  - *.Sts_EO = 0
  - *.Sts_EN = 0
    - IF: Error
      - THEN: *.Sts_ER = 1

1.3.2 Affected Device Handler Status

Status	Value
***.Sts.Faulted**	FALSE
***.Sts.FaultMessage**	''
***.Sts.ERR**	0
***.Sts.EXERR**	0
***.stFrames**	

1.3.3 Execution Table



2 Instruction

2.1 Input Data

Input	Function / Description	DataType
Ref_Handle	Device Handler Data Structure	raM_UDT_Robot_Dvc_DataHndl
Cfg_FrameType	1: Robot, 3: Tool, 4: User	SINT
Cfg_FrameID	Frame unique identifier (for Tool and User)	SINT
Cfg_X	Target Position value for X coordinate (mm)	REAL
Cfg_Y	Target Position value for Y coordinate (mm)	REAL
Cfg_Z	Target Position value for Z coordinate (mm)	REAL
Cfg_Rx	Target Position value for rotation angle around X-axis (deg)	REAL
Cfg_Ry	Target Position value for rotation angle around Y-axis (deg)	REAL
Cfg_Rz	Target Position value for rotation angle around Z-axis (deg)	REAL

2.2 Output Data

Output	Function / Description	DataType
Sts_EO	Instruction has enabled the rung output. Provides a visible indicator of the EnableOut system parameter for use during ladder instantiation	BOOL
Sts_EN	Instruction is Being Scanned - Rung In Condition = TRUE	BOOL
Sts_ER	Instruction is in Error - See Sts_ERR / Sts_EXERR for Additional Error Information	BOOL
Sts_ERR	Instruction Error Code - See Instruction Help for Code Definition	DINT
Sts_EXERR	Instruction Extended Error Code - See Instruction Help for Code Definition	DINT
Sts_MtdID	Method ID	DINT
Sts_DN	Instruction Execution has Completed	BOOL

2.3 Error Codes

Sts_ERR	Description
0	No errors present.
1001	Device Handler is not in a running state. Commands to the device cannot be processed.
1002	Device Handler is in a faulted state.
1003	Device Handler is not in a supported state. Device Handler must be in state Available.
1010	Cfg_FrameType invalid, select User, Tool or Robot frame type
1011	Tool frame ID, out of bounds, input a value <= 0 and <= maximum frame number
1012	User frame ID, out of bounds, input a value <= 0 and <= maximum frame number
1013	Path points are queued using the selected tool frame
1014	Path points are queued using the selected user frame
1015	Invalid frame definition, frame could not be validated

Sts_EXERR	Description
< Number >	If a native instruction error occurs internally, the value of the instruction *.ERR DINT will be placed in Sts_EXERR.

3 Application Code Manager

3.1 Definition Object: raM_Robot_Opr_ConfigureFrame

This object contains the AOI definition and used as linked library to implement object. This gives flexibility to choose to instantiate only definition and create custom implement code. User may also create their own implement library and link with this definition library object.

3.2 Implementation Object: raM_LD_Robot_ConfigureFrame

Implementation Language: Ladder
Content Type: Routine

This implement contains only a rung with an instance of the raM_Robot_Opr_ConfigureFrame object.

Parameter Name	Default Value	Instance Name	Definition	Description
RoutineName	{ObjectName}	{RoutineName}	Routine	Name of the routine where the object will be placed
TagName	_{ObjectName}	{TagName}	Tag	Instruction backing tag
StartBitTagName	Cmd_{ObjectName}	{ StartBitTagName }	Local Tag	Tag name for start command enabling bit
FrameType	1	{TagName}.Cfg_FrameType	DINT	Frame type configuration 1: Robot, 3: Tool, 4: User
FrameID	0	{TagName}.Cfg_FrameID	DINT	Frame unique identifier (for tool and user)
X	0.0	{TagName}.Cfg_X	REAL	X coordinate in mm
Y	0.0	{TagName}.Cfg_Y	REAL	Y coordinate in mm
Z	0.0	{TagName}.Cfg_Z	REAL	Z coordinate in mm
Rx	0.0	{TagName}.Cfg_Rx	REAL	Rx coordinate in deg
Ry	0.0	{TagName}.Cfg_Ry	REAL	Ry coordinate in deg
Rz	0.0	{TagName}.Cfg_Rz	REAL	Rz coordinate in deg

Linked Library

Link Name	Catalog Number	Revision	Solution	Category
RobotHandler	raM_Robot_Dvc_DeviceHandler	2	(RA-LIB) Robotics	Robot Handler
raM_Robot_Opr_ConfigureFrame	raM_Robot_Opr_ConfigureFrame	2	(RA-LIB) Robotics	Asset-Control

3.3 Attachments

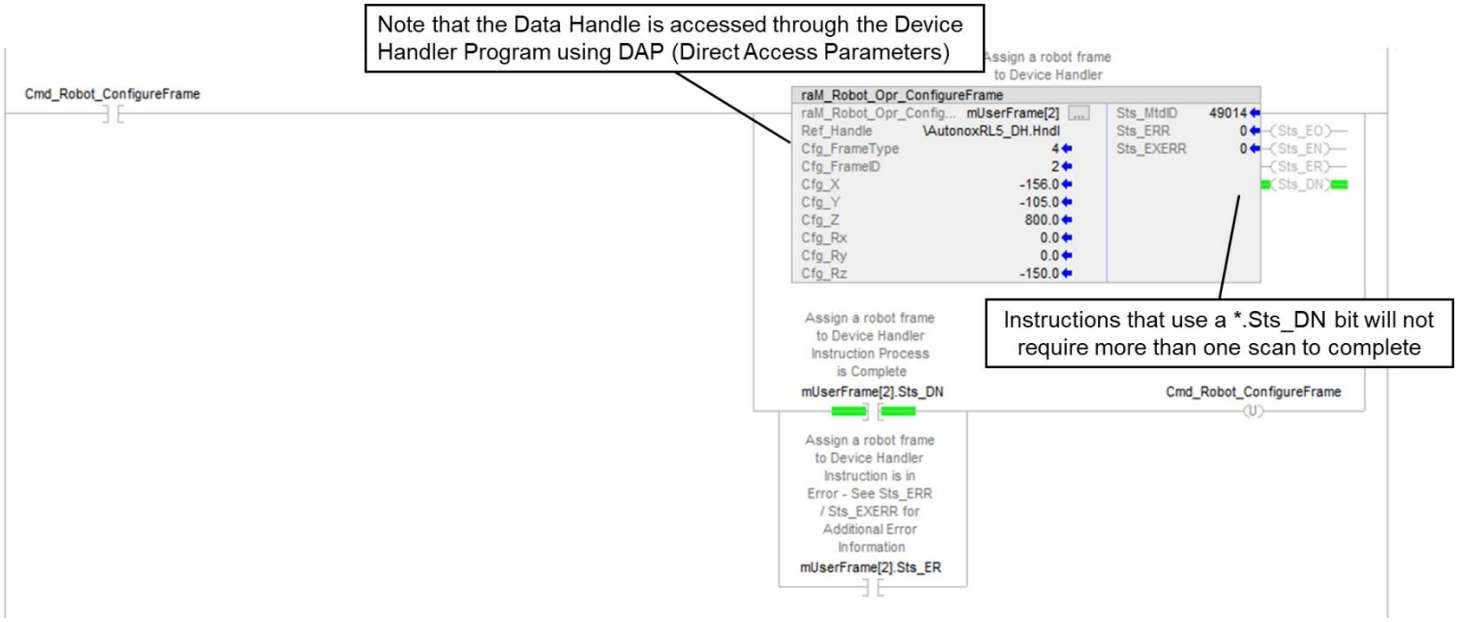
Name	Description	File Name	Extraction path
V2_{LibraryName}	Reference Manual	RM-{LibraryName}.pdf	{ProjectName}\Documentation

4 Application

4.1 Using raM_Robot_Opr_ConfigureFrame

Configure a User frame located at ID 2 with offsets from the World frame of:

X: -156
Y: -105
Z: 800
Rx: 0
Ry: 0
Rz: -150



5 Appendix

General

This document provides a programmer with details on this OEM Building Block instruction for a Logix-based controller. You should already be familiar with how the Logix-based controller stores and processes data.

Novice programmers should read all the details about an instruction before using the instruction. Experienced programmers can refer to the instruction information to verify details.

IMPORTANT This OEM Building Block Instruction includes an Add-On Instruction for use with Version 24 or later of Studio 5000 Logix Designer.

Common Information for All Instructions

Rockwell Automation Building Blocks contain many common attributes or objects. Refer to the following reference materials for more information:

- Foundations of Modular Programming, **IA-RM001C-EN-P**

Conventions and Related Terms

Data - Set and Clear

This manual uses set and clear to define the status of bits (Booleans) and values (non-Booleans):

This Term:	Means:
Set	The bit is set to 1 (ON) A value is set to any non-zero number
Clear	The bit is cleared to 0 (OFF) All the bits in a value are cleared to 0

Signal Processing - Edge and Level

This manual uses Edge and Level to describe how bit (BOOL) Commands, Settings, Configurations and Inputs to this instruction are sent by other logic and processed by this instruction.

Send/Receive Method:	Description:
Edge	• Action is triggered by "rising edge" transition of input (0-1) • Separate inputs are provided for complementary functions (such as "enable" and "disable") • Sending logic SETS the bit (writes a 1) to initiate the action; this instruction CLEARS the bit (to 0) immediately, then acts on the request if possible • LD: use conditioned OTL (Latch) to send • ST: use conditional assignment [if (condition) then bit:=1;] to send • FBD: OREF writes a 1 or 0 every scan, should use Level, not Edge Edge triggering allows multiple senders per Command, Setting, Configuration or Input (many-to-one relationship)
Level	• Action ("enable") is triggered by input being at a level (in a state, usually 1) • Opposite action ("disable") is triggered by input being in opposite state (0) • Sending logic SETS the bit (writes a 1) or CLEARS the bit (writes a 0); this instruction does not change the bit • LD: use OTE (Energize) to send • ST: use unconditional assignment [bit:= expression_resulting_in_1_or_0;] or "if-then-else" logic [if (condition) then bit:= 1; else bit:= 0;] • FBD: use OREF to the input bit Level triggering allows only one sender can drive each Level

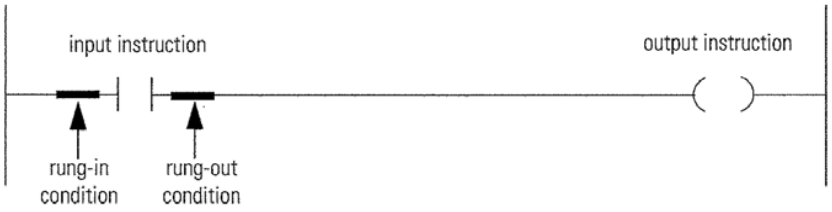
Instruction Execution - Edge and Continuous

This manual uses Edge and Continuous to describe how an instruction is designed to be executed.

Method:	Description:
Edge	• Instruction Action is triggered by "rising edge" transition of the rung-in-condition
Continuous	• Instruction Action is triggered by input being at a level (in a state, usually 1) • Opposite action is triggered by input being in opposite state (0) • Instructions designed for continuous execution should typically be used on rungs without input conditions present allowing the instruction to be continuously scanned

Relay Ladder Rung Condition

The controller evaluates ladder instructions based on the rung condition preceding the instruction (rung-in condition). Based on the rung-in condition and the instruction, the controller sets the rung condition following the instruction (rung-out condition), which in turn, affects any subsequent instruction.



If the rung-in condition to an input instruction is true, the controller evaluates the instruction and sets the rung-out condition based on the results of the instruction. If the instruction evaluates to true, the rung-out condition is true; if the instruction evaluates to false, the rung-out condition is false.

IMPORTANT

The rung-in condition is reflected in the EnableIn parameter and determines how the system performs each Add-On Instruction. If the EnableIn signal is TRUE, the system performs the instruction's main logic routine. Conversely, if the EnableIn signal is FALSE, the system performs the instruction's EnableInFalse routine.

The instruction's main logic routine sets/clears the EnableOut parameter, which then determines the rung-out condition. The EnableInFalse routine cannot set the EnableOut parameter. If the rung-in condition is FALSE, then the EnableOut parameter and the rung-out condition will also be FALSE.

Pre-scan

On transition into RUN, the controller performs a pre-scan before the first scan. Pre-scan is a special scan of all routines in the controller. The controller scans all main routines and subroutines during pre-scan, but ignores jumps that could skip the execution of instructions. The controller performs all FOR loops and subroutine calls. If a subroutine is called more than once, it is performed each time it is called. The controller uses pre-scan of relay ladder instructions to reset non-retentive I/O and internal values.

During pre-scan, input values are not current and outputs are not written. The following conditions generate pre-scan:

- Transition from Program to Run mode.
- Automatically enter Run mode from a power-up condition.

Pre-scan does not occur for a program when:

- Program becomes scheduled while the controller is running.
- Program is unscheduled when the controller enters Run mode.

IMPORTANT The Pre-scan process performs the Process Add-On Instruction's logic routine as FALSE and then performs its Pre-scan routine as TRUE.