

# Communication Commands for 3D Vision-Guided Robotics

## Reference

For details about communication commands that are common to the CV-X Series, see the CV-X Series User's Manual.

## Measurement

### TPR Read 3D Pick Tool Result

Read any robot coordinates from the specified 3D Pick tool results.

#### For non-procedural commands

##### • Send

TPR,nnn,a,b,c Delimiter

##### • Receive

**When c: none or 0**

TPR,m,n,h,xxx,yyy,zzz,ppp,qqq,rrr Delimiter

**When c: 1**

During normal times

TPR m n h xxx yyy zzz ppp qq q rrr Delimiter

During an error

ER TPR 03 Delimiter

**When c: 2**

During normal times

(0,m,n,h,xxx,yyy,zzz,ppp,qqq,rrr) Delimiter

During an error

(3) Delimiter

#### For number-specified commands

The number-specified command No. is "55".

##### • Send

| Word device  | *  | 1   | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--------------|----|-----|---|---|---|---|---|---|---|---|
| Return value | 55 | nnn | a | b | c |   |   |   |   |   |

##### • Receive

| Word device  | *                | 1 | 2 | 3 | 4   | 5   | 6   | 7   | 8   | 9   | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|--------------|------------------|---|---|---|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| Return value | Execution Result | m | n | h | xxx | yyy | zzz | ppp | qqq | rrr |    |    |    |    |    |    |    |    |    |    |

\* Starting word device (command address)

## Parameters

- nnn: Tool No.
- a: 3D Pick Tool Result (0 to 2)
  - 0: Approach Position
  - 1: Grip Position
  - 2: Place Position
- b: 3D Pick Tool Result Label No. (0 to 98)
- c: Data Output Format
  - None or 0: Normal format
  - 1: Changes the delimiter character to a space. (Use this when KUKA, STAUBLI is selected)
  - 2: Eliminates the TPR string and appends an error code in its place (0 if it is successful). Also encloses everything with ( ). (Use this when UNIVERSAL ROBOTS is selected)
- m: Detected Model No. (0 to 999)
- n: Grip Label No. (0 to 999)
- h: Hand Model No. (0 to 1)
  - 0: Hand Model 0
  - 1: Hand Model 1
- xxx: Position X (-9999.999 to 9999.999)
- yyy: Position Y (-9999.999 to 9999.999)
- zzz: Position Z (-9999.999 to 9999.999)
- ppp: Attitude Rx (-180.000 to 180.000)
- qq q: Attitude Ry (-180.000 to 180.000)
- rrr: Attitude Rz (-180.000 to 180.000)

## Reference

The result is the X, Y, Z, Rx, Ry, and Rz for the position that was specified in parameter a (approach position, grip position, or place position).

## Execution result

- 0: Success
- 22: The number of parameters or digits, or the parameter range is incorrect
- 03:
  - A tool other than the 3D Pick tool is specified
  - The specified tool does not exist
  - The 3D Pick tool was not executed
  - The place position is specified where the place position is not set
  - When the place position is specified and the place position setting for the detected model number is Unused (i.e. not set)
  - The grip result for the specified result label number does not exist

## Real-time performance

This command does not affect the measurement processing time.

## PPR Read Path Planning Tool Result

Read the path generated with the Path Planning tool.

### For non-procedural commands

#### • Send

PPR,mmm,nnn,a,d **Delimiter**

PPR,mmm,nnn,a,b1,d **Delimiter** When mmm is "2", "17"

PPR,mmm,nnn,a,b2,d **Delimiter** When mmm is "13"

PPR,mmm,nnn,a,b,c,d **Delimiter** When mmm is "3"

#### • Receive

| Result item                                       | Argument 1<br>mmm | Argument 2<br>nnn     | Argument 3<br>a | Argument 4<br>b   | Argument 5<br>c    | Final argument<br>d | Return value example                                                                                                                                     | Explanation of return value example                                                                                                                                                                     |
|---------------------------------------------------|-------------------|-----------------------|-----------------|-------------------|--------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of Legs                                    | 0                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,7                                                                                                                                                    | Path N has 7 legs.                                                                                                                                                                                      |
| Total Waypoint Count                              | 1                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,32                                                                                                                                                   | The total number of waypoints in the leg is 32.                                                                                                                                                         |
| Number of Waypoints                               | 2                 | Path Planning tool ID | Path label no.  | Leg label no.     | -                  | Data output format  | PPR,10                                                                                                                                                   | The number of waypoints in the specified leg of path N is 10.                                                                                                                                           |
| Waypoint Joint Value                              | 3                 | Path Planning tool ID | Path label no.  | Leg label no.     | Waypoint label no. | Data output format  | PPR,12,345,456,789,98,765,1,234,5,678,98,765                                                                                                             | J1 to J6 of the specified waypoint in the specified leg of path N.                                                                                                                                      |
| Detected Model No.                                | 4                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,1                                                                                                                                                    | The search model number of the detecting surface of the object to grip with path N is 1.                                                                                                                |
| Det.Tool Label No.                                | 5                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,3                                                                                                                                                    | The label number of the detection tool of the object to grip with path N is 3.<br>(The first value is 0, so 3 indicates the fourth object in the detection order.)                                      |
| Grip Label No.                                    | 6                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,1                                                                                                                                                    | The grip label number of the grip selected with path N is 1.                                                                                                                                            |
| Hand Model No.                                    | 7                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,0                                                                                                                                                    | The number of the hand model that will grip the object selected with path N is 0.                                                                                                                       |
| Hand Incl.Angle                                   | 8                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,12.3                                                                                                                                                 | The hand inclination angle at the grip position of the object selected with path N is 12.3°.                                                                                                            |
| Object Overlap %                                  | 9                 | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,0.000                                                                                                                                                | The overlap percentage of the object selected with path N is 0.000.                                                                                                                                     |
| Grip Priority Level Group                         | 10                | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,0                                                                                                                                                    | The priority level group number set on the grip selected with path N.                                                                                                                                   |
| Priority Level No. of Object                      | 11                | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,1                                                                                                                                                    | The object priority level number of the object selected with path N when objects are sorted with [Path Priority Order] of the Path Planning tool.                                                       |
| Priority Level No. of Grip Position               | 12                | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,3                                                                                                                                                    | The grip position order number of the grip position of the object selected with path N when objects are sorted with [Path Priority Order] of the Path Planning tool.                                    |
| Grip Attitude Expansion (°)                       | 13                | Path Planning tool ID | Path label no.  | Rotation axis no. | -                  | Data output format  | Fourth input argument is 0: PPR,10,0,15<br>Fourth input argument is 1: PPR,10<br>Fourth input argument is 2: PPR,0<br>Fourth input argument is 3: PPR,15 | The result values of the expansion angle around each rotation axis of the grip selected with path N are 10° for rotation axis 1, 0° for rotation axis 2, and 15° for rotation axis 3.                   |
| Movement Amount                                   | 14                | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,30.000                                                                                                                                               | The movement amount of the robot on path N is 30.000.                                                                                                                                                   |
| Execution Judgment Value (Overlapped Obj.Lifting) | 15                | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,1                                                                                                                                                    | The [Pull Sideways When Objects Overlap] operation was executed during the departure operation of path N.                                                                                               |
| Execution Judgment Value (Slide)                  | 16                | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,1                                                                                                                                                    | The [Slide] operation was executed during the departure operation of path N.                                                                                                                            |
| Leg Type                                          | 17                | Path Planning tool ID | Path label no.  | Leg label no.     | -                  | Data output format  | PPR,0                                                                                                                                                    | The leg classification of the leg specified for path N is 0.<br>0: Approach position<br>1: Grip position<br>2: Depart destination<br>3: Place position<br>4: Specified position<br>5: Relative position |
| Approach Position/Attitude XYZRxRyRz              | 200               | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,12,345,456,789,98,765,1,234,5,678,98,765                                                                                                             | Approach position/attitude (Cartesian coordinate system) of path N.                                                                                                                                     |
| Grip Position/Attitude XYZRxRyRz                  | 201               | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,12,345,456,789,98,765,1,234,5,678,98,765                                                                                                             | Grip position/attitude (Cartesian coordinate system) of path N.                                                                                                                                         |
| Depart Destination/Attitude XYZRxRyRz             | 202               | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,12,345,456,789,98,765,1,234,5,678,98,765                                                                                                             | Depart destination/attitude (Cartesian coordinate system) of path N.                                                                                                                                    |
| Place Position/Attitude XYZRxRyRz                 | 203               | Path Planning tool ID | Path label no.  | -                 | -                  | Data output format  | PPR,12,345,456,789,98,765,1,234,5,678,98,765                                                                                                             | Place position/attitude (Cartesian coordinate system) of path N.                                                                                                                                        |
| Detection Count                                   | 500               | Path Planning tool ID | -               | -                 | -                  | Data output format  | PPR,1                                                                                                                                                    | The detection count of the specified Path Planning tool is 1.                                                                                                                                           |

**For number-specified commands**

The number-specified command number is “58”.

- **Send**

- When the result items are “2: Waypoint Count” “13: Grip Attitude Expansion”

|              |     |     |     |    |    |    |    |    |    |    |
|--------------|-----|-----|-----|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4   | 8   | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | 55  | mmm | nnn | a  | c  | d  |    |    |    |    |

- When the return item is “3: Waypoint Joint Value”

|              |     |     |     |    |    |    |    |    |    |    |
|--------------|-----|-----|-----|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4   | 8   | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | 55  | mmm | nnn | a  | b  | c  | d  |    |    |    |

- Situations other than those listed above

|              |     |     |     |    |    |    |    |    |    |    |
|--------------|-----|-----|-----|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4   | 8   | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | 55  | mmm | nnn | a  | d  |    |    |    |    |    |

- **Receive**

- When the return value is the joint values

|              |     |    |    |    |    |    |    |    |    |    |
|--------------|-----|----|----|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4  | 8  | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | ret | J1 | J2 | J3 | J4 | J5 | J6 |    |    |    |

- When the return value is the position attitude

|              |     |     |     |     |     |     |     |    |    |    |
|--------------|-----|-----|-----|-----|-----|-----|-----|----|----|----|
| Word device  | 0-1 | 4   | 8   | 12  | 16  | 20  | 24  | 28 | 32 | 36 |
| Return value | ret | xxx | yyy | zzz | qqq | ppp | rrr |    |    |    |

- When the return value is the angle (of rotation axis number 0)

|              |     |    |    |    |    |    |    |    |    |    |
|--------------|-----|----|----|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4  | 8  | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | ret | R0 | R1 | R2 |    |    |    |    |    |    |

- When the return value is the angle (of rotation axis number 1)

|              |     |    |   |    |    |    |    |    |    |    |
|--------------|-----|----|---|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4  | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | ret | R0 |   |    |    |    |    |    |    |    |

- When the return value is the angle (of rotation axis number 2)

|              |     |    |   |    |    |    |    |    |    |    |
|--------------|-----|----|---|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4  | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | ret | R1 |   |    |    |    |    |    |    |    |

- When the return value is the angle (of rotation axis number 3)

|              |     |    |   |    |    |    |    |    |    |    |
|--------------|-----|----|---|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4  | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | ret | R2 |   |    |    |    |    |    |    |    |

- Situations other than those listed above

|              |     |   |   |    |    |    |    |    |    |    |
|--------------|-----|---|---|----|----|----|----|----|----|----|
| Word device  | 0-1 | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| Return value | ret | a |   |    |    |    |    |    |    |    |