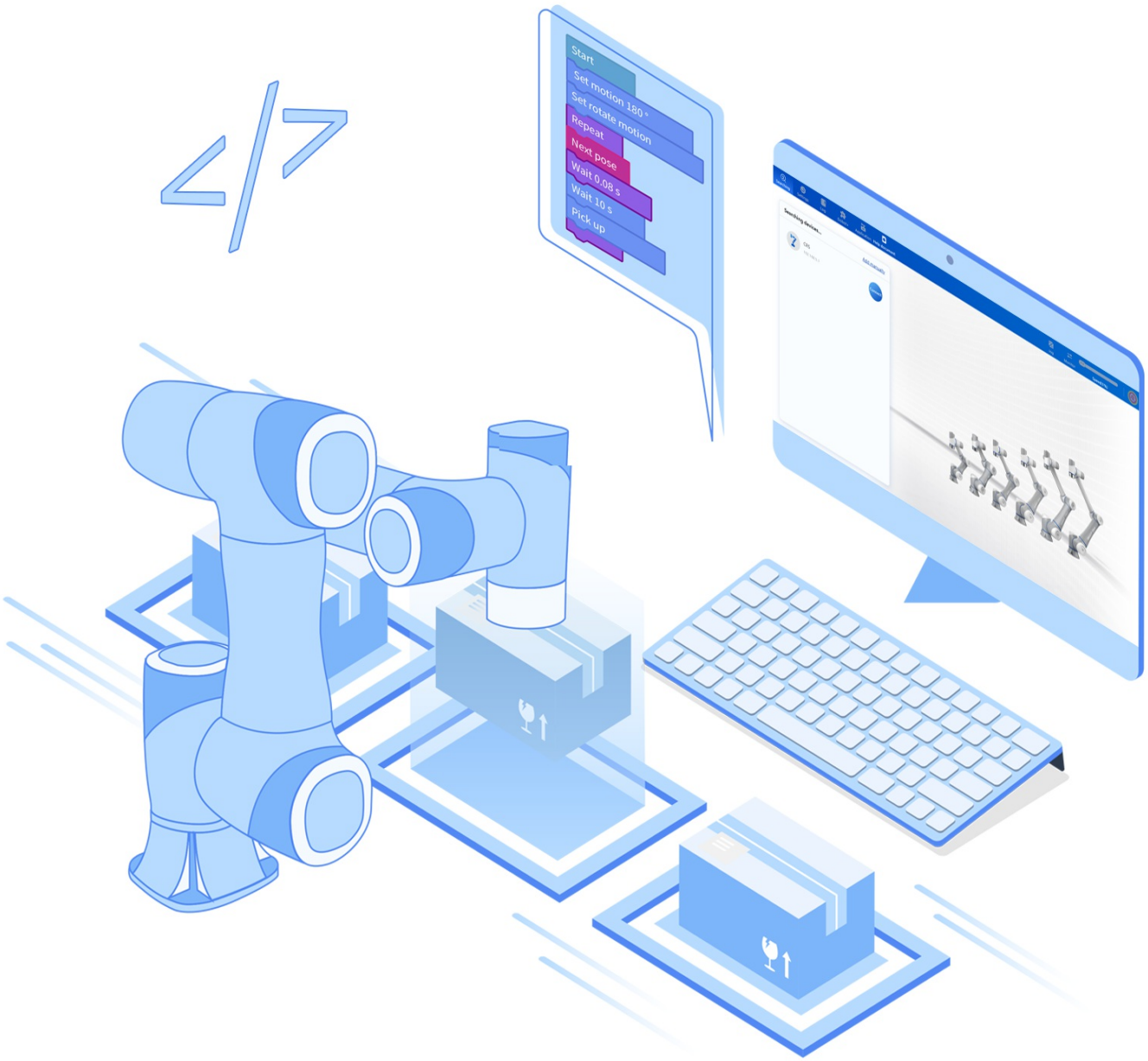
DOBOT

Dobot TCP/IP Remote Control Interface Guide



Shenzhen Yuejiang Technology Co.,Ltd.|China

Table of Contents

Preface

Purpose

This document introduces the TCP/IP secondary development interfaces and their usage of Dobot industrial robot controller (V4), which helps users to understand and develop the robot control software based on TCP/IP.

Intended Audience

This document is intended for：

- Customer
- Sales Engineer
- Installation and Commissioning Engineer
- Technical Support Engineer

Change History

Date	Version	Change Description
28 July, 2023	V4.4.0	Corresponding to six-axis controller V4.4.0
7 June, 2023	V4.3.0	Corresponding to six-axis controller V4.3.0

1. Overview

As the communication based on TCP/IP has high reliability, strong practicability and high performance with low cost, many industrial automation projects have a wide demand for controlling robots based on TCP/IP protocol. Dobot robots, designed on the basis of TCP/IP protocol, provide rich interfaces for interaction with external devices.

Port description

According to the design, Dobot robots will open 29999, 30004, 30005 and 30006 server ports.

- Server port 29999: The upper computer can send some **control commands** directly to the robot via port 29999, or **acquire** certain status of the robot. These functions are called Dashboard.
- Server port 30004, 30005 and 30006: Port 30004 (real-time feedback port) receives robot information every 8ms. Port 30005 feeds back robot information every 200ms. Port 30006 is a configurable port to feed back robot information (feed back every 50ms by default. If you need to modify, please contact technical support). Each packet received through the real-time feedback port has 1440 bytes, which are arranged in a standard format, as shown below.

Message format

Both message commands and message responses are in ASCII format (string).

The format for **sending messages** is shown below:

```
Message name(Param1,Param2,Param3……ParamN)
```

It consists of a message name and parameters in a bracket. Each parameter is separated by an English comma “,”. A complete message ends up with a right bracket.

TCP/IP remote control commands are not case-sensitive in format, e.g. the three expressions below will all be recognized as enabling the robot:

- ENABLEROBOT()
- enablerobot()
- eNabLErobOt()

When the robot receives a command, it returns a **response message** in the following format:

```
ErrorID,{value,...,valuen},`Message name(Param1,Param2,Param3……Paramn);
```

- If ErrorID is 0, the command is received successfully. If ErrorID is a non-zero value, it refers to an error in the command. See Error Code for details.
- {value,...,valueN} refers to the return value. {} means no return value.
- Message name (Param1,Param2,Param3……ParamN) refers to the content delivered.

For example:

Send:

```
MovL(-500,100,200,150,0,90)
```

Return:

```
0,{},MovL(-500,100,200,150,0,90);
```

0: Received successfully. {}: No return value.

Send:

```
Mov(-500,100,200,150,0,90)
```

Return:

```
-10000,{},Mov(-500,100,200,150,0,90);
```

-10000: Command does nor exist. {}: No return value.

2 Dashboard Command

2.1 Control command

Command list

Command	Function
PowerOn	Power on robot
EnableRobot	Enable robot
DisableRobot	Disable robot
ClearError	Clear alarms of robot
RunScript	Run project
Stop	Stop moving (or running project)
Pause	Pause moving (or running project)
Continue	Continue moving (or running paused project)
EmergencyStop	Stop robot arm in an emergency
BrakeControl	Control brake of specified joint

PowerOn

Command

```
PowerOn()
```

Description

Power on the robot. It takes about 10 seconds for the robot arm to be powered on.

Return

```
ErrorID,{},PowerOn();
```

Example

```
PowerOn()
```

Power on the robot.

EnableRobot

Command

```
EnableRobot(load,centerX,centerY,centerZ)
```

Description

Enable the robot, which is necessary before executing the queue commands (robot motion, queue IO, etc.).

Optional parameter

Parameter	Type	Description
load	double	Load weight. The value range should not exceed the load range of corresponding robot models, unit: kg
centerX	double	Eccentric distance in X direction, range: -500~500, unit: mm
centerY	double	Eccentric distance in Y direction, range: -500~500, unit: mm
centerZ	double	Eccentric distance in Z direction, range: -500~500, unit: mm
isCheck	int	Whether to check load. 1: check, 0: not check. If it is set to 1, the robot will check whether the actual load is consistent with the set load. If not, the robot will be automatically disabled. (default: 0)

Number of optional parameters:

- 0: no parameter (not set load weight and eccentric parameters when enabling the robot)
- 1: one parameter (load weight)
- 4: four parameters (load weight and eccentric parameters)
- 5: five parameters (load weight, eccentric parameters and whether to check load)

Return

```
ErrorID,{},EnableRobot(load,centerX,centerY,centerZ,isCheck);
```

Example 1

```
EnableRobot()
```

Enable the robot without setting load weight and eccentric parameters.

Example 2

```
EnableRobot(1.5)
```

Enable the robot and set the load weight to 1.5kg.

Example 3

```
EnableRobot(1.5,0,0,30.5)
```

Enable the robot. Set the load weight to 1.5kg and Z-axis eccentric distance to 30.5mm without checking the load.

Example 4

```
EnableRobot(1.5,0,0,30.5,1)
```

Enable the robot. Set the load weight to 1.5kg and Z-axis eccentric distance to 30.5mm, and check the load.

DisableRobot

Command

```
DisableRobot()
```

Description

Disable the robot.

Return

```
ErrorID,{},DisableRobot();
```

Example

```
DisableRobot()
```

Disable the robot.

ClearError

Command

```
ClearError()
```

Description

Clear the alarms of the robot. After clearing the alarm, you can judge whether the robot is still in the alarm status according to RobotMode. Some alarms cannot be cleared unless you resolve the alarm cause or restart the control cabinet.

Return

```
ErrorID,{},ClearError();
```

Example

```
uint64_t robotMode = parseRobotMode(RobotMode()); // parseRobotMode is used to obtain the valu
e returned by the RobotMode command. Please implement it on yourself
if(robotMode=9){
  ClearError()
}
```

Clear the alarms of the robot.

RunScript

Command

```
RunScript(projectName)
```

Description

Run the project.

Parameter

Parameter	Type	Description
projectName	string	project name. If the name contains Chinese, the encoding method on the sending side must be set to UTF-8, otherwise it will cause an exception in receiving Chinese. If the name is composed of numbers only, it must be enclosed in double inverted commas.

Return

```
ErrorID,{},RunScript(projectName);
```

Example 1

```
RunScript(demo)
```

Run the project named "demo".

Example 2

```
RunScript("123")
```

Run the project named "123".

Stop

Command

```
Stop()
```

Description

Stop the motion command queue that has been delivered or the project run by runScript command.

Return

```
ErrorID,{},Stop();
```

Example

```
Stop()
```

Stop moving.

Pause

Command

```
Pause()
```

Description

Pause the motion command queue that has been delivered or the project run by runScript command.

Return

```
ErrorID,{},Pause();
```

Example

```
Pause()
```

Pause moving.

Continue

Command

```
Continue()
```

Description

Continue the paused motion command queue that has been delivered or the project run by runScript command.

Return

```
ErrorID,{},Continue();
```

Example

```
Continue()
```

Continue moving.

EmergencyStop

Command

```
EmergencyStop(mode)
```

Description

Stop the robot arm in an emergency. After the emergency stop, the robot arm will be disabled and report alarms. The alarms need to be cleared before it can be re-enabled.

Parameter

Parameter	Type	Description
mode	int	emergency stop mode. 1: press emergency stop switch, 0: release emergency stop switch

Return

```
ErrorID,{},EmergencyStop(mode);
```

Example

```
EmergencyStop(1)
```

Stop the robot arm in an emergency.

BrakeControl

Command

```
BrakeControl(axisID,value)
```

Description

Control the brake of specified joint. The joints automatically brake when the robot is stationary. If you need to drag the joints, you can switch on the brake, i.e. hold the joint manually in the disabled status and deliver the command to switch on the brake.

Joint brake can be controlled only when the robot arm is disabled, otherwise, Error ID will return -1.

Parameter

Parameters	Type	Description
axisID	int	joint ID, 1: J1, 2: J2, and so on
value	int	status of brake. 0: switch off brake (joints cannot be dragged). 1: switch on brake (joints can be dragged).

Return

```
ErrorID,{},BrakeControl(axisID,value);
```

Example

```
BrakeControl(1,1)
```

Switch on the brake of Joint 1.

2.2 Settings command

Command list

Command	Function
SpeedFactor	Set global rate of robot arm
User	Set global user coordinate system
SetUser	Modify specified user coordinate system
CalcUser	Calculate user coordinate system
Tool	Switch global tool coordinate system
SetTool	Modify specified tool coordinate system
CalcTool	Calculate tool coordinate system
SetPayload	Set end load
AccJ	Set acceleration rate of joint motion
AccL	Set acceleration rate of linear and arc motion
VelJ	Set velocity rate of joint motion
VelL	Set velocity rate of linear and arc motion
CP	Set continuous path (CP) rate
SetCollisionLevel	Set collision detection level
SetBackDistance	Set backoff distance of collision
SetPostCollisionMode	Set post-collision handling mode
StartDrag	Enter drag mode
StopDrag	Exit drag mode
DragSensivity	Set drag sensitivity
EnableSafeSkin	Enable or disable SafeSkin
SetSafeSkin	Set sensitivity of each part of SafeSkin
SetSafeWallEnable	Switch on/off specified safety wall
SetWorkZoneEnable	Switch on/off specified interference area

NOTE

The parameters set by TCP commands only take effect in the current TCP/IP control mode.

SpeedFactor

Command

```
SpeedFactor(ratio)
```

Description

Set the global speed rate.

- Actual robot acceleration/velocity in jogging = value in Jog settings × global rate.

  Example: If the joint velocity set in the software is 12°/s and the global rate is 50%, then the actual jog velocity is 12°/s × 50% = 6°/s.

- Actual robot acceleration/velocity in playback = rate set in motion commands × value in Playback settings × global rate.

  Example: If the coordinate system velocity set in the software is 2000mm/s, the global rate is 50% and the velocity set in the motion command is 80%, then the actual velocity is 2000mm/s × 50% × 80%= 800mm/s.

If it is not set, the value set in the software before entering TCP/IP mode will be adopted.

Parameter

Parameter	Type	Description
ratio	int	global speed rate, range: 1~100

Return

```
ErrorID,{},SpeedFactor(ratio);
```

Example

```
SpeedFactor(80)
```

Set the global speed rate to 80%.

User

Command

```
User(index)
```

Description

Set the global user coordinate system. You can select a user coordinate system while delivering motion commands. If you do not specify the user coordinate system, the global user coordinate system will be used.

The default global user coordinate system is User coordinate system 0 when not set.

Parameter

Parameter	Type	Description
index	int	Calibrated user coordinate system, which needs to be calibrated by software before it can be selected here.

Return

```
ErrorID,{},User(index);
```

-1 indicates that the set user coordinate system index does not exist.

Example

```
User(1)
```

Set User coordinate system 1 to the global user coordinate system.

SetUser

Command:

```
SetUser(index,table)
```

Description:

Modify the specified user coordinate system.

Required parameter:

Parameter	Type	Description
index	int	user coordinate system index, range: [0,9]. The initial value of Coordinate system 0 is the base coordinate system.
table	string	user coordinate system after modification (format: {x, y, z, rx, ry, rz}), which is recommended to acquire through CalcUser command.

Return

```
ErrorID,{},SetUser(index,table);
```

Example

```
SetUser(1,{10,10,10,0,0,0})
```

Modify the User coordinate system 1 to "X=10, Y=10, Z=10, RX=0, RY=0, RZ=0".

CalcUser

Command

```
CalcUser(index,matrix_direction,table)
```

Description

Calculate the user coordinate system.

Required parameter

Parameter	Type	Description
index	int	user coordinate system index, range: [0,9]. The initial value of Coordinate system 0 is the base coordinate system.
matrix_direction	int	calculation method. 1: left multiplication, indicating that the coordinate system specified by "index" deflects the value specified by "table" along the base coordinate system. 0: right multiplication, indicating that the coordinate system specified by "index" deflects the value specified by "table" along itself
table	string	user coordinate system offset (format: {x, y, z, rx, ry, rz})

Return

```
ErrorID,{x,y,z,rx,ry,rz},CalcUser(index,matrix_direction,table);
```

{x, y, z, rx, ry, rz} is the user coordinate system after calculation.

Example 1

```
newUser = CalcUser(1,1,{10,10,10,10,10,10})
```

Calculate: User coordinate system 1 left-multiplies {10,10,10,10,10,10}. The calculation process can be equivalent to: A coordinate system with the same initial posture as User coordinate system 1, moves {x = 10, y = 10, z = 10} along the base coordinate system and rotates {rx = 10, ry = 10, rz = 10}, and the new

coordinate system is newUser.

Example 2

```
newUser = CalcUser(1,0,{10,10,10,10,10,10})
```

Calculate: User coordinate system 1 right-multiplies {10,10,10,10,10,10}. The calculation process can be equivalent to: A coordinate system with the same initial posture as User coordinate system 1, moves {x = 10, y = 10, z = 10} along User coordinate system 1 and rotates {rx = 10, ry = 10, rz = 10}, and the new coordinate system is newUser.

Tool

Command

```
Tool(index)
```

Description

Set the global tool coordinate system. You can select a tool coordinate system while delivering motion commands. If you do not specify the tool coordinate system, the global tool coordinate system will be used.

The default global tool coordinate system is Tool coordinate system 0 when not set.

Parameter

Parameter	Type	Description
index	int	Calibrated tool coordinate system, which needs to be calibrated by software before it can be selected here.

Return

```
ErrorID,{},Tool(index);
```

-1 indicates that the set tool coordinate system index does not exist.

Example

```
Tool(1)
```

Set Tool coordinate system 1 to the global tool coordinate system.

SetTool

Command:

```
SetTool(index,table)
```

Description:

Modify the specified tool coordinate system.

Required parameter:

Parameter	Type	Description
index	int	tool coordinate system index, range: [0,9]. The initial value of Coordinate system 0 is the flange coordinate system.
table	string	tool coordinate system after modification (format: {x, y, z, rx, ry, rz}), represents the offset of the coordinate system relative to the default tool coordinate system.

Return

```
ErrorID,{},SetTool(index,table);
```

Example:

```
SetTool(1,{10,10,10,0,0,0})
```

Modify the Tool coordinate system 1 to "X=10, Y=10, Z=10, RX=0, RY=0, RZ=0".

CalcTool

Command:

```
CalcTool(index,matrix_direction,table)
```

Description:

Calculate the tool coordinate system.

Required parameter:

Parameter	Type	Description
index	int	tool coordinate system index, range: [0,9]. The initial value of Coordinate system 0 is the flange coordinate system.
		calculation method. 1: left multiplication, indicating that the coordinate system specified by "index" deflects the value specified by "table" along the flange

		coordinate system (TCP0). 0: right multiplication, indicating that the coordinate system specified by "index" deflects the value specified by "table" along itself.
table	string	tool coordinate system offset (format: {x, y, z, rx, ry, rz})

Return:

```
ErrorID,{x,y,z,rx,ry,rz},CalcTool(index,matrix_direction,table);
```

{x, y, z, rx, ry, rz} is the tool coordinate system after calculation.

Example 1:

```
CalcTool(1,1,{10,10,10,0,0,0})
```

Calculate: Tool coordinate system 1 left-multiplies {10,10,10,0,0,0}. The calculation process can be equivalent to: A coordinate system with the same initial posture as Tool coordinate system 1, moves {x = 10, y = 10, z = 10} along the flange coordinate system (TCP0) and rotates {rx = 10, ry = 10, rz = 10}, and the new coordinate system is newTool.

Example 2:

```
CalcTool(1,0,{10,10,10,0,0,0})
```

Calculate: Tool coordinate system 1 right-multiplies {10,10,10,0,0,0}. The calculation process can be equivalent to: A coordinate system with the same initial posture as Tool coordinate system 1, moves {x=10, y=10, z=10} along Tool coordinate system 1 and rotates {rx=10, ry=10, rz=10}, and the new coordinate system is newTool.

SetPayload

Command

```
SetPayload(load,x,y,z)
SetPayload(name)
```

Description

Set the load of the robot arm, supporting two ways of settings.

Method 1: set the load parameters directly **Required parameter 1**

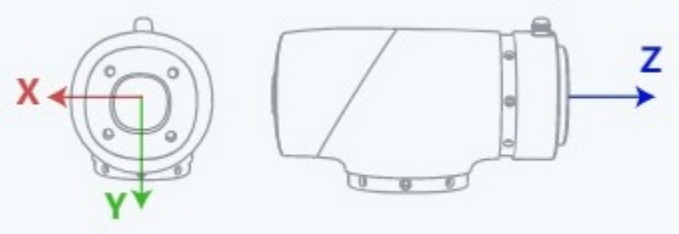
Parameter	Type	Description
load	double	Load weight. The value range should not exceed the load range of corresponding robot models. unit: kg

load	double	corresponding robot models. unit: kg

Optional parameter 1

Parameter	Type	Description
x	double	X-axis eccentric coordinates of end load. range: -500~500, unit: mm
y	double	Y-axis eccentric coordinates of end load. range: -500~500, unit: mm
z	double	Z-axis eccentric coordinates of end load. range: -500~500, unit: mm

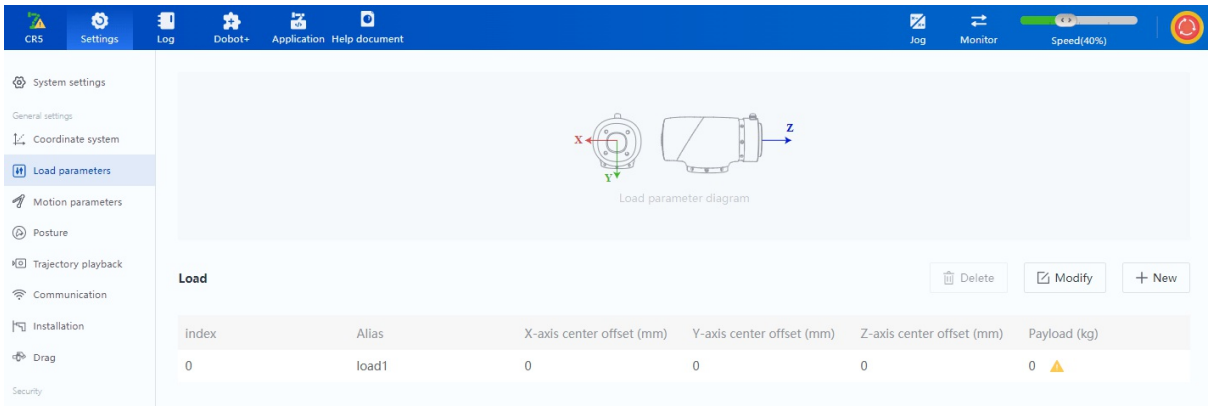
The three parameters need to be set or not set at the same time. The eccentric coordinates are the coordinates of the mass centre of the load (including fixture) in the default tool coordinate system, as shown below.



Method 2: set the load parameters directly

Required parameter 2

Parameter	Type	Description
name	string	preset load parameter group name saved in the software



Return

```
ErrorID,{},SetPayload(load,x,y,z);
```

Example 1

```
SetPayload(3,10,10,10)
```

Example 2

```
SetPayload("Load1")
```

Load the preset parameter group "Load1".

AccJ

Command

```
AccJ(R)
```

Description

Set the acceleration rate of joint motion.

The default value is 100 when not set.

Parameter

Parameter	Type	Description
R	int	acceleration rate, range: 1~100

Return

```
ErrorID,{},AccJ(R);
```

Example

```
AccJ(50)
```

Set the acceleration rate of joint motion to 50%.

AccL

Command

```
AccL(R)
```

Description

Set the acceleration rate of linear and arc motion.

The default value is 100 when not set.

The default value is 100 when not set.

Parameter

Parameter	Type	Description
R	int	acceleration rate, range: 1~100

Return

```
ErrorID,{},AccL(R);
```

Example

```
AccL(50)
```

Set the acceleration rate of linear and arc motion to 50%.

VelJ

Command

```
VelJ(R)
```

Description

Set the velocity rate of joint motion.

The default value is 100 when not set.

Parameter

Parameter	Type	Description
R	int	velocity rate, range: 1~100

Return

```
ErrorID,{},VelJ(R);
```

Example

```
VelJ(50)
```

Set the velocity rate of joint motion to 50%.

Command

```
VelL(R)
```

Description

Set the velocity rate of linear and arc motion.

The default value is 100 when not set.

Parameter

Parameter	Type	Description
R	int	velocity rate, range: 1~100

Return

```
ErrorID,{},VelL(R);
```

Example

```
VelL(50)
```

Set the velocity rate of linear and arc motion to 50%.

CP

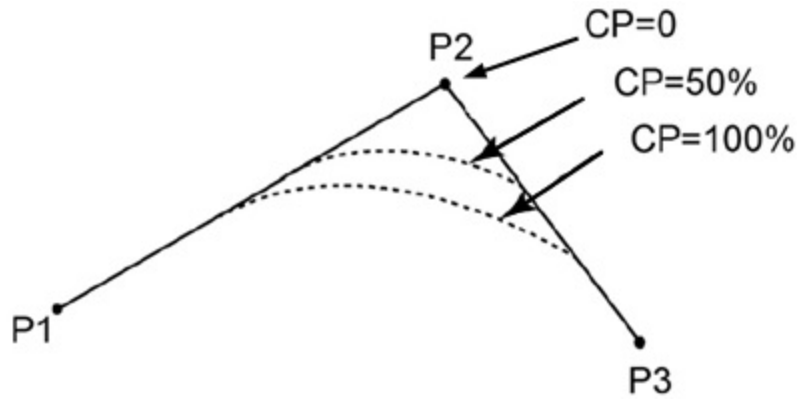
Command

```
CP(R)
```

Description

Set the continuous path (CP) rate, that is, when the robot arm reaches the end point from the starting point through the intermediate point, it passes through the intermediate point in a right angle or in a curve.

The default value is 0 when not set.



Parameter

Parameter	Type	Description
R	int	continuous path rate, range: 0~100

Return

```
ErrorID,{},CP(R);
```

Example

```
CP(50)
```

Set the continuous path rate to 50.

SetCollisionLevel

Command

```
SetCollisionLevel(level)
```

Description

Set the collision detection level.

If it is not set, the value set in the software before entering TCP/IP mode will be adopted.

Parameter

Parameters	Type	Description
level	int	collision detection level 0: switch off collision detection, 1~5: more sensitive with higher level

Return

```
ErrorID,{},SetCollisionLevel(level);
```

Example

```
SetCollisionLevel(1)
```

Set the collision detection level to 1.

SetBackDistance

Command:

```
SetBackDistance(distance)
```

Description:

Set the backoff distance after the robot detects collision.

If it is not set, the value set in the software before entering TCP/IP mode will be adopted.

Required parameter

Parameters	Type	Description
distance	double	collision backoff distance, range: [0,50], unit: mm

Return

```
ErrorID,{},SetBackDistance(distance)
```

Example:

```
SetBackDistance(20)
```

Set the collision backoff distance to 20mm.

SetPostCollisionMode

Command:

```
SetPostCollisionMode(mode)
```

Description

Set the robot to enter the specified status after detecting collision.

If it is not set, the value set in the software before entering TCP/IP mode will be adopted.

Required parameter

Parameters	Type	Description
mode	int	post-collision handling mode. 0: enter stop status after detecting collision. 1: enter pause status after detecting collision.

Return

```
ErrorID,{},SetPostCollisionMode(mode)
```

Example

```
SetPostCollisionMode(0)
```

Set the robot to enter the stop status after detecting collision.

StartDrag

Command

```
StartDrag()
```

Description

Enter the drag mode. The robot cannot enter the drag mode through this command in error status.

Return

```
ErrorID,{},StartDrag();
```

Example

```
StartDrag()
```

The robot enters the drag mode.

StopDrag

Command

```
StopDrag()
```

Description

Exit the drag mode.

Return

```
ErrorID,{},StopDrag();
```

Example

```
StopDrag()
```

The robot exits the drag mode.

DragSensivity

Command:

```
DragSensivity(index,value)
```

Description

Set the drag sensitivity.

The value set by the software before entering the TCP/IP mode will be used when it is not set in this command.

Required parameter

Parameters	Type	Description
index	int	Axis No. 1~6: J1~J6, 0: all axes
value	int	drag sensitivity. The smaller value, the larger resistance force. range: [1, 90]

Return

```
ErrorID,{},DragSensivity(index,value);
```

Example

```
DragSensivity(0,50)
```

Set the drag sensitivity of all axes to 50.

EnableSafeSkin

Command:

```
EnableSafeSkin(status)
```

Description:

Enable or disable the SafeSkin. This command is effective to robots with SafeSkin.

Required parameter:

Parameters	Type	Description
status	int	SafeSkin switch. 0: off, 1: on

Return:

```
ErrorID,{},EnableSafeSkin(status);
```

Example:

```
EnableSafeSkin(1)
```

Switch on the SafeSkin.

SetSafeSkin

Command:

```
SetSafeSkin(part,status)
```

Description:

Set the sensitivity of each part of SafeSkin. This command is only valid for robots installed with SafeSkin.

If it is not set, the value set in the software before entering TCP/IP mode will be adopted.

Required parameter:

Parameters	Type	Description

part	int	part of the robot. 3: forearm, 4~6: J4~J6 joints
status	int	sensitivity. 1: low, 2: medium, 3: high

Return:

```
ErrorID,{},SetSafeSkin(part,status);
```

Example:

```
SetSafeSkin(3,1)
```

Set the SafeSkin sensitivity of the forearm to 0.

SetSafeWallEnable

Command:

```
SetSafeWallEnable(index,value)
```

Description:

Switch on/off the specified safety wall.

Required parameter:

Parameters	Type	Description
index	int	safety wall index, which needs to be added in the software first. range: [1,8]
value	int	safety wall switch. 0: off, 1: on

Return

```
ErrorID,{},SetSafeWallEnable(index,value)
```

Example:

```
SetSafeWallEnable(1,1)
```

Switch on No.1 safety wall.

SetWorkZoneEnable

Command:

```
SetWorkZoneEnable(index,value)
```

Description:

Switch on/off the specified interference area.

Required parameter:

Parameters	Type	Description
index	int	interference area index, which needs to be added in the software first. range: [1,6]
value	int	ON/OFF status of interference area. 0: OFF, 1: ON

Return

```
ErrorID,{},SetWorkZoneEnable(index,value)
```

Example:

```
SetWorkZoneEnable(1,1)
```

Switch on No.1 interference area.

2.3 Calculating and obtaining command

Command list

Command	Function
RobotMode	Get current status of robot arm
PositiveKin	Positive solution
InverseKin	Inverse solution
GetAngle	Get joint coordinates of current posture
GetPose	Get Cartesian coordinates of current posture
GetErrorID	Get current error code of robot

RobotMode

Command

```
RobotMode()
```

Description

Get the current status of the robot arm.

Return

```
ErrorID,{Value},RobotMode();
```

Value range:

Mode	Description	NOTE
1	ROBOT_MODE_INIT	Initialised status
2	ROBOT_MODE_BRAKE_OPEN	Brake switched on
3	ROBOT_MODE_POWER_STATUS	Power-off status
4	ROBOT_MODE_DISABLED	Disabled (no brake switched on)
5	ROBOT_MODE_ENABLE	Enabled and idle
6	ROBOT_MODE_BACKDRIVE	Drag mode
7	ROBOT_MODE_RUNNING	Running status (project, TCP queue motion, etc.)

8	ROBOT_MODE_SINGLE_MOVE	Single motion status (jog, RunTo, etc.)
9	ROBOT_MODE_ERROR	There are uncleared alarms. This status has the highest priority. It returns 9 when there is an alarm, regardless of the status of the robot arm
10	ROBOT_MODE_PAUSE	Project pause status
11	ROBOT_MODE_COLLISION	Collision detection trigger status

Example

```
RobotMode()
```

Get the current status of the robot arm.

PositiveKin

Command

```
PositiveKin(J1,J2,J3,J4,J5,J6,User,Tool)
```

Description

Positive solution. Calculate the coordinates of the end of the robot in the specified Cartesian coordinate system, based on the given angle of each joint.

Required parameter

Parameter	Type	Description
J1	double	J1-axis position, unit: degree
J2	double	J2-axis position, unit: degree
J3	double	J3-axis position, unit: degree
J4	double	J4-axis position, unit: degree
J5	double	J5-axis position, unit: degree
J6	double	J6-axis position, unit: degree

Optional parameter

Parameter	Type	Description
User	string	format: user=index (index: calibrated user coordinate system) The global user coordinate system will be used when it is not specified
Tool	string	format: user=index (index: calibrated tool coordinate system The global tool coordinate system will be used when it is not specified

Return

```
ErrorID,{x,y,z,a,b,c},PositiveSolution(J1,J2,J3,J4,J5,J6,User,Tool);
```

{x,y,z,a,b,c} is the Cartesian coordinates of the point.

Example 1

```
PositiveKin(0,0,-90,0,90,0,user=1,tool=1)
```

Calculate the coordinates of the end of the robot in the User coordinate system 1 and Joint coordinate system 1, based on the joint coordinates ({0,0,-90,0,90,0}).

InverseKin

Command

```
InverseKin(X,Y,Z,Rx,Ry,Rz,User,Tool,useJointNear,JointNear)
```

Description

Inverse solution. Calculate the joint coordinates of the robot, based on the given coordinates in the specified Cartesian coordinate system.

As Cartesian coordinates only define the spatial coordinates and tilt angle of the TCP, the robot arm can reach the same posture through different gestures, which means that one posture variable can correspond to multiple joint variables. To get a unique solution, the system requires a specified joint coordinate, and the solution closest to this joint coordinate is selected as the inverse solution.

Required parameter

Parameter	Description	Type
X	X-axis position, unit: mm	double
Y	Y-axis position, unit: mm	double
Z	Z-axis position, unit: mm	double
Rx	Rx-axis position, unit: degree	double
Ry	Ry-axis position, unit: degree	double
Rz	Ry-axis position, unit: degree	double

Optional parameter

Parameter	Description	Type

User	Calibrated user coordinate system	string
Tool	Calibrated tool coordinate system	string
useJointNear	It is used to set whether JointNear is effective. If the value is 0 or null, JointNear data is ineffective. The algorithm selects the joint angles according to the current angle. If the value is 1, the algorithm selects the joint angles according to JointNear data.	string
JointNear	Joint coordinates for selecting joint angles, format: jointNear={j1,j2,j3,j4,j5,j6}	string

Return

```
ErrorID,{J1,J2,J3,J4,J5,J6},InverseKin(X,Y,Z,Rx,Ry,Rz,User,Tool,useJointNear,JointNear);
```

{j1,j2,j3,j4,j5,j6} is the joint coordinates.

Example 1

```
InverseKin(473.000000,-141.000000,469.000000,-180.000000,0.000,-90.000)
```

The Cartesian coordinates of the end of the robot arm in the global user coordinate system and global joint coordinate system are {473,-141,469,-180,0,-90}. Calculate the joint coordinates and select the nearest solution to the current joint angle of the robot arm.

GetAngle

Command

```
GetAngle()
```

Description

Get the joint coordinates of the current posture.

Return

```
ErrorID,{J1,J2,J3,J4,J5,J6},GetAngle();
```

{J1,J2,J3,J4,J5,J6} refers to the joint coordinates of the current posture.

Example

```
GetAngle()
```

Get the joint coordinates of the current posture.

GetPose

Command

```
GetPose(User,Tool)
```

Description

Get the Cartesian coordinates of the current posture.

Optional Parameter

Parameter	Type	Description
User	string	format: user=index (index: calibrated user coordinate system)
Tool	string	format: user=index (index: calibrated tool coordinate system

They should be set or not set simultaneously, which default to global user and tool coordinate system when not set.

Return

```
ErrorID,{X,Y,Z,Rx,Ry,Rz},GetPose(User,Tool);
```

{X,Y,Z,Rx,Ry,Rz} refers to the Cartesian coordinates of the current posture.

Example

```
GetPose(user=1,tool=1)
```

Get the Cartesian coordinates of the current posture under User coordinate system 1 and Tool coordinate system 1.

GetErrorID

Command

```
GetErrorID()
```

Description

Get the current error code of the robot.

Return

```
ErrorID,{[[id,...,id], [id], [id], [id], [id], [id], [id]]},GetErrorID();
```

- [id,..., id] is the alarm information of the controller and algorithm, and [] refers to no alarm. If there are multiple alarms, they are separated by a comma ",". The collision detection value is 117. For other alarm definition, see the controller alarm document "alarm_controller.json".
- The last six [id] represent the alarm information of six servos respectively (four [id] for four-axis robots), and [] refers to no alarm. For alarm definitions, see the servo alarm document "alarm_servo.json".

Example

```
GetErrorID()
```

Get the current error code of the robot.

2.4 IO command

Command list

Command	Function
DO	Set status of DO port (queue command)
DOInstant	Set status of DO port (immediate command)
GetDO	Get status of DO port
DOGroup	Set status of multiple DO ports (queue command)
GetDOGroup	Get status of multiple DO ports
ToolDO	Set status of tool DO port (queue command)
ToolDOInstant	Set status of tool DO port (immediate command)
GetToolDO	Get status of tool DO port
AO	Set value of AO port (queue command)
AOInstant	Set value of AO port (immediate command)
GetAO	Get value of AO port
DI	Get status of DI port
DIGroup	Get status of multiple DI ports
ToolDI	Get status of tool DI port
AI	Get value of AI port
ToolAI	Get value of tool AI port
SetTool485	Set data type corresponding to RS485 interface of end tool
SetToolPower	Set power status of end tool
SetToolMode	Set communication mode of tool multiplexing terminal

Queue commands and immediate command

- Queue command: The system will execute this command after the previous commands have been executed. For example, if a DO command is preceded by a sequence of motion commands, the system will wait for the robot arm to finish moving before setting the DO.
- Immediate command: The system ignores the command queue and executes this command as soon as the command is read. For example, if a DOInstant command is preceded by a string of motion commands, the system will not wait for the robot arm to finish moving, but will set DO as soon as it

reads the instruction.

If not otherwise specified, the commands for getting input are all immediate commands.

DO

Command

```
DO(index,status,time)
```

Description

Set the status of digital output port (queue command).

Required parameter

Parameter	Type	Description
index	int	DO index
status	int	DO status. 1: ON, 0: OFF

Optional parameter

Parameter	Type	Description
time	int	continuous output time. unit: ms, value range: [25,60000] If this parameter is set, the system will automatically invert the DO after the specified time. The inversion is an asynchronous action, which will not block the command queue. After the DO output is executed, the system will execute the next command.

Return

```
ErrorID,{ResultID},DO(index,status,time);
```

ResultID is the algorithm queue ID, which can be used to judge the execution sequence of commands.

Example

```
DO(1,1,2000)
```

Set DO1 to 1, and

DOInstant

Command

```
DOInstant(index,status)
```

Description

Set the status of digital output port (immediate command).

The command is specific to six-axis robots.

Parameter

Parameter	Type	Description
index	int	DO index
status	int	DO status. 1: ON, 0: OFF

Return

```
ErrorID,{},DOInstant(index,status);
```

Example

```
DOInstant(1,1)
```

Set the status of DO1 to 1 immediately regardless of the current command queue.

GetDO

Command

```
GetDO(index)
```

Description

Get the status of digital output port.

Required parameter

Parameter	Type	Description
index	int	DO index

Return

```
ErrorID,{value},GetDO(index);
```

value: status of DO port. 0: OFF, 1: ON

Example

```
GetDO(1)
```

Get the status of DO1.

DOGroup

Command

```
DOGroup(index1,value1,index2,value2,...,indexN,valueN)
```

Description

Set the status of a group of digital output ports (queue command).

Parameter

Parameter	Type	Description
index1	int	index of the first DO
value1	int	status of the first DO. 1: ON, 0: OFF
...	...	...
indexN	int	index of the last DO
valueN	int	status of the last DO. 1: ON, 0: OFF

Return

```
ErrorID,{},DOGroup(index1,value1,index2,value2,...,indexn,valuen);
```

ResultID is the algorithm queue ID, which can be used to judge the execution sequence of commands.

Example

```
DOGroup(4,1,6,0,2,1,7,0)
```

Set DO4 to 1, DO6 to 0, DO2 to 1 and DO7 to 0.

GetDOGroup

Command

```
GetDOGroup(index1,index2,...,indexN)
```

Description

Get the status of multiple digital output ports.

Required parameter

Parameters	Type	Description
index	int	index of the first DO
...	...	...
indexN	int	index of the last DO

Return

```
ErrorID,{value1,value2,...,valueN},GetDOGroup(index1,index2,...,indexN);
```

{value1,value2,...,valueN}: status of DO1~DON. 0: OFF, 1: ON

Example

```
GetDOGroup(1,2)
```

Get the status of DO1 and DO2.

ToolDO

Command

```
ToolDO(index,status)
```

Description

Set the status of tool digital output port (queue command).

Parameter

Parameter	Type	Description
index	int	Tool DO index
status	int	Tool DO status. 1: ON, 0: OFF

Return

```
ErrorID,{ResultID},ToolDO(index,status);
```

ResultID is the algorithm queue ID, which can be used to judge the execution sequence of commands.

Example

```
ToolDO(1,1)
```

Set the tool DO1 to 1.

ToolDOInstant

Command

```
ToolDOInstant(index,status)
```

Description

Set the status of tool digital output port (immediate command).

Parameter

Parameter	Type	Description
index	int	Tool DO index
status	int	Tool DO status. 1: ON, 0: OFF

Return

```
ErrorID,{},ToolDOInstant(index,status);
```

Example

```
ToolDOInstant(1,1)
```

Set the status of tool DO1 to 1 immediately regardless of the current command queue.

GetToolDO

Command

```
GetToolDO(index)
```

Description

Get the status of tool digital output port.

Required parameter

Parameters	Type	Description
index	int	tool DO index

Return

```
ErrorID,{value},GetToolDO(index);
```

value: status of tool DO port. 0: OFF, 1: ON

Example

```
GetToolDO(1)
```

Get the status of tool DO1.

AO

Command

```
AO(index,value)
```

Description

Set the value of analog output port (queue command).

Parameter

Parameter	Type	Description
index	int	AO index
value	double	AO output. voltage range: [0,10], unit: V; current range: [4,20], unit: mA

Return

```
ErrorID,{},AO(index,value);
```

Example

```
AO(1,2)
```

Set AO1 output to 2.

AOInstant

Command

```
AOInstant(index,value)
```

Description

Set the value of analog output port (immediate command).

Parameter

Parameter	Type	Description
index	int	AO index
value	double	AO output. voltage range: [0,10], unit: V; current range: [4,20], unit: mA

Return

```
ErrorID,{},AOInstant(index,value);
```

Example

```
AOInstant(1,2)
```

Set the AO1 output to 2 immediately regardless of the current command queue.

GetAO

Command

```
GetAO(index)
```

Description

Get the value of analog output port.

Required parameter

Parameters	Type	Description
index	int	AO index

Return

```
ErrorID,{value},GetAO(index);
```

value: value of AO port.

Example

```
GetAO(1)
```

Get the value of AO1.

DI

Command

```
DI(index)
```

Description

Get the status of digital input port.

Parameter

Parameters	Type	Description
index	int	DI index

Return

```
ErrorID,{value},DI(index);
```

value: current status of DI. 0: without signal, 1: signal

Example

```
DI(1)
```

Get the status of DI1.

DIGroup

Command

```
DIGroup(index1,index2,...,indexN)
```

Description

Get the status of a group of digital input ports.

Parameter

Parameters	Type	Description
index1	int	index of the first digital input port
...	...	...
indexN	int	index of the last digital input port

Return

```
ErrorID,{value1,value2,...,valueN},DIGroup(index1,index2,...,indexN);
```

{value1,value2,...,valueN}: status of DI_1~DI_N. 0: OFF, 1: ON

Example

```
DIGroup(4,6,2,7)
```

Get the status of DI4, DI6, DI2 and DI7.

ToolDI

Command

```
ToolDI(index)
```

Description

Get the status of tool digital input port.

Parameter

Parameters	Type	Description
index	int	Tool DI index

Return

```
ErrorID,{value},ToolDI(index);
```

value: status of tool DI. 0: OFF, 1: ON

Example

```
ToolDI(1)
```

Get the status of tool DI1.

AI

Command

```
AI(index)
```

Description

Get the value of analog input port.

Parameter

Parameters	Type	Description
index	int	AI index

Return

```
ErrorID,{value},AI(index);
```

value: AI input

Example

```
AI(1)
```

Get the AI1 input.

ToolAI

Command

```
ToolAI(index)
```

Description

Get the value of tool analog input port. You need to set the port to analog input mode through SetToolMode before using it.

Parameter

Parameters	Type	Description
index	int	Tool AI index

Return

```
ErrorID,{value},ToolAI(index);
```

value: tool AI input

Example

```
ToolAI(1)
```

Get the value of tool AI1.

SetTool485

Command

```
SetTool485(baud,parity,stopbit,identify)
```

Description

Set the data type of tool RS485 interface.

Required parameter

Parameters	Type	Description
baud	int	baud rate of RS485 interface

Optional parameter

Parameters	Type	Description
parity	string	whether there are parity bits. "O" means odd, "E" means even, and "N" means no parity bit. ("N" by default)
stopbit	int	stop bit length. range: 1, 2. (1 by default)
identify	int	When the robot arm has multiple aviation sockets, it is used to specify the sockets, 1: socket 1, 2: socket 2.

Return

```
ErrorID,{},SetTool485(baud,parity,stopbit);
```

Example

```
SetTool485(115200,"N",1)
```

Set the baud rate corresponding to the tool RS485 interface to 115200Hz, parity bit to N, and stop bit length to 1.

SetToolPower

Command

```
SetToolPower(status,identify)
```

Description

Set the power status of the end tool, generally used for restarting the end power, such as repowering and re-initializing the gripper. If you need to call the interface continuously, it is recommended to keep an interval of at least 4ms.

> **NOTE**
> As Magician E6 does not support this command, there is no effect to call this command.

Required parameter

Parameters	Type	Description
status	int	power status of end tool. 0: power off; 1: power on

Optional parameter

| Parameters | Type | Description | | identify | int | When the robot arm has multiple aviation sockets, it is used to specify the sockets, 1: socket 1, 2: socket 2. |

Return

```
ErrorID,{},SetToolPower(status);
```

Example

```
SetToolPower(0)
```

Power off the end tool.

SetToolMode

Command

```
SetToolMode(mode,type,identify)
```

Description

When AI1 interface multiplexes with 485 interface at the end of the robot, the multiplexing mode of the terminals can be set through this command. The default mode is 485 mode.

> **NOTE**
> There is no effect for the robot arm which does not support tool mode switching when calling this interface.

Required parameter

Parameters	Type	Description
mode	int	mode of multiplexing terminals.1: 485 mode. 2: Analog input mode.
type	int	When mode is 1, the parameter is ineffective. When mode is 2, you can set the analog input mode. It consists of two digits, the units digit which represents the mode of AI1, and the tens digit which represents the mode of AI2. When the tens digit is 0, you can just input the units digit.

- Mode:
  - 0: 0~10V voltage input mode
  - 1: current acquisition mode
  - 2: 0~5V voltage input mode
- Example:
  - 0: Both AI2 and AI1 are 0~10V voltage input modes
  - 1: AI2 is 0~10V voltage input mode, and AI1 is current acquisition mode
  - 11: Both AI2 and AI1 are current acquisition modes
  - 12: AI2 is current acquisition mode, and AI1 is 0~5V voltage input mode
  - 20: AI2 is 0~5V voltage input mode, and AI1 is 0~10V voltage input mode

Optional parameter

Parameters	Type	Description
identify	int	When the robot arm has multiple aviation sockets, it is used to specify the sockets, 1: socket 1, 2: socket 2.

Return

```
ErrorID,{},SetToolMode(mode,type);
```

Example

```
SetToolMode(2,0)
```

Set the tool multiplexing terminal to analog input, with 0~10V voltage input mode for both inputs.

2.5 Modbus command

Command list

Command	Function
ModbusCreate	Create Modbus master station
ModbusRTUCreate	Create Modbus master based on RS485
ModbusClose	Disconnect with Modbus slave station
GetInBits	Read discrete input
GetInRegs	Read input register
GetCoils	Read coil register
SetCoils	Write to coil register
GetHoldRegs	Read holding register
SetHoldRegs	Write to holding register

The Modbus commands are used to establish the communication between the Modbus master station and the slave station. For the range and definition of the register address, please refer to the instructions of the corresponding slave.

The Modbus function codes corresponding to various registers follow the standard Modbus protocol.

Register type	Read register	Write single register	Write multiple registers
Coil register	01	05	0F
Contact register	01	-	-
Input register	04	-	-
Holding register	04	06	10

ModbusCreate

Command

```
ModbusCreate(ip,port,slave_id,isRTU)
```

Description

Create Modbus master station, and establish connection to the slave station. (support connecting to at most 5 devices)

Required parameter

Parameters	Type	Description
ip	string	slave IP address
port	int	slave station port
slave_id	int	slave station ID

Optional parameter

Parameters	Type	Description
isRTU	int	null or 0: establish modbusTCP communication 1: establish modbusRTU communication

> **NOTE**
> This parameter determines the protocol format used to transfer data once the connection has been established, and it does not affect the connection result. Therefore, if you set this parameter incorrectly when creating a master, the master can still be created successfully, but there will be anomaly in subsequent communication.

Return

```
ErrorID,{index},ModbusCreate(ip,port,slave_id,isRTU);
```

- ErrorID: 0 indicates that the Modbus master station is created successfully. -1 indicates that the Modbus master station fails to be created. For other error codes, refer to the error code description.
- index: master station index, used when other Modbus commands are called.

Example

```
ModbusCreate(127.0.0.1,60000,1,1)
```

Establish RTU communication master station and connect to the local Modbus slave (port: 60000, slave ID: 1)

ModbusRTUCreate

Command:

```
ModbusRTUCreate(slave_id, baud, parity, data_bit, stop_bit)
```

Description:

Create Modbus master based on RS485, and establish connection with slave station. (support connecting to at most 5 devices)

Required parameter:

Parameters	Type	Description
slave_id	int	slave ID
baud	int	RS485 baud rate

Optional parameter:

Parameters	Type	Description
parity	string	whether there are parity bits. "O" means odd, "E" means even, and "N" means no parity bits ("E" by default)
data_bit	int	data bit length. range: 8 (8 by default)
stop_bit	int	stop bit length. range: 1, 2 (1 by default)

Return:

```
ErrorID,{index},ModbusRTUCreate(slave_id, baud, parity, data_bit, stop_bit)
```

- ErrorID: 0 indicates that the Modbus master station is created successfully. -1 indicates that the Modbus master station fails to be created. For other error codes, refer to the error code description.
- index: master station index, used when other Modbus commands are called.

Example:

```
err, id = ModbusRTUCreate(1, 115200)
```

Create Modbus master, and establish connection with the slave station through RS485. The slave ID is 1 and baud rate is 115200.

ModbusClose

Command

```
ModbusClose(index)
```

Description

Disconnect with Modbus slave station.

Parameter

Parameters	Type	Description
index	int	master index

Return

```
ErrorID,{},ModbusClose(index);
```

Example

```
ModbusClose(0)
```

Release the Modbus master station 0.

GetInBits

Command

```
GetInBits(index,addr,count)
```

Description

Read discrete input data from the Modbus slave.

Parameter

Parameters	Type	Description
index	int	master index
addr	int	start sddress of discrete input
count	int	number of discrete inputs, range: 1~16

Return

```
ErrorID,{value1,value2,...,valuen},GetInBits(index,addr,count);
```

{value1,value2,...,valuen}: values read from the discrete input (number of values equals to **count**)

Example

```
GetInBits(0,3000,5)
```

Read five values from the discrete input starting from address 3000.

GetInRegs

Command

```
GetInRegs(index,addr,count,valType)
```

Description

Read the input register value with the specified data type from the Modbus slave.

Required parameter

Parameters	Type	Description
index	int	master index
addr	int	start address of input register
count	int	number of values from input register, range: 1~4

Optional parameter

Parameters	Type	Description
valType	string	data type U16: 16-bit unsigned integer (two bytes, occupy one register) U32: 32-bit unsigned integer (four bytes, occupy two registers) F32: 32-bit single-precision floating-point number (four bytes, occupy two registers) F64: 64-bit double-precision floating-point number (eight bytes, occupy four registers)

Return

```
ErrorID,{value1,value2,...,valuen},GetInBits(index,addr,count);
```

{value1,value2,...,valuen}: values read from the input register (number of values equals to **count**)

Example

```
GetInRegs(0,4000,3)
```

Read three U16 values from the input register starting from address 4000.

GetCoils

Command

```
GetCoils(index,addr,count)
```

Description

Read the coil register from the Modbus slave.

Parameter

Parameters	Type	Description
index	int	master index
addr	int	start sddress of coil register
count	int	number of values from coil register, range: 1~16

Return

```
ErrorID,{value1,value2,...,valuen},GetCoils(index,addr,count);
```

{value1,value2,...,valuen}: values read from the coil register (number of values equals to **count**)

Example

```
GetCoils(0,1000,3)
```

Read 3 values in succession from the coil register starting from address 1000.

SetCoils

Command

```
SetCoils(index,addr,count,valTab)
```

Description

Write the specified value to the specified address of coil register.

Parameter

Parameters	Type	Description
index	int	master index
addr	int	start sddress of coil register
count	int	number of values from coil register, range: 1~16
valTab	string	values to write to coil register (number of values equals to **count**)

Return

```
ErrorID,{},SetCoils(index,addr,count,valTab);
```

Example

```
SetCoils(0,1000,3,{1,0,1})
```

Write 3 values: 1, 0, 1, in succession to the coil register starting from address 1000.

GetHoldRegs

Command

```
GetHoldRegs(index,addr, count,valType)
```

Description

Read the holding register value with the specified data type from the Modbus slave.

Required parameter

Parameters	Type	Description
index	int	master index
addr	int	start address of holding register
count	int	number of values from holding register, range: 1~4

Optional parameter

Parameters	Type	Description
valType	string	data type null or U16: 16-bit unsigned integer (two bytes, occupy one register) U32: 32-bit unsigned integer (four bytes, occupy two registers) F32: 32-bit single-precision floating-point number (four bytes, occupy two registers) F64: read 64-bit double-precision floating-point number (eight bytes, occupy four registers)

Return

```
ErrorID,{value1,value2,...,valuen},GetHoldRegs(index,addr, count,valType);
```

{value1,value2,...,valuen}: values read from the holding register (number of values equals to **count**)

Example

```
GetHoldRegs(0,3095,1)
```

Read a U16 value from the holding register starting from address 3095.

SetHoldRegs

Command

```
SetHoldRegs(index,addr, count,valTab,valType)
```

Description

Write the specified value according to the specified data type to the specified address of holding register.

Required parameter

Parameters	Type	Description
index	int	master index
addr	int	start address of holding registers
count	int	number of values written in the holding register. range: 1~4
valTab	string	values to write (number of values equals to **count**)

Optional parameter

Parameters	Type	Description
valType	string	data type U16: 16-bit unsigned integer (two bytes, occupy one register) U32: 32-bit unsigned integer (four bytes, occupy two registers) F32: 32-bit single-precision floating-point number (four bytes, occupy two registers) F64: read 64-bit double-precision floating-point number (eight bytes, occupy four registers)

Return

```
ErrorID,{},SetHoldRegs(index,addr, count,valTab,valType);
```

Example

```
SetHoldRegs(0,3095,2,{6000,300}, U16)
```

Write two U16 values: 6000, 300, from the holding register starting from address 3095.

2.6 Bus register command

Command list

The bus register commands are used to read or write Profinet or Ethernet/IP bus registers.

Command	Function
GetInputBool	Get boolean value of specified input register address
GetInputInt	Get int value of specified input register address
GetInputFloat	Get float value of specified input register address
GetOutputBool	Get boolean value of specified register address
GetOutputInt	Get int value of specified output register address
GetOutputFloat	Get float value of specified output register address
SetOutputBool	Set boolean value of specified output register address
SetOutputInt	Set int value of specified output register address
SetOutputFloat	Set float value of specified output register address

GetInputBool

Command

```
GetInputBool(address)
```

Description

Get the boolean value of the specified input register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-63]

Return

```
ErrorID,{value},GetInputBool(address);
```

value: value of the specified register address, 0 or 1.

Example

```
GetInputBool(0)
```

Get the boolean value of input register 0.

GetInputInt

Command

```
GetInputInt(address)
```

Description

Get the int value of the specified input register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-23]

Return

```
ErrorID,{value},GetInputInt(address);
```

value: value of the specified register address (data type: int32)

Example

```
GetInputInt(1)
```

Get the int value of input register 1.

GetInputFloat

Command

```
GetInputFloat(address)
```

Description

Get the float value of the specified input register address.

Required parameter

Parameter	Type	Description

address	int	Register address, range: [0-23]

Return

```
ErrorID,{value},GetInputInt(address);
```

value: value of the specified register address (data type: float)

Example

```
GetInputFloat(2)
```

Get the float value of input register 2.

GetOutputBool

Command

```
GetOutputBool(address)
```

Description

Get the boolean value of the specified register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-63]

Return

```
ErrorID,{value},GetInputBool(address);
```

value: value of the specified register address, 0 or 1.

Example

```
GetOutputBool(0)
```

Get the boolean value of output register 0.

GetOutputInt

Command

```
GetOutputInt(address)
```

Description

Get the int value of the specified output register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-23]

Return

```
ErrorID,{value},GetInputInt(address);
```

value: value of the specified register address (data type: int32)

Example

```
local regInt = GetOutputInt(1)
```

Get the value of output register 1 and assign it to the variable "regint".

GetOutputFloat

Command

```
GetOutputFloat(address)
```

Description

Get the float value of the specified output register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-23]

Return

```
ErrorID,{value},GetInputInt(address);
```

value: value of the specified register address (data type: float)

Example

```
local regFloat = GetOutputFloat(2)
```

Get the value of output register 2 and assign it to the variable "regFloat".

SetOutputBool

Command

```
SetOutputBool(address, value)
```

Description

Set the boolean value of the specified output register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-63]
value	int	value to be set, 0 or 1

Return

```
ErrorID,{},SetOutputBool(address, value);
```

Example

```
SetOutputBool(0,0)
```

Set the output register 0 to 0.

SetOutputInt

Command

```
SetOutputInt(address, value)
```

Description

Set the int value of the specified output register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-23]
value	int	value to be set

Return

```
ErrorID,{},SetOutputInt(address, value);
```

Example

```
SetOutputInt(1,123)
```

Set the value of output register 1 to 123.

SetOutputFloat

Command

```
SetOutputFloat(address, value)
```

Description

Set the float value of the specified output register address.

Required parameter

Parameter	Type	Description
address	int	Register address, range: [0-23]
value	float	value to be set

Return

```
ErrorID,{},SetOutputFloat(address, value);
```

Example

```
SetOutputFloat(2,12.3)
```

Set the value of output register 2 to 12.3.

2.7 Motion command

General description

Parameter format

The **point parameter** and **optional parameter** in the motion command are of "string" type, in the format "key=value", such as "joint = {10, 10, 10, 0, 0, 0}", "user=1". To make it easier for the user to understand the parameters, the ”Type“ column of such parameters in the tables below refers to the type of value.

Motion mode

The motion modes of the robot include the following types.

Joint motion

The robot arm plans the motion of each joint according to the difference between the current joint angle and the joint angle of the target point, so that each joint completes the motion at the same time. The joint motion does not constrain the trajectory of TCP (Tool Center Point), which is generally not a straight line.

As the joint motion is not limited by the singularity position (see the corresponding hardware guide for details), if there is no requirement for the motion trajectory, or the target point is near the singularity position, it is recommended to use joint motion.

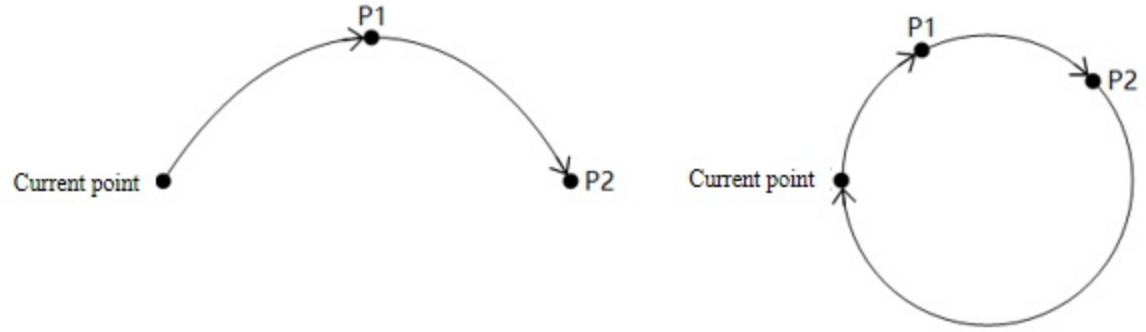
Linear motion

The robot arm plans the motion trajectory according to the current posture and the posture of the target point, so that the TCP motion trajectory is a straight line, and the posture of the end changes uniformly during the movement.

When the trajectory may pass through the singularity position, an error will be reported when the linear motion command is delivered to the robot arm. It is recommended to re-plan the point or use joint motion near the singularity position.

Arc motion

The robot arm determines an arc or a circle through three non-collinear points: the current position, P1 and P2. The posture of the end of the robot arm during the movement is calculated by the posture interpolation of the current point and P2, and the posture of P1 is not included in the operation (i.e, the posture of the robot arm when it reaches P1 during the movement may be different from the taught posture).



When the trajectory may pass through the singularity position, an error will be reported when the arc motion command is delivered to the robot arm. It is recommended to re-plan the point or use joint motion near the singularity position.

Point parameters

All point parameters in this document support two expressions unless otherwise specified.

- Joint variable: describe the target point using the angle of each joint (j1~ j6) of the robot arm.

  When the joint variable is used as a linear or arc motion parameter, the system will convert it into a posture variable through a positive solution, but the algorithm will ensure that the joint angle of the robot arm when it reaches the target point will be consistent with the set value.

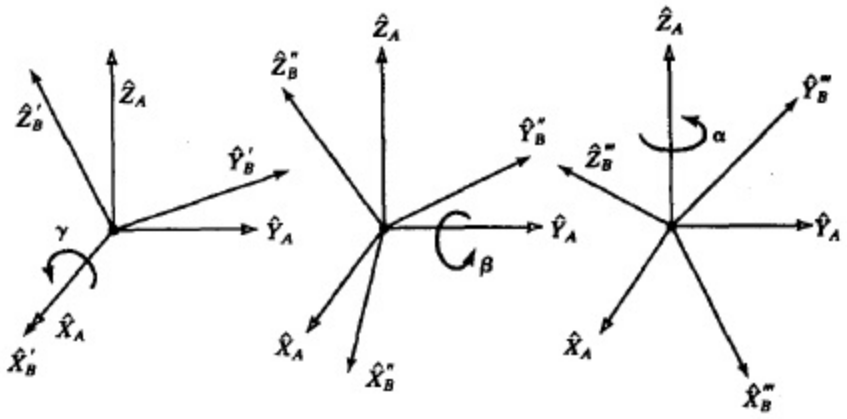
```
{joint = {j1, j2, j3, j4, j5, j6} }
```

- Posture variable: describe the spatial position of the target point in the user coordinate system using Cartesian coordinates (x, y, z), and describe the rotation angle of the tool coordinate system relative to the user coordinate system when the TCP (Tool Center Point) reaches a specified point using Euler angles (rx，ry，rz).

  When the posture variable is used as a point parameter of the joint motion, the system will convert it into a joint variable (the solution closest to the current joint angle of the robot arm) through the inverse solution.

```
{pose = {x, y, z, rx, ry, rz} }
```

The rotation order when calculating the Euler angle of Dobot robot is X->Y->Z, and each axis rotates around a fixed axis (user coordinate system), as shown below (rx=γ, ry=β, rz=α).



Once the rotation order is determined, the rotation matrix (cα is short for cosα, sα is short for sin α, and so on)

$$
\begin{aligned}
{}^{A}_{B}R_{XYZ}(\gamma,\beta,\alpha) &= R_Z(\alpha)R_Y(\beta)R_X(\gamma) \\
&= \begin{bmatrix} c\alpha & -s\alpha & 0 \\ s\alpha & c\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} c\beta & 0 & s\beta \\ 0 & 1 & 0 \\ -s\beta & 0 & c\beta \end{bmatrix}\begin{bmatrix} 1 & 0 & 0 \\ 0 & c\gamma & -s\gamma \\ 0 & s\gamma & c\gamma \end{bmatrix}
\end{aligned}
$$

can be derived as the equation

$$
{}^{A}_{B}R_{XYZ}(\gamma,\beta,\alpha) = \begin{bmatrix} c\alpha c\beta & c\alpha s\beta s\gamma - s\alpha c\gamma & c\alpha s\beta c\gamma + s\alpha s\gamma \\ s\alpha c\beta & s\alpha s\beta s\gamma + c\alpha c\gamma & s\alpha s\beta c\gamma - c\alpha s\gamma \\ -s\beta & c\beta s\gamma & c\beta c\gamma \end{bmatrix}
$$

The posture of the end of robot arm can be calculated through the equation.

```
pose = {x, y, z, rx, ry, rz}
```

Coordinate system parameters

The "user" and "tool" in the optional parameters of motion commands related to the Cartesian coordinate system are used to specify the user and tool coordinate systems of the target point.

Now the coordinate system can be specified only through the index, and the corresponding coordinate system needs to be added in the software first.

If the "user" and "tool" parameters are not carried, the global user and tool coordinate system is used. See the description on User and Tool in Settings command for details (the default coordinate system is 0 when not set through commands).

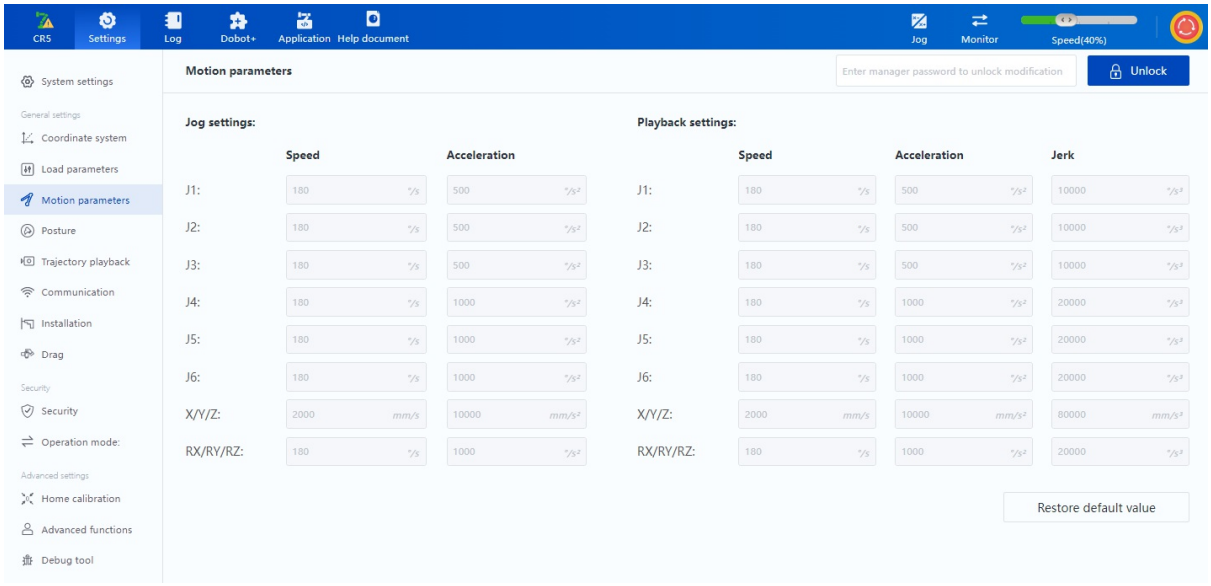
Speed parameters

Relative speed rate

The "a" and "v" in the optional parameters are used to specify the acceleration and velocity rate when the robot arm executes motion commands.

```
Robot actual motion speed = maximum speed x global speed x command rate
Robot actual acceleration = maximum acceleration x command rate
```

The maximum acceleration/velocity is limited by Playback settings, which can be viewed and modified in "Motion parameters" page in the software.



The global speed rate can be set through the control software (upper right corner of the figure above) or the SpeedFactor command.

The command rate is carried by the optional parameters of the motion commands. When the acceleration/velocity rate is not specified through the optional parameters, the value set in the motion parameters is used by default (see VelJ, AccJ, VelL, AccL commands for details, and the default value is 100 when the command setting is not called). Example:

```
AccJ(50) -- Set the default acceleration of joint motion to 50%
VelJ(60) -- Set the default speed of joint motion to 60%
AccL(70) -- Set the default acceleration of linear motion to 70%
VelL(80) -- Set the default speed of linear motion to 80%

-- global speed rate: 20%

MovJ(P1) -- Move to P1 at the acceleration of (maximum joint acceleration x 50%) and speed of
(maximum joint speed x 20% x 60%) through the joint motion
MovJ(P2,{a = 30, v = 80}) -- Move to P1 at the acceleration of (maximum joint acceleration x 3
0%) and speed of (maximum joint speed x 20% x 80%) through the joint motion

MovL(P1) -- Moves to P1 at the acceleration of (maximum Cartesian acceleration x 70%) and spee
d of (maximum Cartesian speed x 20% x 80%) in the linear mode
MovL(P1,{a = 40, v = 90})  -- Moves to P1 at the acceleration of (maximum Cartesian accelerati
on x 40%) and speed of (maximum Cartesian speed x 20% x 90%) in the linear mode
```

Absolute speed

The "speed" in the optional parameter of linear and arc motion commands is used to specify the absolute speed when the robot executes the command.

The absolute speed is not affected by the global speed, but limited by the maximum speed in Playback settings (or the maximum speed after reduction if the robot is in reduced mode), i.e. if the target speed set by the "speed" parameter is greater than the maximum speed in Playback settings, then the maximum speed takes precedence.

Example:

```
MovL(P1,{speed = 1000})  -- Move to P1 in the linear mode at a absolute speed of 1000
```

If the speed set in MovL is 1000 (less than the maximum speed of 2000 in Playback settings), the robot will move at a target speed of 1000 mm/s, which is independent of the global speed at this point. However, if the robot is in reduced mode (assuming a reduction rate of 10%), the maximum speed turns to 200 (less than 1000), and the robot will move at a target speed of 200 mm/s.

The "speed" and "v" cannot be set at the same time. If both exist, "speed" takes precedence.

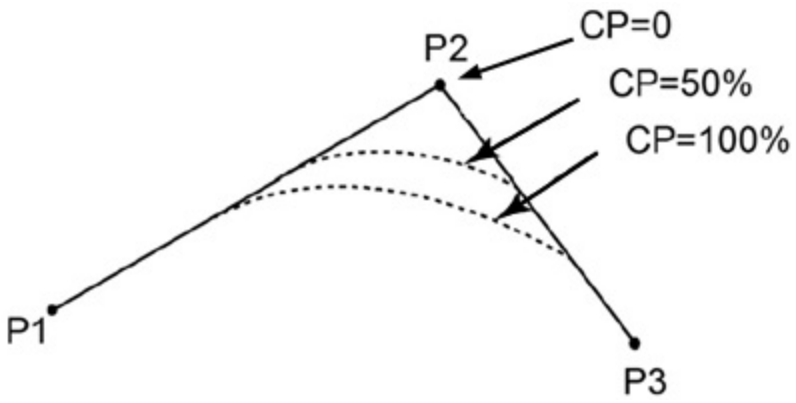
Continuous path parameters

When the robot arm moves through multiple points continuously, it can pass through the intermediate point through a smooth transition so the robot arm will not turn too bluntly.

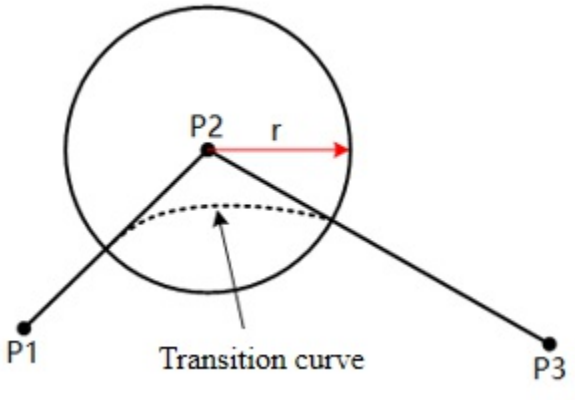
The "cp" or "r" in the optional parameters are used to specify the continuous path rate (cp) or continuous path radius (r) between the current and the next motion commands. The two parameters are mutually exclusive. If both exist, r takes precedence.

> **NOTE**
> Joint motion related commands do not support setting the continuous path radius (r). See the optional parameters of each command for details.

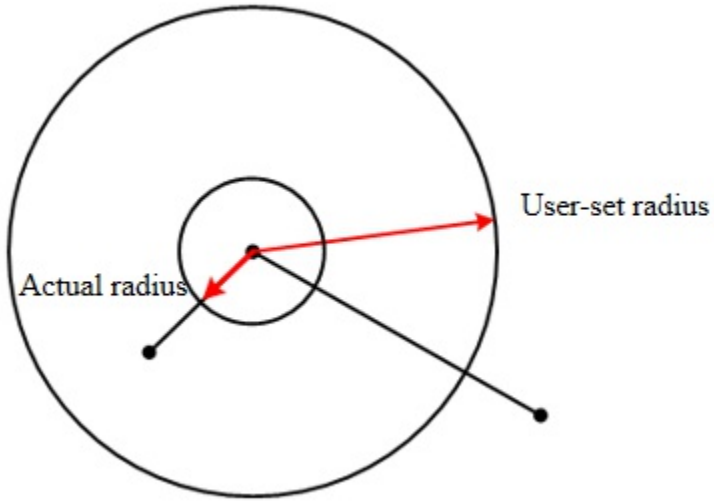
When setting the continuous path rate, the system will automatically calculate the curvature of the transition curve. The larger the CP value, the smoother the curve, as shown in the figure below. The CP transition curve will be affected by the motion speed/acceleration. Even if the point and CP values are the same, the curvature of the transition curve will vary due to different motion speed/acceleration.



When setting the continuous path radius, the system will calculate the transition curve according to the specified radius with the transition point as the center of the circle. The R transition curve is not affected by the motion speed/acceleration, but determined by the point and continuous path radius.



If the continuous path radius is set too large (more than the distance between the start/end point and the intermediate point), the system will automatically calculate the transition curve using half of the shorter distance between the start/end point and the transition point as the continuous path radius.



When the continuous path rate and radius are not specified in the optional parameters, the continuous path rate set in the motion parameter is used by default (See CP command for details. The default value is 0 when no command is called).

NOTE

As the continuous path causes the robot to move without passing the intermediate point, if the continuous path is set, the IO signal output or function settings (such as switching on/off SafeSkin) commands between two motion commands will be executed in the transition process.
If you want to output the IO signal when the robot arm reaches exactly the target point, please set the continuous parameter of last command to 0.

Command list

Command	Function
MovJ	Joint motion
MovL	Linear motion
MovLIO	Move in linear mode and output DO
MovJIO	Move in joint mode and output DO
Arc	Arc motion
Circle	Circle motion
MoveJog	Jog robot
GetStartPose	Get start point of trajectory
StartPath	Play back recorded trajectory
RelMovJTool	Move relatively through joint motion along tool coordinate system
RelMovLTool	Move relatively in linear mode along tool coordinate system
RelMovJUser	Move relatively through joint motion along user coordinate system
RelMovLUser	Move relatively in linear mode along user coordinate system
RelJointMovJ	Move to specified offset angle through joint motion
GetCurrentCommandID	Get algorithm queue ID of current command

MovJ

Command

```
MovJ(P,user,tool,a,v,cp)
```

Description

Move from the current position to the target position through joint motion.

Required parameter

Parameter	Type	Description
P	string	target point, supporting joint variables or posture variables

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, range: (0,100]
cp	int	continuous path rate, range: [0,100]

Return

```
ErrorID,{ResultID},MovJ(P,user,tool,a,v,cp);
```

ResultID is the algorithm queue ID which can be used to judge the sequence of command execution.

Example

```
MovJ(pose={-500,100,200,150,0,90},user=1, tool=0, a=20, v=50, cp=100)
```

The robot arm moves from the current position to the target Cartesian position {-500,100,200,150,0,90} through joint motion with 50% speed, 20% acceleration and 100% CP in User coordinate system 1 and Tool coordinate system 0.

MovL

Command

```
MovL(P,user,tool,a,v,cp|r)
```

Description

Move from the current position to the target Cartesian position in a linear mode.

Required parameter

Parameter	Type	Description
P	string	target point, supporting joint variables or posture variables

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, range: (0,100]
speed	int	target speed, incompatible with v (if both speed and v exist, speed takes precedence). range: [1,maximum motion speed], unit: mm/s
cp	int	continuous path rate, incompatible with r, range: [0,100]
r	int	continuous path radius, incompatible with cp (r takes precedence if both exist). range: [0,100], unit: mm

Return

```
ErrorID,{ResultID},MovL(P,user,tool,a,v,cp|r);
```

Example

```
MovL(pose={-500,100,200,150,0,90},v=60)
```

The robot arm moves from the current position to the target Cartesian position {-500,100,200,150,0,90} in the linear mode with 60% speed.

MovLIO

Command

```
MovLIO(P,{Mode,Distance,Index,Status},...,{Mode,Distance,Index,Status},user,tool,a,v,cp|r)
```

Description

Move from the current position to the target Cartesian position in a linear mode, and set the status of digital output port when the robot is moving.

Required parameter

Parameter	Type	Description
P	string	target point, supporting joint variables or posture variables

{Mode, Distance, Index, Status} are parallel digital output parameters, which are used to set the specified DO to be triggered when the robot arm moves to the specified distance or percentage. You can set multiple groups, and see below for the specific meanings of the parameters.

Parameter	Type	Description
Mode	int	trigger mode. 0: distance percentage; 1: distance value
Distance	int	specified distance. If Distance is positive, it refers to the percentage/distance away from the starting point If Distance is negative, it refers to the percentage/distance away from the target point If Mode is 0, Distance refers to the percentage of total distance. range: (0,100] If Mode is 1, Distance refers to the distance value. unit: mm
Index	int	DO index
Status	int	DO status. 0: without sidnal, 1: signal

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, incompatible with speed. range: (0,100]
speed	int	target speed, incompatible with v (if both speed and v exist, speed takes precedence). range: [1,maximum motion speed], unit: mm/s
cp	int	continuous path rate, incompatible with r. range: [0,100]
r	int	continuous path radius, incompatible with cp (r takes precedence if both exist). range: [0,100], unit: mm

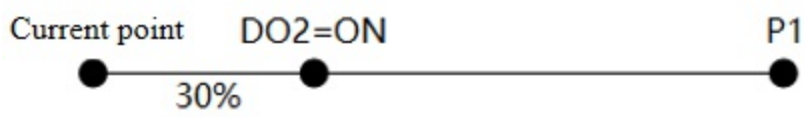
Return

```
ErrorID,{ResultID},MovLIO(P,{Mode,Distance,Index,Status},...,{Mode,Distance,Index,Status},user
,tool,a,v,cp|r);
```

Example 1

```
MovLIO(pose={-500,100,200,150,0,90},{0, 30, 2, 1})
```

The robot moves from the current position to the Cartesian point {-500,100,200,150,0,90} in a linear mode. When it moves 50% distance away from the starting point, set DO2 to 1.



Example 2

```
MovLIO(pose={-500,100,200,150,0,90},{1, -15, 3, 0})
```

The robot moves from the current position to the Cartesian point {-500,100,200,150,0,90} in a linear mode. When it moves 15mm away from the end point, set DO3 to 0.

MovJIO

Command

```
MovJIO(P,{Mode,Distance,Index,Status},...,{Mode,Distance,Index,Status},user,tool,a,v,cp)
```

Description

Move from the current position to the target Cartesian position through joint motion, and set the status of digital output port when the robot is moving.

Required parameter

Parameter	Type	Description
P	string	target point, supporting joint variables or posture variables

{Mode, Distance, Index, Status} are parallel digital output parameters, which is used to set the specified DO to be triggered when the robot arm moves to the specified distance or percentage. You can set multiple groups, and see below for the specific meanings of the parameters.

Parameter	Type	Description
Mode	int	trigger mode. 0: distance percentage; 1: distance value. The system will synthesise the joint angles into an angular vector and calculate the angular difference between the end point and the start point as the total distance of the motion.
Distance	int	specified distance. If Distance is positive, it refers to the percentage/distance away from the starting point If Distance is negative, it refers to the percentage/distance away from the target point If Mode is 0, Distance refers to the percentage of total distance. range: (0,100] If Mode is 1, Distance refers to the angle. unit: °
Index	int	DO index

Status	int	DO status. 0: without sidnal, 1: signal

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, range: (0,100]
cp	int	continuous path rate, range: [0,100]

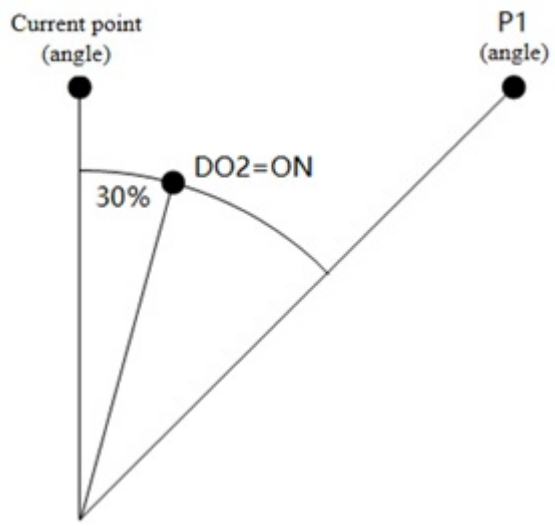
Return

```
ErrorID,{ResultID},MovJIO(P,{Mode,Distance,Index,Status},...,{Mode,Distance,Index,Status},user
,tool,a,v,cp);
```

Example 1

```
MovJIO(pose={-500,100,200,150,0,90},{0, 30, 2, 1})
```

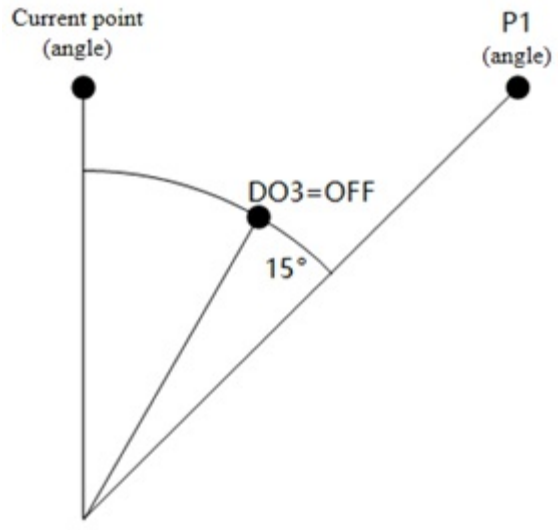
The robot arm moves from the current position to the Cartesian point {-500,100,200,150,0,90} through joint motion. When it moves to 30% distance away from the starting point, set DO2 to 1.



Example 2

```
MovJIO(pose={-500,100,200,150,0,90},{1, -15, 3, 0})
```

The robot arm moves from the current position to the Cartesian point {-500,100,200,150,0,90} through joint motion. When it moves to 15° away from the end point, set DO3 to 0.



Arc

Command

```
Arc(P1,P2,user,tool,a,v,cp|r)
```

Description

Move from the current position to the target position in an arc interpolated mode.

As the arc needs to be determined through the current position, P1 and P2, the current position should not be in a straight line determined by P1 and P2.

Required parameter

Parameter	Type	Description
P1	string	intermediate point of the arc, supporting joint variables or posture variables
P2	string	target point, supporting joint variables or posture variables

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, incompatible with speed. range: (0,100]
speed	int	target speed, incompatible with v (if both speed and v exist, speed takes precedence). range: [1,maximum motion speed], unit: mm/s
cp	int	continuous path rate, incompatible with r. range: [0,100]

r	int	continuous path radius, incompatible with cp (r takes precedence if both exist). range: [0,100], unit: mm

Return

```
ErrorID,{ResultID},Arc(P1,P2,user,tool,a,v,cp|r);
```

ResultID is the algorithm queue ID which can be used to judge the sequence of command execution.

Example

```
Arc(pose={-350,-200,200,150,0,90},pose={-300,-250,200,150,0,90})
```

The robot moves from the current position to {-300,-250,200,150,0,90} via {-350,-200,200,150,0,90} in an arc interpolated mode.

Circle

Command

```
Circle(P1,P2,count,user,tool,a,v,cp|r)
```

Description

Move from the current position in a circle interpolated mode, and return to the current position after moving specified circles.

As the circle needs to be determined through the current position, P1 and P2, the current position should not be in a straight line determined by P1 and P2, and the circle determined by the three points cannot exceed the motion range of the robot arm.

Required parameter

Parameter	Type	Description
P1	string	intermediate point of the circle, supporting joint variables or posture variables
P2	string	target point, supporting joint variables or posture variables
count	int	circles of motion, range: [1,999]

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system

a	int	acceleration rate, range: (0,100]
v	int	velocity rate, incompatible with speed. range: (0,100]
speed	int	target speed, incompatible with v (if both speed and v exist, speed takes precedence). range: [1,maximum motion speed], unit: mm/s
cp	int	continuous path rate, incompatible with r. range: [0,100]
r	int	continuous path radius, incompatible with cp (r takes precedence if both exist). range: [0,100], unit: mm

Return

```
ErrorID,{ResultID},Circle(P1,P2,count,user,tool,a,v,cp|r)
```

ResultID is the algorithm queue ID which can be used to judge the sequence of command execution.

Example

```
Circle(pose={-350,-200,200,150,0,90},pose={-300,-250,200,150,0,90},1)
```

The robot arm moves a full circle determined by the current point and two specified points, and then return to the current point.

MoveJog

Command

```
MoveJog(axisID,coordType,user,tool)
```

Description

Jog or stop jogging the robot arm. After the command is delivered, the robot arm will continuously jog along the specified axis, and it will stop once MoveJog () is delivered. In addition, when the robot arm is jogging, the delivery of MoveJog (string) with any non-specified string will also stop the motion of the robot arm.

Required parameter

Parameter	Type	Description
		Jog motion axis **(case sensitive)**. No parameter or incorrect parameter means stopping jogging the robot J1+ means joint 1 is moving in the positive direction and J1- means joint 1 is moving in the negative direction J2+ means joint 2 is moving in the positive direction and J2- means joint 2 is moving in the negative direction J3+ means joint 3 is moving in the positive direction and J3- means joint 3

axisID	string	is moving in the negative direction J4+ means joint 4 is moving in the positive direction and J4- means joint 4 is moving in the negative direction J5+ means joint 5 is moving in the positive direction and J5- means joint 5 is moving in the negative direction J6+ means joint 6 is moving in the positive direction and J6- means joint 6 is moving in the negative direction X+ means joint X is moving in the positive direction and X- means joint X is moving in the negative direction Y+ means joint Y is moving in the positive direction and Y- means joint Y is moving in the negative direction Z+ means joint Z is moving in the positive direction and Z- means joint Z is moving in the negative direction Rx+ means joint Rx is moving in the positive direction and Rx- means joint Rx is moving in the negative direction Ry+ means joint Ry is moving in the positive direction and Ry- means joint Ry is moving in the negative direction Rz+ means joint Rz is moving in the positive direction and Rz- means joint Rz is moving in the negative direction

Optional parameter

Parameter	Type	Description
CoordType	int	Specify the coordinate system of axis (effective only when axisID specifies the axis in Cartesian coordinate system). 0: joint, 1: user coordinate system, 2: tool coordinate system (0 by default)
user	int	user coordinate system
tool	int	tool coordinate system

Return

```
ErrorID,{},MoveJog(axisID,coordType,user,tool);
```

Example

```
MoveJog(j2-)
// Stop jogging
MoveJog()
```

Jog in the J2 negative direction, and then stop jogging.

```
MoveJog(X+,coordType=1,user=1)
// Stop jogging
MoveJog()
```

Jog in the X-axis positive direction in User coordinate system 1, and then stop jogging.

GetStartPose

Command

```
GetStartPose(traceName)
```

Description

Get the first point of the trajectory.

Required parameter

Parameter	Type	Description
traceName	string	trajectory file name (including suffix) The trajectory file is stored in /dobot/userdata/project/process/trajectory/ If the name contains Chinese, the encoding method on the sending side must be set to UTF-8, otherwise it will cause an exception in receiving Chinese.

Return

```
ErrorID,{pointtype,{j1,j2,j3,j4,j5,j6},user,tool,{x,y,z,rx,ry,rz}},GetStartPose(traceName);
```

pointtype refers to the type of point returned. 0: taught point, 1: joint variable, 2: posture variable. The carried point data differs depending on the point type, as the examples shown below.

```
ErrorID,{0,{j1,j2,j3,j4,j5,j6},user,tool,{x,y,z,rx,ry,rz}},GetStartPose(traceName); // teachin
g point
ErrorID,{1,{j1,j2,j3,j4,j5,j6}},GetStartPose(traceName); // joint variables
ErrorID,{2,{x,y,z,rx,ry,rz}},GetStartPose(traceName); // posture variables
```

Example

```
GetStartPose(recv_string.csv)
```

Get the first point of the "recv_string.csv" file.

StartPath

Command

```
StartPath(traceName,isConst,multi,user,tool)
```

Description

Move according to the recorded points (including at least 4 points) in the specified trajectory file to play back the recorded trajectory.

After delivering the trajectory playback command, you can query the running status of the robot by RobotMode. ROBOT_MODE_RUNNING means the robot is running the trajectory playback. ROBOT_MODE_IDLE means the trajectory playback is completed. ROBOT_MODE_ERROR means an alarm.

Required parameter

Parameter	Type	Description
traceName	string	Trajectory file name (with suffix) The trajectory file is stored in /dobot/userdata/project/process/trajectory/ If the name contains Chinese, the encoding method on the sending side must be set to UTF-8, otherwise it will cause an exception in receiving Chinese.

Optional parameter

Parameter	Type	Description
isConst	int	Whether to reproduce at a constant speed. 1 means the trajectory will be reproduced at the global rate at a uniform rate by the arm; 0 means the trajectory will be reproduced at the same speed as when it was recorded, and the motion speed can be scaled equivalently using the multi parameter, where the motion speed of the arm is not affected by the global rate.
multi	double	speed multiplier in playback, valid only when isConst=0. range: [0.25, 2], 1 by default
user	int	user coordinate system index corresponding to the trajectory point (use the user coordinate system index recorded in the trajectory file if not specified)
tool	int	tool coordinate system index of the target point (use the tool coordinate system index recorded in the trajectory file if not specified)

Return

```
ErrorID,{},StartPath(traceName,isConst,multi,sample,freq,user,tool);
```

Example

```
StartPath(recv_string.csv,isConst=0,multi=1)
```

Play back the trajectory recorded in the "recv_string.csv" file at the original speed.

RelMovJTool

Command

```
RelMovJTool(offsetX,offsetY,offsetZ,offsetRx,offsetRy,offsetRz,user,tool,a,v,cp)
```

Description

Perform relative motion along the tool coordinate system, and the end motion is joint motion.

Required parameter

Parameter	Type	Description
OffsetX	double	X-axis coordinates, unit: mm
OffsetY	double	Y-axis coordinates, unit: mm
OffsetZ	double	Z-axis coordinates, unit: mm
OffsetRx	double	Rx -axis coordinates, unit: °
OffsetRy	double	Ry-axis coordinates, unit: °
OffsetRz	double	Rz-axis coordinates, unit: °

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, range: (0,100]
cp	int	continuous path rate, range: [0,100]

Return

```
ErrorID,{ResultID},RelMovJTool(offsetX,offsetY,offsetZ,offsetRx,offsetRy,offsetRz,user,tool,a,
v,cp);
```

Example

```
RelMovJTool(10,10,10,0,0,0)
```

The robot arm moves relatively in the joint mode along the tool coordinate system, and displaces 10mm in X-axis, Y-axis and Z-axis respectively.

RelMovLTool

Command

```
RelMovLTool(offsetX,offsetY,offsetZ,offsetRx,offsetRy,offsetRz,user,tool,a,v,cp|r)
```

Description

Perform relative motion along the tool coordinate system, and the end motion is linear motion.

Required parameter

Parameter	Type	Description
OffsetX	double	X-axis coordinates, unit: mm
OffsetY	double	Y-axis coordinates, unit: mm
OffsetZ	double	Z-axis coordinates, unit: mm
OffsetRx	double	Rx -axis coordinates, unit: °
OffsetRy	double	Ry-axis coordinates, unit: °
OffsetRz	double	Rz-axis coordinates, unit: °

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, incompatible with speed. range: (0,100]
speed	int	target speed, incompatible with v (if both speed and v exist, speed takes precedence). range: [1,maximum motion speed], unit: mm/s
cp	int	continuous path rate, incompatible with r. range: [0,100]
r	int	continuous path radius, incompatible with cp (r takes precedence if both exist). range: [0,100], unit: mm

Return

```
ErrorID,{ResultID},RelMovLTool(offsetX,offsetY,offsetZ,offsetRx,offsetRy,offsetRz, user,tool,a
,v,cp|r);
```

ResultID is the algorithm queue ID which can be used to judge the sequence of command execution.

Example

```
RelMovLTool(10,10,10,0,0,0)
```

The robot arm moves relatively in the linear mode along Tool coordinate system 0, and displaces 10mm in X-axis, Y-axis and Z-axis respectively.

RelMovJUser

Command

```
RelMovJUser(OffsetX,OffsetY,OffsetZ,OffsetRx,OffsetRy,OffsetRz,user,tool,a,v,cp)
```

Description

Perform relative motion along the user coordinate system, and the end motion mode is the joint motion.

Parameter

Parameter	Type	Description
OffsetX	double	X-axis offset, unit: mm
OffsetY	double	Y-axis offset, unit: mm
OffsetZ	double	Z-axis offset, unit: mm
OffsetRx	double	Rx-axis offset, unit: °
OffsetRy	double	Ry-axis offset, unit: °
OffsetRz	double	Rz-axis offset, unit: °

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, range: (0,100]
cp	int	continuous path rate, range: [0,100]

Return

```
ErrorID,{ResultID},RelMovJUser(OffsetX,OffsetY,OffsetZ,OffsetRx,OffsetRy,OffsetRz,user,tool,a,
v,cp);
```

ResultID is the algorithm queue ID which can be used to judge the sequence of command execution.

Example

```
RelMovJUser(10,10,10,0,0,0)
```

The robot arm moves relatively in the joint mode along the user coordinate system, and displaces 10mm in X-axis, Y-axis and Z-axis respectively.

RelMovLUser

Command

```
RelMovLUser(OffsetX,OffsetY,OffsetZ,OffsetRx,OffsetRy,OffsetRz,user,tool,a,v,cp|r)
```

Description

Perform relative motion along the user coordinate system, and the end motion mode is a linear motion.

Parameter

Parameter	Type	Description
OffsetX	double	X-axis offset, unit: mm
OffsetY	double	Y-axis offset, unit: mm
OffsetZ	double	Z-axis offset, unit: mm
OffsetRx	double	Rx-axis offset, unit: °
OffsetRy	double	Ry-axis offset, unit: °
OffsetRz	double	Rz-axis offset, unit: °

Optional parameter

Parameter	Type	Description
user	int	user coordinate system
tool	int	tool coordinate system
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, incompatible with speed. range: (0,100]
speed	int	target speed, incompatible with v (if both speed and v exist, speed takes precedence). range: [1,maximum motion speed], unit: mm/s
cp	int	continuous path rate, incompatible with r. range: [0,100]
r	int	continuous path radius, incompatible with cp (r takes precedence if both exist). unit: mm

Return

```
ErrorID,{ResultID},RelMovLUser(OffsetX,OffsetY,OffsetZ,OffsetRx,OffsetRy,OffsetRz,user,tool,a,v,cp|r);
```

ResultID is the algorithm queue ID which can be used to judge the sequence of command execution.

Example

```
RelMovLUser(10,10,10,0,0,0)
```

The robot arm moves relatively in the linear mode along the user coordinate system, and displaces 10mm in X-axis, Y-axis and Z-axis respectively.

RelJointMovJ

Command

```
RelJointMovJ(Offset1,Offset2,Offset3,Offset4,Offset5,Offset6,a,v,cp)
```

Description

Perform relative motion along the joint coordinate system of each axis, and the end motion mode is joint motion.

Required parameter

Parameter	Type	Description
Offset1	double	J1-axis offset, unit: °
Offset2	double	J2-axis offset, unit: °
Offset3	double	J3-axis offset, unit: °
Offset4	double	J4-axis offset, unit: °
Offset5	double	J5-axis offset, unit: °
Offset6	double	J6-axis offset, unit: °

Optional parameter

Parameter	Type	Description
a	int	acceleration rate, range: (0,100]
v	int	velocity rate, range: (0,100]
cp	int	continuous path rate, range: [0,100]

Return

```
ErrorID,{ResultID},RelJointMovJ(Offset1,Offset2,Offset3,Offset4,Offset5,Offset6,a,v,cp);
```

ResultID is the algorithm queue ID which can be used to judge the sequence of command execution.

Example

```
RelJointMovJ(10,10,10,0,0,0)
```

Displace 10 degrees in J1, J2 and J3 respectively.

GetCurrentCommandID

Command

```
GetCurrentCommandID()
```

Description

Get the algorithm queue ID of the current command. It can be used to determine which command the robot is executing.

The following commands will be returned immediately after successful delivery, which means that the command has been accepted. Actually, the command will enter the algorithm queue and be queued for execution in sequence in the background. The ResultID returned when delivery is the ID of the command in the algorithm queue.

```
User(), Tool(), SetPayload(), DO(), ToolDO(), AO(), SetCollisionLevel(), DOGroup(), SetSafeWal
lEnable(), SetBackDistance(), SetPostCollisionMode(), SetUser(), SetTool(), MovJ(), MovL(), Mo
vLIO(), MovJIO(), Arc(), Circle(), MoveJog(), StartPath(), RelMovJTool(), RelMovLTool(), RelMo
vJUser(), RelMovLUser(), RelJointMovJ(), EnableSafeSkin(), SetSafeSkin()
```

Which command the robot is actually executing and whether the command has been executed need to be judged combined with the algorithm command ID and the robot status. Please refer to the example of this command.

Return

```
ErrorID,{ResultID},GetCurrentCommandID();
```

ResultID is the algorithm queue ID of the current command.

Example

```
MovJ(P1)
```

```
uint64_t p2Id = parseResultId(MovJ(P2)); // parseResultId is used to obtain ResultID returned
by the command

while(true) {
  uint64_t currentId = parseResultId (GetCurrentCommndID()); // Get the ResultID of the curren
t command
  bool isStop = parseResultId (RobotMode()) == 5; // RobotMode is 5 which means the robot is e
nabled and idle, that is, the motion command has been executed
  if (currentId == p2Id && isStop ) { // currentId is p2Id, and the motion command has been ex
ecuted
    break; // Exit loop
  }
  Sleep(1);
}
```

In the example above, according to the algorithm queue ID and the robot status, the robot has moved to P2 and then exits the loop.

3. Real-time Feedback

The controller feeds back robot status through port 30004, 30005 and 30006.

- Port 30004 (real-time feedback port) receives robot information every 8ms.
- Port 30005 feeds back robot information every 200ms.
- Port 30006 is a configurable port to feed back robot information (feed back every 1000ms by default. If you need to modify, please contact technical support).

Each packet received through the real-time feedback port has 1440 bytes, which are arranged in a standard format, as shown below.

For example, "1234", converted to binary 0000 0100 1101 0010, is passed in two bytes: the first byte is 110100010 (the lower 8 bits of the binary value) and the second byte is 0000 0100 (the upper 8 bits of the binary value).

Meaning	Type	Number of values	Size in bytes	Byte position value	Notes
MessageSize	unsigned short	1	2	0000 ~ 0001	Total message length in bytes
N/A	N/A	N/A	6	0002 ~ 0007	Reserved
DigitalInputs	uint64	1	8	0008 ~ 0015	Current status of digital inputs. See DI/DO description
DigitalOutputs	uint64	1	8	0016 ~ 0023	Current status of digital outputs. See DI/DO description
RobotMode	uint64	1	8	0024 ~ 0031	Robot mode. See RobotMode
TimeStamp	uint64	1	8	0032 ~ 0039	Time stamp (ms)
RunTime	uint64	1	8	0040 ~ 0047	Robot running time (unit: ms)
TestValue	uint64	1	8	0048 ~ 0055	Memory test standard value 0x0123 4567 89AB CDEF
N/A	double	1	8	0056 ~ 0063	Reserved
SpeedScaling	double	1	8	0064 ~ 0071	Speed scaling

N/A	N/A	N/A	8	0072 ~ 0087	Reserved
VRobot	double	1	8	0088 ~ 0095	Robot voltage
IRobot	double	1	8	0096 ~ 0103	Robot current
ProgramState	double	1	8	0104 ~ 0111	Script running status
N/A	N/A	N/A	80	0112 ~ 0191	Reserved
QTarget	double	6	48	0192 ~ 0239	Target joint position
QDTarget	double	6	48	0240 ~ 0287	Target joint velocity
QDDTarget	double	6	48	0288 ~ 0335	Target joint acceleration
ITarget	double	6	48	0336 ~ 0383	Target joint current
MTarget	double	6	48	0384 ~ 0431	Target joint torque
QActual	double	6	48	0432 ~ 0479	Actual joint position
QDActual	double	6	48	0480 ~ 0527	Actual joint velocity
IActual	double	6	48	0528 ~ 0575	Actual joint current
N/A	N/A	N/A	48	0576 ~ 0623	Reserved
ToolVectorActual	double	6	48	0624 ~ 0671	TCP actual Cartesian coordinates
TCPSpeedActual	double	6	48	0672 ~ 0719	TCP actual speed in Cartesian coordinate system
TCPForce	double	6	48	0720 ~ 0767	TCP force value (calculated by joint current）
ToolVectorTarget	double	6	48	0768 ~ 0815	TCP target Cartesian coordinates
TCPSpeedTarget	double	6	48	0816 ~ 0863	TCP Target speed in Cartesian coordinate system
MotorTemperatures	double	6	48	0864 ~	Joint temperature

MotorTemperatures	double	6	48	0911	Joint temperature
JointModes	double	6	48	0912 ~ 0959	Joint control mode. 8: position mode, 10: force torque mode
VActual	double	6	48	960 ~ 1007	Joint voltage
N/A	N/A	N/A	4	1008 ~ 1011	Reserved
User	char	1	1	1012	User coordinate system
Tool	char	1	1	1013	Tool coordinate system
RunQueuedCmd	char	1	1	1014	Queue running flag
PauseCmdFlag	char	1	1	1015	Queue pause flag
VelocityRatio	char	1	1	1016	Joint velocity rate(0~100)
AccelerationRatio	char	1	1	1017	Joint acceleration rate(0~100)
N/A	N/A	N/A	1	1018	Joint jerk rate(0~100)
XYZVelocityRatio	char	1	1	1019	Cartesian position velocity rate (0~100)
RVelocityRatio	char	1	1	1020	Cartesian pose velocity rate (0~100)
XYZAccelerationRatio	char	1	1	1021	Cartesian position acceleration rate (0~100)
RAccelerationRatio	char	1	1	1022	Cartesian posture acceleration ratio(0~100)
N/A	N/A	N/A	2	1023 ~ 1024	Reserved
BrakeStatus	char	1	1	1025	Brake status. See BrakeStatus description
EnableStatus	char	1	1	1026	Enable status
DragStatus	char	1	1	1027	Drag status
RunningStatus	char	1	1	1028	Running status
ErrorStatus	char	1	1	1029	Alarm status
JogStatusCR	char	1	1	1030	Jogging status
RobotType	char	1	1	1031	Robot type. See RobotType description

EnableButtonSignal	char	1	1	1033	Enabling signal
RecordButtonSignal	char	1	1	1034	Recording signal
ReappearButtonSignal	char	1	1	1035	Playback signal
JawButtonSignal	char	1	1	1036	Gripper control signal
N/A	N/A	N/A	1	1037	Reserved
CollisionState	char	1	1	1038	Collision status
ArmApproachState	char	1	1	1039	Forearm SafeSkin-approach-pause
J4ApproachState	char	1	1	1040	J4 SafeSkin-approach-pause
J5ApproachState	char	1	1	1041	J5 SafeSkin-approach-pause
J6ApproachState	char	1	1	1042	J6 SafeSkin-approach-pause
N/A	N/A	N/A	77	1043-1103	Reserved
VibrationDisZ	double	1	8	1104 ~ 1111	Z-axis jitter displacement measured by accelerometer
CurrentCommandId	uint64	1	8	1112 ~ 1119	Current queue id
MActual[6]	double	6	48	1120 ~ 1167	Actual torque
Load	double	1	8	1168-1175	Payload (kg)
CenterX	double	1	8	1176-1183	Eccentric distance in X direction (mm)
CenterY	double	1	8	1184-1191	Eccentric distance in Y direction (mm)
CenterZ	double	1	8	1192-1199	Eccentric distance in Z direction (mm)
User[6]	double	6	48	1200-1247	User coordinates
Tool[6]	double	6	48	1248-1295	Tool coordinates
N/A	N/A	N/A	8	1296-1303	Reserved
SixForceValue[6]	double	6	48	1304-1351	Six-axis force original value

TargetQuaternion[4]	double	4	32	1352-1383	Target quaternion [qw,qx,qy,qz]
ActualQuaternion[4]	double	4	32	1384-1415	Actual quaternion[qw,qx,qy,qz]
AutoManualMode	char	1	2	1416 ~ 1417	Manual/Automatic mode
N/A	N/A	N/A	24	1418 ~ 1440	Reserved
TOTAL			1440		1440byte package

DI/DO description

DI/DO each occupies 8 bytes. Each byte has 8 bits (binary) and can represent the status of up to 64 ports each. Each bit from low to high indicates the status of one terminal. 1 indicates the corresponding terminal is ON, and 0 indicates the corresponding terminal is OFF or no corresponding terminal.
For example, the first byte is 0x01 (00000001). The bits from low to high represent the status of D1_1 ~ DI_8 respectively, that is, DI_1 is ON and the remaining DIs are OFF.
The second byte is 0x02 (00000010). The bits from low to high represent the status of D1_9 ~ DI_16 respectively, that is, DI_10 is ON and the remaining DIs are OFF.
Different control cabinets vary in the number of IO terminals. The binary bits exceeding the number of IO terminals will be filled with 0.

BrakeStatus description

This byte indicates the brake status of the each joints by bit. 1 means that the corresponding joint brake is switched on. The bits correspond to the joints in the following table:

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Description	**Reserved**	**Reserved**	**J1**	**J2**	**J3**	**J4**	**J5**	**J6**

Example:

- 0x01 (00000001): J6 brake is switched on
- 0x02 (00000010): J5 brake is switched on
- 0x03 (00000011): J5 and J6 brakes are switched on
- 0x03 (00000100): J4 brake is switched on

RobotType description

Value	Model
3	CR3
31	CR3L
5	CR5

10	CR10
12	CR12
16	CR16
101	Nova 2
103	Nova 5
113	CR3A
115	CR5A
117	CR7A
120	CR10A
122	CR12A
126	CR16A
130	CR20A

4.Error code

Error code	Description	Note
0	No error	The command has been delivered successfully.
-1	Fail to execute	The command has been received but failed to be executed.
-2	In alarm status	The robot cannot execute commands in the alarm status. You need to clear the alarm and redeliver the command.
-3	In emergency stop status	The robot cannot execute commands in the emergency stop status. You need to release the emergency stop switch, clear the alarm and redeliver the command.
-4	In power-off status	The robot cannot execute commands in the power-off status. You need to power the robot on.
...	...	...
-10000	Command error	The command does not exist.
-20000	Parameter number error	The number of parameters in the command is incorrect.
-30001	The type of the first parameter is incorrect	30000 indicates that the parameter type is incorrect. The last bit 1 indicates that the parameter type of the first parameter is incorrect.
-30002	The type of the second parameter is incorrect	30000 indicates that the parameter type is incorrect. The last bit 2 indicates that the parameter type of the second parameter is incorrect.
...	...	...
-40001	The range of the first parameter is incorrect	-40000 indicates that the required parameter range is incorrect. The last bit 1 indicates that the range of the first required parameter is incorrect.
-40002	The range of the second parameter is incorrect	-40000 indicates that the required parameter range is incorrect. The last bit 2 indicates that the range of the second required parameter is incorrect.
...	...	...
	When an optional parameter has a	-50000 indicates that the optional parameter type is incorrect.

-50001	parameter with a name, it indicates that the format of any optional parameter with a name is incorrect. Otherwise, it indicates that the type of the first optional parameter is incorrect	When an optional parameter has a parameter with a name, it indicates that the format of the optional parameter with a name is incorrect, such as use=1. The last bit 1 indicates that the type of the first optional parameter is incorrect
-50002	The type of the second optional parameter is incorrect	-50000 indicates that the optional parameter type is incorrect. The last bit 2 indicates that the type of the second parameter is incorrect
...	...	...
-60001	When an optional parameter has a parameter with a name, it indicates that the range of any optional parameter with a name is incorrect. Otherwise, it indicates that the range of the first parameter is incorrect	-60000 indicates that the optional parameter range is incorrect. When an optional parameter has a parameter with a name, it indicates that the optional parameter with a name is incorrect, such as a=200. The last bit 1 indicates that the range of the first optional parameter is incorrect
-60002	The range of the second optional parameter is incorrect	-60000 indicates that the optional parameter range is incorrect. The last bit 2 indicates that the range of the second optional parameter is incorrect
...	...	...