ER Series RCS2 Command System Manual

(**RCS2**V1.13)

ESTUN Robotics Engineering Co., Ltd.

— Total Solution Supplier

Revision History

S/N	Date	Revision	Description
1	2019.04.17	V1.0	Initial issue
2	2019.04.22	V1.1	Modify the initial revision
3	2019.07.22	V1.2	1. Add new commands of SetMotionMode and GetCurOverRide. 2. Modify the parameter description of the PALLET command.
4	2019.12.31	V1.3	1. Remove the descriptions of EMovL and EMovC commands. 2. Add TOOL, USERCOOR, PAYLOAD attribute variables to all motion commands except MovJRel and MovLRel, which have PAYLOAD attribute added to them. 3. Modify the description of the SetPayload command. 4. Add instructions for SetRtInfo and SetRtWarning commands. 5. Add description of the PAYLOAD variable. 6. Make other modifications.
5	2020.7.13	V1.4	1. Add SetExternalTCP command. 2. Modify the description of the Coord attribute in the MovL and MovC commands. 2. 3. Add Type attribute to the WAVE variable. 4. Add EXTTCP variable type. 5. Make other modifications.
6	2021.2.8	V1.5	1. Add the commands MovLSync, MovJSyncQuit, MovLSyncQuit, WaitWObj and SetTargetPos and create a new conveyor tracking command list to store them. 2. Add a new SYNCOORD variable. 3. Add new Goto attribute variable to the time waiting commands WaitCondition, WaitDI, WaitDI8421, WaitAI, WaitSimDI, WaitSimDI8421 and WaitSimAI. 4. Add the new attributes initActivate, enInPut, and enInHigh to the AREA variables. 5. Add the ELSIF command
7	2021.5.24	V1.6	1. Add two new Goto attribute variables to the MovLSync command as well as the lift height. 2. Add LsScale and LsThresh variables. 3. Add AutoGainEnable, AutoGainDisable commands to the SETUP commands.
8	2021.7.26	V1.7	1. Add new parameters for MovL, MovC, MovLRel, MovLW, MovCW commands: whether they are affected by the Global Speed Multiplier or not. 2. Add the commands MovLOffset, SetSingularPass, SetColliEnable, SetAxisColliParam, SetMatrix, GetMatrix, SocketSendReal, SocketSendInt, SetPositioner and SetBlendParam 3. Change the command name GetOverRide to GetCurOverRide.
9	2021.10.15	V1.8	1. Refine system keywords (words). 2. Add polyhedron area variable for AREA data type. 3. Modify the coordinate system parameters in the MovL, MovC, MovLRel, MovLW and MovCW commands. 4. Add the commands PolyhedronAreaActivate and PolyhedronAreaDeactivate.

S/N	Date	Revision	Description
10	2022.1.6	V1.9	1. Modify the type description of the time parameter in Wait, WaitCondition, WaitDI, WaitDI8421, WaitAI, WaitSimDI, WaitSimDI8421 and WaitSimAI commands, and modify the type description of the Speed multiplier parameter in SetOverride command. 2. Create a new list of string commands, move the string functions in assignment and process control commands to it, and add findEnd, format, getAt, left, right, reverse, strcmp, trimLeft, trimRight, IToStr, RToStr, StrToI, StrToR, APosToStr, etc, StrToR, APosToStr, CPosToStr, TranStrToInt, TranStrToReal, TranStrToApos and TranStrToCpos commands. Also remove the string functions from the assignment and process control commands. 3. Add WaitConvDis command to the list of Conveyor Tracking commands. 4. Add SetRestorePC and SetAxisVibraBLevel commands to the list of SETUP commands. 5. Change the Amp attribute in the WEAVE variable to Amp_L, Amp_R and the StopTime attribute to StopTime_L, StopTime_C and StopTime_R. 6. Add MovCircle, MovCircleW commands to the list of motion commands. 7. Add PLCBOOL, PLCINT and PLCDINT variables to the PLC data types. 8. Add ModbusTcp command list.
11	2022.4.13	V1.10	1. Add ToolOffset and UserOffset commands to the list of Position Operation commands.
12	2022.7.18	V1.11	1. Add H2 parameter in MovArch command, and modify the descriptions of some command parameters. 2. Add SimConveyorOn, SimConveyorOff, ReceiveWObj and ResetWObjBuf commands to the Conveyor Tracking command.
13	2022.10.28	V1.12	1. Modify the format description of received data in the SocketReadReal and SocketReadInt commands, and the parameter description in the SocketSendStr command. 2. Add SocketResetBuf command to the Socket command set. 3. Add the isFlangeEnd parameter to the AREA variable. 4. Modify the description of the RUN command. 5. 5. Modify the parameter description order of WaitDI8421 and WaitSimDI8421 commands.

S/N	Date	Revision	Description
14	2023.3.16	V1.13	1. Add APOSARRAY, CPOSARRAY and INTERRUPT. 2. Modify the description of the distance and time parameters in the OnDistance command. 3. Modify the description of the time parameter in the OnParameter command. 4. Modify the Returned value parameter descriptions in the MovJSearch and MovLSearch commands, and add the SearchP and Goto parameters. 5. Add MovJOffset and MovLArch commands to the list of motion commands. 6. Add SetOriMode, GetRobotIsMoving, SetColliAutoTune and SetColliParam commands to the list of SETUP commands. 7. Added the CalPosOffset command to the list of Position Operation commands. 8. Add AreaConnectIO, AreaDisConnectIO, PolyhedronAreaConnectIO, PolyhedronAreaDisConnectIO commands to the list of AREA commands. 9. Add INTERRUPT command list. 9. Add a list of online load tuning commands. 10. Add INTERRUPT, COLLIPARAM parameters to system variables.

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Preface

Overview

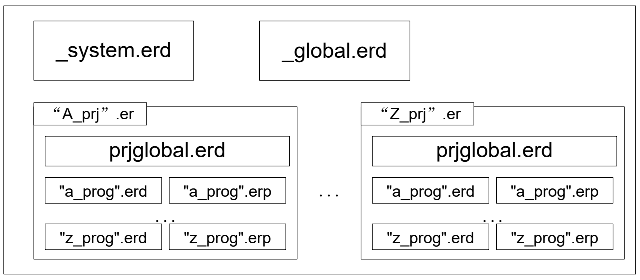
This document is applicable to the control system RCS2 V1.30 and above versions. It describes the structure definitions, variable types, and parameter meanings in the RCS2 command system of ER series robots, aiding users in gaining a profound understanding of the command system.

Chapter 1 System Introduction

1.1 System overview

The command system file structure is divided into three parts: Project, Program, and Data. Among them, the data is further divided into four domins: System, Global, Project and Program. Program code is saved in files with the following extensions: .er, .erp, and .erd. These files are typically located in the Project folder.

The overall structure of the Project file is as follows:



- System domin data file: _system.erd
- Global domin data file: _global.erd
- Project folder: "A_prj".er
  - Project domin data file: prjglobal.erd
  - Program command file: "a_prog".erp
  - Program domin data file: "a_prog".erd

Note: The names of the System and Global scope data files are predetermined and cannot be modified. Other file names can be customized.

Users can edit the command files using a teach pendant or other interfaces.

1.2 System domin data file

The _system.erd file, located in the Project directory, is the system data file. Variables in this file correspond to the System domin and are predefined. Users cannot edit these variables, but they can be referenced by all projects. This file primarily includes four types of predefined variables (the variable types will be explained in detail in the next chapter):

- TOOL
- USERCOORD
- SPEED
- ZONE
- PAYLOAD

1.2.1 System domin TOOL variable

The TOOL type variables predefined by the system, as shown in the table below:

Name	x	y	z	a	b	c	M	Mx	My	Mz	Ixx	Iyy	Izz	Ixy	Iyz	Ixz
nullTool	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1.2.2 System domain USERCOORD variables

USERCOORD type variables predefined by the system, as shown in the following table:

Name	x	y	z	a	b	c
World	0	0	0	0	0	0

1.2.3 Predefined constants for the System domain SPEED

The system predefined SPEED type variables, as shown in the following table:

Name	Joint speed percentage (per): %	TCP linear speed (tcp): mm/s	Spatial rotation speed (ori): deg/s	External axis linear speed (exj_l): mm/s	External axis angular speed (exj_r): deg/s
V5	1	5	360	360	180
V10	2	10	360	360	180
V30	3	30	360	360	180
V50	5	50	360	360	180
V60	6	60	360	360	180
V80	8	80	360	360	180
V100	10	100	360	360	180
V200	20	200	360	360	180
V300	30	300	360	360	180
V500	50	500	360	360	180
V800	80	800	360	360	180
V1000	100	1000	360	360	180
V1500	100	1500	360	360	180
V2000	100	2000	360	360	180
V3000	100	3000	360	360	180
V4000	100	4000	360	360	180

1.2.4 Predefined constants for the System domain ZONE

ZONE type variables are predefined by the system, as shown in the following table:

Name	Bend radius percentage (per): %	Bend radius distance (dis): mm	Constant bend radius speed (vConst)
C0	0	0	0
C5	5	5	0
C10	10	10	0
C20	20	20	0
C30	30	30	0
C50	50	50	0
C60	60	60	0
C80	80	80	0
C100	100	100	0
C150	100	150	0
C200	100	200	0

1.2.5 System domain PAYLOAD variables

PAYLOAD type variables as predefined by the system, as shown in the following table:

Name	M(kg)	Mx	My	Mz	Ixx	Iyy	Izz	Ixy	Iyz	Ixz
FullPayLoad	x	0	0	0	0	0	0	0	0	0

1.3 Global domain data file

The _global.erd in the Project directory is a Global data file. The variables correspond to the Global domain and can be edited by the user. The data in the Global domain can be referenced in all projects.

1.4 Project file

1.4.1 Project domin data file

In each project directory (project.er), the prjglobal.erd file is the Project data file. Variables in this file correspond to the Project domin and can be edited by the user. Data within the Project scope can only be referenced by all Program commands within the same project.

1.4.2 Program command files

Each Project directory should contain at least one or multiple Program command files, all with the extension .erp. These files store the commands edited by the user, such as the MovJ command mentioned in subsequent chapters.

1.4.3 Program domin data file

Each program has a corresponding data file with the same name and the .erd extension. The variables stored in this file can only be referenced by the commands within the respective program.

1.5 System keywords

说明

The following "names" are reserved by the system, and mainly include basic functions, commands, variable names, and specific names. Users cannot create variables with the same names.

Basic functions:

and, break, do, else, elseif, end, false, for, function, if, in, local, nil, not, or, repeat, return, then, true, until, while, assert, tostring, tonumber, rawget, xpcall, ipairs, print, pcall, rawset, error, loadfile, rawequal, load, pairs, require, collectgarbage, dofile, next, select, type getmetatable, goto, setmetatable, debug, log, max, acos, huge, pi, cos, deg, tan, random, randomseed, ceil, floor, rad, abs, sqrt, modf, asin, min, fmod, log, atan, exp, sin, coroutine, math, io, os, package, string, table, byte, find, find2, char, gsub, len, sub, lower, trim, upper

Variable types:

BOOL, INT, REAL, STRING, BOOLONEARRAY, INTONEARRAY, REALONEARRAY, APOS, CPOS, TOOL, USERCOOR, AI, AO, DI, DO, SimAI, SimAO, SimDI, SimDO, RET, AREA, POLYHEDRON, CLOCK, PLCREAL, SOCKET, PALLET, WEAVE, SPEED, ZONE, PAYLOAD, EXTTCP, POSITIONER, SYNCOORD, LsScale, LsThresh

Name of commands:

... =... , /*... */, APosToCPos, AreaActivate, AreaDeactivate, PolyhedronAreaActivate, PolyhedronAreaDeactivate, AutoGainDisable, AutoGainEnable, BitAnd, BitLSH, BitNeg, BitOr, BitRSH, BitXOr, CalcCoord, CalcTool, CALL, CLKRead, CLKReset, CLKStart, CLKStop, CompareAI, CompareSimAI, CPosToAPos, CPosToCPos, ELSE, ELSIF, ENDIF, ENDWHILE, GetCamPos, GetCurAPos, GetCurCPos, GetDI8421, GetMatrix, GetSimAIToVar, GetSimDI8421, GetSimDIToVar, GetTrackId, GOTO, Hand, IF, LABEL, MovArch, MovC, MovCW, MovH, MovJ, MovJRel, MovJSearch, MovJSyncQuit, MovL, MovLOffset, MovLRel, MovLSearch, MovLSync, MovLSyncQuit, MovLW, OnDistance, OnParameter, PalletFromGet, PalletFromPut, PalletToGet, PalletToPut, PalletReset, PulseOut, PulseSimOut, RefRobotAxis, RETURN, RUN, SendMessage, SetAO, SetAxisColliParam, SetBlendParam, SetCartDyn, SetColliEnable, SetCoord, SetCurOverRide, SetDIEdge, SetDO, SetDO8421, SetExternalTCP, SetJointDyn, SetMatrix, SetMotionMode, SetPayload, SetPositioner, SetRtInfo, SetRtToErr, SetRtWarning, SetSimAO, SetSimAOByVar, SetSimDIEdge, SetSimDO, SetSimDO8421, SetSimDOByVar, SetSingularPass, SetSyncoord, SetTargetPos, SetTool, SocketClose, SocketCreate, SocketReadInt, SocketReadReal, SocketReadStr, SocketSendInt, SocketSendReal, SocketSendStr, SoftFloatStart, SoftFloatStop, Stop, SyncToUserC, TrigCam, Wait, WaitAI, WaitCondition, WaitDI, WaitDI8421, Waitfinish, WaitFinishCAM, WaitSimAI, WaitSimDI, WaitSimDI8421, WaitWObj, WHILE

Specific names

POSCFG, PLACEOPTION

Chapter 2 Variable Data Types

Different types of variables are supported by different domains, which are detailed as follows:

- System Domain: The system predefined variables, which cannot be edited.
- Global Domain: IO data type, PLC data type, socket data type, position data types, area data type, basic data type, weave data type, clock data type, pallet data type, and system data type.
- Project Domain: IO data type, socket data type, position data types, basic data type, weave data type, pallet data type, and system data type.
- Program Domain: IO data type, socket data type, position data type, basic data type, and system data type.

2.1 Basic data types

BOOL

This variable is used to store bool type data. It supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- value: Data type: bool
  Meaning: Variable value
- saveflag: Data type: bool
  Meaning: Power-down memory

INT

This variable is used to store integers. It supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- value: Data type: int
  Meaning: Variable value
- saveflag: Data type: bool
  Meaning: Power-down memory

REAL

This variable is used to store real numbers. It supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- value: Data type: real
  Meaning: Variable value
- saveflag: Data type: bool
  Meaning: Power-down memory

STRING

This variable is used to store character strings. It supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- value: Data type: string
  Meaning: Variable value
- saveflag: Data type: bool
  Meaning: Power-down memory

BoolOneArray

This variable is used to store bool type array data. It supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- count: Data type: int
  Meaning: Count of data
- value: Data type: bool
  Meaning: Variable value

IntOneArray

This variable is used to store the integer array data. It supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- count: Data type: int
  Meaning: Count of data
- value: Data type: int
  Meaning: Variable value

RealOneArray

This variable is used to store the real array data. It supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- count: Data type: int
  Meaning: Count of data
- value: Data type: real
  Meaning: Variable value

2.2 Position data type

APOS

This variable is used to store the coordinate values of axis in the joint space. It supports users to create and modify independently, and to perform assignment operations and other jobs in the teaching program. Also, it supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- a1: Data type: real
  Meaning: The coordinates of the 1# axis of the joint.
- a2: Data type: real
  Meaning: The coordinates of the 2# axis of the joint.

- a3: Data type: real

  Meaning: The coordinates of the 3# axis of the joint.
- ...: The attributes of the parameters a4~a15 are the same as above, they are Real type variables, representing in turn the coordinate values of the axes of joints 4~15.
- a16: Data type: real

  Meaning: The coordinates of the 16# axis of the joint.

  [Note] The number of parameters of axes will be displayed based on the number of axes. For example, the general six-axis robot displays aa1~a6, while the scara robot displays a1~a4.

POSCFG

Robot may have differed joint position combinations under the same Cartesian space position (corresponding to the multiple solutions of the robot inverse solution). This attribute is used to define the morphological configuration data corresponded to the spatial target point.

Parameter description:

- mode: Data type: int
- cf1: Data type: int

  Meaning: The value of quadrant where the angle of the1 # axis of the joint is located.
- cf2: Data type: int

  Meaning: The value of quadrant where the angle of the 2# axis of the joint is located.
- cf3: Data type: int

  Meaning: The value of quadrant where the angle of the 3# axis of the joint is located.
- cf4: Data type: int

  Meaning: The value of quadrant where the angle of the 4# axis of the joint is located.
- cf5: Data type: int

  Meaning: The value of quadrant where the angle of the 5# axis of the joint is located.
- cf6: Data type: int

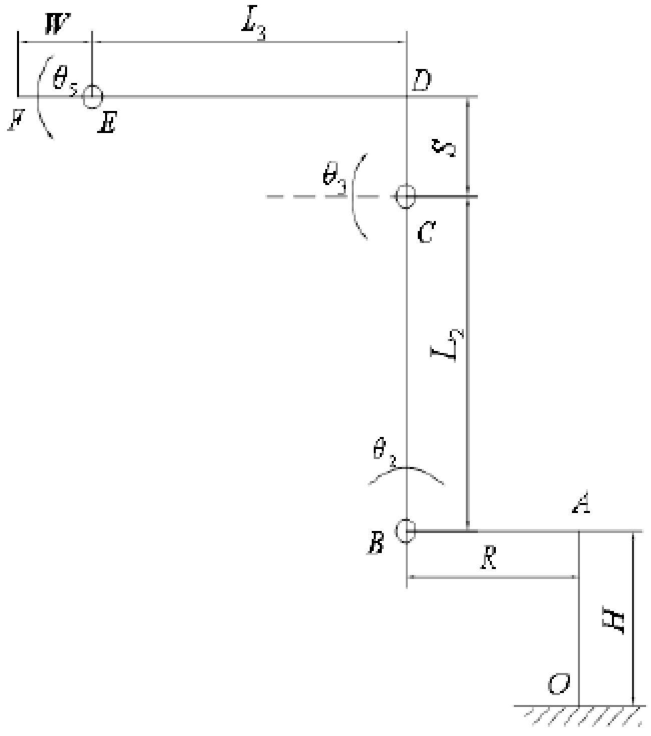
  Meaning: The value of quadrant where the angle of the 6# axis of the joint is located.

The values of these quadrants are divided as follows:

Non-negative numbers: 0: (-pi,pi], 1: (pi,3pi], 2: (3pi,5pi], ...; 2pi difference between each quadrant

Negative numbers: -1: (-3pi,-pi], -2: (-5pi,-3pi], ...; -2pi difference between each quadrant

① Definition of general-purpose six-joint dynamics mode



There are eight sets of solutions for the dynamics of the general-purpose six-joint. The mode value is defined as 0~7. The meanings are listed in table below:

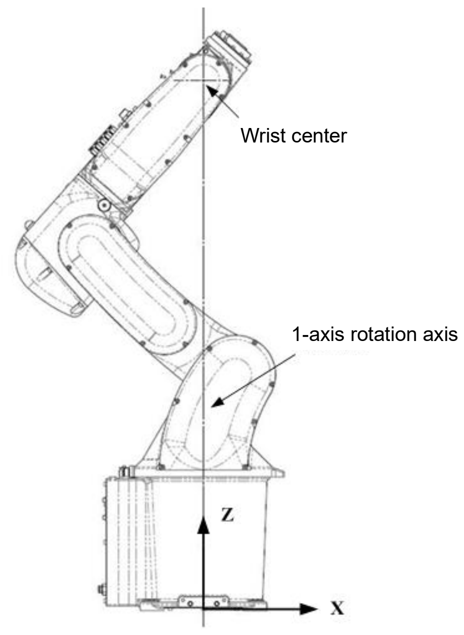
Mode	The relationship between the center of the wrist and the center of the axis (flag1)
	0: Front 1: Back
	$R + L_3 \bullet \cos(\theta_2+\theta_3) + L_2 \bullet \sin\theta_2 + S \bullet \sin(\theta_2+\theta_3)$
		Axis3(flag3)
		$(\theta_3 + 90 - \arctan(S/L3))$
		0: [0,180]
		1:(-180,0)
			Axis5(flag5)
			(θ_5)
			0: [0,180]
			1:(-180,0)

0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

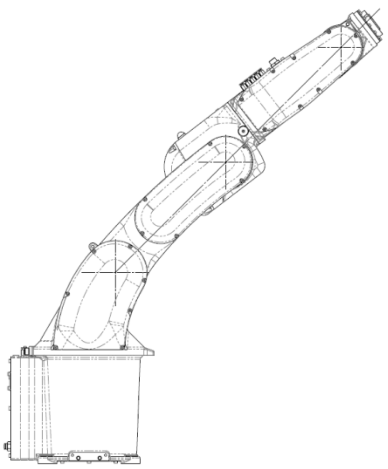
mode = flag5 + 2*flag3 + 4*flag1.

Notes:

aa. The relationship between the wrist center and the center of the axis is shown in the figure below. Front: refers to the positive direction of x in the figure; Back: refers to the negative direction of x in the figure.



Meaning of bb: Axis3 (flag3): The second and third axis are on a straight line are taken as the boundary condition. 0 is for forward inclination, and 1 is for backward inclination.



Meaning of cc: Axis5(flag5): The angle of 5 axes.

② Definition of SCARA dynamics mode

There are two sets of solutions for Scara dynamics. The mode values are defined as 0 and 1, with the meanings listed as follows:

Mode	Axis2(flag2) (θ_2) 0:[0,180] 1: (-180,0)
0	0
1	1

mode = flag2.

③ Definition of 3-axis plane robot dynamics + "3+1" robot mode

Mode	Aixs2(flag2) $(\theta_2 + 90)$ 0: [0,180] 1: (-180,0)
0	0
1	1

mode = flag2.

④ Definition of SCARA hoisting dynamics mode

There're two sets of solutions for Scara hoisting dynamics. The mode value is defined as 0 and 1, with the meanings listed below:

Mode	Axis2(flag2) $(\theta_2 - 180)$ 0:[0,180] 1: (-180,0)
0	0
1	1

CPOS

This variable is used to store the position of the TCP point in the Cartesian coordinates. It supports users to create and modify independently, and to perform assignment operations and other jobs in the teaching program. It also supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program

Parameter description:

- confdata: Data type: POSCFG

  Meaning: The morphological configuration information corresponded to the space target point.
- x: Data type: real

  Meaning: The coordinates of TCP point in the x direction in reference coordinates.
- y: Data type: real

  Meaning: The coordinates of TCP point in the y direction in reference coordinates.
- z: Data type: real

  Meaning: The coordinates of TCP point in the z direction in reference coordinates.
- a: Data type: real

  Meaning: The Euler angle of the TCP point relative to the z-axis of the reference coordinates
- b: Data type: real

  Meaning: The Euler angle of the TCP point relative to the y′-axis of the reference coordinates
- c: Data type: real

  Meaning: The Euler angle of the TCP point relative to the x″-axis of the reference coordinates
- a7: Data type: real

  Meaning: The coordinates of the 7# axis of the joint.
- ...: The attributes of parameters a8~a15 are similar to those mentioned above. They are all real-type variables and represent the coordinate values of Joints 8 to 15, respectively.
- a16: Data type: real

  Meaning: The coordinates of the 16# axis of the joint.

  [Note] The number of parameters of axes will be displayed based on the number of axes.

DAPOS

This variable is used to store the relative offset of each axis in the joint space. It supports users to create and modify independently, and to perform assignment operations and other jobs in the teaching program. It also supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- da1: Data type: real

  Meaning: The angle offset of the 1# axis of the joint.
- da2: Data type: real

  Meaning: The angle offset of the 2# axis of the joint.
- da3: Data type: real

  Meaning: The angle offset of the 3# axis of the joint.
- ...: The attributes of parameters da4~da15 are similar to those mentioned above. They are all real-type variables and represent the offset angles of Joints 4 to 15, respectively.
- da16: Data type: real

  Meaning: The angle offset of the 16# axis of the joint.

  [Note] The number of parameters of axes will be displayed based on the number of axes.. For example, the six-axis robot displays d1~d6, while the scara robot displays d1~d4.

DCPOS

This variable is used to store the relative offset of the TCP point in the Cartesian coordinates. It supports users to create and modify independently, and to perform assignment operations and other jobs in the teaching program. It also supports operations such as Create, Delete, and Modify in the scope of the three major variables: Global, Project, and Program.

Parameter description:

- dx: Data type: real

  Meaning: The displacement offset of TCP point in the x direction on the reference coordinates.
- dy: Data type: real

  Meaning: The displacement offset of TCP point in the y direction on the reference coordinates.
- dz: Data type: real

  Meaning: The displacement offset of TCP point in the z direction on the reference coordinates.
- da: Data type: real

  Meaning: The Euler angle offset of TCP point relative to the z-axis of the reference coordinates.
- db: Data type: real

  Meaning: The Euler angle offset of TCP point relative to the y′-axis of the reference coordinates.
- dc: Data type: real

  Meaning: The Euler angle offset of TCP point relative to the x″-axis of the reference coordinates.
- da7: Data type: real

  Meaning: The angle offset of the 7# axis of the joint.
- ...: The attributes of parameters da8 to da15 are indeed similar to those mentioned earlier. They are real-type variables and represent the offset angles of Joints 8 to 15, respectively.
- da16: Data type: real

  Meaning: The angle offset of the 16# axis of the joint.

  [Note] The number of parameters of axes will be displayed based on the number of axes.

APOSARRAY

To store the APOS point array data. You can create, delete, and modify this variable only within the Global variable scope.

Parameter description:

- count: Data type: int

  Meaning: Count of data
- APOSARRAY[X]: Data type: APOS

  Meaning: The stored individual APOS values.

Note: [X] represents the index number of the array, such as APOSARRAY[0], APOSARRAY[1].

CPOSARRAY

To store the CPOS point array data. You can create, delete, and modify this variable only within the Global variable scope.

Parameter description:

- count: Data type: int

  Meaning: Count of data
- CPOSARRAY[X]: Data type: CPOS

  Meaning: The stored individual CPOS values.

  Note: [X] represents the index number of the array, such as CPOSARRAY[0], CPOSARRAY[1].

2.3 System data type

CenterPos

The center of mass vector is set based on the position of the installed tool or load on the coordinates O_{Tool}-XYZ, which his described below.

The direction of the tool & load mass information reference coordinates is shown in Figure 1 Figure 2 shows the definition example of the tool & load mass information coordinates.

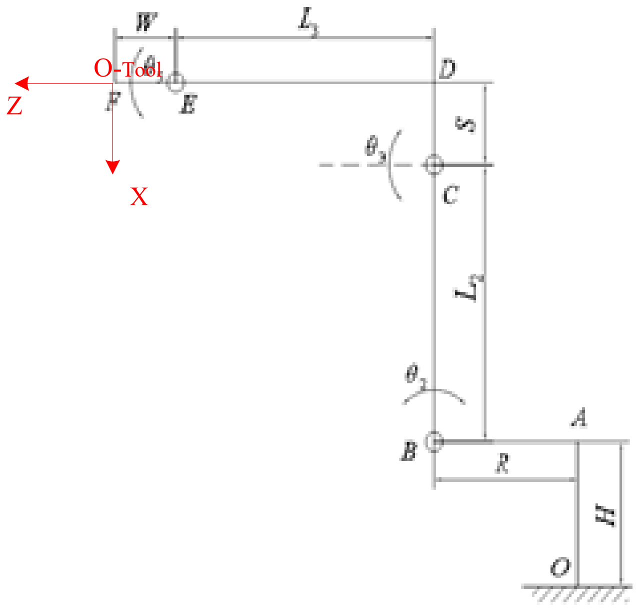


Figure 1. Explanation of tool & load mass information coordinates

Note: The coordinate system O_{Tool}-XYZ is located at the end flange plane of the robot, and the Z axis of the coordinate system is coaxial with the axis of the J6 joint (taking 6-axis robot as an example).

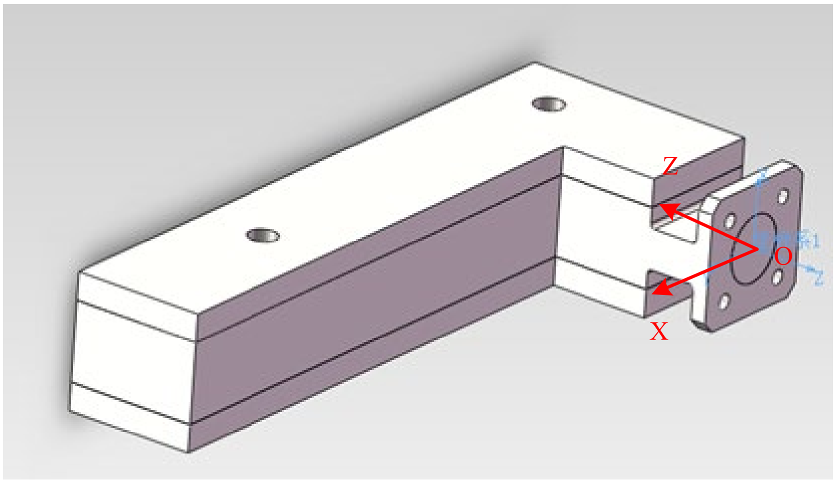


Figure 2. Example of tool & load mass information coordinates

Note: Please refer to the coordinates OTool-XYZ in Figure 5-1 for the mass information output coordinates of tools and loads.

Parameter description:

- Mx: Data type: real

  Meaning: The offset of the load of the installed tool or fixture in the X direction in coordinates O_{Tool}-XYZ, in mm. My: Data type: real

  Meaning: The offset of the load of the installed tool or fixture in the Y direction in coordinates O_{Tool}-XYZ, in mm. Mz: Data type: real

  Meaning: The offset of the load of the installed tool or fixture in the Z direction in coordinates O_{Tool}-XYZ, in mm.

InertiaTensor

This parameter represents the inertia tensor determined at the center position of the installed tool or payload. For a specific coordinate system diagram, you can refer to the explanatory diagram in the "CenterPos" variable type mentioned above.

Parameter description:

- Ixx: Data type: real

  Meaning: The moment of inertia when the load of the installed tool or fixture rotates in the X direction at the center of gravity, in kg·mm^2.
- Iyy: Data type: real

  Meaning: The moment of inertia when the load of the installed tool or fixture rotates in the Y direction at the center of gravity, in kg·mm^2
- Izz: Data type: real

  Meaning: The moment of inertia when the load of the installed tool or fixture rotates in the Z direction at the center of gravity, in kg·mm^2.
- Ixy: Data type: real

  Meaning: The product of inertia of the load of the installed tool or fixture in the XY cross direction at the center of gravity, in kg·mm^2.
- Ixz: Data type: real

  Meaning: The product of inertia of the load of the installed tool or fixture in the XZ cross direction at the center of gravity, in kg·mm^2
- Iyz: Data type: real

  Meaning: The product of inertia of the load of the installed tool or fixture in the YZ cross direction at the center of gravity, in kg·mm^2.

LoadDyn

It is used to store the end tool & load mass parameters of robot, and to calculate the full model of robot dynamics.

Parameter description:

- M: Data type: real

  Meaning: The weight of the tool & load, in kg.
- pos: Data type: CenterPos

  Meaning: See the meanings of CenterPos.
- tensor: Data type: InertiaTensor

  Meaning: See the meanings of InertiaTensor.

TOOL

The TOOL variable is used to record the tool parameters, and to define the displacement and rotation of the tool end in relation to the robot flange. The parameter can be calculated by the user based on the calibration of the variable interface or can be entered by the user. This variable can only be created and modified in the Global domain.

Parameter description:

- id: Data type: int

  Meaning: The unique index number of tool coordinates. The value cannot be modified. It is assigned automatically by the system when being created.
- x: Data type: real

  Meaning: The displacement offset of TCP relative to the flange coordinates in the x direction, in mm.
- y: Data type: real

  Meaning: The displacement offset of TCP relative to the flange coordinates in the y direction, in mm.
- z: Data type: real

  Meaning: The displacement offset of TCP relative to the flange coordinates in the z direction, in mm.
- a: Data type: real

  Meaning: The Euler angle of TCP relative to the z-axis of the flange coordinates, in deg.

- b: Data type: real

  Meaning: The Euler angle of TCP relative to the y′-axis of the flange coordinates, in deg.
- c: Data type: real

  Meaning: The Euler angle of TCP relative to the x″-axis of the flange coordinates, in deg.
- dyn: Data type: LoadDyn

  Meaning: The mass information of the tool, which is used to calculate the full model of robot dynamics.

  The system predefines the tool variable nullTool, in which the value of each offset is 0 by default. User can define the tool coordinates to be used on the basis of site requirements.

USERCOOR

The USERCOOR variable type is used to record user coordinate system parameters, defining the displacement and rotation of the user coordinate system relative to the World (Base) Coordinate System. This parameter can be calculated based on calibration using the variable interface or input manually by the user. The creation and modification of this variable are only allowed within the Global domin.

Parameter description:

- id: Data type: int

  Meaning: The unique index number of the user coordinates. The value cannot be modified. It is assigned automatically by the system when being created.
- x: Data type: real

  Meaning: Displacement offset of TCP in the x-direction relative to the World (Base) Coordinate System, measured in mm.
- y: Data type: real

  Meaning: Displacement offset of TCP in the y-direction relative to the World (Base) Coordinate System, measured in mm.
- z: Data type: real

  Meaning: Displacement offset of TCP in the z-direction relative to the World (Base) Coordinate System, measured in mm.
- a: Data type: real

  Meaning: uler angle representing the rotation of TCP around the z-axis of the World (Base) Coordinate System, measured in degrees.
- b: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the y -axis of the World (Base) Coordinate System, measured in degrees.
- c: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the x -axis of the World (Base) Coordinate System, measured in degrees.

The system predefines the world coordinates World, in which the value of each offset is 0 by default. User can define the user coordinates to be used on the basis of site requirements.

EXTTCP

EXTTCP variable is used to record the parameters of external tool coordinates, and to define the displacement and rotation of the external tool coordinates relative to the world coordinates. The parameter can be calculated based on the variable interface calibration, or be input by the user. This variable can only be created and modified in the Global domain.

Parameter description:

- id: Data type: int

  Meaning: The unique index number of the external tool coordinates. The value cannot be modified. It is assigned automatically by the system when being created.
- x: Data type: real

  Meaning: Displacement offset of TCP in the x-direction relative to the Tool Coordinate System, measured in mm.
- y: Data type: real

Meaning: Displacement offset of TCP in the y-direction relative to the Tool Coordinate System, measured in mm.

- z: Data type: real

  Meaning: Displacement offset of TCP in the z-direction relative to the Tool Coordinate System, measured in mm.

- a: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the z-axis of the Tool Coordinate System, measured in degrees.

- b: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the y -axis of the Tool Coordinate System, measured in degrees.

- c: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the x -axis of the Tool Coordinate System, measured in degrees.

SYNCOORD

The SYNCOORD variable type is used to record moving coordinate system parameters, defining the displacement and rotation of the moving coordinate system relative to the World (Base) Coordinate System. These parameters can be calculated by the user based on calibration using the variable interface or entered manually. The creation and modification of this variable are only allowed within the Global domin.

Parameter description:

- id: Data type: int

  Meaning: The unique index number of the External Tool Coordinate System cannot be modified and is automatically assigned by the system upon creation.

- x: Data type: real

  Meaning: Displacement offset of TCP in the x-direction relative to the World (Base) Coordinate System, measured in mm.

- y: Data type: real

  Meaning: Displacement offset of TCP in the y-direction relative to the World (Base) Coordinate System, measured in mm.

- z: Data type: real

  Meaning: Displacement offset of TCP in the z-direction relative to the World (Base) Coordinate System, measured in mm.

- a: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the z-axis of the World (Base) Coordinate System, measured in degrees.

- b: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the y -axis of the World (Base) Coordinate System, measured in degrees.

- c: Data type: real

  Meaning: Euler angle representing the rotation of TCP around the x -axis of the World (Base) Coordinate System, measured in degrees.

POSITIONER

The POSITIONER type variable selects the positioner (ID) by index.

Parameter description:

- index: Positioner serial number

  Data type: int

  Meaning: The range of index values is [0, 6]. In this context, 0 represents that the variable is invalid, while other values represent the coordinate system of the POSITIONER ID is the index.

SPEED

It is used to define the motion speed of the robot and the external axis. For easy use, the system presets the common speed variables (system variables, not to be modified by users). It also supports operations such as Create, Delete, and Modify in the scope of the three major variables Global, Project, and Program.

Parameter description:

- per: The percentage of joint speed.

  Data type: real

  Meaning: It is used to specify the motion speed for joint motion commands. It is applicable to commands MovJ, MovJRel and MovJSearch, and the value ranged from 1% to 100%.
- tcp: TCP line speed

  Data type: real

  Meaning: It is used to define the linear speed of the robot endpoint. It is used for MovL, MovC and other linear and full-circle motion commands.
- ori: Spatial rotating speed

  Data type: real

  Meaning: It is used to define the rotation speed of the endpoint posture of the robot.
- exj_l: The external axis linear speed.

  Data type: real

  Meaning: It is used to define the motion speed of the external linear axis.
- exj_r: The angular speed of the external axis.

  Data type: real

  Meaning: It is used to define the motion speed of the external rotating axis.

ZONE

It is used to define how a motion ends, or to define the size of the turning area between two motion trajectories. For easy use, the system presets the commonly used transition variables (system variables, not to be modified by the user). It also supports operations such as Create, Delete, and Modify in the scope of the three major variables Global, Project, and Program.

Parameter description:

- per: Joint path turn percentage:

  Data type: real

  Meaning: Applicable to joint motion commands such as MovJ, MovJRel, MovJSearch, etc. It represents the distance remaining to the target angle when the turn begins.
- dis: The size of the turning area in Cartesian space.

  Data type: real

  Meaning: It is used in linear arc motion commands such asMovL, MovC, etc., to define the turning area size of the Cartesian space trajectory, that is, when the robot moves to a place that is still dis mm away from the target point, it starts to move to the next target point. It is in mm.
- vConst: Constant speed transition enable state.

  Data type: int

  Meaning: The enable state indicating whether the linear speed of the transition section to be constant or not. 1 means the transition is constant, and 0 means the change in the tracking transition parameters.

  Note: This parameter is typically used when the online speed is not high, and the specific value may vary depending on the robot type.

PAYLOAD

The PAYLOAD variable is used to record the workpiece load parameters, and to define the robot end-load parameters and mass information. The use of detailed mass information assists in the full model calculation of the robot dynamics in order to improve the motion tact even more. This parameter can currently only be entered by the user after calculating the value in advance, without a programming pendant calibration calculation. This variable can only be created and modified in the Global domain.

Parameter description:

- id: Data type: int

  Meaning: The unique index number of the workpiece load. The value cannot be modified. It is assigned automatically by the system when being created.
- dyn: Data type: LoadDyn

  Meaning: Mass information of workpiece loads for full model calculations of robot dynamics.

  The system has a predefined workload of PAYLOAD0, where the default value for each offset is 0. The user may define the workpiece parameters to be used according to the site requirements.

LsScale

The LsScale variable is used to record the gain ratio threshold parameter for each joint axis to improve the low-speed jitter in a certain speed range and is used in conjunction with the speed range threshold parameter. This variable can only be created and modified in the Global domain.

Parameter description:

- J1: Data type: int

  Meaning: Gain ratio threshold corresponding to J1 axis, in %
- J2: Data type: int

  Meaning: Gain ratio threshold corresponding to J2 axis, in %
- J3: Data type: int

  Meaning: Gain ratio threshold corresponding to J3 axis, in %
- J4: Data type: int

  Meaning: Gain ratio threshold corresponding to J4 axis, in %
- J5: Data type: int

  Meaning: Gain ratio threshold corresponding to J5 axis, in %
- J6: Data type: int

  Meaning: Gain ratio threshold corresponding to J6 axis, in %

LsThresh

The LsThresh variable is used to record the speed interval threshold for each joint axis to improve low speed jitter in a certain speed interval and is used in conjunction with the gain ratio threshold parameter. The range is [10,1000], in r/min. This variable can only be created and modified in the Global domain.

Parameter description:

- J1: Data type: int

  Meaning: Speed interval threshold corresponding to J1 axis, in %
- J2: Data type: int

  Meaning: Speed interval threshold corresponding to J2 axis, in %
- J3: Data type: int

  Meaning: Speed interval threshold corresponding to J3 axis, in %
- J4: Data type: int

  Meaning: Speed interval threshold corresponding to J4 axis, in %
- J5: Data type: int

  Meaning: Speed interval threshold corresponding to J5 axis, in %
- J6: Data type: int

  Meaning: Speed interval threshold corresponding to J6 axis, in %

INTERRUPT

This variable is used to store information about the INTERUPT name as a unique index of the interrupt identifier. It only supports It also supports operations such as Create, Delete, and Modify in the Global variable scope.

Parameter description:

- value: Data type: string

  Meaning: Store information on the name of the interrupt marker.

  Note: When creating this variable on the teach pendant, the Variable value will automatically synchronize with the variable name. For example, if an INTERRUPT type variable named "Inq" is created, the Inq.value will also be "Inq" after creation.

COLLIPARAM

The COLLIPARAM variable is used to select the corresponding collision self-tuning parameter (ID) by means of an index.

Parameter description:

- index: The Collision Auto Tune parameter index

  Data type: int

  Meaning: The range of values is [0, 6]. Where 0 means that the variable is invalid, and other means that the collision self-tuning parameter with ID index.

2.4 IOData type

DI

The digital input variable.

Parameter description:

- port: Data type: int

  Meaning: The digital input port number bound to such variable.
- value: Data type: int

  Meaning: The value is 0 or 1, indicating the input status of the corresponding port.
- riseSts: Data type: bool

  Meaning: The rising edge signal status of the port.
- downSts: Data type: bool

  Meaning: The falling edge status of the port.

DO

The digital output variable.

Parameter description:

- port: Data type: int

  Meaning: The digital output port number bound to such variable.
- value: Data type: int

  Meaning: The value is 0 or 1, indicating the output status of the corresponding port.

AI

The analog input variable.

Parameter description:

- port: Data type: int

  Meaning: The analog input port number bound to such variable.
- value: Data type: real

  Meaning: Its value is ranged from -10 to 10V, indicating the input voltage value of the corresponding port.

AO

The analog output variable.

Parameter description:

- port: Data type: int

  Meaning: The analog output port number bound to such variable.
- value: Data type: real

  Meaning: Its value is ranged from -10 to 10V, indicating the output voltage value of the corresponding port.

SimDI

The virtual analog input variable.

Parameter description:

- port: Data type: int

  Meaning: The virtual analog input port number bound to such variable.
- value: Data type: int

  Meaning: The value is 0 or 1, indicating the input status of the corresponding port.
- riseSts: Data type: bool

  Meaning: The rising edge signal status of the port.
- downSts: Data type: bool

  Meaning: The falling edge status of the port.

SimDO

The virtual analog output variable.

Parameter description:

- port: Data type: int

  Meaning: The virtual digital output port number bound to such variable.
- value: Data type: int

  Meaning: The value is 0 or 1, indicating the output status of the corresponding port.

SimAI

The virtual analog input variable.

Parameter description:

- port: Data type: int

  Meaning: The virtual analog input port number bound to such variable.
- value: Data type: real

  Meaning: Indicates the input value of the corresponding port.

SimAO

The virtual analog output variable.

Parameter description:

- port: Data type: int

  Meaning: The virtual analog output port number bound to such variable.
- value: Data type: real

  Meaning: Indicates the output value of the corresponding port.

2.5 Weave data type

WEAVE

This variable is used to store some configuration parameters when the robot weaves on a straight line/arc trajectory. Also, it allows users to Create, Delete, Modify and other operations in the three variable scopes Global, Project, and Program.

Parameter description:

- Type: Data type: int

  Meaning: Weave type of robot. It is a sine Weave when the value is 1, and is a triangular Weave when the value is 2.
- Freq: Data type: real

  Meaning: The frequency when the robot weaves, in Hz.
- Amp_L: Data type: real

  Meaning: The amplitude when the robot weaves left, in mm.
- Amp_R: Data type: real

  Meaning: The amplitude when the robot weaves right, in mm.
- StopTime_L: Data type: int

  Meaning: The time when robot stops at wave peak. It refers to the time in ms at which the weaving stops when it reaches the left amplitude.
- StopTime_R: Data type: int

  Meaning: The time when robot stops at wave trough. It refers to the time in ms at which the weaving stops when it reaches the right amplitude.
- StopTime_C: Data type: int

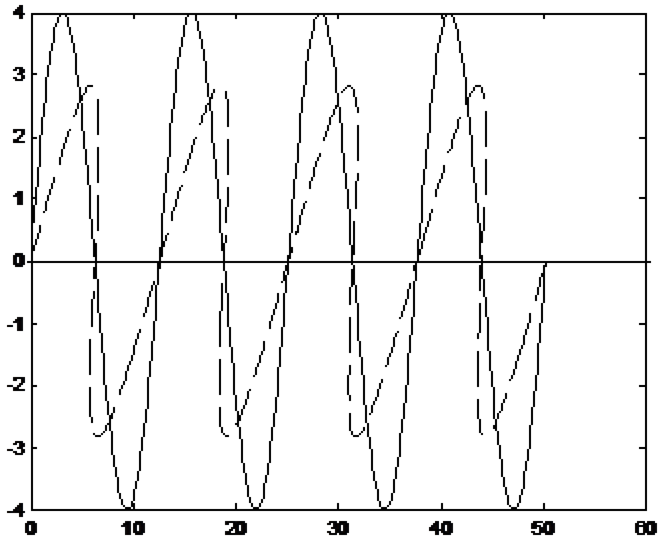
  Meaning: The time when robot stops at the middle. It refers to the time in ms at which the weaving stops when it reaches the middle position.
- RotAngle_X: Data type: real

  Meaning: The rotating angle of the weaving reference plane around the weaving direction. This parameter is used to determine the final weaving plane, in deg.
- RotAngle_Z: Data type: real

  Meaning: The rotating angle around the normal vector of the weaving plane, which determines the shape of the sine weave, in deg.

Caution

- The normal vector of the plane determined by the motion path and the Tz direction of tool coordinates, and the plane formed by the motion path is the reference plane for weaving.
- The function of RotAngle_Z is in the figure below: it is indicated by a solid line if RotAngle_Z=0 is a solid line, and a dotted line if it is not 0.



2.6 Clock data type

CLOCK

It is used to store the value of the clock information. It supports only the operations such as Create, Delete and Modify in the Global domin.

Parameter description:

- id: Data type: int

  Meaning: The number of the Clock variable.
- state: Data type: real

  Meaning: The enable state of the Clock variable.
- value: Data type: real

  Meaning: The count value of the Clock variable.

2.7 Area data type

AREA

It is used to store the value of Area information. It supports only the operations such as Create, Delete and Modify in the Global domin.

Parameter description:

- id: Data type: int

  Meaning: The number of local variables.
- activate: Data type: bool

  Meaning: Activate this area or not.
- isInArea: Data type: bool

Meaning: Whether it is in this area.

- initActivate: Data type: bool
  Meaning: The AREA auto-activation flag.
- areaType: Data type: int
  Meaning: The type of area.
- areaShape: Data type: int
  Meaning: The shape of area.
- refSysScope: Data type: int
  Meaning: The scope of reference coordinates.
- refSysName: Data type: string
  Meaning: The name of the reference coordinates.
- enInPut: Data type: bool
  Meaning: Input enabling.
- enInHigh: Data type: bool
  Meaning: The input enabling is high and valid.
- enOutPut: Data type: bool
  Meaning: Output enabling.
- enOutHigh: Data type: bool
  Meaning: The output enabling is high and valid.
- diType: Data type: int
  Meaning: The type of DI.
- InputActStatePort: Data type: int
  Meaning: The actual input status.
- doType: Data type: int
  Meaning: The type of DO.
- OutputActStatePort: Data type: int
  Meaning: The actual output status.
- StartPointX: Data type: real
  Meaning: The coordinate x of the origin of the area.
- StartPointY: Data type: real
  Meaning: The coordinate y of the origin of the area.
- StartPointZ: Data type: real
  Meaning: The coordinate z of the origin of the area.
- lenXR: Data type: real
  Meaning: The length of the rectangular area, or the radius of the cylindrical area.
- lenYH: Data type: real
  Meaning: The width of the rectangular area, or the height of the cylindrical area.
- lenZ: Data type: real
  Meaning: The height of the rectangular area.
- isFlangeEnd: Data type: int
  Meaning: Used to monitor TCP or flange side in area monitoring.

POLYHEDRON

The POLYHEDRON variable selects the polyhedron region (ID) by index. It supports only the operations such as Create, Delete and Modify in the Global domin.

Parameter description:

- index: Data type: int
  Meaning: The polyhedron area index. The index values range from 0 to 4. Here, 0 indicates that the variable is invalid, while other values represent the polyhedron area with the ID equal to the specified index.
- activate: Data type: bool

Meaning: Whether this polyhedron area is active or not.

- isInArea: Data type: bool

  Meaning: Whether it is within the polyhedron area.

2.8 PLCData type

PLCREAL

It is used to store PLC real number, which correspond to real variables on the plc side according to the data number. It supports only the operations such as Create, Delete and Modify in the Global domin.

Parameter description:

- plcNum: Data type: int

  Meaning: Data number
- value: Data type: real

  Meaning: Variable value
- saveflag: Data type: bool

  Meaning: Power-down memory

PLCBOOL

It is used to store PLC boolean values, which correspond to bool variables on the plc side according to the data number. It supports only the operations such as Create, Delete and Modify in the Global domin.

Parameter description:

- plcNum: Data type: int

  Meaning: Data number
- value: Data type: bool

  Meaning: Variable value
- saveflag: Data type: bool

  Meaning: Power-down memory

PLCINT

It is used to store PLC short integer data according to the data number corresponding to the int variable on the PLC side. This variable only supports operations such as Create, Delete, and Modify in the global variable scope.

Parameter description:

- plcNum: Data type: int

  Meaning: Data number
- value: Data type: int

  Meaning: Variable value
- saveflag: Data type: bool

  Meaning: Power-down memory

PLCDINT

It is used to store PLC short integral values, which correspond to dint variables on the plc side according to the data number. It supports only the operations such as Create, Delete and Modify in the Global domin.

Parameter description:

- plcNum: Data type: int

  Meaning: Data number
- value: Data type: int

Meaning: Variable value

- saveflag: Data type: bool

  Meaning: Power-down memory

2.9 Pallet data type

PLACEOPTIONS

The information contained in the pre-place and the post-place points in the Pallet variable. This data type can only be used together in a way being nested in the Pallet data type.

Parameter description:

- isUse: Data type: bool

  Meaning: Whether the parameter is valid or not.
- sideOffset: Data type: real

  Meaning: Horizontal offset.
- height: Data type: real

  Meaning: Height offset.

PALLET

It is used to store the Pallet information. This variable allows users to create and modify independently. It supports operations such as Create, Delete, and Modify in the scope of Global and Project variables.

Parameter description:

- actParts: Data type: int

  Meaning: The actual number of workpieces in the pallet.
- maxParts: Data type: int

  Meaning: The maximum number of workpieces in the pallet.
- isEmpty: Data type: bool

  Meaning: Pallet is empty or not.
- isFull: Data type: bool

  Meaning: Pallet is full or not.
- xNum: Data type: int

  Meaning: The number of workpieces in the x direction of the pallet.
- yNum: Data type: int

  Meaning: The number of workpieces in the y direction of the pallet.
- zNum: Data type: int

  Meaning: The number of workpieces in the z direction of the pallet.
- xdistOfPart: Data type: real

  Meaning: The length of a single workpiece in the x direction of the pallet.
- ydistOfPart: Data type: real

  Meaning: The length of a single workpiece in the y direction of the pallet.
- zdistOfPart: Data type: real

  Meaning: The length of a single workpiece in the z direction of the pallet.
- refSysScope: Data type: int

  Meaning: The scope of coordinates referred by the pallet parameters.
- refSysName: Data type: string

  Meaning: The name of coordinates referred by the pallet parameters.
- palletDir: Data type: int

  Meaning: The palletizing or de-palletizing direction.
- palletOrder: Data type: int

Meaning: The palletizing or de-palletizing sequence.

- firstPartScope: Data type: int

  Meaning: The scope of the first workpiece position variable.
- firstPartPos: Data type: string

  Meaning: The name of the first workpiece position variable.
- isEntryPosUsed: Data type: bool

  Meaning: Move to the palletizing entry point or not.
- palletEntryScope: Data type: int

  Meaning: The scope of the palletizing entry point position variable.
- palletEntryPos: Data type: string

  Meaning: The name of the palletizing entry point position.
- preplaceOptions: Data type: PLACEOPTIONS

  Meaning: The pre-place information.
- postplaceOptions: Data type: PLACEOPTIONS

  Meaning: The post-place information.

2.10 SOCKET data type

Socket

It is used to store Socket name information. This variable allows users to create and modify independently. It supports operations such as Create, Delete, and Modify in the scope of Global, Project and Program variables.

Parameter description:

- value: Data type: string

  Meaning: The name of socket.

Chapter 3 Commands

3.1 Motion commands

The list of motion commands:

Motion commands	MovJ
	MovL
	MovC
	MovCircle
	MovJRel
	MovLRel
	MovJSearch
	MovLSearch
	MovJOffset
	MovLOffset
	MovLW
	MovCW
	MovCircleW
	MovArch
	MovLArch
	MovH
	OnDistance
	OnParameter

MovJ

It indicates that each joint of the robot performs point-to-point motion. The end trajectory of the robot is an irregular curve, and the IO command can be operated when the command operates to an end. Description of the command parameters:

MovJ P [V] [B] [C] [Tool][Coord] [PayLoad][DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.
- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovJ. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others . The per component of the SPEED variable is valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: Default type.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE variable

  Meaning: The transition value when the robot approaches the endpoint.

  Note: This parameter is optional and defaults to C100.
- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to to the current Tool Parameters set in the system.
- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to defaults to the current Coordinate System Parameters set in the system.
- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and to the current payload parameter set in the system.
- [DO]: IO operation to be performed after motion done (Add Do)

  Data type: string

  Meaning: The IO operation that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO commands: Perform IO operations. Currently supported IO instructions include SetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge and SetSimDIEdge.

Example 1:

```
    MovJ (P1, V50, "RELATIVE", C100)
    The robot moves to point P1 at a speed of V50, with a transitional value of C100 between the current path and
the next.
```

Example 2:

```
    MovJ (P2, V50, "RELATIVE", C0)Do SetDo(DO0,0)
    The robot moves to point P2 at a speed of V50, without any transitional effect. Upon reaching point P2, the
variable DO0 corresponding to the IO port is set to 0 using SetDo.
```

Example 3:

```
    MovJ (P1, V50, "RELATIVE", C100,nullTool,World)
```

MovJ (P2, V50, ”RELATIVE”, C100,Tool1,UserCoord1)

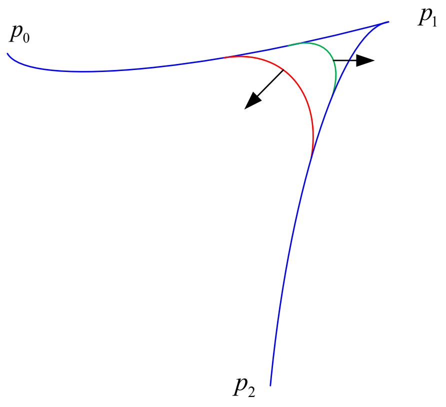
The robot moves at a speed of 50 to point P1. Subsequently, due to the difference in coordinate systems between P1 and P2, the Tool Parameters are automatically switched to Tool1 and the User coordinate system is switched to UserCoord1 before moving to P2. As the coordinate system is automatically switched, there is no transitional effect during the movement from P1 to P2.

Example 4:

MovJ (P1, V50, ”RELATIVE”, C100,Tool1,UserCoord1)
MovL (P2, V50, ”RELATIVE”, C100,Tool1)

The robot moves to point P1 at a speed of 50. Since the coordinate system at point P2 is the same as P1, there is no need to switch coordinate systems. The robot smoothly transitions from P1 to P2.

Figure 3-1 Schematic diagram of the path



MovL

MovL is the linear motion command, through which the TCP point of the robot can be moved linearly to the target position at the set speed. If the start and end postures of the motion differ, then during operation the posture will synchronously rotate to the ending posture along with the position. It is the same as MovJ. An additional IO operation can be performed when the command is executed. The parameter setting of MovL is similar to MovJ. The command parameters are described as below:

MovLP [V] [B] [C][Tool][Coord] [PayLoad][O] [DO]

(Note: parameters indicated with [] are optional)

- P: Target Position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  To specify the speed at which the robot executes MovL. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE variable

Meaning: The transition value when the robot approaches the endpoint.
Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR or EXTTCP or POSITIONER variable

  Meaning: The user coordinate system/external TCP coordinate system/POSITIONER coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO commands: Executing IO operation. The IO commands currently available are SetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

MovC

Arc command refers to the full-circle motion made by the robot's TCP point from the starting position to the target by passing through the middle position. If the start and end postures of the motion are different, the posture will rotate to the end posture synchronously with the position, but it may not necessarily pass through the middle position.

MovCA P[V] [B] [C][Tool][Coord] [PayLoad][O] [DO]

(Note: parameters indicated with [] are optional)

- A: Middle position (AuxPos)

  Data type: APOS or CPOS variable

  Meaning: The auxiliary point position used to determine the size of the arc and its motion direction. The orientation of this point does not affect the final path execution.

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovC. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

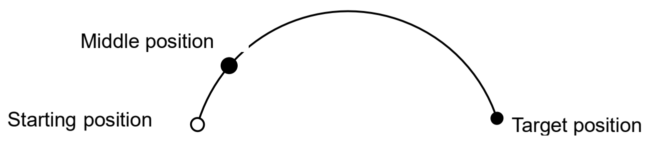
  Meaning: The way of transition when the robot approaches the endpoint.

− FINE: No transition.
− RELATIVE: Relative transition.
− ABSOLUTE: Absolute transition.
− DEFAULT: The type of default.
Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)
  Data type: ZONE variable
  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.
- [Tool]: Tool Parameters (Tool)
  Data type: TOOL variable
  Meaning: The tool parameters used when the robot executes the path.
  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.
- [Coord]: Coordinate System Parameters (Coord)
  Data type: USERCOOR or EXTTCP or POSITIONER variable
  Meaning: The user coordinate system/external TCP coordinate system/POSITIONER coordinate system used by the robot when executing the path.
  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.
- [PayLoad]: Workpiece load (PayLoad)
  Data type: PAYLOAD variable
  Meaning: The workpiece load parameter used by the robot when executing the path.
  Note: This parameter is optional and defaults to the payload parameters set in the current system.
- O: Rate type (OverrideType)
  Data type: enum (GOVRON/GOVROFF)
  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.
  Note: This parameter is optional and defaults to GOVRON.
- [DO]: IO operations to be executed after motion done (Add Do)
  Data type: string
  Meaning: The IO operations that can be triggered after the robot completes the command:
  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Figure 3-2 Key points of MovC arc



This command must satisfy:

To perform a full full-circle motion with the robot's TCP end, two arc motion commands need to be executed.

MovCircle

MovCircle command means that the robot TCP point moves in a full circle from the start position to the start position through the auxiliary point 1 and auxiliary point 2 positions, with the pose remaining constant during the movement.

MovCircle A P[V] [B] [C][Tool] [Coord] [PayLoad] [O] [DO]

(Note: parameters indicated with [] are optional)

- A: Middle position1 (AuxPos1)

Data type: APOS or CPOS variable

Meaning: The position 1 of the middle auxiliary point of the full circle, which is used to determine the size and movement direction of the arc. The pose of this point will not affect the final trajectory.

- P: Middle position2 (AuxPos2)

  Data type: APOS or CPOS variable

  Meaning: The position 2 of the middle auxiliary point of the full circle, which is used to determine the size and movement direction of the arc. The pose of this point will not affect the final trajectory.

- [V]: Target speed (Velo)
  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovCircle. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE variable

  Meaning: The transition value when the robot approaches the endpoint.

  Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR or EXTTCP or POSITIONER variable

  Meaning: The user coordinate system/external TCP coordinate system/POSITIONER coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.

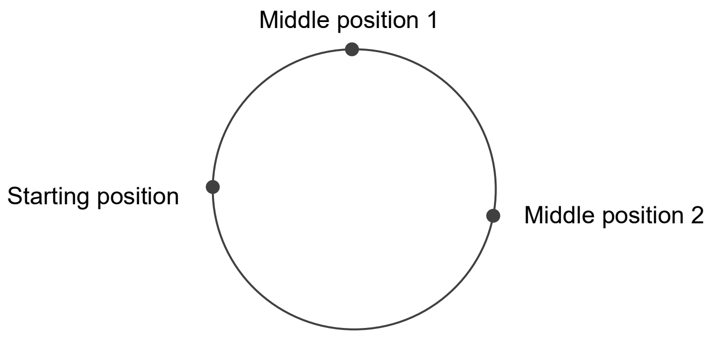
- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO commands: executing io operation. The IO commands currently available are SetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Figure 3-3 Key points of MovCircle full circle



The command must adhere to the following specifications:

- When teaching the points for the circular path, the "Middle position1" or "Middle position2" should not be too close to the starting point. The distance between "Middle position1" and "Middle position2" should also not be too close. Otherwise, it will trigger an alarm of "Calculating arc auxiliary information error";
- The robots orientation remains constant during the full-circle motion;
- During the full-circle motion, transitions are supported, and the command speed is not affected by the Global Multiplier;
- If the starting point is in a singular position, cross-singularity mode must be enabled to execute the full-circle motion;
- External TCP functionality supports full-circle motion;
- Variable positioner and linear guides support full-circle motion, but it is crucial to ensure that the additional axis position remains unchanged during the full-circle motion;
- Conveyor tracking functionality does not support full-circle motion;

MovJRel

The MovJ interpolation relative offset command. It works by taking the current robot position or the target position of the previous motion command as the starting point, and then perform the robot motion operation.

Unlike the commands such as MovJ, the target relative position value used by this command cannot be obtained through teaching. User needs to create a new joint relative position variable in the list of variables before, and then select it from the drop-down list. The parameters are defined as follows.

MovJRelP[V] [B] [C] [PayLoad][DO]

(Note: parameters indicated with [] are optional)

- P: Target Relative Position (RelPos)

  Data type: DAPOS variable

  Meaning: The position increment the robot will move when executing this command.
- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovJRel. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the per component in the SPEED variable is valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.
  - FINE: No transition.
  - RELATIVE: Relative transition.
  - ABSOLUTE: Absolute transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE variable

Meaning: The transition value when the robot approaches the endpoint.
Note: This parameter is optional and defaults to C100.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example 1:

```
MovJ(P1, V50, ”RELATIVE”, C100)
MovJRel (DAPOS0, V50, ”RELATIVE”, C100)
```
The robot moves at a speed of 50 to reach point P1, and then, based on the position at P1, it performs a relative movement using the transition parameters from C100 to move to point P1.

Example 2:

```
MovJRel (DAPOS0, V50, ”RELATIVE”, C100)
```
The robot moves at a speed of 50 and performs a relative movement from the current position, using the distance specified by DAPOS0, to reach point P1’.

MovLRel

This command is used for relative linear motion. The command always starts from the current robot position or the target position of the previous motion command, and the robot moves relative to the specified displacement or orientation offset. Transition parameters can also be set, similar to MovJRel. The parameters are defined as shown in the following diagram:

MovLRelPT [V] [B] [C][PayLoad][O] [DO]

(Note: parameters indicated with [] are optional)

- P: Target Relative Position (RelPos)

  Data type: DCPOS variable

  Meaning: The position increment the robot will move when executing this command.

- T: Reference Coordinate System (RefSys)

  Data type: enum (COORD/TOOL)

  - COORD: Reference Coordinate System (RefSys).
  - TOOL: Tool coordinate system.

  Meaning: Reference coordinate system: Cartesian or Tool.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovLRel. It includes the translational speed of the robots end eff ector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  - FINE: No transition.
  - RELATIVE: Relative transition.
  - ABSOLUTE: Absolute transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE variable

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example 1:

MovL(P1, V50, ”RELATIVE”, C100)
MovLRel (DCPOS0, V50, ”RELATIVE”, C100)
The robot moves at a speed of 50 to reach point P1, and then, based on the position at P1, it performs a relative movement using the transition parameters from C100 to move a distance specified by DCPOS0 and reaches point P1’.

Example 2:

MovLRel (DCPOS0, V50, ”RELATIVE”, C100)
The robot moves at a speed of 50 and performs a relative movement from the current position, using the distance specified by DCPOS0, to reach point P1’.

MovJSearch

A search command. It performs IO detection or torque detection when executing the MovL command.

When the search condition is IO detection, if the indexed IO value reaches the Trigger value, the execution of the current command is stopped, and the next command is continued.

When the search condition is torque detection, if the indexed axis torque value reaches the Trigger value, the execution of the current command is stopped, and the next command is continued.

Please note that this command interrupts the transition.

The command parameters are defined as follows:

MovJSearchP [V] [B] [C][Tool][Coord] [PayLoad]Type Number Value [StopType] [StopDecScale] R SearchP Goto [DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovJSearch. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the per component in the SPEED variable is valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.
  - FINE: No transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- Type: Type of detection (SearchType)

  Data type: enum (DITrig/AITrig/SIMDITrig/SIMAITrig/TorqTrig)
  - DITrig: Physical digital input trigger.
  - AITrig: Physical analog input trigger.
  - SIMDITrig: Virtual digital input trigger.
  - SIMAITrig: Virtual analog input trigger.
  - TorqTrig: Torque trigger.

  Meaning: The type of operation to be monitored when the robot runs the path.

- Number: Trigger index (SearchIndex)

  Data type: int

  Meaning: The Trigger index number to be monitored when the robot runs the path. For example, in the case of DITrig trigger, this index number corresponds to the input port to be monitored. In the case of TorqTrig trigger, this index number corresponds to the axis to be monitored.

- Value: Trigger value (SearchValue)

  Data type: real

  Meaning: The threshold value to be detected when the robot runs the path. For example, in the case of DITrig trigger, this value represents the high or low logic level to be detected on a specific input port. In the case of TorqTrig trigger, this value represents the rated torque permillage of a specific axis.

- StopType: STOP type (StopType)

  Data type: enum (HARDSTOP/SOFTSTOP/DEFAULT)
  - HARDSTOP: Stops immediately;
  - SOFTSTOP: Stop at reduced speed;
  - DEFAULT: The type of default.

  Meaning: The way to stop when a signal is detected.

  Note: This parameter is optional and defaults to HARDSTOP.

- StopDecScale: Decel Factor (StopDecScale)

  Data type: real.

  Meaning: The value is valid when "SOFTSTOP" is selected as "Stop Type". It is used to adjust the Decel/Accel factor, the greater the value, the faster the deceleration.

- R: Returned value (ResultV)

  Data type: INT variable

  Meaning: To return the status of the command execution upon completion. Returning 0 indicates that the condition triggering the command was not satisfied, returning 1 indicates that the condition triggering the command was satisfied, and returning 2 indicates that the condition triggering the command was satisfied at the motion starting point.

- SearchP: Position of successful search (SearchPos)

  Data type: APOS

  Meaning: To return the coordinate position of the robot when the condition triggering the command is satisfied.

  Note: This parameter is optional.

- Goto: Label name to jump to in case of a search failure (LabelName)

  Data type: label.

  Meaning: The name of the label to which the program pointer will jump in case of a search failure.

  This parameter is optional. If set to default, the system will not jump to the specified label for execution in case of a search failure.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example 1:

```
    MovJ(P1, V50, ”RELATIVE”, C100)
    MovJSearch(P2, V50, ”RELATIVE”, C100,"DITrig",16,1,INT0)
    MovJ(P3, V50, ”RELATIVE”, C100)
```

The robot moves to point P1 at a speed of 50, after which it starts to detect the status of input port 16 during the movement to point P2. When a high level is detected, the robot will immediately stop moving towards point P2 and start moving towards point P3, while the value in INT0 will be set to 1. If there is no high level signal at input port 16 during the movement towards point P2, the robot will continue moving towards point P3 when it reaches point P2, while INT0 is set to 0.

MovLSearch

The Search Ccommand. It refers to IO detection or torque detection while executing this MovL command, which is similar to MovJSearch.

When the search condition is of IO detection and the value of the indexed IO reaches the trigger value, stop running this command and continue to execute the next command

When the search condition is of torque detection and the value of the index axis torque reaches the trigger value, stop running the command and continue to execute the next command.

Please note that this command will interrupt the transition.

The specific command parameters are defined as follows:

MovLSearchP [V] [B] [C][Tool][Coord] [PayLoad]Type Number Value [StopType] [StopDecScale] R SearchP Goto [DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovJSearch. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  - FINE: No transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR or EXTTCP or POSITIONER variable

  Meaning: The user coordinate system/external TCP coordinate system/POSITIONER coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- Type: Type of detection (SearchType)

  Data type: enum (DITrig/AITrig/SIMDITrig/SIMAITrig/TorqTrig)

  - DITrig: Physical digital input trigger.
  - AITrig: Physical analog input trigger.
  - SIMDITrig: Virtual digital input trigger.
  - SIMAITrig: Virtual analog input trigger.
  - TorqTrig: Torque trigger.

  Meaning: The type of operation to be monitored when the robot runs the path.

- Number: Trigger index (SearchIndex)

  Data type: int

  Meaning: The Trigger index number to be monitored when the robot runs the path. For example, in the case of DITrig trigger, this index number corresponds to the input port to be monitored. In the case of TorqTrig trigger, this index number corresponds to the axis to be monitored.

- Value: Trigger value (SearchValue)

  Data type: real

  Meaning: The threshold value to be detected when the robot runs the path. For example, in the case of DITrig trigger, this value represents the high or low logic level to be detected on a specific input port. In the case of TorqTrig trigger, this value represents the rated torque permillage of a specific axis.

- StopType: STOP type (StopType)

  Data type: enum (HARDSTOP/SOFTSTOP/DEFAULT)

  - HARDSTOP: Stops immediately.
  - SOFTSTOP: Stop at reduced speed.
  - DEFAULT: The type of default.

  Meaning: The way to stop when a signal is detected.

  Note: This parameter is optional and defaults to HARDSTOP.

- StopDecScale: Decel Factor (StopDecScale)

  Data type: real.

  Meaning: The value is valid when "SOFTSTOP" is selected as "Stop Type". It is used to adjust the Decel/Accel factor, the greater the value, the faster the deceleration.

- R: Returned value (ResultV)

Data type: INT variable

Meaning: To return the execution status of this command. Returning 0 indicates that the condition triggering the command was not satisfied and the execution ended. Returning 1 indicates that the condition triggering the command was satisfied and the execution ended. Returning 2 indicates that the condition triggering the command was satisfied at the starting point of the motion and the execution ended.

- SearchP: Position of successful search (SearchPos)

  Data type: CPOS

  Meaning: To return the coordinate position of the robot when the condition triggering the command is satisfied.

  Note: This parameter is optional.

- Goto: Label name to jump to in case of a search failure (LabelName)

  Data type: label.

  Meaning: The name of the label to which the program pointer will jump in case of a search failure.

  This parameter is optional. If set to default, the system will not jump to the specified label for execution in case of a search failure.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example 1:

```
MovL(P1, V50, ”RELATIVE”, C100)
MovLSearch(P2, V50, ”RELATIVE”, C100,"DITrig",16,1,INT0)
MovL(P3, V50, ”RELATIVE”, C100)
```

The robot moves to point P1 at a speed of 50, after which it starts to detect the status of input port 16 during the movement to point P2. When a high level is detected, the robot will immediately stop moving towards point P2 and start moving towards point P3, while the value in INT0 will be set to 1. If there is no high level signal at input port 16 during the movement towards point P2, the robot will continue moving towards point P3 when it reaches point P2, while INT0 is set to 0.

MovJOffset

The Joint Space Offset command. It refers to a relative motion starting from a specified reference position, relative to a coordinate system or tool. The only difference from MovJRel is that this command specifies the starting point of the offset motion, which may not be the current position or the endpoint of the previous command. Other functionalities remain the same.

The specific command parameters are defined as follows:

MovJOffset RP TP T Tool Coord [V] [B] [C][PayLoad][O] [DO]

(Note: parameters indicated with [] are optional)

- RP: Reference position (RefPos)

  Data type: APOS or CPOS variable

  Meaning: The position of the reference point in the coordinate system

- TP: Target Relative Position (RelPos)

  Data type: DCPOS or DAPOS variable

  Meaning: The position increment relative to the reference position

- T: Reference Coordinates (RefSys)

  Data type: enum (COORD/TOOL)

  - COORD: The user coordinate system.
  - TOOL: The tool coordinate system.

  Meaning: The reference coordinate system, either Cartesian or Tool.

- Tool: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

- Coord: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.
- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot performs the MovJOffset command. Please note that only the "per" component of the SPEED variable is valid in this context.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.
  - FINE: No transition.
  - RELATIVE: Relative transition.
  - ABSOLUTE: Absolute transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.
- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.
- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:
  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example 1:

```
        MovJOffset(P1, DAPOS0, "COORD", nullTool, World, V50, ”RELATIVE”, C100)
        In Cartesian coordinate system, with Tool Parameters set to nullTool and the coordinate system set to World,
perform a linear offset motion using the transition parameters from C100 to move to a new point relative to the
position DAPOS0.
```

MovLOffset

The Linear Offset command. Itspecifies a reference position as the starting point and performs a relative offset motion with respect to the coordinate system or tool. The key difference from MovLRel is that this command explicitly specifies the starting point for the offset motion, which may not necessarily be the current position or the endpoint of the previous instruction, while other functionalities remain the same.

The specific command parameters are defined as follows:

MovLOffset RPTP T Tool Coord [V] [B] [C][PayLoad][O] [DO]

(Note: parameters indicated with [] are optional)

- RP: Reference position (RefPos)

  Data type: APOS or CPOS variable

  Meaning: The position of the reference point in the coordinate system
- TP: Target Relative Position (RelPos)

  Data type: DCPOS variable

  Meaning: The position increment relative to the reference position
- T: Reference coordinate system (RefSys)

Data type: enum (COORD/TOOL)

- COORD: The Cartesian coordinate system.
- TOOL: The tool coordinate system.

Meaning: Reference Coordinates: either Cartesian or Tool

- Tool: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

- Coord: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovLOffset. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  - FINE: No transition.
  - RELATIVE: Relative transition.
  - ABSOLUTE: Absolute transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example 1:

```
MovLOffset(P1, DCPOS0, "COORD", nullTool, World, V50, ”RELATIVE”, C100)
```

The robot, with the Tool Parameters set to nullTool and the coordinate system set to World, will perform a linear motion using the transition parameters from C100 to move to a new point relative to the DCPOS0 position of P1 in the Cartesian coordinate system.

MovLW

The WEAVE Motion command. It refers to the weave motion performed along the arc direction by setting the weave frequency and weave mplitude.

The parameters for this command are defined as shown in the diagram:

MovLWP [V] [B] [C][Tool][Coord] [PayLoad]WEAVE [O] [DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.
- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovLW. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.

  Note: This parameter is optional and defaults to C100.
- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.
- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR or POSITIONER variable

  Meaning: The user coordinate system/positioner coordinate system used by the robot to execute the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.
- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.
- WEAVE: WEAVE variable (Weave Value)

  Data type: WEAVE variable

  Meaning: The parameter set for the robots weave motion, which includes the weave frequency, weave amplitude, dwell time, rotation, and other related parameters.
- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.
- [DO]: IO operations to be executed after motion done (Add Do)

Data type: string

Meaning: The IO operations that can be triggered after the robot completes the command:

- NULL: No operation.
- IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

MovCW

The Circular Weave command. It refers to the weave motion performed along the arc direction by setting the weave frequency and weave mplitude.

The parameters for this command are defined as shown in the diagram:

MovCW AP [V] [B] [C][Tool][Coord] [PayLoad]WEAVE [O] [DO]

(Note: parameters indicated with [] are optional)

- A: Middle position (AuxPos)

  Data type: APOS or CPOS variable

  Meaning: The auxiliary point position used to determine the size of the arc and its motion direction. The orientation of this point does not affect the final path execution.

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovCW. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  - FINE: No transition.
  - RELATIVE: Relative transition.
  - ABSOLUTE: Absolute transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.

  Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR or POSITIONER variable

  Meaning: The user coordinate system/positioner coordinate system used by the robot to execute the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- WEAVE: WEAVE variable (Weave Value)

Data type: WEAVE variable

Meaning: The parameter set for the robots weave motion, which includes the weave frequency, weave amplitude, dwell time, rotation, and other related parameters.

- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

MovCircleW

The Circle Weave command. It allows the robot to maintain continuous weave motion during a full circle movement. The supported weave motions currently include sinusoidal weave and triangular weave.

The parameters for this command are defined as shown in the diagram:

MovCircleW A P [V] [B] [C] [Tool] [Coord] [PayLoad] WEAVE [O] [DO]

(Note: parameters indicated with [] are optional)

- A: Middle position1 (AuxPos1)

  Data type: APOS or CPOS variable

  Meaning: The middle position 1, which is used to determine the size and direction of the circular arc during a full-circle motion. The posture of this point does not affect the final path execution.

- P: Middle position2 (AuxPos2)

  Data type: APOS or CPOS variable

  Meaning: The middle position 2, which is used to determine the size and direction of the circular arc during a full-circle motion. The posture of this point does not affect the final path execution.

- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovCircleW. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  - FINE: No transition.
  - RELATIVE: Relative transition.
  - ABSOLUTE: Absolute transition.
  - DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.

  Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR or POSITIONER variable

  Meaning: The user coordinate system/positioner coordinate system used by the robot to execute the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- WEAVE: WEAVE variable (Weave Value)

  Data type: WEAVE variable

  Meaning: The parameter set for the robots weave motion, which includes the weave frequency, weave amplitude, dwell time, rotation, and other related parameters.

- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

<u>OnDistance</u>

The Distance Trigger command. It allows the controller to perform certain actions, such as assigning values or setting IO, when the robot moves a specified distance from the start or end point of a linear or circular path, without interrupting the transition.

The parameter definitions for this command are as follows:

OnDistance TypeDistTimeMs DO

- Type: Trigger type (Type)

  Data type: enum (FromBegin/FromEnd)

  - FromBegin: Trigger from the start point.
  - FromEnd: Trigger from the end point.

  Meaning: The method to detect the distance trigger. It determines whether the trigger distance is calculated from the start or end point

- Dist: Trigger distance (TrigDis)

  Data type: real or REAL variable

  Meaning: The distance relative to the start or end point that triggers the action.

- TimeMs: The distance relative to the start or end point that triggers the action.

  Data type: int or INT variable

  Meaning: The delay time after meeting the trigger condition before executing the action. This value can be negative, where a negative value indicates a forward delay trigger.

- DO: IO operation to be executed after motion done (Do)

  Data type: string

  Meaning: To specify the command operation to be triggered when the robot meets the trigger condition. These operations can include assignment commands and IO commands.

When the trigger type is set to "FromBegin", the controller enters the trigger wait state after the robot moves the specified distance from the start point. After the delay trigger time, the related trigger operation is executed.

When the trigger type is set to "FromEnd", the controller enters the trigger wait state after the robot moves the specified distance from the end point. After the delay trigger time, the related trigger operation is executed.

Example 1: Execute the Do operation with a delay of 100ms when the distance from the start point to P2 on the trajectory from P1 to P2 is 200mm.

```
MovL (P1, V50, ”RELATIVE”, C0)
OnDistance(“FromBegin”,200,100) DO SetDO(DO0,1);
MovL (P2, V50, ”RELATIVE”, C0)
```

Example 2: Execute the Do operation with a delay of 100ms when the distance from the start point to P2 on the trajectory from P1 to P2 is 200mm.

```
MovL (P1, V50, ”RELATIVE”, C0)
OnDistance(“FromEnd”,200,100) DO SetDO(DO0,1);
MovL (P2, V50, ”RELATIVE”, C0)
```

注意

- When the distance trigger condition is met and the time trigger is still in delay, if the current path has already completed, the trigger execution will be postponed until the time trigger condition is met.
- When the set trigger distance exceeds the length of the path, two situations can occur: For the trigger type "FromBegin", the trigger evaluation will be performed when reaching the end point. For the trigger type "FromEnd", the trigger evaluation will be performed at the start point. If the conditions are met, the trigger will be immediately executed.
- If there are multiple distance trigger instructions between two path segments, each trigger will be evaluated independently. Once the conditions are met, each trigger will be executed without interference.
- Prior to executing the OnDistance command, it is necessary to perform a motion command in Cartesian coordinate system. Otherwise, the OnDistance command will not take effect, and the status bar will indicate that the operation is invalid. However, it does not affect the systems op eration.
- Between OnDistance and the next motion command in Cartesian coordinate system, commands other than waiting commands (e.g., wait, waitcondition, waitfinish) can be inserted. If any other command is inserted, an error will occur during execution.

OnParameter

The Distance Percentage Trigger command. It is used to trigger certain operations, such as assigning values or setting IO, at a specific location along the motion paths without interrupting the transitions. When the robot reaches the defined percentage of the path, the controller enters a trigger waiting state. After a specified delay time, it proceeds to execute the associated trigger operations.

The parameter definitions for this command are as follows:

OnParameter Percence TimeMsDO

- Perence: Trigger Type (Type)

  Data type: int

  Meaning: The percentage of the path where the trigger should occur
- TimeMs: Trigger Time (TrigTime)

  Data type: int or INT variable

  Meaning: The delay time after satisfying the trigger condition. Negative values indicate a delay towards the beginning of the motion.
- DO: IO operations to be executed after motion done (Do)

  Data type: string

  Meaning: The command operations that can be triggered when the robot satisfies the trigger condition, including assignment instructions and IO commands.

Example:

```
MovJ (P1, V50, ”RELATIVE”, C0)
OnParameter(60,500) DO SetDO(DO0,1);
MovL (P2, V50, ”RELATIVE”, C0)
After running along the path from P1 to P2 and reaching 60% completion, there is a 500ms delay before executing the Do operation.
```

MovArch

The joint arc motion comand for SCARA robot models. It is executed in the form of MovJ to complete a path. The entire motion process involves the following steps: first, the robot lifts to a height of h1 at the current point, then moves to a height of h2 relative to the target point, and finally descends by a height of h2 to reach the target point, thereby accomplishing an arc motion. Similar to regular motion instructions, additional I/O operations can be performed upon completion of this command. The Target Speed of this command is specified as a percentage.

Note: This command is currently only applicable to SCARA robot models and does not support six-axis robots.

The command parameters are described as below:

MovArchP [V] [B] [C][Tool][Coord] [PayLoad]H H2Z [DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.
- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovL. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the per component in the SPEED variable is valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: When the robot approaches the endpoint, the Transition Value (a ZONE-type variable) is utilized. In this context, the "per" parameter corresponds to the relative transition type, while the "dis" parameter corresponds to the absolute transition type.

  Note: This parameter is optional and defaults to C100.
- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.
- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.
- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.
- H: Lifting height (Lift High)

  Data type: real

  Meaning: The height that the robot needs to lift during the arc motion.
- H2: Drop height Drop High)

  Data type: real

  Meaning: The height that the robot needs to descend during the arc motion.

- Z: CornerValue

  Data type: ZONE

  Meaning: The corner value that the robot follows during the arc motion.
- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

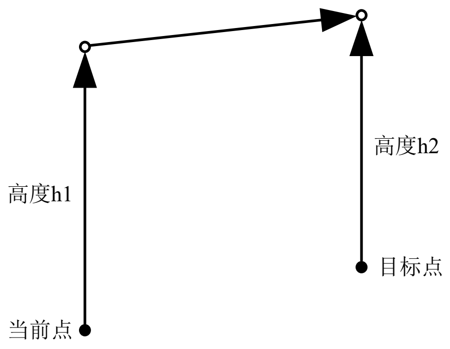
  Meaning: The IO operations that can be triggered after the robot completes the command:
  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example:

```
MovL (P1, V50, ”RELATIVE”, C50)
MovArch (P2, V100, ”FINE”,10,10,C100)
The robot will first move to point P1 at the speed of V50, and then execute the arching command. The robot will move to a position of P1.z+ 10mm at speed V100, then move to a position of  P2.Z+10mm, and finally move to position P2. The entire motion will be smoothly transitioned with a speed of C100.
```

MovLArch

The linear arch-shaped motion comand for SCARA robot models. It is executed in the form of MovL to complete the path. The motion process involves raising the robot to a height of h1 at the current point, then moving in a MovL manner to a height of h2 relative to the target point, and finally descending by a height of h2 to reach the target point, thereby accomplishing an arch-shaped motion. Similar to normal motion commands, additional I/O operations can be performed upon completion of this command. The target speed of this command is specified as a percentage.



Note: This command is currently only applicable to SCARA robot models and is not supported for six-axis robots.

The command parameters are described as below:

MovLArchP [V] [B] [C][Tool][Coord] [PayLoad]H H2Z [O] [DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.
- [V]: Target speed (Velo)
  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovL. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the per component in the SPEED variable is valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)
  Meaning: The way of transition when the robot approaches the endpoint.
  − FINE: No transition.
  − RELATIVE: Relative transition.

− ABSOLUTE: Absolute transition.

− DEFAULT: The type of default.

Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The value of the transition when the robot approaches the end point (ZONE type variable) is determined by the "per" parameter for the relative Transition type, and the "dis" parameter for the absolute Transition type.

  Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- H: Lifting height (Lift High)

  Data type: real

  Meaning: The height that the robot needs to lift during the arch-shaped motion.

- H2: Drop height Drop High)

  Data type: real

  Meaning: The height that the robot needs to descend during the arch-shaped motion.

- Z: Corner Value

  Data type: ZONE

  Meaning: The corner value that the robot follows during the arch-shaped motion.

- O: Rate type (OverrideType)

  Data type: enum (GOVRON/GOVROFF)

  - GOVRON: This path segment is affected by the Global Speed Multiplier.
  - GOVROFF: This path segment is not affected by the Global Speed Multiplier.

  Meaning: To set whether the current command path is affected by the Global Speed Multiplier.

  Note: This parameter is optional and defaults to GOVRON.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

Example:

```
MovL (P1, V50, ”RELATIVE”, C50)
MovLArch (P2, V100, ”FINE”,10,20,C100)
The robot will first move to point P1 at the speed of V50, and then execute the arching
command. The robot will move to a position of P1.z+ 10mm at speed V100, then move to a
position of  P2.Z+10mm, and finally move to position P2. The entire motion will be
smoothly transitioned with a speed of C100.
```

MovH

The helical motion command. It allows the robots TCP point to perform a helical motion to the target position. If the starting and ending orientations of the motion are different, the posture will rotate synchronously with the position during the motion to reach the final posture.

The command parameters are described as below:

MovH A P [V] [B] [C] [Tool] [Coord] [PayLoad] R S [DO]

(Note: parameters indicated with [] are optional)

- A: Middle position (AuxPos)

  Data type: APOS or CPOS variable

  Meaning: The position of the helical middle auxiliary point. The auxiliary point is used to determine the helical plane and the helical direction (precession in clockwise and counterclockwise). The helical movement may not pass through the auxiliary point.

  P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.

- [V]: Target speed (Velo)

  Data type: SPEED variable

Meaning: To specify the speed at which the robot executes the MovH command. The maximum path linear speed of the helical line is 0.25 times the maximum system speed.

- [B]: Transition type (BlendType)

Note: MovH does not support transitions.

- [C]: Transition Value (BlendValue)

  Note: This parameter does not have any effect.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- [Coord]: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.

  Note: This parameter is optional and defaults to the Coordinate System Parameters set in the current system.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- R: Radius)

  Data type: real

  Meaning: The radius of the helical line during the helical motion, in millimeters (mm).

- S: Stepping distance

  Data type: real

  Meaning: The distance moved in the direction from the starting point to the ending point after completing one revolution of the helical rotation, in millimeters (mm).

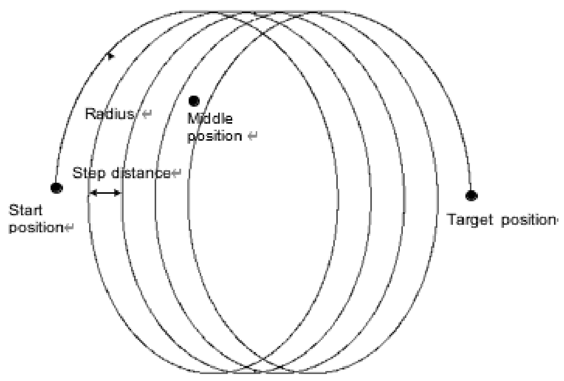
- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetSimDO8421, SetDIEdge, SetSimDIEdge.

Figure 3-4 Key points of MovH helical motion



For Helical motion, the transition and WaitFinish are not supported.

Example:

```
MovL (P1, V50, ”RELATIVE”, C50)
MovH (P2,P3, V100, ”FINE”,nullTool,World,PayLoad0,10,5)
The robot will move to point P1 at the speed of V50, and then when executing the Helical
command by taking point P1 as the starting point of the motion, and determining the
Helical motion plane using the three points P1, P2, and P3, while determining the
precession direction using point P2. Then, perform the precession to the endpoint P3 at a
helical radius of 10mm and the step distance of 5mm. The entire helical motion is
finished by this moment.
```

3.2 Control commands

The list of control commands:

Control commands	LABEL
	GOTO
	IF
	ELSIF
	ELSE
	WHILE
	FOR
	CALL
	RUN
	KILL
	RETURN
	...=...
	/*...*/

LABEL

Label command is used to define the GOTO jump target.

Example:

```
label1:
The LABEL command is used to set a label line, labeled as "label1".
```

GOTO

GOTO command is used to jump to different parts of the program. The jump target is defined by the LABEL. It is not allowed to jump into the WHILE loop program block or the IF program block from outside.

Example:

```
label1:
MovJ(P0)
GOTO lable1
In the LABEL command, set the label1, and upon execution of the GOTO command, the robot jumps to the line "label1: "
```

IF

IF command is used for jump control of the conditional judgment expression. When the result of the conditional judgment expression is TRUE, the program executes the block content under IF. Every IF command must be followed by the keyword ENDIF to mark the end of the conditional statement block.

Example:

```
IFx >1 and y == 1 or z < 1 THEN
y = 10
ENDIF
If the conditional expression of the IF statement is satisfied, execute “y = 10”;
otherwise, exit the ENDIF
```

ELSIF

ELSIF relies upon the IF command. It follows closely the IF command block. When the IF logic is not established, the ELSIF logic judgment is performed.

The way to set the ELSIF expression is the same as that of the IF expression.

```
IFx >1 and y == 1 or z < 1 THEN
y = 10
ELSIF x <1 THEN
y = 20
ENDIF
If the conditional expression of the IF statement is satisfied, execute "y = 10". If the
condition is not satisfied, continue to check. If the ELSIF condition expression is
satisfied, execute "y = 20". Finally, exit the ENDIF
```

ELSE

The ELSE command is used in conjunction with the IF command to specify the statements to be executed when the condition of the IF statement is not satisfied.

Example:

```
IFx >1 and y == 1 or z < 1 THEN
y = 10
ELSE
y = 20
ENDIF
If the conditional expression of the IF statement is satisfied, execute "y = 10".
Otherwise, execute "y = 20", and exit the ENDIF
```

WHILE

WHILE command executes sub-statements in loops when the conditions are met. The loop control for this command must be terminated using the keyword ENDWHILE.

Example:

```
WHILE X < Y DO
MovJ(P1)
MovJ(P2)
X=X+1
ENDWHILE
While the conditional expression of the WHILE statement is satisfied, execute the command
line within the loop. Continue executing the commands until reaching the ENDWHILE
statement. At the ENDWHILE statement, the program will jump back to the WHILE statement
to reevaluate the conditional expression. This looping process continues until the
conditional expression of the WHILE statement is no longer satisfied. At that point, the
program will proceed to execute the next line after the ENDWHILE statement.
```

FOR

The FOR command is used to loop and execute a substatement while a condition is satisfied. This command must be terminated using the keyword ENDFOR as the loop control end. The FOR command consists of three segments separated by commas and has the following format:

```
FOR    INT0.value = 0, INT0.value < 10, INT0.value = INT0.value + 1    DO
…
ENDFOR
```

The first segment of characters initializes the assignment. The second segment of characters is the loop condition. If the condition is satisfied, the content within the FOR loop is executed. If the condition is not satisfied, the program exits the FOR loop. The third segment consists of periodic execution statements that are executed once at the end of each iteration of the FOR loop

Example:

```
FOR INT0.value = 0, INT0.value < 5, INT0.value = INT0.value + 1 DO
MovJ(P1)
MovJ(P2)
ENDFOR
When executing the FOR command, with INT0.value initialized to 0, if INT0.value < 5 is
satisfied, execute MovJ (P1) and MovJ (P2). Upon reaching the ENDFOR statement, execute
INT0.value = INT0.value + 1, which sets INT0.value to 2. Repeat the evaluation of
INT0.value < 5 and repeat the aforementioned steps. When INT0.value < 5 is no longer
satisfied, proceed to execute the next line after the ENDFOR statement.
```

CALL

The CALL program command. The current program jumps to another subroutine in the same project, which then jumps back to the current program after execution.

For example, CALL B in program A, CALL C in B, CALL D in C, and CALL E in D

Example:

```
CALL program1
Jump to the program named "program1" and execute it. After completion, return to the
current program and continue execution
```

RUN

The program parallel running command. It enables the robot to run other programs while running the current program (programs must be in the same project), which means a new thread will be started to execute the other program while the current program continues to run normally.

Note: The current system supports running up to eight concurrent programs (excluding the main running program), and the RUN programs should not include motion-related commands.

Example:

```
RUN program1
Run program "program1" in parallel
```

KILL

To stop the commands running in parallel. This command is used to terminate programs launched by the RUN command.

Example:

```
KILL program1
Stop the parallel program "program1"
```

RETURN

The Return command. After executing this command, the program will jump to the end of the program, to effectively terminate the current program.

Example:

```
IFx >1THEN
RETURN
ENDIF
x = x + 1
/*other instructions*/
END;
When the condition is met, the robot executes to the RETURN command and jumps to END
```

...=...

Establish an expression to assign a value to a variable.

Example:

```
X = Y + Z + 1
This command can be used for mixed operations and assignments involving variables,
constants, and functions
```

/*...*/

COMMENT command, to add definitions or remarks to the program.

This command will not affect the operation of the program, but only for reading and understanding the program.

Example:

```
/*goto program1*/
CALL program1
```

3.3 WAIT commands

List of WAIT commands:

WAIT commands	Wait
	WaitFinish
	WaitCondition

Wait

It is used to set the robot wait time in ms, either as an int constant or as an INT variable.

Example:

```
Wait(1000)
Wait for 1 second
```

WaitFinish

It is used to control the execution of the program during the robots motion, and can be set to execute the next line of command when a certain percentage of the motion is executed.

Example:

```
MovL(P1, 1000,”RELATIVE”, C100)
WaitFinish (20)
SetDO(DO1, 1)
Execute the SetDO command when the MovL instruction reaches 20%. The command parameter
should be specified as a percentage, ranging from 0 to 100
```

WaitCondition

Set the conditions for the robot to execute the WAIT. If the condition is satisfied, the next command is executed. If the condition is not satisfied within the set time, it returns to the timeout state and continues with the next command.

WaitConditionCTIETV [Goto]

- C: Judgement condition (Condition)

  Meaning: Conditional Expression: Execute the next instruction only when the condition is true; otherwise, the program will continue to wait until the condition becomes true.

- T: Duration (Time)

  Data type: int or INT variable, with a value of a positive integer or 0.

  Meaning: Represents the time duration required for waiting, measured in milliseconds (ms). If the value of this parameter is 0, the program will wait until the condition is true before proceeding to execute the next command. If the value is not 0, even if the condition is still not true, the system will skip this command after waiting for the specified duration and continue executing the subsequent command.

- IE: Interrupt enabling (Interrupt enable)

  Data type: 0 or 1

  Meaning: Set whether or not to continue timing after the program resumes during the waiting process.

  0: Stop timing when the program stops, and continue timing before the program stopped when being resumed.

  1: When the program stops, stop timing, and continue timing when being resumed.

- TV: Timeout judgment value (Timeout Value)

  Data type: INT variable.

Meaning: If the input condition is TRUE and the command is executed, assign a value of 0 to the variable； When the command is executed due to timeout, assign 1 to the variable.

- [Goto]: Tag name for timeout jump (Label name)

  Data type: label

  Meaning: The name of the label, which should correspond to a LABEL command that has been taught in the currently loaded program, such as "Start." After a timeout, the program pointer will jump to the corresponding command line associated with the specified label name.

  Note: This parameter is optional and defaults to "No Jump".

Example:

```
WaitCondition("X> 0", 1000, 0, INT0)
```

When the waiting time is up to 1 second, if X> 0 is satisfied, the variable INT0 is assigned to 0 and the next command is executed; if it is executed for 0.5 seconds, the program stops, resumes and continues timing on the basis of 0.5 seconds, and when the condition is not satisfied at 1 second, the variable INT0 is assigned to 1 and the next command is executed.

3.4 IO commands

The list of IO commands:

IO commands	SetDO
	SetAO
	SetSimDO
	SetSimAO
	WaitDI
	WaitDI8421
	WaitAI
	WaitSimDI
	WaitSimDI8421
	WaitSimAI
	PulseOut
	PulseSimOut
	GetDI8421
	GetSimDI8421
	SetDO8421
	SetSimDO8421
	GetSimDIToVar
	SetSimDOByVar

	GetSimAIToVar
	SetSimAOByVar
	SetDIEdge
	SetSimDIEdge

SetDO

This command is used to set a digital output port to the TRUE (1) or FALSE (0) state.

The command parameters are described as below:

SetDO DOUT VALUE

- DOUT: Digital Output variable (Target DO Port)
  Data type: DO variable type
  Meaning: The digital output port variable to be set.
- VALUE: Target value (Value)
  Data type: int
  Meaning: The value of the digital output port to be set, either 0 or 1 can be entered, representing the low or high level of the port respectively.

For example 1:

```
SetDO (DO1, 1)
Set the DO1 variable to 1, i.e. set the digital output port bound to the DO1 variable to high
```

SetAO

Set the analog output port to a certain value.

The command parameters are described as below:

SetAOAOUT VALUE

- AOUT: Analog output variable (Target AO Port)
  Data type: AO variable type
  Meaning: The analog output port variable to be set.
- VALUE: Target value (Value)
  Data type: real
  Meaning: The value to set for the analog output port. It can be in the range of -10.0 to 10.0, representing the output level of the port.

For example 1:

```
SetAO (AO1, 5.0)
Set the AO1 variable to 5.0, i.e. set the voltage of the analog output port bound to the AO1 variable to 5.0V.
```

SetSimDO

Set the virtual digital output port to TRUE (1) or FALSE (0)

SetSimDOSIMDOUT VALUE

- SIMDOUT: Virtual digital output variable (Target SimDO Port)
  Data type: SimDO variable type
  Meaning: The virtual digital output port variable to be set.
- VALUE: Target value (Value)
  Data type: int
  Meaning: The value to set for the virtual digital output port. It can be either 0 or 1, representing the state of the port.

For example 1:

```
SetSimDO (SimDO1, 1)
```
Set the SimDO1 variable to 1, i.e. set the virtual digital output port bound to the SimDO1 variable to 1.

SetSimAO

Set the virtual analog output port to a certain value.

The command parameters are described as below:

SetSimAOSIMAOUT VALUE

- SIMAOUT: Virtual analog output variable (Target SimAO Port)

  Data type: SimAO variable type

  Meaning: The virtual analog output port variable to be set.

- VALUE: Target value (Value)

  Data type: real

  Meaning: The value to set for the virtual analog output port. It can be in the range of -10.0 to 10.0, representing the output value of the port.

Example 1:

```
SetSimAO (SimAO1, 5.0)
```
Set the value of the virtual analog output variable SimAO1 to 5.0, i.e. set the output value of the port to which the variable is bound to 5.0.

WaitDI

This command is used to wait for a digital input port to be set (1) or reset (0) within a specified duration. If the condition is met within the set duration, the program continues executing. If the condition is not met within the set duration, the Timeout judgment value is set to 1, and the program continues executing.

Explanation of the command parameters:

WaitDIDIN VALUE T INTERENABLE RET [Goto]

- DIN: Digital input variable (Target DI Port)

  Data type: DI variable type

  Meaning: The digital input variable used for the wait condition evaluation.

- VALUE: Target value (Value)

  Data type: int

  Meaning: When the value of the digital input variable matches the Target value, it is considered as the condition being met, and the program can continue executing.

- T: Duration (Time)

  Data type: int or INT variable

  Meaning: The duration for waiting for a specific DI signal. This parameter specifies the duration in milliseconds (ms). When the value is 0, it forces the program to wait until the DI signal is satisfied before considering it a successful execution.

- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: This parameter determines whether the timer restarts when the program is halted and resumed during the waiting process.

  - 0: Stop timing when the program stops, and continue timing before the program stopped when being resumed.
  - 1: When the program stops, stop timing, and continue timing when being resumed.

- RET: Timeout judgment value (Timeout Flag)

  Data type: INT

  Meaning: Return to the state after the command is executed

  - 0: Signal is detected successfully
  - 1: No signal is detected, and the command times out and returns.

- [Goto]: Tag name for timeout jump (Label name)

Data type: label

Meaning: The name of the label, which should correspond to a LABEL command that has been taught in the currently loaded program, such as "Start." After a timeout, the program pointer will jump to the instruction line corresponding to the specified label name.

Note: This parameter is optional and defaults to "No Jump".

Example 1:

```
WaitDI (DI1, 1, 1000, 0, INT1)
Wait for the digital input variable DI1 to be "1" and wait for 1,000ms (if the program is halted during this period, the timing will continue after resuming operation); if the signal is not waited for within 1,000ms, INT1 will be set to 1, indicating the waiting timeout.
```

WaitAI

This command is used to wait for an analog input port to have a value equal to the specified value within a specified duration. If the condition is met within the set duration, the program continues executing. If the condition is not met within the set duration, the Timeout judgment value is set to 1, and the program continues executing.

The command parameters are described as below:

WaitAIAIN VALUE T INTERENABLE RET [Goto]

- AIN: Analog input variable (Target AI Port)

  Data type: AI variable type

  Meaning: The analog input variable used for the wait condition evaluation.
- VALUE: Target value (Value)

  Data type: real.

  Meaning: When the value of the analog input variable matches the target value, it is considered as satisfying the wait condition, and the program can continue executing.
- T: Duration (Time)

  Data type: int or INT variable

  Meaning: The duration for waiting for a specific AI signal, specified in milliseconds (ms). If the value is 0, it forces the program to wait until the AI signal satisfies the condition before considering it a successful execution.
- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: This parameter determines whether the timer restarts when the program is halted and resumed during the wait process.
  - 0: Stop timing when the program stops, and continue timing before the program stopped when being resumed.
  - 1: When the program stops, stop timing, and continue timing when being resumed.
- RET: Timeout judgment value (Timeout Flag)

  Data type: INT

  Meaning: To return the status after the execution of this command.
  - 0: Signal is detected successfully
  - 1: No signal is detected, and the command times out and returns.
- [Goto]: Label name for timeout jump (Label name)

  Data type: label

  Meaning: The label name to jump to after a timeout occurs. This label should correspond to a LABEL command that has been taught in the currently loaded program. When a timeout occurs, the program pointer will jump to the command line associated with the specified label name.

  Note: This parameter is optional and defaults to "No Jump".

Example 1:

```
WaitAI (AI1 , 5.0 , 1000 , 1 , INT1)
Wait for analog input variable AI1 to reach the value of "5.0" for a duration of 1000ms
(if the program is halted during this period, the timer will restart upon resumption). If
the signal is not detected within 1000ms, set INT1 to 1, indicating a timeout.
```

WaitSimDI

The command is used to wait for a virtual digital input port to match a given value within a specified duration. If the condition is met within the set duration, the program will continue execution. If the condition is not met within the set duration, the Timeout judgment value will be set to 1, and the program will continue execution.

The command parameters are described as below:

WaitSimDISIMDIN VALUE T INTERENABLE RET [Goto]

- SIMDIN: Virtual digital input variable (Target SimDI Port)

  Data type: SimDI variable type

  Meaning: The virtual digital input variable used for the wait condition evaluation.
- VALUE: Target value (Value)

  Data type: int

  Meaning: When the value of the virtual digital input variable matches the Target value, the condition is considered met, and the program continues execution.
- T: Duration (Time)

  Data type: int or INT variable

  Meaning: The waiting duration, which is used to specify the duration for waiting a specific SimDI signal, measured in milliseconds. When the value is 0, it forces the program to wait until the DI signal is satisfied before considering it a successful execution.
- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: The parameter is used to set whether or not to restart timing after restarting if the program is halted when waiting.
  - 0: Stop timing when the program stops, and continue timing before the program stopped when being resumed.
  - 1: When the program stops, stop timing, and continue timing when being resumed.
- RET: Timeout judgment value (Timeout Flag)

  Data type: INT

  Meaning: To return the status after the command execution is done.
  - 0: Signal is detected successfully
  - 1: No signal is detected, and the command times out and returns.
- [Goto]: Tag name for timeout jump (Label name)

  Data type: label

  Meaning: The label name to jump to after a timeout occurs. This label should correspond to a LABEL command that has been taught in the currently loaded program, such as "Start". When a timeout occurs, the program pointer will jump to the command line associated with the specified label name.

  Note: This parameter is optional and defaults to "No Jump".

Example 1:

```
WaitSimDI (SimDI1, 1, 1000, 0, INT1)
Wait for the digital input variable SimDI1 to reach the value of "1" for a duration of
1000ms (if the program is halted during this period, the timer will restart upon
resumption). If the signal is not detected within 1000ms, set INT1 to 1, indicating a
timeout.
```

This command is used to wait for the virtual analog input variable to be equal to a given value within a specified duration. If the condition is met within the set duration, the program continues executing; otherwise, the timeout judgment value is set to 1, and the program continues executing.

The command parameters are described as below:

WaitSimAISIMAIN VALUE T INTERENABLE RET [Goto]

- SIMAIN: Virtual analog input variable (Target SimAI Port)

  Data type: SimAI variable type

  Meaning: The virtual analog input variable for the wait condition evaluation.
- VALUE: Target value (Value)

  Data type: real

Meaning: When the value of the virtual analog input variable is equal to the target value, it is considered as satisfying the wait condition, and the program can proceed to the next step.

- T: Duration (Time)

  Data type: int or INT variable

  Meaning: The waiting duration, which is used to specify the duration for waiting a specific SimDI signal, measured in milliseconds. When the value is 0, it forces the program to wait until the DI signal is satisfied before considering it a successful execution.

- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: The parameter is used to set whether or not to restart timing after restarting if the program is halted when waiting.

  - 0: Stop timing when the program stops, and continue timing before the program stopped when being resumed.
  - 1: When the program stops, stop timing, and continue timing when being resumed.

- RET: Timeout judgment value (Timeout Flag)

  Data type: INT

  Meaning: To return the status after the command execution is done.

  - 0: Signal is detected successfully
  - 1: No signal is detected, and the command times out and returns.

- [Goto]: The label name for timeout jump (Label name)

  Data type: label

  Meaning: The label name to jump to after a timeout occurs. This label should correspond to a LABEL command that has been taught in the currently loaded program, such as "Start". When a timeout occurs, the program pointer will jump to the command line associated with the specified label name.

  Note: This parameter is optional and defaults to “No Jump”.

Example 1:

```
WaitSimAI (SimAI1, 5.0 , 1000, 0, INT1)
Wait for virtual analog input variable SimAI1 to reach the value of "5.0" for a duration
of 1000ms (if the program is halted during this period, the timer will restart upon
resumption). If the signal is not detected within 1000ms, set INT1 to 1, indicating a
timeout.
```

WaitDI8421

The command is used to wait for a specific combination of states in a group of consecutive digital input (DI) ports within a specified duration. If the condition is met within the set duration, the program will proceed to the next step. If the condition is not met within the set duration, the timeout judgment value will be set to 1, and the program will continue executing the subsequent steps.

The command parameters are described as below:

WaitDI8421 BEGINPORT ENDPORT VALUE T INTERENABLE RET [Goto]

- BEGINPORT: The beginning DI port (Begin Port)

  Data type: int

  Meaning: The beginning port number of the consecutive DI ports in the segment.

- ENDPORT: The ending DI port (End Port)

  Data type: int

  Meaning: The ending port number of the consecutive DI ports in the segment.

- VALUE: Target value (Value)

  Data type: int

  Meaning: To convert the value of the consecutive DI port segment into a decimal number. If it is equal to the target value (VALUE), it is considered to meet the condition.

- T: Duration (Time)

  Data type: int or INT variable

  Meaning: The duration in milliseconds to wait for the digital input (DI) signal in this group. When the value is 0, it will forcefully wait until the DI signal satisfies the condition before considering it as a successful execution.

- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: This parameter is used to determine whether the timing restarts if the program is halted and resumed during the waiting process.

  - 0: Stop timing when the program stops, and continue timing before the program stopped when being resumed.
  - 1: When the program stops, stop timing, and continue timing when being resumed.

- RET: Timeout judgment value (Timeout Flag)

  Data type: INT

  Meaning: To return the status after the command execution is done.

  - 0: Signal is detected successfully
  - 1: No signal is detected, and the command times out and returns.

- [Goto]: Tag name for timeout jump (Label name)

  Data type: label

  Meaning: The label name to jump to after a timeout occurs. This label should correspond to a LABEL command that has been taught in the currently loaded program, such as "Start". When a timeout occurs, the program pointer will jump to the command line associated with the specified label name.

  Note: This parameter is optional and defaults to “No Jump”.

Example 1:

```
WaitDI8421(1000, 1 , 9, 16 , 255 ,INT1)
Within a duration of 1000ms, wait for the status of DI ports 9 to 16 to be 11111111. If
the condition is met within 1000ms, the program will continue execution. If the condition
is not met within 1000ms, set INT1 to 1. If the program is halted during the waiting
process and resumed, the timer will restart.
```

WaitSimDI8421

This command is used to wait for a specified duration for a group of consecutive virtual digital input (SimDI) ports to satisfy a specific state combination. If the condition is met within the set duration, the program will continue execution. If the condition is not met within the set duration, the timeout judgment value will be set to 1, and the program will continue execution.

The command parameters are described as below:

WaitSimDI8421 BEGINPORT ENDPORT VALUE T INTERENABLE RET [Goto]

- BEGINPORT: The beginning SimDI port (Begin Port)

  Data type: int

  Meaning: The beginning port number of the consecutive SimDI ports in the segment.

- ENDPORT: The ending SimDI port (End Port)

  Data type: int

  Meaning: The ending port number of the consecutive SimDI ports in the segment.

- VALUE: Target value (Value)

  Data type: int

  Meaning: To convert the value of the consecutive SimDI port segment into a decimal number. If it is equal to the target value (VALUE), it is considered to meet the condition.

- T: Duration (Time)

  Data type: int or INT variable

  Meaning: The duration in milliseconds to wait for the digital input (SimDI) signal in this group. When the value is 0, it will forcefully wait until the DI signal satisfies the condition before considering it as a successful execution.

- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: This parameter is used to determine whether the timing restarts if the program is halted and resumed during the waiting process.

  - 0: Stop timing when the program stops, and continue timing before the program stopped when being resumed.
  - 1: When the program stops, stop timing, and continue timing when being resumed.

- RET: Timeout judgment value (Timeout Flag)

  Data type: INT

  Meaning: To return the status after the command execution is done.

  - 0: Signal is detected successfully
  - 1: No signal is detected, and the command times out and returns.
- [Goto]: Tag name for timeout jump (Label name)

  Data type: label

  Meaning: The label name to jump to after a timeout occurs. This label should correspond to a LABEL command that has been taught in the currently loaded program, such as "Start". When a timeout occurs, the program pointer will jump to the command line associated with the specified label name.

  Note: This parameter is optional and defaults to “No Jump”.

For example1:

```
WaitSimDI8421(1000, 0 , 9, 16 , 255 ,INT1)
Within a duration of 1000ms, wait for the status of DI ports 9 to 16 to be 11111111. If
the condition is met within 1000ms, the program will continue execution. If the condition
is not met within 1000ms, set INT1 to 1. If the program is halted during the waiting
process and resumed, the timer will restart.
```

PulseOut

This command is used to generate a pulse with a specified duration and state at a specific digital output port.

The command parameters are described as below:

PulseOutDOUT VALUE T INTERENABLE

- DOUT: Digital output variable (Target DO Port)

  Data type: DO variable type

  Meaning: To specify the digital output port of the output pulse.
- VALUE: Target value (Value)

  Data type: int

  Meaning: The state of the pulse to be output at the specified digital output port.
- T: Duration (Time)

  Data type: int

  Meaning: The duration for which the pulse signal will be maintained
- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: This parameter determines whether the port continues to output the pulse signal if the program is halted during the pulse output process.

  - 0: When the program is stopped, the pulse output will continue for the set time and then stop. Its function will not be affected by the program stopping.
  - 1: When both the program and output are stopped, the output will continue when the program continues to run, which means that it is synchronized with the program running state. The output acts based on the state of the program.

For example1:

```
PulseOut (DO1, 1, 500, 1)
A 500ms pulse signal with a pulse amplitude of 1 is output at the digital output variable DO1 binding port. If the program stops during the pulse output, the port stops output and resumes pulse output when the program is restarted.
```

PulseSimOut

This command is used to generate a pulse with a specified duration and state at a specific virtual digital output port.

The command parameters are described as below:

PulseOutSIMDOUT VALUE T INTERENABLE

- SIMDOUT: Virtual digital output variable (TargetSim DO Port)

  Data type: SimDO variable type

Meaning: To specify the virtual digital output port of the output pulse.

- VALUE: Target value (Value)

  Data type: int

  Meaning: The state of the pulse to be output at the specified virtual digital output port.

- T: Duration (Time)

  Data type: int

  Meaning: The duration for which the pulse signal will be maintained

- INTERENABLE: Interrupt enabling (Interrupt Enable)

  Data type: int

  Meaning: This parameter determines whether the port continues to output the pulse signal if the program is halted during the pulse output process.

  - 0: When the program is stopped, the pulse output will continue for the set time and then stop. Its function will not be affected by the program stopping.
  - 1: When both the program and output are stopped, the output will continue when the program continues to run, which means that it is synchronized with the program running state. The output acts based on the state of the program.

For example1:

```
PulseSimOut (SimDO1, 1, 500, 1)
```
A 500ms pulse signal with a pulse amplitude of 1 is output at the virtual digital output variable SimDO1 binding port. If the program stops during the pulse output, the port stops output and resumes pulse output when the program is restarted.

GetDI8421

This command is used to get the status of a consecutive digital input DI port, (regard it as a segment of binary data) and return it as a decimal number.

The command parameters are described as below:

GetDI8421BEGINPORT ENDPORT RETURNVALUE

- BEGINPORT: The beginning DI port (Begin Port)

  Data type: int

  Meaning: The beginning port number of the consecutive DI ports in the segment.

- ENDPORT: The ending DI port (End Port)

  Data type: int

  Meaning: The ending port number of the consecutive DI ports in the segment.

- RETURNVALUE: Returned value (Return Value)

  Data type: INT

  Meaning: To treat the consecutive DI ports as a binary number, convert it to a decimal value and return the decimal number.

For example1:

```
GetDI8421 (9, 16, INT1)
```
Regard the status of digital input ports 9 to 16 as a binary number, convert it to a decimal number and return it to the variable INT1.

GetSimDI8421

This command is used to get the status of a consecutive digital input SimDI port, (regard it as a segment of binary data) and return it as a decimal number.

The command parameters are described as below:

GetSimDI8421BEGINPORT ENDPORT RETURNVALUE

- BEGINPORT: The beginning SimDI port (Begin Port)

  Data type: int

  Meaning: The beginning port number of the consecutive SimDI ports in the segment.

- ENDPORT: The ending SimDI port (End Port)

  Data type: int

Meaning: The ending port number of the consecutive SimDI ports in the segment.

- RETURNVALUE: Returned value (Return Value)

  Data type: INT

  Meaning: To treat the consecutive SimDI ports as a binary number, convert it to a decimal value and return the decimal number.

For example1:

```
GetSimDI8421 (9, 16, INT1)
Regard the status of virtual digital input ports 9 to 16 as binary numbers, convert them to decimal numbers and return them to the variable INT1.
```

SetDO8421

Set a segment of continuous DO port status (regard it as a segment of binary data); convert the decimal number transmitted in into a binary number, and set it to the designated DO port.

The command parameters are described as below:

SetDO8421BEGINPORT ENDPORT SETVALUE

- BEGINPORT: Start DO port (Begin Port)

  Data type: int

  Meaning: The beginning port number of the consecutive DO ports in the segment.

- ENDPORT: End DO port (End Port)

  Data type: int

  Meaning: The ending port number of the consecutive DO ports in the segment.

- SETVALUE: Set Value

  Data type: int

  Meaning: To convert the decimal number into a binary number and set it to the specified consecutive DO ports in the segment.

For example1:

```
SetDO8421 (9, 16, 255)
Set virtual digital output ports 9 to 16 to 1.
```

SetSimDO8421

This command is used to set the state of a consecutive range of SimDO ports (regard them as a segment of binary data). It converts the incoming decimal number into a binary number and sets it to the specified SimDO ports.

The command parameters are described as below:

SetSimDO8421BEGINPORT ENDPORT SETVALUE

- BEGINPORT: Start SimDO port (Begin Port)

  Data type: int

  Meaning: The beginning port number of the consecutive SimDO ports in the segment.

- ENDPORT: End SimDO port (End Port)

  Data type: int

  Meaning: The ending port number of the consecutive SimDO ports in the segment.

- SETVALUE: Set Value

  Data type: int

  Meaning: To convert the decimal number into a binary number and set it to the specified consecutive SimDO ports in the segment.

For example1:

```
SetSimDO8421 (9, 16, 255)
Set virtual digital output ports 9 to 16 to 1.
```

GetSimDIToVar

Map the virtual digital input signal to a variable.

The command parameters are described as below:

GetSimDITOVarSIMDIN VAR

- SIMDIN: Virtual digital input port variable (SimDI Port)

  Data type: SimDI variable type

  Meaning: To retrieve the status of the virtual digital input port and assigns it as the value to the target variable.
- VAR: Target variable (Target Variable)

  Data type: BOOL

  Meaning: To accept the value retrieved from the simulated digital input port.

For example1:

```
GetSimDITOVar (SimDI9, BOOL1)
Get the value of the virtual digital input port bound to the variable SimDI9 and assigns the value to the BOOL1 variable.
```

SetSimDOByVar

Map the value of a Boolean variable to a digital output variable.

The command parameters are described as below:

SetSimDOByVarSIMDOUT VAR

- SIMDOUT: Virtual digital output port variable (SimDO Port)

  Data type: SimDO variable type

  Meaning: To output the acquired variable value on the SimDO port to which the variable is bound.
- VAR: Variable

  Data type: BOOL

  Meaning: To get the value of this variable and output it to the specified virtual digital output port.

Example 1:

```
SetSimDOTOVar (SimDO9, BOOL1)
Output the state of the variable BOOL1 at the port corresponding to the virtual digital variable SimDO9.
```

GetSimAIToVar

This command is used to map a virtual analog input signal to a variable.

The command parameters are described as below:

GetSimAIToVarSIMAIN VAR

- SIMAIN: Virtual analog input port variable (Sim AI Port)

  Data type: SimAI variable type

  Meaning: To get the state of the virtual analog input port at this end as the value to be assigned to the target variable.
- VAR: Target variable

  Data type: REAL

  Meaning: To accept the value of the virtual analog input port on the acquisition end.

For example1:

```
GetSimAIToVar (SimAI9, REAL1)
Get the value of the virtual analog input port bound to the variable SimAI9 and assigns this value to the REAL1 variable.
```

SetSimAOByVar

This command maps the value of a REAL variable to a virtual analog output variable.

The command parameters are described as below:

SetSimAOByVarSIMAOUT VAR

- SIMAOUT: Virtual analog output port variable (Sim AO Port)
  Data type: SimAI variable type
  Meaning: The virtual analog output port to be set and output.
- VAR: variable
  Data type: REAL
  Meaning: To get the value of this variable and output it to the specified virtual analog output port.

For example1:

```
SetSimAOByVar (SimAO9, REAL1)
```
Output the value of the REAL1 variable at the virtual analog output port bound to the variable SimAO9.

SetDIEdge

Set the edge signal state of a virtual digital input port forcibly by using the commands.

The command parameters are described as below:

SetDIEdgeDIN EDGETYPE VALUE

- DIN: Digital input port variable (Target DI Port)
  Data type: DI variable type
  Meaning: The digital input variable for the edge signal to be forced.
- EDGETYPE: Edge type (Edge Type)
  Data type: enum
  Meaning: To select the edge type to be forced on a given port.
- VALUE: Force Value
  Data type: int
  Meaning: The value of the edge signal to be forced at a given port.

For example1:

```
SetDIEdge (DI9, "riseEdge",1)
```
Set the rising edge signal of the DI9 port forcibly to a "1" state.

SetSimDIEdge

Set the edge signal state of a virtual digital input port forcibly by using the commands.

The command parameters are described as below:

SetDIEdgeSIMDIN EDGETYPE VALUE

- SIMDIN: Vrtual digital input port variable (Target SimDI Port)
  Data type: SimDI variable type
  Meaning: The virtual digital input variable for the edge signal to be forced.
- EDGETYPE: Edge type (Edge Type)
  Data type: enum
  Meaning: The virtual digital input variable for the edge signal to be forced.
- VALUE: Force Value
  Data type: int
  Meaning: The value of the edge signal to be forced at a given port.

For example1:

```
SetSimDIEdge (SimDI9, "riseEdge",1)
```
Set the rising edge signal of the SimDI9 port forcibly to a "1" state.

3.5 SET commands

The list of SET commands:

SET commands	SetTool
	SetCoord
	SetExternalTCP
	SetPositioner
	SetJointDyn
	SetCartDyn
	SetBlendParam
	SetOverRide
	SetPayload
	SetSingularPass
	SetColliEnable
	SetAxisColliParam
	GetCurOverRide
	Hand
	CalcTool
	CalcCoord
	SetRtToErr
	SetRtInfo
	SetRtWarning
	Stop
	RefRobotAxis
	SetMotionMode
	AutoGainEnable
	AutoGainDisable

	SetRestorePC
	SetOriMode
	GetRobotIsMoving
	SetColliAutoTune
	SetColliParam
	SetAxisVibraBLevel

SetTool

This command is used to select the Tool Parameters. The command parameters are described as below:

SetTool Tool

- Tool: Tool Parameters (Tool Param)
  Data type: TOOL variable
  Meaning: The selected tool parameters

For example:

```
SetTool(TOOL0)
Select TOOL0 as the Tool Parameters for the robot.
```

SetCoord

Select the command of User Coordinates. The command parameters are described as below:

SetCoordCoord

- Coord: User Coordinate System parameters (UserCoord Param)
  Data type: USERCOORD variable
  Meaning: The selected parameters for User Coordinate System

For example:

```
SetCoord(USERCOORD0)
Select USERCOORD0 for the parameters of the robot's User Coordinate System.
```

SetExternalTCP

This command is used to select the external tool coordinate system (TCP). The command parameters are described as below:

SetExternalTCPExtTCP

- ExtTCP: External TCP parameters (ExternalTCP Param)
  Data type: EXTTCP variable
  Meaning: The selected external TCP parameters

For example:

```
SetExternalTCP(EXTTCP0)
Select EXTTCP0 as the parameters of the robot's external TCP coordinates.
```

SetPositioner

It is used to set the reference coordinates of the system to POSITIONER coordinates. After command execution, the system will switch the reference coordinates to the POSITIONER coordinates. The robot will then move relative to the POSITIONER coordinates. The command parameters are described as below:

SetPositioner Positioner

- Positioner: Positioner Coordinate System Parameters (Positioner Param)

  Data type: POSITIONER variable

  Meaning: The selected parameters of Positioner Coordinate System

For example:

```
SetPositioner(POSITIONER0)
/* Select POSITIONER0 as the parameter of positioner coordinate system of robot */
```

SetJointDyn

It is used to set dynamic joint parameters. After running the command, the subsequent motion commands will all run using such dynamic parameters. The command parameters are described as below:

SetJointDynAcc Dec Jerk Torq

- Acc: Acceleration (%) (Acc(%))

  Data type: int

  Meaning: The percentage of the maximum acceleration of the joint, with the value ranged from 1 to 100.

- Dec: Deceleration (%) (Dec(%))

  Data type: int

  Meaning: The percentage of joint maximum deceleration, with the value ranged from 1 to 100.

- Jerk: Jerk (Jerk(%))

  Data type: int

  Meaning: The percentage of the maximum jerk of the joint, with the value ranged from 1 to 100.

- Torq: Torque (Torq(%))

Data type: int

  Meaning: The percentage of the maximum torque of the joint, with the value ranged from 1 to 100.

For example:

```
SetJointDyn(80, 80, 80, 60)
After running this command, the subsequent motion commands in the joint space will run using this dynamic parameter.
```

SetCartDyn

Set the dynamic parameters in Cartesian space. After running this command, the subsequent motion commands will run using this dynamic parameter. The command parameters are described as below:

SetCartDynAcc Dec Jerk OriAcc OriDec OriJerk Torq

- Acc: Acceleration (%) (Acc(%))

  Data type: int

  Meaning: The percentage of maximum acceleration for linear and circular motion, with the value ranged from 1 to 100.

- Dec: Deceleration (%) (Dec(%))

  Data type: int

  Meaning: The percentage of maximum deceleration for linear and circular motion, with the value ranged from 1 to 100.

- Jerk: Jerk (Jerk(%))

  Data type: int

  Meaning: The percentage of maximum acceleration jerk for linear and circular motion, with the value ranged from 1 to 100.

- OriAcc: Posture Acceleration (%) (OriAcc(%))

  Data type: int

  Meaning: The percentage of the maximum rotating acceleration of the posture, with the value ranged from 1 to 100.

- OriDec: Posture Deceleration (%) (OriDec(%))

  Data type: int

  Meaning: The percentage of the maximum rotating deceleration of the posture, with the value ranged from 1 to 100.

- OriJerk: Posture Jerk (OriJerk(%))

  Data type: int

  Meaning: The percentage of the maximum rotating jerk of the posture, with the value ranged from 1 to 100.

- Torq: Torque (Torq(%))

Data type: int

  Meaning: The percentage of the maximum torque of the joint, with the value ranged from 1 to 100.

For example:

```
SetCartDyn(80, 80, 80, 80, 80, 80, 60)
After running this command, subsequent motion commands in Cartesian space will run using this dynamic parameter.
```

SetBlendParam

It is used to set the transition parameters. After running this command, subsequent motion commands are run with this transition parameter. The command parameters are detailed below:

SetBlendParamB C

- B: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)
  Meaning: The way of transition when the robot approaches the endpoint.
  − FINE: No transition.
  − RELATIVE: Relative transition.
  − ABSOLUTE: Absolute transition.

- C: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

For example:

```
SetBlendParam("RELATIVE ")
After this command is run, subsequent motion commands are run using this transition parameter.
```

SetOverRide

This command is used to set the Global Speed. After executing this command, all subsequent motion commands will be executed at this speed. The command parameters are described as below:

SetOverRidevf

- vf: Global speed (%) (speed factor(%)

  Data type: int or INT variable

  Meaning: The percentage of Global Ppeed, with the value ranged from 1 to 100.

For example:

```
SetOverRide(80)
After executing this command, the subsequent motion commands will run using such speed.
```

SetPayload

This command is used to set the payload of the workpiece. The command parameters are described as below:

SetPayloadpl

- pl: Payload

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter, which stores a series of relevant parameters such as PAYLOAD command.

For example:

```
SetPayload (PAYLOAD0)
After executing this command, the system will take the parameters in variablePAYLOAD0 as
the current workpiece payload parameter. All subsequent motion commands will be executed
with this payload.
```

SetSingularPass

The command to set the cross-wrist singularity function switch can be selected as "OPEN" or "CLOSE".

SetSingularPass SingularPass

- SingularPass: Cross-wrist Singularity (SingularPass)

  Data type: enum (OPEN/CLOSE)

  Meaning: Whether the wrist singularity is performed?

  − OPEN: to open.
  − CLOSE: To close.

For example:

```
SingularPass("OPEN")
After executing this command, the cross-wrist singularity function will be enabled.
```

SetColliEnable

A command to set the collision detection enable.

SetColliEnableAxisIDValid

- AxisID: Axis ID

  Data type: enum (GROUP/A1/A2/A3/A4/A5/A6)

  Meaning: The axis ID for setting collision enable.

  − GROUP: All axes.
  − A1: Axis 1.
  − A2: Axis 2.
  − A3: Axis 3.
  − A4: Axis 4.
  − A5: Axis 5.
  − A6: Axis 6.

- Valid: Valid

  Data type: enum (ENABLE/DISABLE)

  Meaning: Determine if it is valid.

  − ENABLE: Valid.
  − DISABLE: Invalid.

For example:

```
SetColliEnable("GROUP","ENABLE")
Collision enable valid for all axes.
```

SetAxisColliParam

A command used to set the collision detection sensitivity value.

SetAxisColliParamAxisIDValue

- AxisID: Axis ID

  Data type: enum (A1/A2/A3/A4/A5/A6)

  Meaning: The axis ID for setting collision parameters.

  − A1: Axis 1.
  − A2: Axis 2.
  − A3: Axis 3.
  − A4: Axis 4.
  − A5: Axis 5.
  − A6: Axis 6.
- Value: Sensitivity value (Value)

  Data type: Constant

  Meaning: The sensitivity to collision.

For example:

```
SetAxisColliParam("A1",100)
```
Set the collision detection sensitivity value for axis 1 to `100`.

GetCurOverRide

Get the current override. When this command is executed, the Global Speed value retrieved will be stored in the incoming variable. The command parameters are described as below:

GetCurOverRideV

- V: Global Speed (%) (speed factor(%)

  Data type: INT variable

  Meaning: To store the Global Speed percentage read from the system for other uses.

For example:

```
GetCurOverRide(INT0)
```
After running this command, the current override value will be read into INT0, which can be viewed in the variable list.

Hand

Set the lefty and righty system. It is only applicable to SCARA models. The command parameters are described as below:

Handst

- st: left-right hand setting type (set type)

  Data type: enum (Lefty/Righty/Default)
  Meaning: To set the robots left -right hand type mode.
  − Lefty: To set the left hand.
  − Righty: To set the right hand.
  − Default: To set to the default mode.

For example:

```
Hand (“Lefty”)
```
After executing this command, the subsequent motion commands will use the left-hand setting.

CalcTool

It calculates the tool parameters according to the four "calibration points". The command parameters are described as below:

CalcToolP1 P2 P3 P4 Tool

- P1: Calibration point 1 (the first position)
  Data type: CPOS
  Meaning: The 1st calibration point.
- P2: Calibration point 2 (the second position)
  Data type: CPOS
  Meaning: The 2nd calibration point.
- P3: Calibration point 3 (the third position)
  Data type: CPOS
  Meaning: The 3rd calibration point.
- P4: Calibration point 4 (the forth position)
  Data type: CPOS
  Meaning: The 4th calibration point.
- Tool: Tool Parameters (Tool Param)
  Data type: TOOL
  Meaning: The tool parameters as calibrated are calculated.

For example:

```
CalcTool (P1, P2, P3, P4, TOOL1)
```
After this command is executed, calculate the tool parameters according to the four calibration points, and be saved to TOOL1.

CalcCoord

This command calculates the parameters for calibration of user coordinate system based on the three points so provided. The command parameters are described as below:

CalcCoordP1 P2 P3 Coord

- P1: The original position
  Data type: CPOS
  Meaning: The 1st calibration point, also the origin of the user coordinate system.
- P2: Calibration point in RX direction (the second position)
  Data type: CPOS
  Meaning: The 2nd calibration point, also the calibration point in the RX direction of the user coordinate system.
- P3: RXRY plane calibration points (the third position)
  Data type: CPOS
  Meaning: The 3rd calibration point, also the RXRY plane calibration point of the user coordinate system.
- Coord: User parameters (UserCoord Param)
  Data type: USERCOORD
  Meaning: The parameter of user coordinate system as calibrated are calculated.

For example:

```
CalcCoord (P1, P2, P3, USERCOORD1)
```
After executing this command, you can calculate the user coordinate system parameters using the three calibration points, and save it to the USERCOORD1.

SetRtToErr

Enable the robot to stop running and issue an error message. The command parameters are described as below:

SetRtToErrmsg errId

- msg: Error message (errInfo)

  Data type: str

  Meaning: Set the error message.

- errId: Error number (errId)

  Data type: int

  Meaning: To set the error number, with value ranging from 90001 to 100000.

For example:

```
SetRtToErr (“halt”, 90001)
Enable the robot to stop and issue the error number 90001 with the error message "halt".
```

SetRtInfo

This command is used to set a reminder information but does not affect the running of the program. The command parameters are described as below:

SetRtInfo msg errId

- msg: Remainder message (errInfo)

  Data type: str

  Meaning: The reminder message as set.

- errId: Reminder ID (errId)

  Data type: int

  Meaning: The reminder ID as set, with the value ranging from 70001 to 80000.

For example:

```
SetRtInfo (“Info”, 70001)
The command to stop the robot's operation and generate an error with the error code 70001
and error message "Info".
```

SetRtWarning

Set the warning message but does not affect the robot operation. The command parameters are described as below:

SetRtWarning msg errId

- msg: Warning message (errInfo)

  Data type: str

  Meaning: The warning message as set.

- errId: Warning ID (errId)

  Data type: int

  Meaning: The warning ID as set, with the value ranging from 80001 to 90000.

For example:

```
SetRtWarning (“Warning”, 80001)
Set the robot to stop and issue the warning number 80001 with the error message "Warning".
```

Stop

Stop the execution of all the activated programs, and stop the robots movement simultaneously.

For example:

```
Stop ()
Stop all executing programs.
```

RefRobotAxis

Calibrate the zero return position and run in single step. The command parameters are described as below:

RefRobotAxisnum

- num: Axis number

  Data type: int

  Meaning: The axis number of joint, with the value ranging from 1 to 16.

For example:

```
RefRobotAxis (1)
Perform a zero-return operation on the robot's joint 1 axis.
```

SetMotionMode

This command is used to set the robot motion mode. The command parameters are described as below:

SetMotionMode MotionMode

- MotionMode: Motion mode (Mode)

  Data type: enum (STANDARD/LOW_OSCILLATION)
  Meaning: To set the robots motion mode
  − STANDARD: Standard mode.
  − LOW_OSCILLATION: The low oscillation mode.

For example:

```
SetMotionMode (STANDARD)
Set the robot's current motion mode to standard one.
```

AutoGainEnable

The command to enable servo Auto Tune. After executing this command, the system will optimize the subsequent motion commands at low speed according to the incoming LsScale and LsThresh parameters. For details on how to use this command, refer to the command parameters described as below:

AutoGainEnableLsScaleP LsThreshP

- LsScaleP: Low-speed segment gain ratio (LsScale)

  Data type: LsScale type variable
  Meaning: To set the low-speed segment gain ratio threshold for each joint axis of the robot.

- LsThreshP: Low-speed segment speed threshold (LsThresh)

  Data type: LsThresh type variable
  Meaning: To set the low-speed segment speed threshold for each joint axis of the robot.

For example:

```
AutoGainEnable(LsScale0,LsThresh0)
/* Enable the servo parameter Auto Tune function */
```

AutoGainDisable

Disable servo parameter gain command. After executing this command, the system will deactivate the optimized processing of low-speed segments for motion commands.

For example:

```
AutoGainDisable()
/* Disable the servo parameter Auto Tune function */
```

SetRestorePC

This command sets the pc pointer when the run program goes from Halt/Stop to run. Please note that this command is only valid for use in run programs. The command parameters are detailed as below:

SetRestorePCindex

- index: Program pointer (PC index)

Data type: int

Meaning: run 程序恢复运行时的行号.

For example:

```
SetRestorePC(3)
/* The program pointer will run from line 3 when the run program is transferred from Halt/Stop state to run.*/
```

SetOriMode

The orientation mode setting command, which enables interpolation in a certain pose mode when the robot executes a motion path. The command parameters are described as below:

SetOriMode OriMode

- OriMode: Orientation Mode (orientation Mode)

  Data type: enum(CirMidPassOpen/CirMidPassClose)

  Meaning: To set the orientation mode of the current path.

  − CirMidPassOpen: Enable the interpolation of arcs passing through intermediate auxiliary points to optimize the problem of having to split the full circle into 3-4 arcs in order to guarantee the weld orientation.

  − CirMidPassClose: Disable the interpolation of arcs passing through intermediate auxiliary points.

For example:

```
SetOriMode("CirMidPassOn ")
MovC(P1,P2)
/* Enable the interpolation of arcs passing through intermediate auxiliary point, so that
the robot can move according to the optimized effect when it executes the MovC(P1,P2)
command. */
```

GetRobotIsMoving

It is used to get the current robot motion status. The command parameters are described as below:

GetRobotIsMoving MovStatus

- MovStatus: Robot Moving Status)

  Data type: BOOL variable

  Meaning: To store the current motion state of the robot. True is for the motion state, and False is for the non-motion state.

For example:

```
GetRobotIsMoving(BOOL0)
/* Get the current motion state of the system and store the returned value in
BOOL0.value.*/
```

SetColliAutoTune

The following command is used to configure the Auto Tune feature for collision detection. When the Auto Tune stage for collision detection parameters is set to Start, Pause, Continue, or End, the data recording status for the Auto Tune feature will be configured accordingly. When the Auto Tune stage for collision detection parameters is set to CalCulate, the collision Auto Tune parameters will be calculated based on the data recorded by the Auto Tune feature. The command parameters are described as below:

SetColliAutoTune cmdType method level colliId

- cmdType: Collision detection parameter Auto Tune stage (Colli cmd Type)

  Data type: enum (Start/Pause/Continue/End/Calculate)

  Meaning: Data recording status for the Auto Tune feature.

  − Start: To restart.

  − Pause: To pause.

  − Continue: To continue.

  − End: To end.

  − Calculate: To calculate and generate.

- method: Calculate and generate.

  Data type: enum (Default/ Default +/ Default ++/)

  Meaning: Collision detection method used for Auto Tune.

  − Default: Default.
  − Default +: Strong.
  − Default ++: Stronger.

  Note: This parameter is only valid when the collision detection parameter Auto Tune stage is set to Calculate.

- level: Sensitivity (level)

  Data type: enum (Highest/High/Default/Low/Lowest)

  Meaning: Sensitivity level of the Auto Tune results.

  − Highest
  − High
  − Default
  − Low
  − Lowest

  Note: This parameter is only valid when the collision detection parameter Auto Tune stage is set to Calculate.

- colliId: Collision parameter (Colli id)

  Data type: COLLIPARAM variable

  Meaning: To store the collision parameters resulting from Auto Tune calculations.

  Note: This parameter is only valid when the collision detection parameter Auto Tune stage is set to Calculate.

SetColliParam

This command is used to set the collision detection parameters. Refer to the command parameters described as below:

SetColliParam colliId AxisID Valid Value

- colliId: Collision parameter (Colli id)

  Data type: COLLIPARAM variable

  Meaning: The parameter used by the collision detection function. This parameter is optional and defaults to DEFAULT (factory default) .

- AxisID: Axis number (AxisID)

  Data type: enum (DEFAULT/GROUP/A1/A2/A3/A4/A5/A6)

  Meaning: The axis number for which the collision detection validity and sensitivity values need to be set.

  − DEFAULT: meaningless.
  − GROUP: All axes
  − A1: Axis 1.
  − A2: Axis 2.
  − A3: Axis 3.
  − A4: Axis 4.
  − A5: Axis 5.
  − A6: Axis 6.

- Valid: Validity (Valid)

  Data type: enum (ENABLE//DISABLE)

  Meaning: Controls the ON and OFF of the collision detection function for the corresponding axis number.

  − ENABLE: To enable collision detection.
  − DISABLE: To disable collision detection.

  Note: This parameter is only valid when the axis number is set to non-DEFAULT.

- Value: Sensitivity value (Value)

  Data type: int

  Meaning: Sensitivity value of the collision detection in percentage, parameter range 1~500.

  Note: This parameter is only valid when the axis number is set to other than DEFAULT.

SetAxisVibraBLevel

The vibration suppression level setting command, which is valid only for input setting.

SetAxisVibraBLevel AxisID Level

- AxisID: AxisID

  Data type: enum (A1/A2/A3/A4/A5/A6)

  Meaning: To set the axis ID for which you want to set the vibration suppression level.

  − A1: Axis 1.
  − A2: Axis 2.
  − A3: Axis 3.
  − A4: Axis 4.
  − A5: Axis 5.
  − A6: Axis 6.
- level: Calibration Level

  Data type: enum (Highest/High/Default/Low/Lowest)

  Meaning: To set the level of vibration suppression.

  − Highest
  − High
  − Default
  − Low
  − Lowest

3.6 POSITION operation commands

The list of POSITION operation commands:

POSITION operation commands	GetCurAPos
	GetCurCPos
	APosToCPos
	CPosToAPos
	CPosToCPos
	ToolOffset
	UserOffset
	CalPosOffset

GetCurAPos

Get the position in the current joint coordinate system, and assign it to the Apos variables. The command parameters are described as below:

GetCurAPosP

- P: Joint position

  Data type: APOS

  Meaning: The current position of the robot in the joint coordinate system.

For example:

```
GetCurAPos (P1)
```
Get the current position of the robot in the joint coordinates and save it in P1.

GetCurCPos

Get the Cartesian space position in the current coordinate system (world coordinates or user coordinates), and assign it to the Cpos variables. The command parameters are described as below:

GetCurCPosP

- P: Cartisian position

  Data type: CPOS

  Meaning: Cartesian position of the robot in the current coordinate system (World or User).

For example:

```
GetCurCPos (P1)
```
Get the Cartesian space position in the robot's current coordinates (World or User Coordinates) and save it in P1.

APosToCPos

This command is used for robot position point transformation. By utilizing the provided APos point, target CPos point, user coordinate system, and Tool parameters, it is possible to convert the APos point into the CPos point. The command parameters are described as below:

APosToCPosOP TP Tool Coord

- OP: Original position (originalposition)

  Data type: APOS

  Meaning: The joint position before conversion.

- TP: Target position (target position)

  Data type: CPOS

  Meaning: The target Cartesian space position.

- Tool: Target Tool Parameters (target tool param)

  Data type: TOOL

  Meaning: The target tool parameters.

- Coord: Target coordinates (target usercoord)

  Data type: USERCOORD, EXTTCP, POSITIONER

  Meaning: The reference coordinates

For example:

```
APosToCPos (P1, P2, TOOL1, USERCOORD1)
```
The target point P2 can be acquired according to P1, TOOL1, USERCOORD1.

CPosToAPos

This command is used for robot position point transformation. By utilizing the provided CPos point, its associated user coordinate system, and tool parameters, it is possible to convert the CPos point into the APos point. The command parameters are described as below:

CPosToAPosOP Tool Coord TP

- OP: Original position (originalposition)

  Data type: CPOS

  Meaning: The Cartesian space position before the conversion.

- Tool: Original tool Parameters (originaltool param)

  Data type: TOOL

  Meaning: The tool parameters before the conversion.

- Coord: Original coordinates (originalusercoord)

  Data type: USERCOORD, EXTTCP, POSITIONER

  Meaning: The parameter of the reference coordinate system before conversion.

- TP: Target position (target position)

  Data type: APOS

  Meaning: The joint position after the conversion.

For example:

```
APosToCPos (P1, TOOL1, USERCOORD1, P2)
The target point P2 can be acquired according to P1, TOOL1, USERCOORD1.
```

CPosToCPos

The command of robot position point conversion, through which CPos points can be converted to CPos points. Being given the CPos point, as well as the user coordinates and tool parameters of the target CPos point to be converted, the value of the target CPos point can then be derived. The command parameters are described as below:

CPosToCPosOP OTool OCoord TP TTool TCoord

- OP: Original position (originalposition)

  Data type: CPOS

  Meaning: The Cartesian space position before the conversion.

- Tool: Original tool Parameters (originaltool param)

  Data type: TOOL

  Meaning: The Tool parameters before the conversion.

- OCoord: Original coordinates (originalusercoord)

  Data type: USERCOORD, EXTTCP, POSITIONER

  Meaning: The parameter of coordinate system before the conversion.

- TP: Target position (target position)

  Data type: CPOS

  Meaning: The target Cartesian space position.

- TTool: Target Tool Parameters (targettool param)

  Data type: TOOL

  Meaning: The parameter of target tool.

- TCoord: Target coordinates (targetusercoord)

  Data type: USERCOORD, EXTTCP, POSITIONER

  Meaning: The parameter of target reference coordinate system.

For example:

```
CPosToCPos(P1, TOOL1, USERCOORD1, P2, TOOL2, USERCOORD2)
The target point P2 can be derived from P1, TOOL1, USERCOORD1, TOOL2, USERCOORD2.
```

ToolOffset

By using this command, a new tool coordinate system can be generated by rotating or offsetting the reference tool coordinate system. The robots TCP can then perform positional movements in the corrected coordinate system, without the need to reprogram points. This effectively improves on-site debugging efficiency and reduces the complexity of debugging. The command parameters are described as below:

ToolOffset F1 P F2

- F1: Reference Tool Parameters (Tool1)

  Data type: TOOL

  Meaning: The parameters defining the original reference tool coordinate system.

- P: Offset

  Data type: DCPOS

  Meaning: The offset of the new tool coordinate system relative to the original tool parameters.

- F2: Target Tool Parameters (Tool2)

  Data type: TOOL

  Meaning: The new tool parameters that are obtained by offsetting based on the reference tool parameters.

For example:

```
ToolOffset (TOOL1, DCPOS1, TOOL2)
The offset tool coordinate system TOOL2 can be obtained based on the tool coordinate
system TOOL1 and the offset DCPOS1.
```

UserOffset

By using this command, a new user coordinate system can be generated by rotating or offsetting the reference user coordinate system. The robots T CP can then perform positional movements in the corrected coordinate system, without the need to reprogram points. This effectively improves on-site debugging efficiency and reduces the complexity of debugging. The command parameters are described as below:

UserOffsetF1PF2

- F1: User Coordinate System (Usercoord1)

  Data type: USERCOORD

  Meaning: The parameter of the user coordinate system before conversion.

- P: Offset

  Data type: DCPOS

  Meaning: The offset of the new user coordinate system relative to the parameters of original user coordinate system.

- F2: Target User Coordinate System Parameters (Usercoord2)

  Data type: USERCOORD

  Meaning: The parameter of new user coordinate system obtained upon the offset of the reference user coordinate system.

For example:

```
UserOffset (USERCOORD1, DCPOS1, USERCOORD2)
Based on the tool coordinate system USERCOORD1, offset DCPOS1, the user coordinate system
upon offset USERCOORD2 can then be obtained.
```

CalPosOffset

The Calculate Position Point Offset Result command. It calculates the position value after the original position has been offset relative to the coordinates or tool, based on the original position amount and the relative offset amount. The command parameters are described as below:

CalPosOffset OP RP T Tool Coord TP

- OP: Original position (originalposition)

  Data type: APOS/CPOS

  Meaning: The start point of the offset motion.

- RP: Relative offset (Rel position)

  Data type: DCPOS

  Meaning: The increment of the position to be moved relative to the original position.

- T: Reference coordinates (RefSys)

  Data type: enum (COORD/TOOL)

  - COORD: The user coordinate system.
  - TOOL: The tool coordinate system.

  Meaning: The reference coordinate system, either Cartesian or tool.

- Tool: Target Tool Parameters (target tool param)

  Data type: TOOL

  Meaning: Target Tool Parameters.

- Coord: Target coordinates (target usercoord)

  Data type: USERCOORD, EXTTCP, POSITIONER

  Meaning: The reference coordinate system.

- TP: Target position (target position)

  Data type: CPOS

  Meaning: The target Cartesian position.

For example:

```
CalPosOffset(P0, DCPOS0,"COORD",TOOL1, USERCOORD1,P1)
According to P0, DCPOS0, TOOL1 and USERCOORD1, the target point P1 can then be obtained.
```

3.7 Bit operation commands

The list of bit operation commands:

Bit operation commands	BitAnd
	BitNeg
	BitOr
	BitXor
	BitLSH

	BitRSH

BitAnd

This command performs a bitwise AND operation on two operands and assigns the result to the first operand, achieving the bitwise AND operation. The command parameters are described as below:

BitAndI1 I2

- I1: Operand 1 (data1)

  Data type: INT

  Meaning: Data to be manipulated,the result of the operation is also assigned to this operand.

- I2: Operand 2 (data2)

  Data type: INT

  Meaning: Data to be compared.

For example:

```
BitAnd (INT1, INT2)
```
Perform a bitwise AND operation on INT1 and INT2 and assign the result to INT1.

BitNeg

This command performs a bitwise NOT operation on an operand and assigns the result to that operand, achieving the bitwise NOT operation. Additionally, the NOT operation only applies to the last 16 bits of the operand. The command parameters are described as below:

BitNegI1

- I1: Operand (data)

  Data type: INT

  Meaning: Data to be manipulated, and the result of the operation is also assigned to this operand.

For example:

```
BitNeg (INT1)
```
Perform a bitwise negation operation on INT1 and assign the result to INT1.

BitOr

This command performs a bitwise OR operation on two operands and assigns the result to the first operand, achieving the bitwise OR operation. The command parameters are described as below:

BitOrI1 I2

- I1: Operand 1 (data1)

  Data type: INT

  Meaning: Data to be manipulated,the result of the operation is also assigned to this operand.

- I2: Operand 2 (data2)

  Data type: INT

  Meaning: Data to be compared.

For example:

```
BitOr (INT1, INT2)
```
Perform a bitwise OR operation on INT1 and INT2 and assign the result to INT1.

BitXOr

This command performs a bitwise XOR operation on two operands and assigns the result to the first operand, achieving the bitwise XOR operation. The command parameters are described as below:

BitXOrI1 I2

- I1: Operand 1 (data1)

  Data type: INT

  Meaning: Data to be manipulated,the result of the operation is also assigned to this operand.

- I2: Operand 2 (data2)

  Data type: INT

  Meaning: Data to be compared.

For example:

```
BitXOr (INT1, INT2)
Perform a bitwise XOr operation on INT1 and INT2 and assign the result to INT1.
```

BitLSH

This command performs a bitwise left shift operation on two operands and assigns the result to the first operand, achieving the bitwise left shift operation. The command parameters are described as below:

BitLSHI1 I2

- I1: Operand 1 (data1)

  Data type: INT

  Meaning: Data to be manipulated,the result of the operation is also assigned to this operand.

- I2: Operand 2 (data2)

  Data type: INT

  Meaning: Data to be compared.

For example:

```
BitLSH (INT1, INT2)
Perform a bitwise left-shift operation on INT1 and INT2 and assign the result to INT1.
```

BitRSH

This command performs a bitwise right shift operation on two operands and assigns the result to the first operand, achieving the bitwise right shift operation. The command parameters are described as below:

BitRSHI1 I2

- I1: Operand 1 (data1)

  Data type: INT

  Meaning: Data to be manipulated,the result of the operation is also assigned to this operand.

- I2: Operand 2 (data2)

  Data type: INT

  Meaning: Data to be compared.

For example:

```
BitRSH (INT1, INT2)
Perform a bitwise right-shift operation on INT1 and INT2 and assign the result to INT1.
```

3.8 CLOCK commands

The list of CLOCK commands:

CLOCK commands	CLKStart
	CLKStop
	CLKRead
	CLKReset

CLKStart

This command is used to start a specific clock. Once started, you can see that the state of the specified clock variable in the variable list is set to true. The command parameters are described as below:

CLKStartclk

- clk: clock)

  Data type: CLOCK

  Meaning: The variable of the clock to be started.

For example:

```
CLKStart (CLOCK0)
Start clock CLOCK0.
```

CLKStop

Stop the specified clock (its state is false, but will not be reset). The command parameters are described as below:

CLKStopclk

- clk: clock

  Data type: CLOCK

  Meaning: The variable of the clock to be stopped.

For example:

```
CLKStop (CLOCK0)
Stop clock CLOCK0.
```

CLKRead

Read the value of the specified clock, by checking the value corresponding to the variable in the list of variables. The command parameters are described as below:

CLKReadclk

- clk: clock

  Data type: CLOCK

  Meaning: The variable of the clock to be read from.

For example:

```
CLKRead (CLOCK0)
Read clock and store it in CLOCK0.
```

CLKReset

This command is used to reset the state and value of a specific clock. The command parameters are described as below:

CLKResetclk

- clk: clock

  Data type: CLOCK

  Meaning: The variable of the clock to be reset.

For example:

```
CLKReset (CLOCK0)
Rest clock CLOCK0.
```

3.9 AREA commands

The list of AREA commands:

AREA commands	AreaActivate
	AreaDeactivate
	PolyhedronAreaActivate
	PolyhedronAreaDeactivate
	AreaConnectIO
	AreaDisConnectIO
	PolyhedronAreaConnectIO
	PolyhedronAreaDisConnectIO

AreaActivate

Activate the standard AREA command to make the specified standard area be valid. The command parameters are described as below:

AreaActivateArea

- Area: Standard AREA variable (Area)

  Data type: AREA

  Meaning: The variable of the standard AREA to be activated.

For example:

```
AreaActivate (AREA0)
Activate standard area monitoring to enable AREA0.
```

AreaDeactivate

This is the command for deactivating standard AREA commands to invalidate the specified standard area. The command parameters are described as below:

AreaDeactivateArea

- Area: Standard AREA variable (Area)

  Data type: AREA

  Meaning: The variable of the standard AREA to be deactivated.

  For example:

```
AreaDeactivate (AREA0)
Deactivate standard area monitoring to enable AREA0.
```

PolyhedronAreaActivate

Activate the polyhedron AREA command to enable the specified polyhedron area. The command parameters are described as below:

PolyhedronAreaActivate Polyhedron

- Polyhedron: Polyhedron AREA variable (Polyhedron)

  Data type: POLYHEDRON

  Meaning: The variable of polyhedron area to be activated.

For example:

```
PolyhedronAreaActivate (POLYHEDRON0)
Activate the polyhedron area monitoring to enable the polyhedron area corresponding to POLYHEDRON0.
```

PolyhedronAreaDeactivate

Deactivate the polyhedron AREA command to disable the specified polyhedron area. The command parameters are described as below:

PolyhedronAreaDeactivate Polyhedron

- Polyhedron: Polyhedron AREA variable (Polyhedron)

  Data type: POLYHEDRON

  Meaning: The variable of polyhedron area to be deactivated.

For example:

```
PolyhedronAreaDeactivate (POLYHEDRON0)
Deactivate the polyhedron area monitoring to disable the polyhedron area corresponding to POLYHEDRON0.
```

AreaConnectIO

The command to bind an AREA IO, by which an input port can be bound to the selected area and specify a high and low active level for controlling the start and stop of the robot. The command parameters are described as below:

AreaConnectIOArea IoType IoPort IoPol

- Area: Standard AREA variable (Area)

  Data type: AREA

  Meaning: The standard area variable to be bound.

- IoType: IO type (IoType)

  Data type: enum (DI/SIMDI)

  Meaning: The type of IO port to be bound.

  − DI: Actual DI.
  − SIMDI: Virtual DI.

- IoPort: IO port number (IoPort)

  Data type: int

Meaning: The IO port number to be bound.

- IoPol: IO polarity (IoPolarity)

  Data type: enum (HIGH/LOW)

  Meaning: The IO polarity to be bound.

  − HIGH: Absolute transition.
  − LOW: The type of default.

AreaDisConnectIO

The command to unbind the area IO, by which the binding to the selected area input port can be removed. The command parameters are described as below:

AreaDisConnectIO Area

- Area: Standard AREA variable (Area)

  Data type: AREA

  Meaning: The standard area variable that needs to be unbound.

PolyhedronAreaConnectIO

The command to bind an area IO, by which an input port can be bound to the selected area and a high and low active level can be specified for controlling the start and stop of the robot. The command parameters are described as below:

PolyhedronAreaConnectIO Polyhedron IoType IoPort IoPol

- Polyhedron: Polyhedron AREA variable (Polyhedron)

  Data type: POLYHEDRON

  Meaning: the polyhedron area variable to be bound.

- IoType: IO type (IoType)

  Data type: enum (DI/SIMDI)

  Meaning: Type of IO port to be bound.

  − DI: Actual DI.
  − SIMDI: Virtual DI.

- IoPort: IO port number (IoPort)

  Data type: int

  Meaning: The IO port number to be bound.

- IoPol: IO polarity (IoPolarity)

  Data type: enum (HIGH/LOW)

  Meaning: The IO polarity to be bound.

  − HIGH: Absolute transition.
  − LOW: The type of default.

PolyhedronAreaDisConnectIO

Unbind area IO command, by which the binding to the selected area input port can be removed. The command parameters are described as below:

PolyhedronAreaDisConnectIO Polyhedron

- Polyhedron: Polyhedron AREA variable (Polyhedron)

  Data type: POLYHEDRON

  Meaning: The polyhedron AREA variable to be unbound.

3.10 Visual commands

The list of visual commands:

Visual commands	TrigCam
	WaitFinishCAM
	GetCamPos
	SendMessage

TrigCam

This is the command to trigger the camera shooting. The command parameters are described as below:

TrigCamtiid

- ti: Camera trigger parameter (trigger info)

  Data type: string

  Meaning: The camera trigger parameter.

- id: Camera index parameter (camera id)

  Data type: int

  Meaning: The camera index parameter.

For example:

```
TrigCam (“OK”,1)
The string "OK" triggers the camera to shoot a picture.
```

WaitFinishCAM

This is the command for waiting for the camera to finish shooting. The command parameters are described as below:

WaitFinishCAMwtid

- wt: wait time

  Data type: int

  Meaning: The waiting time for the camera to complete capturing an image, ranging from 0 to 20000 ms.

- id: Camera index parameter (camera id)

  Data type: int

  Meaning: The camera index parameter.

For example:

```
WaitFinishCAM (1000,1)
The time to wait for the camera to finish shooting is 1000ms.
```

GetCamPos

This command is used to obtain the position of the camera. The command parameters are described as below:

GetCamPosP tarID ret id

- P: Target position (target position)

  Data type: CPOS

Meaning: The camera has to get the target position.

- tarID: Target position (targetID)

  Data type: INT

  Meaning: ID value of the target object.

- ret: valid

  Data type: INT

  Meaning: Whether the retrieved position point is valid.

- id: Camera index parameter (camera id)

  Data type: int

  Meaning: The camera index parameter.

For example:

```
GetCamPos (P6, INT0, INI1,1)
Get the camera's position P6, the target object ID is INT0 and determine if it is valid as INT1..
```

SendMessage

Send a string message, which can be used for 3D visual commands. It sends the specified string to the camera, and enables the camera to shoot. The command parameters are described as below:

SendMessagemsg id

- msg: message info

  Data type: string

  Meaning: The content of the message sent.

- id: Camera index parameter (camera id)

  Data type: int

  Meaning: The camera index parameter.

For example:

```
SendMessage (“OK”,1)
Send the string "OK" to the camera.
```

3.11 Palletizing commands

The list of palletizing commands:

Palletizing commands	PalletReset
	PalletToPut
	PalletFromPut
	PalletToGet
	PalletFromGet

PalletReset

This is the command for palletizing reset. When a pallet is forced to stop before the palletizing is completed, call this command to restore it. The command parameters are described as below:

PalletResetPalletName actPart

- PalletName: Palletizing name (Pallet Name)
  Data type: PALLET variable
  Meaning: The current pallet information variable
- actPart: Number of workpieces in the pallet (ActPart)
  Data type: int
  Meaning: The current quantity of workpieces placed on the pallet. The range is set between 0 and the maximum capacity of the pallet.

For example1:

```
PalletReset (Pallet0,8)
```

For example, Pallet0 with a maximum number of workpieces of 60 will halt when 8 workpieces have been placed. Call "PalletReset (Pallet0, 8);" to restart the palletizing of subsequent workpieces.

PalletToPut

This is the command for putting workpieces. The command parameters are described as below:

PalletToPutPalletName[V] [B] [C]

(Note: parameters indicated with [] are optional)

- PalletName: Pallet Name
  Data type: PALLET variable
  Meaning: The current pallet information variable
- [V]: Target speed (Velo)
  Data type: SPEED variable
  Meaning: To specify the speed at which the robot performs the PalletToPut operation, including the translational speed of the robots end effector, the rotational speed, and the movement speed of external axes.
  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)
  Data type: enum (FINE/RELATIVE/DEFAULT)
  Meaning: The way of transition when the robot approaches the endpoint.
  − FINE: No transition.
  − RELATIVE: Relative transition.
  − ABSOLUTE: Absolute transition.

− DEFAULT: The type of default.

Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE

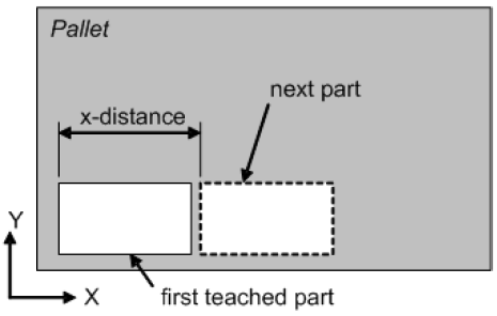
  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

For example1:

```
PalletToPut (PALLET1,V2000)
```

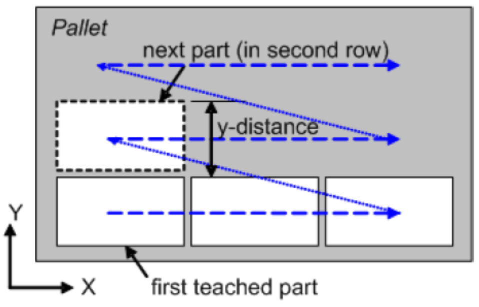
The palletizing position is calculated based on the first taught workpiece position as well as the configured palletizing distance. Add the set palletizing distance to the position of the previous workpiece, so as to get the position of the next workpiece, as shown in Figure 3-5.

Figure 3-5 Calculate the position of the next workpiece



According to Figure 3-6, the defaulted palletizing sequence starts from X. Arrange all the parts in the x direction first, and then the next row. Arrange the workpiece in the x direction until the pre-determined number of workpieces in the x direction is reached.

Figure 3-6 The defaulted palletizing order

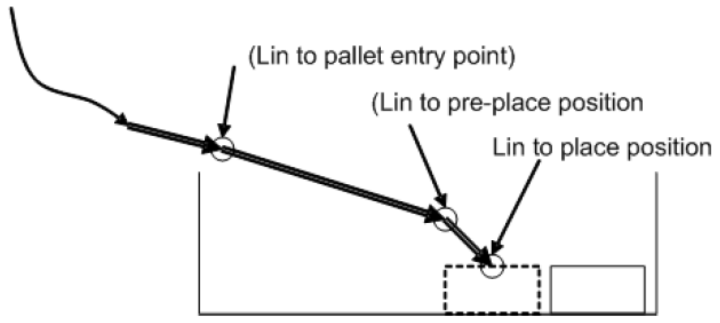


When starting placement for a new row, the position data of the workpiece in the new row will be produced by adding the offset in the y direction to the position of the workpiece in the first row.

The default palletizing sequence is x y z. First, put the workpiece in the x direction and then proceed to the second row. The placement of the first part of the new row starts at the position shown in the figure below. They will be put on the next row if the current row is full. After all the rows in this layer are filled, the xy layer repeats translation in the z direction until it is fully palletized.

Figure 3-7 illustrates the recommended path for placement.

Figure 3-7 Path for placement



Following motion commands are executed when PalletToPut command is called:

- The robot moves to the entry position of the pallet in a linear motion (optional)
- The robot moves to the front position of the palletizing point in a linear motion (optional)
- The robot moves to the arranged position of the workpiece in a linear motion (required)

PalletFromPut

This is the command used when the robot moves away from the putting position after the workpieces are placed. The command parameters are described as below:

PalletFromPutPalletName [V] [B] [C]

(Note: parameters indicated with [] are optional)

- PalletName: Palletizing name (Pallet Name)

  Data type: PALLET variable

  Meaning: The current pallet information variable
- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot performs the PalletFromPut operation, including the translational speed of the robots end effector, the rotational speed, and the movement speed of external axes.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.

  Note: This parameter is optional and defaults to C100.

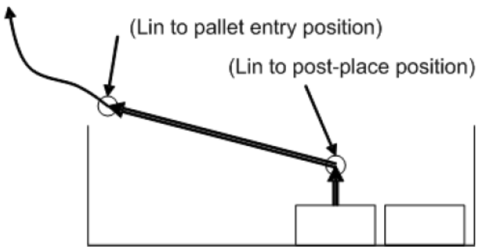
For example1:

```
PalletFromPut (PALLET1,V2000)
```

This is the command for the opposite action of workpiece placement, making the robot leaves from the position of the workpiece that has been placed.

The recommended path when leaving is shown in Figure 3-8.

Figure3-8 The path for leaving upon placement



Following motion commands are executed when calling the PalletFromPut command:

- The robot moves to the rear of palletizing point in a linear motion (optional)
- The robot moves to the entry position of the pallet in a linear motion (optional)

If neither the post-pallet point nor the entry position has been set, the robot will maintain its current posture when the PalletFromPut command is executed.

PalletToGet

This is the command for picking the workpiece. When executing this command, the robot will move from the current point to the palletizing point of the target workpiece to Pick such workpiece. The command parameters are described as below:

PalletToGetPalletName[V] [B] [C]

(Note: parameters indicated with [] are optional)

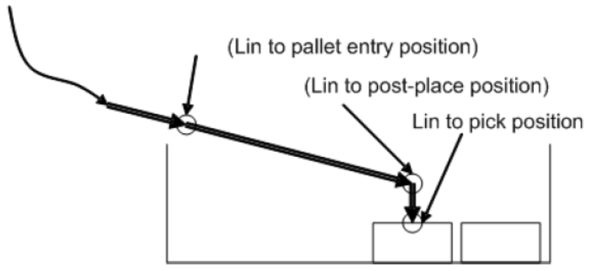
- PalletName: Palletizing name (Pallet Name)
  Data type: PALLET variable
  Meaning: The current pallet information variable
- [V]: Target speed (Velo)
  Data type: SPEED variable
  Meaning: To specify the speed at which the robot performs the PalletToGet operation, including the translational speed of the robots end effector, the rotational speed, and the movement speed of external axes.
  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)
  Data type: enum (FINE/RELATIVE/DEFAULT)
  Meaning: The way of transition when the robot approaches the endpoint.
  − FINE: No transition.
  − RELATIVE: Relative transition.
  − ABSOLUTE: Absolute transition.
  − DEFAULT: The type of default.
  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)
  Data type: ZONE
  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

For example1:

```
PalletToGet (PALLET1,V2000)
```

The recommended path for picking is shown in Figure3-9.

Figure3-9 Path for workpiece picking



Following motion commands are executed when calling the PalletToGet command:

- The robot moves to the entry position of palletizing point in a linear motion (optional)
- The robot moves to the post position of the pallet in a linear motion (optional)
- The robot moves to the picking position in a linear motion (required)

After making these motion sequences, the robot reaches the position where the workpiece is placed, then closes the fixture for picking workpieces.

PalletFromGet

This is the command indicating the process of leaving after workpiece pick. When executing this instruction, the robot will leave from the palletizing point where the workpiece is picked. The command parameters are described as below:

PalletFromGetPalletName [V] [B] [C]

(Note: parameters indicated with [] are optional)

- PalletName: Palletizing name (Pallet Name)

  Data type: PALLET variable

  Meaning: The current pallet information variable
- [V]: Target speed (Velo)

  Data type: SPEED variable

  Meaning: To specify the speed at which the robot performs the PalletFromGet operation, including the translational speed of the robots end effector, the rotational speed, and the movement speed of external axes.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE

  Meaning: The transition value when the robot approaches the endpoint.

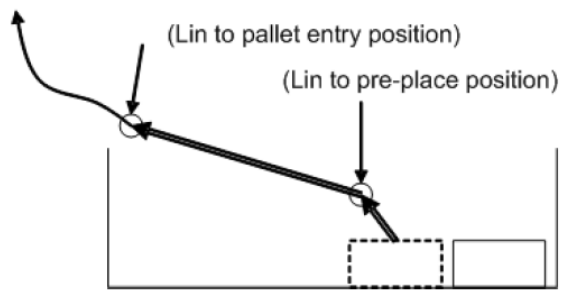
  Note: This parameter is optional and defaults to C100.

For example1:

```
PalletFromGet (PALLET1,V2000)
```

The recommended path for picking is shown in Figure3-10.

Figure3-10 Path for leaving after picking



Following motion commands are executed when calling the PalletFromGet command:

- The robot moves to the palletizing point in a linear motion (optional)
- The robot moves to the entry position of the pallet in a linear motion (optional)

If neither the post-point nor the entry position of the pallet point has been set, the robot will maintain its current posture when executing the PalletFromGet command.

3.12 Socket commands

The list of Socket commands:

Socket commands	SocketCreate
	SocketClose
	SocketSendStr
	SocketSendReal
	SocketSendInt
	SocketReadReal
	SocketReadInt
	SocketReadStr
	SocketResetBuf

SocketCreate

Create a socket client for purpose of data exchange with the server. Create a client locally and connect it with the server-side according to the server-side parameters transmitted.

SocketCreateSN IP P RV

- SN: Socket name
  Parameter type: Socket variable
- IP: IP address
  Parameter type:string
  Meaning: The IP address of the server to be connected to.
- P: Port number
  Parameter type:int

Meaning: The port number of the server to be connected.

- RV: Operation returned value

  Parameter type: INT variable

  Meaning: To create the operation returned value variable, a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketCreate (Socket0, "192.168.1.1", 8888, INT0)
Create a Socket named Socket0, the connected server IP is "192.168.1.1", and the port is 8888
```

SocketClose

Close the socket client that has been created before.

SocketClose SN RV

- SN: Socket name

  Parameter type:Socket variable

  Meaning: The socket created by the SocketCreate

- RV: Operation returned value

  Parameter type: INT variable

  Meaning: The returned value variable of operation, for which a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketClose (Socket0, INT0)
Close the Socket0
```

SocketSendStr

Send a string to the server that has established a connection.

SocketSendStr SN SD RV

- SN: Socket name

  Parameter type: Socket variable

  Meaning: The socket created by the SocketCreate

- SD: Send data

  Parameter type: STRING constant or STRING variable

- RV: Operation returned value

  Parameter type: INT variable

  Meaning: The returned value variable of operation, for which a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketSendStr (Socket0, "test string", INT0)
Send the "test string" to the server
```

SocketSendReal

Send a real array to the connected server.

SocketSendReal SN RA RV

- SN: Socket name

  Parameter type: Socket variable

  Meaning: The socket created by the SocketCreate

- RA: Real array data sent (Real array)

  Parameter type: Real array

- RV: Operation returned value

  Parameter type: INT variable

  Meaning: The returned value variable of operation, for which a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketSendReal (Socket0, RealOneArray0, INT0)
Send the real array RealOneArray0 to the server.
```

SocketSendInt

Send an int array to the connected server.

SocketSendIntSN IA RV

- SN: Socket name

  Parameter type: Socket variable

  Meaning: The socket created by the SocketCreate
- IA: Int array data sent (Int array)

  Parameter type: int array
- RV: Operation returned value

  Parameter type: INT variable

  Meaning: The returned value variable of operation, for which a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketSendInt (Socket0, IntOneArray0, INT0)
Send the int array IntOneArray0 to the server
```

SocketReadReal

Read the string sent from the server-side, and store it in the form of a real array.

Wait for and receive the string sent by the server. Its format is [1.1,2.2,3.3,4.4] (that is, the beginning and the end of the data are[], and the figures are separa ted by,). The robot system will split and parse the received string, and store it in the array in sequence.

SocketReadReal SN DN RD DT RV

- SN: Socket name

  Parameter type: Socket variable

  Meaning: The socket created by the SocketCreate
- DN: Count of data (Data num)

  Parameter type:int
- RD: The data actually read (Real data)

  Parameter type: RealOneArray variable
- DT: Detection time (Detection time)

  Parameter type:int

  Meaning: The waiting time (ms) for data to be sent from the server, with an alarm triggered if a timeout occurs
- RV: Operation returned value

  Parameter type:INT variable

  Meaning: The returned value variable of operation, for which a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketReadReal (Socket0, 5, RealOneArray0, 100, INT0)
Read 5 real numbers from the server within 100ms, and put them in the variable RealOneArray0
```

SocketReadInt

Read the string sent from the server and store it in the form of an int array.

Wait for and receive the string sent by the server-side. Its format is [1,2,3,4] (the beginning and the end of the data are[], and the figures are separated by,). The robot system will split and parse the received string, and store it in the array in sequence.

SocketReadInt SN DN ID DT RV

- SN: Socket name

  Parameter type:Socket variable

  Meaning: The socket created by the SocketCreate
- DN: Count of data (Data num)

  Parameter type:int
- ID: The data actually read (Int data)

  Parameter type: IntOneArray variable
- DT: Detection time (Detection time)

  Parameter type: int

  Meaning: The waiting time (ms) for data to be sent from the server, with an alarm triggered if a timeout occurs
- RV: Operation returned value

  Parameter type:INT variable

  Meaning: The returned value variable of operation, for which a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketReadInt (Socket0, 5, IntOneArray0, 100, INT0)
Read 5 integers from the server within 100ms and store them in the variable variableIntOneArray0
```

SocketReadStr

Read the string sent from the server-side, and store it in the form of a string variable.

Wait and receive the string sent by the server. Its format is [Hello world!] (The beginning and the end of the data are[]). The robot system will store the received string in the string variable.

SocketReadStr SN SD DT RV

- SN: Socket name

  Parameter type:Socket variable

  Meaning: The socket created by the SocketCreate
- SD: The data actually read (String data)

  Parameter type:STRING variable
- DT: Detection time (Detection time)

  Parameter type:int

  Meaning: The waiting time (ms) for data to be sent from the server, with an alarm triggered if a timeout occurs
- RV: Operation returned value

  Parameter type:INT variable

  Meaning: The returned value variable of operation, for which a returned value of 0 indicates success, while a returned value of 1 indicates failure.

For example:

```
SocketReadStr (Socket0, STRING0, 100, INT0)
Read the strings from the server within 100ms, and put them in the variable STRING0
```

SocketResetBuf

This command is used to reset local cache strings. It is intended to reset the data already received in the cache before the SocketRead read command is executed, to avoid the problem of misplaced data reading.

SocketReadStr SN

- SN: Socket name

  Parameter type:Socket variable

  Meaning: The socket created by the SocketCreate

For example:

```
SocketResetBuf (Socket0)
Reset the cached communication data in Socket0
```

3.13 SoftFloat commands

The list of SoftFloat commands:

SoftFloat commands	SoftFloatStart
	SoftFloatStop

SoftFloatStart

This command allows the robot to transition from a rigid state to a compliant state without using external sensors or modifying the mechanical structure. Once the command is activated, the robots end effector can move linearly along the specified direction in response to external forces. The command parameters are described as below:

SoftFloatStartType Coordinate[Tool] [User]DirectionSensitivity

(Note: parameters indicated with [] are optional)

- Type: Type of SoftFloat (SoftType)

  Data type: enum ("CART")

  Meaning: Type of SoftFloat. Only the linear SoftFloat is supported currently.

  ---"CART": The linear type.
- Coordinate: Reference coordinate system (Coordinate)
  Data type: enum ("WORLD","TOOL","USER")

  Meaning: SoftFloat reference coordinate system

  ---"WORLD": World Coordinates

  ---"TOOL": Tool Coordinates

  ---"USER": User Coordinates
- Tool: Coordinate system number (SoftTool)

  Data type: TOOL variable

  Meaning: Tool Parameters variable. This parameter is only valid when the reference coordinate system is set to "TOOL".

  Note: This parameter is invalid when the reference coordinate system is set to “WORLD” or “USER”.
- User: Coordinate system number (SoftUser)

  Data type: USERCOOR variable

  Meaning: The variable of user coordinate system. This parameter is only valid when the reference coordinate system is set to "USER".

  Note: This parameter is invalid when the reference coordinate system is set to “WORLD” or “TOOL”.
- Direction: SoftFloat direction (SoftDirection)
  Data type: enum ("X","Y","Z")

  Meaning: SoftFloat direction

  ---"X": The X direction of the selected reference coordinate system or its number

  ---"Y": The Y direction of the selected reference coordinate system or its number

  ---"Z": The Z direction of the selected reference coordinate system or its number
- Sensitivity: SoftFloat sensitivity (SoftSensitivity)
  Data type: enum ("HIGH","MidHigh","MID","MidLow","LOW")

  Meaning: The SoftFloat compliance parameter

  ---"HIGH": The highest level of compliance

  ---"MidHigh": The second highest level of compliance

  ---"MID": The medium compliance

  ---"MidLow": The second lowest level of compliance

  ---"LOW": The lowest level of compliance

For example1:

```
SoftFloatStart ("CART","TOOL",tool1,"Y","MID")
```

SoftFloatStop

Use this command to turn off the SoftFloat function.

For example1:

```
SoftFloatStop ()
```

3.14 Conveyor tracking commands

The list of conveyor tracking commands:

Conveyor tracking commands	MovLSync
	MovJSyncQuit
	MovLSyncQuit
	WaitWObj
	SetTargetPos
	SetSyncoord
	SyncCToUserC
	WaitConvDis
	SimConveyorOn
	SimConveyorOff
	ReceiveWObj
	ResetWObjBuf

MovLSync

The MovLSync command is a conveyor synchronous motion command. It allows the robots TCP to move linearly at the set speed to the target position while maintaining synchronization with the conveyors motion. Similar to MovJ, additional IO operations can be performed after executing this command. The command parameters are described as below:

MovLSyncP [V][Tool] Coord [PayLoad][SyncGoto]HeightConvyGoto[DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: CPOS variable

  Meaning: The target point to be followed is specified as an offset relative to the recognized point of the target object, rather than being obtained through teaching.
- [V]: Target speed (Velo)

  Data type: SPEED variable

Meaning: To specify the speed at which the robot executes MovLSync. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

Note: This parameter is optional and defaults to V4000.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.
- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The moving coordinate system used by the robot when executing this path should be consistent with the moving coordinate system enabled in the conveyor configuration interface.
- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.
- [SyncGoto]: Jump labels on abort during sync (SyncGoto)

  Data type: label

  Meaning: Used for the abort function during synchronization. When the robot fails to achieve synchronization with the target object during the MovLSync command, the program pointer will jump to the line where the specified label is located to execute the abort operation. Users can add corresponding commands under this label based on the on-site conditions.

  Note: This parameter is optional. When set to default, it will jump to the Label used for "Jump label when aborted after synchronization".
- Height: Lift height when aborting after sync (Height)

  Data type: real

  Meaning: The distance to lift when aborting after synchronization, relative to the positive direction of the dynamic coordinate systems Z -axis.
- ConvyGoto: Jump labels on abort after sync (ConvyGoto)

  Data type: label

  Meaning: Used for aborting during the tracking process. When the robot is unable to continue tracking during the tracking motion, specifically when the subsequent commands after the MovLSync fail to execute, the program pointer will jump to the line where the specified label is located to perform the aborting operation. Under this label, users can include corresponding commands based on the on-site conditions.
- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:
  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

MovJSyncQuit

The MovJSyncQuit command is used to exit the conveyor synchronized joint motion. This command allows the robot to move at the set speed to exit the synchronized motion with the conveyor. The robot will move to the target position using joint motion. If the starting and ending postures of the motion are different, the robots posture will rotate synchronously with the position during the motion to reach the final posture. Similar to MovJ, additional IO operations can be performed after executing this command. The command parameters are described as below:

MovJSyncQuitP [V] [B] [C][Tool] Coord [PayLoad][DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.

- [V]: Target speed (Velo)
  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovJSyncQuit. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

  Note: This parameter is optional and defaults to V4000.
- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.
- [C]: Transition Value (BlendValue)

  Data type: ZONE variable

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.
- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.
- Coord: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.
- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.
- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  - NULL: No operation.
  - IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

MovLSyncQuit

The MovLSyncQuit command is used to exit the conveyor synchronized linear motion. This command allows the robots TCP point to move at the set speed to exit the synchronized motion with the conveyo r. The robot will move to the target position using linear motion. If the starting and ending postures of the motion are different, the robots posture will rotate synchronously with the position during the motion to reach the final posture. Similar to MovJ, additional IO operations can be performed after executing this command. The command parameters are described as below:

MovLSyncQuit P [V] [B] [C][Tool] Coord [PayLoad][DO]

(Note: parameters indicated with [] are optional)

- P: Target position (Target Pos)

  Data type: APOS or CPOS variable

  Meaning: The target point position in the coordinate system.
- [V]: Target speed (Velo)
  Data type: SPEED variable

  Meaning: To specify the speed at which the robot executes MovLSyncQuit. It includes the translational speed of the robots end effector, rotational speed, and speed of external axes, among others. In this case, the tcp and ori components in the SPEED variable are valid. If there are external axes present, the exj_l and exj_r components in the SPEED variable are valid as well.

Note: This parameter is optional and defaults to V4000.

- [B]: Transition type (BlendType)

  Data type: enum (FINE/RELATIVE/DEFAULT)

  Meaning: The way of transition when the robot approaches the endpoint.

  − FINE: No transition.

  − RELATIVE: Relative transition.

  − ABSOLUTE: Absolute transition.

  − DEFAULT: The type of default.

  Note: This parameter is optional and defaults to FINE.

- [C]: Transition Value (BlendValue)

  Data type: ZONE variable

  Meaning: The transition value when the robot approaches the endpoint.
  Note: This parameter is optional and defaults to C100.

- [Tool]: Tool Parameters (Tool)

  Data type: TOOL variable

  Meaning: The tool parameters used when the robot executes the path.

  Note: This parameter is optional and defaults to the Tool Parameters set in the current system.

- Coord: Coordinate System Parameters (Coord)

  Data type: USERCOOR variable

  Meaning: The user coordinate system used by the robot when executing the path.

- [PayLoad]: Workpiece load (PayLoad)

  Data type: PAYLOAD variable

  Meaning: The workpiece load parameter used by the robot when executing the path.

  Note: This parameter is optional and defaults to the payload parameters set in the current system.

- [DO]: IO operations to be executed after motion done (Add Do)

  Data type: string

  Meaning: The IO operations that can be triggered after the robot completes the command:

  − NULL: No operation.

IO COMMANDS: EXECUTING IO OPERATION. THE IO COMMANDS CURRENTLY AVAILABLE ARESetDo, SetAo, SetSimDo, SetSimAo, PulseOut, PulseSimOut, SetDO8421, SetDIEdge, SetSimDIEdge.

WaitWObj

The command is used to wait for the position information of a workpiece on a specified conveyor belt from an external device within a specified duration. If the waiting condition is met within the set duration, the program will continue executing; if the condition is not met within the set duration, the timeout judgment value will be set to 1, and the program will continue executing.

The command parameters are described as below:

WaitWObj Coord T Ret [Goto]

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The moving coordinate system referenced for the position information of the workpiece that the robot is currently waiting for should be consistent with the moving coordinate system enabled in the conveyor configuration interface.

- T: Duration (Time)

  Data type: int

  Meaning: The duration, in milliseconds, for waiting for the position information of the workpiece from the external device. When the value is 0, it will force a wait until the DI signal is satisfied, and then consider it as a successful execution.

- Ret: Timeout judgment value (Timeout Flag)

  Data type: INT

  Meaning: To return the status after the command execution is done.

  - 0: Signal is detected successfully
  - 1: No signal is detected, and the command times out and returns.

- [Goto]: Tag name for timeout jump (Value)

  Data type: label

  Meaning: The label name to jump to after a timeout occurs. This label should correspond to a LABEL command that has been taught in the currently loaded program, such as "Start". When a timeout occurs, the program pointer will jump to the command line associated with the specified label name.

  Note: This parameter is optional and defaults to “No Jump”.

For example1:

```
WaitWObj (SYNCOORD0, 1000, INT1, "Goto Start")
Wait for the position information of the workpiece from the external device, bound to the
moving coordinate system SYNCOORD0, within a duration of 1000ms. If the condition is
successfully met within 1000ms, the program will continue executing. However, if the
condition is not met within 1000ms, INT1 will be set to 1, and the program pointer will
jump to the line where the "Start" label is located (the first line) to begin execution.
```

SetTargetPos

This command is used to send the position information of the workpiece to the specified conveyor, enabling the robot to perform conveyor tracking. This command can only be executed when the trigger type selected in the conveyor interface is non-vision trigger type.

The command parameters are described as below:

SetTarget Coord P

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The moving coordinate system to which the current workpiece position information refers should be consistent with the moving coordinate system enabled in the conveyor configuration interface.

- P: Target position (Target Pos)

  Data type: CPOS variable

  Meaning: The offset of the workpiece relative to the origin of the SYNCOORD coordinate system. Only the values for X, Y, and A are valid in this parameter.

SetSyncoord

The moving coordinate system set commands. It is used to set the current robot reference coordinates to moving coordinates. This command enables the current robot reference coordinates to be switched to a moving coordinate system, which can quickly teach the posture of the point position during the following process.

The command parameters are described as below:

SetSyncoord Coord

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The parameter of the coordinate system to which the robot is currently referenced, which can only be set to variables of SYNCOORD.

SynCToUserC

The teaching reference coordinate system transformation command. It is used to calculate the coordinate system referenced during the path point teaching tracking synchronization.

The command parameters are described as below:

SynCToUserC Sync P Coord

- Sync: Movable Coordinate System Parameters (SynCoord)

  Data type: SYNCOORD variable

Meaning: The current moving coordinate system that the workpiece position information is referenced to should be consistent with the moving coordinate system enabled in the conveyor configuration interface.

- P: Target position (Target Pos)

  Data type: DCPOS variable

  Meaning: Indicating the offset of the position of the workpiece entering the conveyor relative to the origin of the moving coordinate system.

- Coord: Coordinate System Parameters (Coord)

  Data type: USERCOORD variable

  Meaning: The user coordinate system that is used as a reference when teaching the path waypoints after tracking sync.

WaitConvDis

It is used to enable the robot to move in the positive direction of the conveyor in synchronization with the conveyor up to a certain increment before executing subsequent commands, thus allowing the robot to delay the movement for a specified increment. Unlike the Wait commands, this command requires a fixed increment while the Wait command requires a fixed time.

The command parameters are described as below:

WaitConvDis Coord Dis

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The moving coordinate system that is used as a reference for the current position information of the workpiece. It should be consistent with the moving coordinate system enabled in the conveyor configuration interface.

- Dis: Awaiting increment (Increment)

  Data type: real

  Meaning: The value of the increment in which the robot is to be synchronized. In mm for straight conveyors and in deg for disc conveyors.

SimConveyorOn

The Virtual Conveyor ON command. It is used to enable the virtual conveyor and specify its running speed.

The command parameters are described as below:

SimConveyorOnCoord Speed

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The moving coordinate system that is used as a reference for the current position information of the workpiece. It should be consistent with the moving coordinate system enabled in the conveyor configuration interface.

- Speed: Conveyor speed (ConveyorSpeed)

  Data type: real

  Meaning: The speed at which the virtual conveyor runs.

SimConveyorOff

The Virtual Conveyor OFF command. It is used to disable the virtual conveyor.

The command parameters are described as below:

SimConveyorOffCoord

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

Meaning: The moving coordinate system that is used as a reference for the current position information of the workpiece. It should be consistent with the moving coordinate system enabled in the conveyor configuration interface.

ReceiveWObj

A command to set the receive status of workpiece data. This command can be used in combination to allow the robot system to not receive workpiece position information from vision or run programs within a certain segment of the path, to prevent instances of incorrect tracking and cater to various on-site processes

The command parameters are described as below:

ReceiveWObjCoordenableSts

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The moving coordinate system that is used as a reference for the current position information of the workpiece. It should be consistent with the moving coordinate system enabled in the conveyor configuration interface.
- enableSts: Enable receive status (EnableSts)

  Data type: enum (OFF/ON)

  Meaning: Enables the robot system to receive information on the position of the workpiece.

ResetWObjBuf

A command to reset the queue of received workpiece data. It empties the queue of received and unexecuted workpiece information.

The command parameters are described as below:

ReceiveWObjCoord

- Coord: Coordinate System Parameters (Coord)

  Data type: SYNCOORD variable

  Meaning: The moving coordinate system that is used as a reference for the current position information of the workpiece. It should be consistent with the moving coordinate system enabled in the conveyor configuration interface.

3.15 INTERRUPT commands

The list of INTERRUPT commands:

INTERRUPT commands	IConnect
	IDelete
	ITimer
	ISignalDI
	ISignalSimDI
	IEnter
	MovToIPos
	IExit

	ExitCycle

IConnect

The interrupt connection command. It binds the INTERRUPT identifier to the interrupt handler for operation, so that the system can execute the INTERRUPT program bound to the interrupt index when the trigger condition corresponding to the INTERRUPT identifier is met. The command parameters are described as below:

IConnect Interrupt TrigProg

- Interrupt: INTERRUPT ID (Interrupt)

  Data type: INTERRUPT variable

  Meaning: The unique Interrupt index number.
- TrigProg: Interrupt handler (TrigProgram)

  Data type: program

  Meaning: The handler to be called when the signal corresponding to this INTERRUPT index is satisfied.

  Note: This parameter only allows for the selection of local programs and does not support global programs.

IDelete

The INTERRUPT release command. It removes any data associated with the INTERRUPT identifier in the system, effectively removing the detection of the INTERRUPT identifier and any corresponding execution data. The command parameters are described as below:

IDeleteInterrupt

- Interrupt: INTERRUPT ID (Interrupt)

  Data type: INTERRUPT variable

  Meaning: The unique INTERRUPT index number.

ITimer

The timer INTERRUPT command is used to set the INTERRUPT detection mode as timer-based detection. This means that the system will periodically execute the INTERRUPT program based on the configured trigger time. The command parameters are described as below:

ITimerInterrupt timeMs

- Interrupt: INTERRUPT ID (Interrupt)

  Data type: INTERRUPT variable

  Meaning: The unique INTERRUPT index number.
- timeMs: Trigger time (TrigProgram)

  Data type: int

  Meaning: The timing detection time, range: 100~3000000ms.

ISignalDI

The input INTERRUPT command. It is used to set the INTERRUPT detection mode as DI edge signal detection. It monitors the rising/falling edge signal of DI in real time to process the corresponding INTERRUPT program of the robot. The command parameters are described as below:

ISignalDIInterrupt IO EdgeType

- Interrupt: INTERRUPT ID (Interrupt)

  Data type: INTERRUPT variable

  Meaning: The unique INTERRUPT index number.
- IO: Port variable (IO)

  Data type: DI

  Meaning: The DI port number to be monitored.

- EdgeType: Trigger Edge type (EdgeType)

  Data type: enum(RiseEdge/DownEdge)

  Meaning: The type of DI edge signal to be monitored.

  - RiseEdge: The rising edge signal.
  - DownEdge: The falling edge signal.

ISignalSimDI

The virtual input port INTERRUPT command. It sets the detection of the INTERRUPT index to SimDI edge triggering, i.e. the rising/falling edge signals of SimDI are monitored in real time to process the corresponding INTERRUPT program of the robot. The command parameters are described as below:

ISignalSimDI Interrupt IO EdgeType

- Interrupt: INTERRUPT ID (Interrupt)

  Data type: INTERRUPT variable

  Meaning: The unique INTERRUPT index number.
- IO: Port variable (IO)

  Data type: SimDI

  Meaning: The virtual SimDI port number (SimDI type) to be monitored.
- EdgeType: Trigger Edge type (EdgeType)

  Data type: enum(RiseEdge/DownEdge)

  Meaning: The type of SimDI edge signal to be monitored

  - RiseEdge: The rising edge signal
  - DownEdge: The falling edge signal

IEnter

The command that interrupts the current parsing and motion, stops the parsing and motion of the main program and switches to the INTERRUPT program.

Note: This command can only be executed in the INTERRUPT program.

IExit

The command to resume parsing and motion, which cuts the INTERRUPT program to background for execution and resumes parsing and motion of the main program.

Note: 1. This command can only be executed in the INTERRUPT program.

2. This command must be used in conjunction with the IEnter and MovToIPos commands.

MovToIPos

The Return Interrupt Point command. It is used to automatically move the robot back to the interrupted position in the main program using the specified motion. When an interrupt occurs, the system automatically stores the interrupted position in memory. When this command is executed, the interrupted position is retrieved from memory and the robot moves to that position. The command parameters are described as below:

MovToIPosModeV

- Mode: Motion mode (Mode)

  Data type: enum(MOVJ/MOVL)

  Meaning: The mode of motion to the interrupt point

  - MOVJ: Return to the target point as a joint motion
  - MOVL: Return to the target point as a linear motion
- V: Target speed (Velo)

  Data type: SPEED

  Meaning: The speed of motion to the interrupt point

Note: 1. This command can only be executed in the INTERRUPT program.

- 2. This command must be used in conjunction with the IEnter and IExit commands.

ExitCycle

The exit cycle command. When this command is executed, the system will immediately end the current INTERRUPT program, return the PC pointer to the start of the main program, and bring the system to a halt.

Note: 1. This command can only be executed in the INTERRUPT program.

2. This command must be used in conjunction with the IEnter command

3. When this command is executed, the system will jump to the "CycleLable" label command if it is taught by the main program, or to the first line of the program being loaded if it is not taught.

3.16 ARRAY commands

The list of ARRAY commands:

ARRAY commands	SetMatrix
	GetMatrix

SetMatrix

Form a parallelogram in space with the specified three points and divide this parallelogram equally according to the set number of rows and columns to obtain a matrix point set.

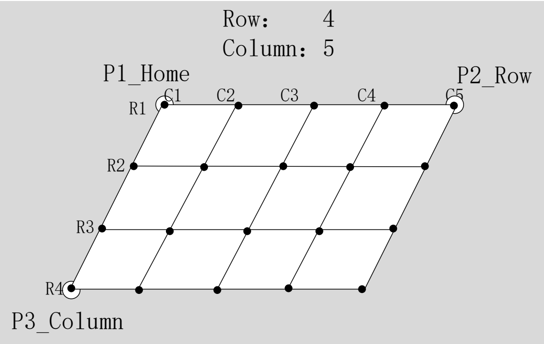
The command parameters are described as below:

SetMatrixP1 P2 P3 Row Column

- P1: Origin (HomePos)
  Data type: CPOS variable
  Meaning: Specifies the first point of the parallelogram,也称为原点.
- P2: Last point in row direction (RowPos)
  Data type: CPOS variable
  Meaning: Specifies the last point in the row direction of the parallelogram.
- P3: Last point in column direction (ColumnPos)
  Data type: CPOS variable
  Meaning: Specifies the last point in the column direction of the parallelogram.
- Row: Number of rows (Row)
  Data type: constant
  Meaning: The number of rows of the generated matrix.
- Column: Number of columns (Column)
  Data type: constant
  Meaning: The number of columns of the generated matrix.

For example:

Divide the quadrilateral formed by P1, P2 and P3 equally in 4 rows and 5 columns:



SetMatrix (P1,P2,P3,4,5)

GetMatrix

The value of this point in the corresponding row after executing the SetMatrix command and assigned to the target point. The posture and additional axis angle values of the point as described in SetMatrix remain the same as the origin.

The command parameters are described as below:

GetMatrixRow Column TarPos

- Row: Number of rows (Row)
  Data type: INTtype variable
  Meaning: The row number of the matrix from which the point is to be taken
- Column: Number of columns (Column)
  Data type: INTtype variable
  Meaning: The column number of the matrix from which the point is to be taken
- TarPos: Target point (TarPos)
  Data type: CPOS variable
  Meaning: Used to store the value of the picked point.

3.17 Mathematical Functions

This section provides an explanation of the “Mathematical Functions” that can be used.

sin

The sine trigonometric function

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

cos

The cosine trigonometric function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

tan

The tangent trigonometric function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

asin

The inverse sine trigonometric function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

acos

The inverse cosine trigonometric function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

atan

The inverse tangent trigonometric function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

atan2

X/Y inverse tangent value function, returning the value in radian from the X axis to the point (x, y).

- Parameter 1: A variable or constant of type int or REAL.
- Parameter 2: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

sinh

The hyperbolic sine function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

cosh

The hyperbolic cosine function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

tanh

The hyperbolic tangent function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

log

The natural logarithmic function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

log10

The logarithmic function of base 10.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

sqrt

The square root function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

exp

The exponential function of base e.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

pow

The exponential function.

- Parameter 1: int or real type variables or constants, base.
- Parameter 2: int or real type variables or constants, exponent.
- Function return value: The real constants.

deg

The radian to degree function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

rad

The degree to radian function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

fmod

The remainder function.

- Parameter 1: int or real type variables or constants, dividend.
- Parameter 2: int or real type variables or constants, divisor.
- Function return value: The real constants.

floor

The floor function.

- Parameter 1: A variable or constant of type int or REAL.
- Function return value: A constant of type REAL.

random

Random integers selected from one of the 2 parameters.

- Parameter 1: A variable or constant of type int or REAL.
- Parameter 2: A variable or constant of type int or REAL.
- Function return value: A constant of type int.

3.18 STRING commands

The list of STRING commands:

STRING commands	byte
	char
	find2
	findEnd
	format
	getAt
	gsub
	len
	left
	lower
	right
	reverse
	strcmp
	sub
	trimLeft
	trimRight
	IToStr
	upper
	RToStr
	StrToI
	StrToR
	APosToStr
	CPosToStr
	TranStrToInt

	TranStrToReal
	TranStrToApos
	TranStrToCpos

.

byte

Take the ASCCII code of the character in the nth position of the string.

- Parameter 1: The variable or constant of string type.
- Parameter 2: The variable or constant of type int.
- Function return value: The int-type constant.

char

Return the character corresponding to the ASCCII code.

- Parameter 1: The variable or constant of type int.
- Function return value: The constant of string type.

find2

Return the position of the substring in the string.

- Parameter 1: The variable or constant of string type.
- Parameter 2: The variable or constant of type int.

  Function return value: The int-type constant. (The return value is -1 when the corresponding character or string is not found)

findEnd

The string inversion lookup command, which locates the last occurrence of a specified string in a string and returns the index number.

- Parameter 1: The source string to be looked up, a variable or constant of type string.
- Parameter 2: The specified string to be looked up, a variable or constant of type string.
- Return value: The index number of the search, a variable of type int.

format

The formatted STRING command, which transmits a reasonable formatting control in parameter 1, fills this formatting control with any number of subsequent parameters, and returns the filled data.

- Parameter 1: The String format, a variable or constant of type string.
- Parameter 2: The parameter of the formatting controller to be filled, a variable or constant of type string/real/int.
- Parameter 3: The parameter of the formatting controller to be filled, a variable or constant of type string/real/int.
- ... (no limit on the number of parameters, as long as the total length does not exceed the length of a single commanded string)
- Function return value: The count of successfully split and saved to an array, a variable of type int

The formatted string starts with % and supports the following uses.

%c - accepts a number and converts it to the corresponding character in the ASCII table

%d, %i - accepts a number and converts it into signed integer format

%o - accepts a number and converts it to octal format

%u - accepts a number and converts it to unsigned integer format

%x - accepts a number and converts it to hexadecimal format, using the lowercase letter x

%X - accepts a number and converts it to hexadecimal format, using an uppercase X

%f - accepts a number and converts it to floating point format

%s - accepts a string and formats it according to the given parameters

Example:

format("%%c: %c", 83)	Output S
format("%+d", 17.0)	Output +17
format("%05d", 17)	Output 00017
format("%o", 17)	Output 21
format("%u", 3.14)	Output 3
format("%x", 13)	Output d
format("%X", 13)	Output D
format("%6.3f", 13)	Output 13.000
format("%s", "monkey")	Output monkey
format("%10s", "monkey")	Output monkey

getAt

The command to obtain a single string. It gets the string data of a certain bit and returns the obtained data.

- Parameter 1: The string to be intercepted, a variable or constant of type string.
- Parameter 2: The position to be intercepted, a variable or constant of type int.
- Function return value: The acquired string, a variable of type string.

gsub

Search for substring a within string s and replace a with string b.

- Parameter 1: The variable or constant of string type.
- Parameter 2: The variable or constant of string type.
- Parameter 3: The variable or constant of string type.
- Function return value: The constant of string type.

len

Calculate the length of a string.

- Parameter 1: The variable or constant of string type.
- Function return value: The int-type constant.

left

The command to take the left of a string. It intercepts a specified number of strings starting from the left side of the string and returns the intercepted data.

- Parameter 1: The string to be intercepted, a variable or constant of type string.
- Parameter 2: The number to be intercepted, a variable or constant of type int.
- Function return value: The intercepted string, a variable of type string.

lower

Return the string in lowercase format.

- Parameter 1: The variable or constant of string type.
- Function return value: The constant of string type.

right

The command to take the right of a string. It intercepts a specified number of strings starting from the right side of the string and returns the intercepted data.

- Parameter 1: The string to be intercepted, a variable or constant of type string.
- Parameter 2: The number to be intercepted, a variable or constant of type int.
- Function return value: The intercepted string, a variable of type string.

reverse

The string inversion command, which inverts the string and returns it.

- Parameter 1: The string to be inverted, a variable or constant of type string.
- Function return value: The string to be inverted, a string variable.

strcmp

The String comparison command. Under this command, the return value is the ASCII difference between the first different characters.

- Parameter 1: The string data to be compared, a variable or constant of type string.
- Parameter 2: The string data to be compared, a variable or constant of type string.
- Function return value: The returned ASCII value, a variable of type int.

trimLeft

The command to trim the string by left. This command removes the spaces to the left of the string and returns the modified string data.

- Parameter 1: String to be trimmed, a variable or constant of type string.
- Function return value: The trimmed string, a variable of type string.

trimRight

The command to trim the string by right. This command removes the spaces to the right of the string and returns the modified string data.

- Parameter 1: String to be trimmed, a variable or constant of type string.
- Function return value: The trimmed string, a variable of type string.

upper

Return the string in uppercase format.

- Parameter 1: The variable or constant of string type.
- Function return value: The constant of string type.

IToStr

Integer data to STRING command. The command allows to convert integer data to string type data and return the converted string.

- Parameter 1: The integer data to be converted, a variable or constant of type int.
- Function return value: The converted string data, a variable of type string.

RToStr

REAL parameter to STRING command. The command allows to convert the real data to string type data and return the converted string.

- Parameter 1: The real data to be converted, a variable or constant of type REAL.
- Function return value: The converted string data, a variable of type string.

StrToI

The String to Integer command. This command converts string data to integer type data and returns the converted integer data.

- Parameter 1: The string data to be converted, a variable or constant of type string.
- Function return value: The converted integer data, a variable of type int.

StrToR

The String to REAL data command. This command converts string data to REAL type data and returns the converted real number.

- Parameter 1: The string data to be converted, a variable or constant of type string.
- Function return value: The real data to be converted, a variable of type REAL.

APosToStr

The APOS point data to STRING command. This command converts apos points into strings in the specified format and returns the converted string data. The converted apos point is in the format "0; 1,2,3,4,5,6,0,0,0,0,0,0,0,0,0,0,0,0;", where the semicolon in front represents the apos point type and coordinate value, respectively.

- Parameter 1: The APOS point data to be converted, a variable of type APOS.
- Function return value: The converted string data, a variable of type string.

CPosToStr

The CPOS point data to STRING command. This command converts cpos points into strings in the specified format and returns the converted string data. The converted cpos point is in the format "**1;0,0,0,0,0,0;1,2,3,4,5,6,0,0,0,0,0,0,0,0,0,0;**", where the semicolon in front represents the cpos point type, cfg parameter and coordinate value, respectively.

- Parameter 1: The CPOS point data to be converted, a variable of type CPOS.
- Function return value: The converted string data, a variable of type string.

TranStrToInt

- The command to get integer string array. This command splits the string according to the passed split character, converts the split value to an integer one-dimensional array and returns the number of valid splits.
- Parameter 1: The string to be split, a variable or constant of type string.
- Parameter 2: The separator, a variable or constant of type string.
- Parameter 3: The split integer being stored as an array, a variable of type IntOneArray.
- Function return value: The count of successfully split and saved to an array, a variable of type int

  Example:

  P:INT0.value = TranStrToInt("1_2_3er", "_", G:IntOneArray0) // The command passes in the character "1_2_3er", and after execution the system extracts the data by splitting it according to the incoming split character _. The split data is stored in the one-dimensional integer array variable IntOneArray0 in the order of 1, 2, 0, and the number of splits 3 is assigned to INT0.value.

TranStrToReal

- A command to get an array of REAL strings. This command splits the strings according to the passed splitters and converts the split values into a REAL one-dimensional array and returns the number of valid splits.
- Parameter 1: The string to be split, a variable or constant of type string.
- Parameter 2: The separator, a variable or constant of type string.
- Parameter 3: Store the split REAL type variable as an array, a variable of type RealOneArray.
- Function return value: The count of successfully split and saved to an array, a variable of type int

  Example:

  P:INT0.value = TranStrToReal("1.1_2.2_3er", "_", G:IntOneArray0) // The command passes in the character "1.1_2.2_3er", after execution the system extracts the data by splitting it according to the incoming split character _. The split data is stored in the one -dimensional integer array variable RealOneArray0 in the order of 1.1, 2.2, 0 respectively, and the number of splits 3 is assigned to INT0.value.

TranStrToApos

- The command to get an array of apos point data strings. This command splits the string according to the passed split character and converts the split value to an apos point variable, while returning a status of whether the conversion was successful or not. The string to be converted must be in the format "0; 1,2,3,4,5,6,0,0,0,0,0,0,0,0,0,0,0,0;", where the leading semicolon represents the apos point type, the coordinate value, and the last semicolon can be followed by any string.
- Parameter 1: The string to be split, a variable or constant of type string.
- Parameter 2: The separator, a variable or constant of type string.
- Parameter 3: Store the split apos point data as an apos variable, a variable of type APOS.
- Function return value: Return the status of the extraction success or failure, a variable of type int

  Example:

  P:INT0.value = TranStrToApos("0; 21,22,23,24,25,26,0,0,0,0,0,0,0,0,0,0,0,0;$qwqewe", "$", G: P0) // The command passes in the characters "0;21,22,23,24,25,26,0,0,0,0,0,0,0,0,0,0,0,0;$qwqewe". After execution, the system will split the extracted data according to the incoming separator $, and the data after $ will be discarded. The split data are stored in the order 21, 22, 23, 24, 25, 26... in the order of a1, a2, a3, a4, a5, a6... of P0. and the successful return value 0 is assigned to INT0.value.

TranStrToCpos

- The command to get an array of cpos point data strings. This command splits the string according to the incoming separator and converts the split value to an apos point variable, while returning a status of whether the conversion was successful or not. The string to be converted must be in the format "1;0,0,0,0,0,0,0;1,2,3,4,5,6,0,0,0,0,0,0,0,0,0,0,0,0;", with the semicolon preceding the cpos point type, the cfg parameter, and the coordinate value respectively.
- Parameter 1: The string to be split, a variable or constant of type string.
- Parameter 2: The separator, a variable or constant of type string.
- Parameter 3: Store the split apos point data as a cpos variable, a variable of type CPOS.
- Function return value: Return the status of the extraction success or failure, a variable of type int

  Example:

  P:INT0.value = TranStrToCpos("1;0,0,0,0,0,0;21,22,23,24,25,26,0,0,0,0,0,0,0,0,0,0,0,0;$qwqewe", "$", G: P0) // The command passes in the characters "0; 0,0,0,0,0,0,0;21,22,23,24,25,26,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0;$qwqewe". After execution, the system will split the extracted data according to the passed splitting character $, the data after $ will be discarded. The data after the first ";" will be stored in the cfg parameter in the order of "0,0,0,0,0,0" and the data after the second ";" will be stored in the order of 21, 22, 23, 24, 25, 26... in the order of x, y, z, a, b, c... of P0, and the successful return value 0 is assigned to INT0.value.

3.19 ModbusTCP commands

The list of ModbusTCP commands:

ModbusTCP commands	GetModConState
	ReadModbusReg
	WriteModbusReg

GetModConState

This command is used to get the status of the robots connection to the external world using ModbusTCP communication. The command parameters are described as below:

GetModConState IsConnected

- IsConnected: Connection status (Is Connected)

  Data type: BOOL variable

  Meaning: Return the current connection status.

For example1:

```
GetModConState(BOOL0)
```

ReadModbusReg

The command is used to read the value of a specified Modbus register. The command parameters are described as below:

ReadModbusRegRegisterID RegisterValue

- RegisterID: Target Modbus Register ID

  Data type: int, with a value range of 101 to 1500.

  Meaning: The ID number of the register to be read.
- RegisterValue: Target Modbus Register Value

  Data type: INT variable

  Meaning: Return the value of the register after reading.

For example1:

```
ReadModbusReg(101, INT0)   // Read the value of the 101 register
```

WriteModbusReg

The command is used to set the value of a specified Modbus register. The command parameters are described as below:

WriteModbusReg RegisterIDRegisterValue

- RegisterID: Target Modbus Register ID

  Data type: int, with a value range of 101 to 1500.

  Meaning: The ID number of the register to be modified.
- RegisterValue: Target Modbus Register Value

  Data type: INT variable

  Meaning: The value of the register to be modified.

For example1:

```
INT0.value = 100
WriteModbusReg(101, INT0)  // Change the 101 register value to 100
```

3.20 Online payload identification command

List of the online payload identification command:

Online payload identification command	StartMdlLog
	StopMdlLog
	CalcDynLog

StartMdlLog

The online payload identification command. It is used to collect the robot motion data required for payload identification of the robot. The command parameters are described as below:

StartMdlLog dataType

- dataType: Data storage type (Data type)

  Data type: enum(Robot/WithLoad/ValidData)

  Meaning: Data storage type.

  - Robot: Collect the motion data of the robot body, that is, when no load is installed.

- WithLoad: Collect the robot motion data when the robot is installed with a load at the flange.
- Used for applications where model accuracy verification is required, to collect the robot motion data when the robot is installed with a load.

Note:

Note: 1. The "WithLoad" data type is mandatory for collection, while "Robot" and "ValidData" data types are optional.

2. Using "Robot" data type for tuning improves the accuracy but increases the tuning computation time.

3. Using "ValidData" data type allows simultaneous model accuracy verification during tuning but increases the computation time.

4. For load tuning data collection, when selecting "Robot" or "WithLoad" as the Data type, the motion commands for tuning path should be MovJ. For "ValidData" type, the tuning path can use a combination of MovJ, MovL, MovC, and other commands.

StopMdlLog

The online payload identification stopping command. This command is used to conclude the collection of robot motion data for load tuning and automatically save the data.

Note: This command must be used in conjunction with the "StartMdlLog" command.

For example1:

```
StartMdlLog(WithLoad)
MovJ(P0)
MovJ(P1)
MovJ(P2)
StopMdlLog()
```

CalcDynMdl

This command is used to perform tuning calculations on the previously collected robot payload information and store the computed results in the corresponding variables. The command parameters are described as below:

CalcDynMdl mdlType Tool Payload dataStepPer validEnable

- mdlType: Identified model type

  Data type: enum(TypeTool/TypePayload)

  Meaning: The identified model type.

  - TypeTool: Use for identification of tool parameters.
  - TypePayload: Use for identification of payload parameters.
- Tool: Tool variable (TOOL)

  Data type: TOOL variable

  Meaning: To save the identification results. It is only effective when the model type for identification is selected as TypeTool.
- Payload: Workpiece load variable (PAYLOAD)

  Data type: PAYLOAD variable

  Meaning: To save the identification results. It is only effective when the model type for identification is selected as TypePayload.
- dataStepPer: Data interval length (Identify the percentage of data extraction length)

  Data type: int

  Meaning: Extract valid identification data from the raw data. A greater value indicates a grater interval, resulting in fewer data points used for identification. As a result, the accuracy of the payload identification results may be lower. The valid range for this parameter is from 0 to 100.
- validEnable: If it is model validation

  Data type: enum(Enable/Disable)

  Meaning: Enable or disable model validation during payload identification.

  - Enable: Enable model validation.
  - Disable: Disable model validation.

For example1:

```
StartMdlLog(WithLoad)
MovJ(P0)
MovJ(P1)
MovJ(P2)
StopMdlLog()
/* Upon the completion of payload identification, the results will be stored in the user-specified payload/tool variable. */
CalcDynMdl{mdlType="TypePayload",PayLoad=t_g.idenPayload,dataStepPer=1,validEnable="Disable"}
```

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