Vision Sensor
FH Series

Vision System
3D Robot Vision System

Communication Command Macro
Custom Command

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1. Overview

1.1. Overview

To simplify data communication between the Vision Sensor FH (hereafter referred to as Vision Sensor) and the robot when constructing 3D robot vision application by connecting your robot controller to the Vision Sensor, commands (hereafter referred to as custom commands) are available.

This document describes the communication specification of custom commands.

Construct robot vision application referring to *3. Related Manuals* and this document together.

1.2. Preconditions

- The vision sensor and the robot controller shall be connected with TCP/IP communication.
- Configuration copy data of the vision sensor output by the data set output tool for 3D robot vision shall be loaded.

2. Custom Commands

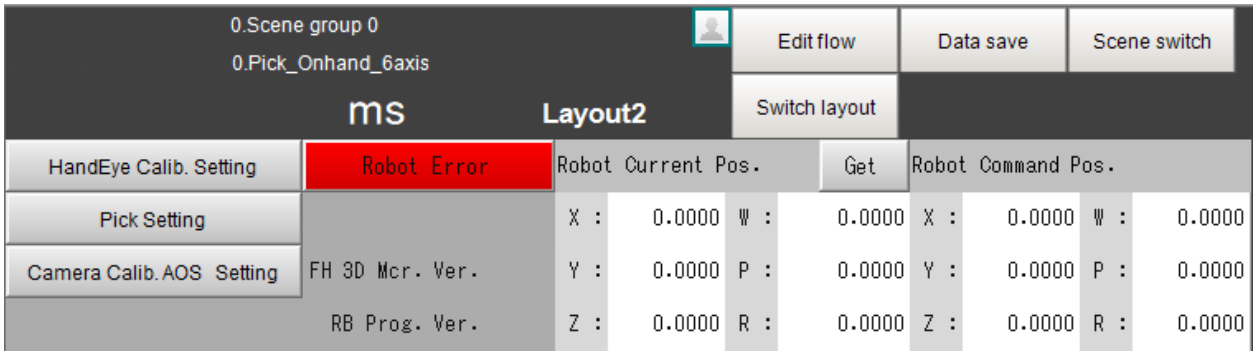
This chapter describes the custom commands for 3D robot vision application.

2.1. Custom Command List

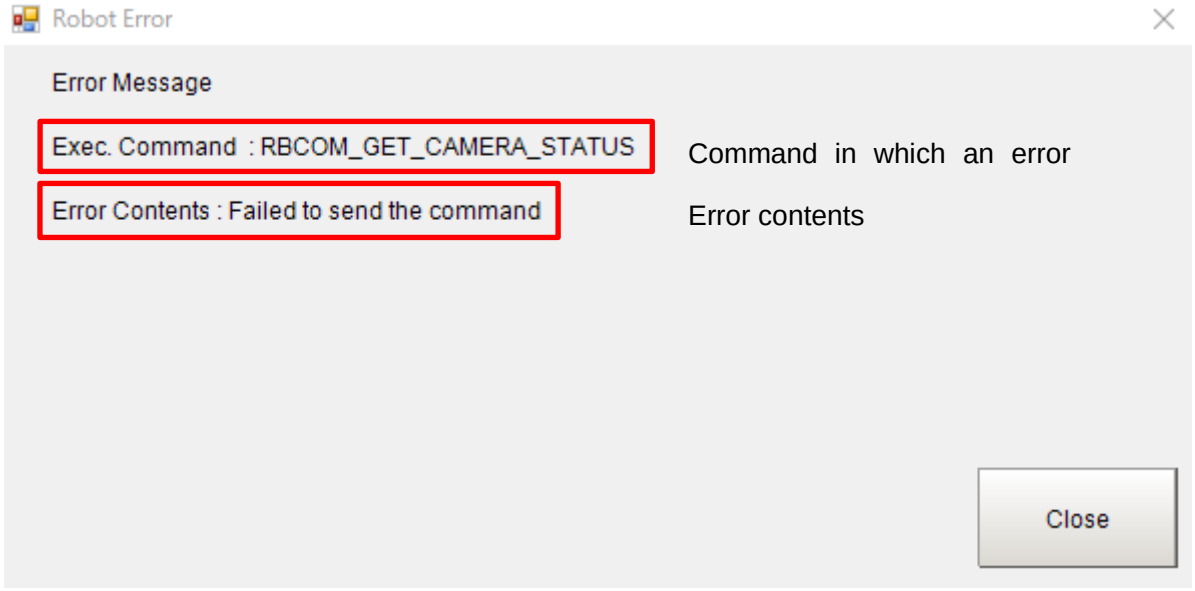
Command	Function	Reference
RBCOM_GET_CAMERA_STATUS	Gets 3D vision sensor status.	2.3.1
RBCOM_GET_CALIBTIME_COMP	Gets comparison results between the date and time of 3D vision sensor calibration and the current date and time.	2.3.2
RBCOM_GET_CALIB_POS	Gets near/far imaging position for camera calibration of the 3D vision sensor.	2.3.3
RBCOM_SET_CALIB_POS	Set the processing mode for measurement for camera calibration of the 3D vision sensor.	2.3.4
RBCOM_GET_GRASP_NUM	Gets the number of grasp candidates from the *Grasp Planning* processing unit of the current scene.	2.3.5
RBCOM_GET_GRASP_POS	Gets the position information of the grasp candidates from the *Grasp Planning* processing unit of the current scene.	2.3.6
RBCOM_GET_GRASP_POSID	Gets the ID information of the grasp candidates from the *Grasp Planning* processing unit of the current scene.	2.3.7
RBCOM_GET_GRASP_HANDINFO	Gets the hand information of the grasp candidates from the *Grasp Planning* processing unit of the current scene.	2.3.8
RBCOM_GET_GRASP_ADDINFO	Gets the detailed information of the top grasp candidate from the *Grasp Planning* processing unit of the current scene.	2.3.9
RBCOM_SET_GRASP_FILTERMODE	Set the filter mode of the grasp candidates from the *Grasp Planning* processing unit of the current scene.	2.3.10

2.2. Error Processing

When custom command processing has failed, click the **Robot Error** button on the main screen to display the following screen.



▼



Error contents	Remedy
Failed to send the command	• Communication settings of the robot or vision sensor may be incorrect. Adjust settings of IP address and port number of the robot controller or vision sensor. • The setup program may not be started on the robot side. Operate with the setup program started.
Wrong number of input argument	• Number of input argument of the communication command is too high or low. Recheck the communication command specifications, and adjust the contents of the communication command.
Wrong value for input argument	• Value of input argument of communication command is out of range. Recheck the communication command specifications, and adjust the contents of the communication command.

The target system/scene variable has not been defined.	• A system variable or scene variable targeted for setting or getting data is not defined. The robot does not operate properly if variables are deleted. Load the sensor project data output from the 3D robot vision data set output tool.
The target processing unit is not in the flow	• A processing unit targeted for setting or getting data does not exist in the flow. When adding a scene for such as adding a new product type, copy an existing scene using the scene maintenance function.

2.3. Details of the Custom Commands

2.3.1. RBCOM_GET_CAMERA_STATUS

■ Function

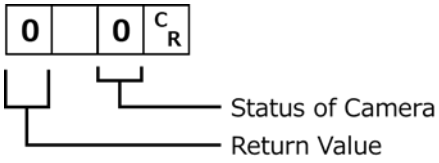
Gets 3D vision sensor status.

■ Command format

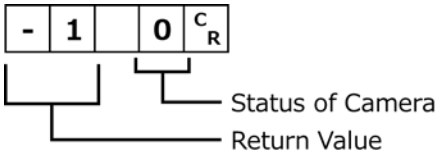
R	B	C	O	M	_	G	E	T	_	C	A	M	E	R	A	_	S	T	A	T	U	S	C_R

■ Response format

• When the process is done normally:



• When the process is not done normally:



■ Parameter description

Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Status of Camera	Returns 3D vision sensor status. 1: OK -1: Warmup -2: Overheat For more information, refer to *1-2-8 External Reference Tables (Camera Image Input AOS)* of *Vision System FH Series Processing Item Function Reference Manual for 3D Robot Vision (Z445-E1)*.

■ Example

When the 3D vision sensor is warming up:

<Command>

R	B	C	O	M	_	G	E	T	_	C	A	M	E	R	A	_	S	T	A	T	U	S	C_R

<Response>

0		-	1	C_R

2.3.2. RBCOM_GET_CALIBTIME_COMP

■ Function

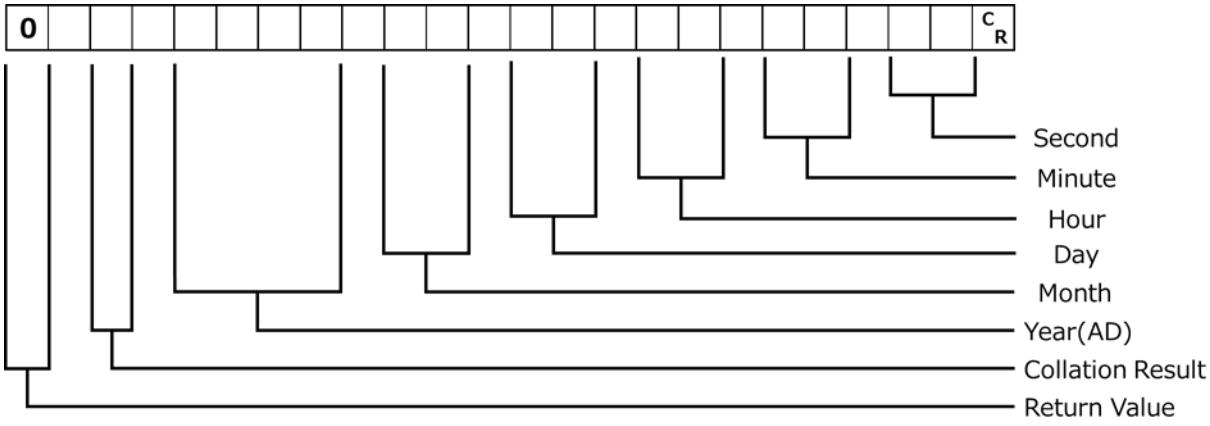
Gets comparison results between the date and time of 3D vision sensor calibration and the current date and time.

■ Command format

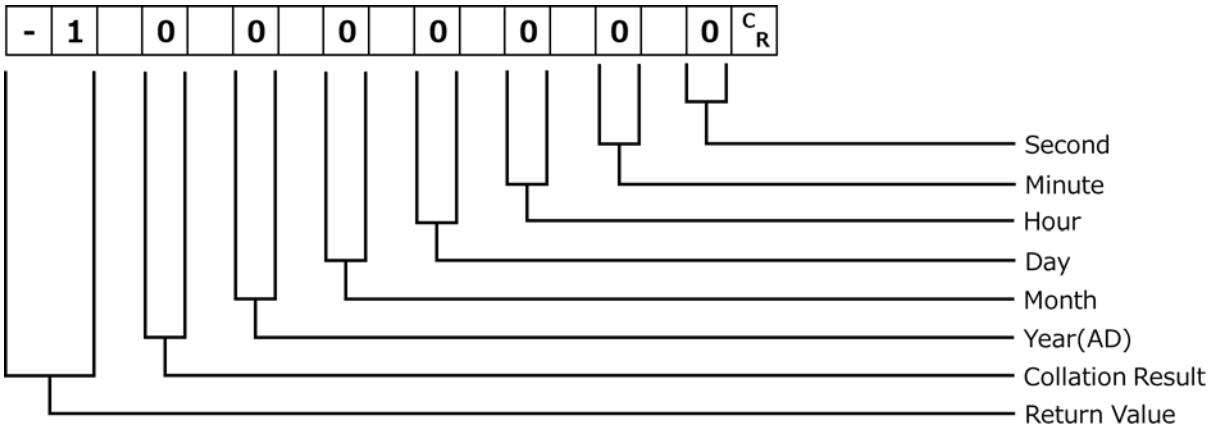
R	B	C	O	M	_	G	E	T	_	C	A	L	I	B	T	I	M	E	_	C	O	M	P	C_R

■ Response format

• When the process is done normally:



• When the process is not done normally:



■ Parameter description

Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Collation Result	Returns the result of comparison between the date and time of camera calibration and the current date and time. 0: Date and time of calibration and current date and time do not match 1: Date and time of calibration and current date and time match

Year(AD)	Returns the year of camera calibration. Returned value is a value of the internal clock of the vision sensor.
Month	Returns the month of camera calibration. Returned value is a value of the internal clock of the vision sensor.
Day	Returns the day of camera calibration. Returned value is a value of the internal clock of the vision sensor.
Hour	Returns the hour of camera calibration. Returned value is a value of the internal clock of the vision sensor.
Minute	Returns the minute of camera calibration. Returned value is a value of the internal clock of the vision sensor.
Second	Returns the second of camera calibration. Returned value is a value of the internal clock of the vision sensor.

■ Example

When the date and time of 3D vision sensor calibration is 2021/03/02/12:30:33, and the date and time of the internal clock of the vision sensor is 2021/03/03/11:30:44:

<Command>

R	B	C	O	M	_	G	E	T	_	C	A	L	I	B	T	I	M	E	_	C	O	M	P	C_R

<Response>

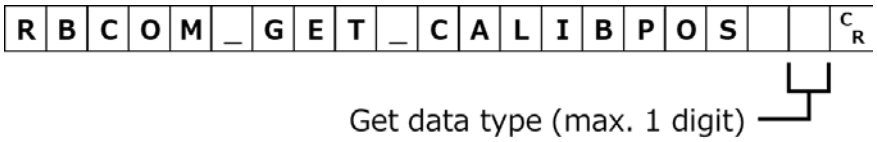
0		0		2	0	2	1		3		2		1	2		3	0		3	3	C_R

2.3.3. RBCOM_GET_CALIB_POS

■ Function

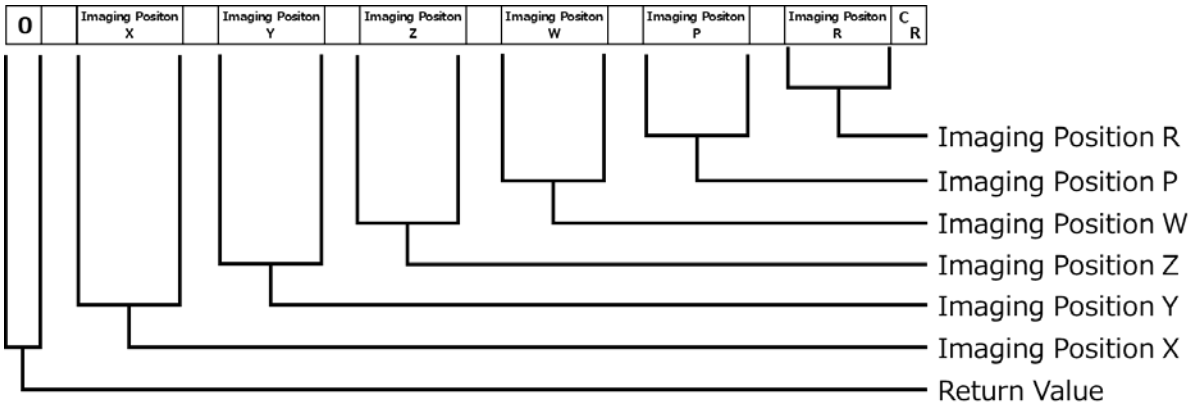
Gets near/far imaging position for camera calibration of the 3D vision sensor.

■ Command format

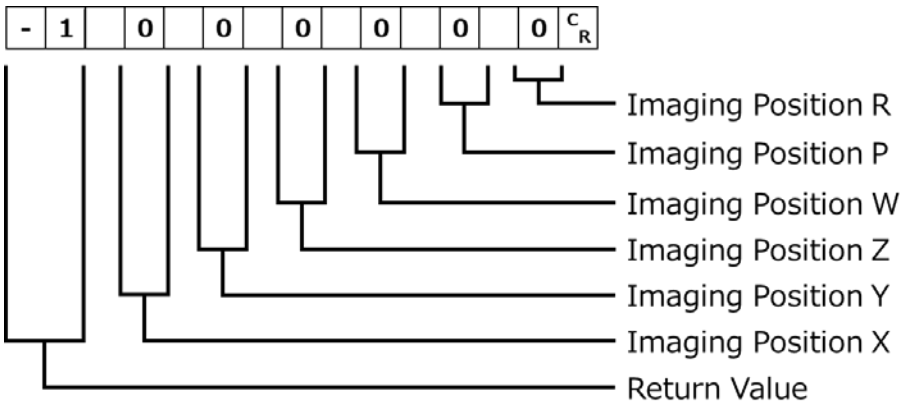


■ Response format

• When the process is done normally:



• When the process is not done normally:



■ Parameter description

Get Data Type	Specify the type of data to be acquired. 0: Near imaging position 1: Far imaging position
Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Imaging Position X	Returns the imaging position X of camera calibration. A value that matches the value of get data type is returned.

Imaging Position Y	Returns the imaging position Y of camera calibration. A value that matches the value of get data type is returned.
Imaging Position Z	Returns the imaging position Z of camera calibration. A value that matches the value of get data type is returned.
Imaging Position W	Returns the imaging position W of camera calibration. A value that matches the value of get data type is returned.
Imaging Position P	Returns the imaging position P of camera calibration. A value that matches the value of get data type is returned.
Imaging Position R	Returns the imaging position R of camera calibration. A value that matches the value of get data type is returned.

■ Example

When the far imaging position of camera calibration is registered as (X, Y, Z, W, P, R) = (300, 100, 600, 180, 15, 90):

<Command>

R	B	C	O	M	_	G	E	T	_	C	A	L	I	B	P	O	S		1	C_R

<Response>

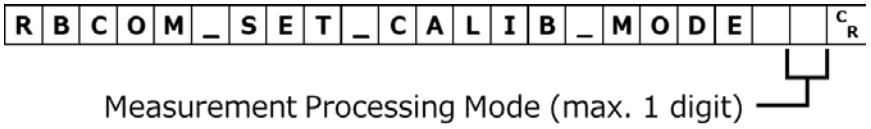
0		300.000		100.000		600.000		180.000		15.000		90.000	C_R

2.3.4. RBCOM_SET_CALIB_MODE

■ Function

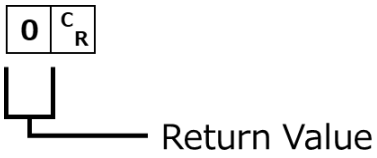
Set the processing mode for measurement for camera calibration of the 3D vision sensor.

■ Command format

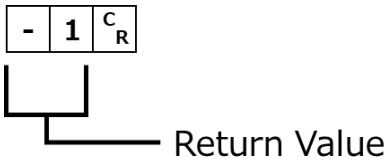


■ Response format

• When the process is done normally:



• When the process is not done normally:



■ Parameter description

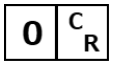
Measurement Processing Mode	Specify the processing mode of camera calibration. 0: Manual mode (for calibrating on the processing item setting screen) 1: Auto mode (for calibrating at the time of measurement) For more information, refer to *4-3-6 Key Points for Test Measurement and Adjustment (Camera Calibration AOS)* of *Vision System FH Series Processing Item Function Reference Manual for 3D Robot Vision (Z445-E1)*.
Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed

■ Example

When setting the processing mode of camera calibration to auto mode:

<Command>

<Response>



2.3.5. RBCOM_GET_GRASP_NUM

■ Function

Gets the number of grasp candidates from the *Grasp Planning* processing unit of the current scene.

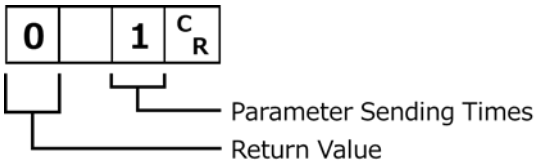
■ Command format

R	B	C	O	M	_	G	E	T	_	G	R	A	S	P	_	N	U	M	C_R

■ Response format

• When the process is done normally:

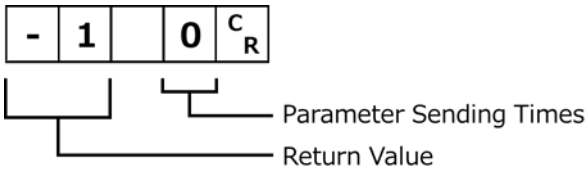
Header part



Parameter part

• When the process is not done normally:

Header part



■ Parameter description

Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Parameter Sending Times	Returns sending times of the parameter part. (0 to 1)
Graspable Candidate Count	Returns the candidate count of the acquired grasp plan. (0 to 1023)

■ Example

When there are 5 candidates in the grasp plan:

<Command>

R	B	C	O	M	_	G	E	T	_	G	R	A	S	P	_	N	U	M	C_R

<Response>

0		1	C_R

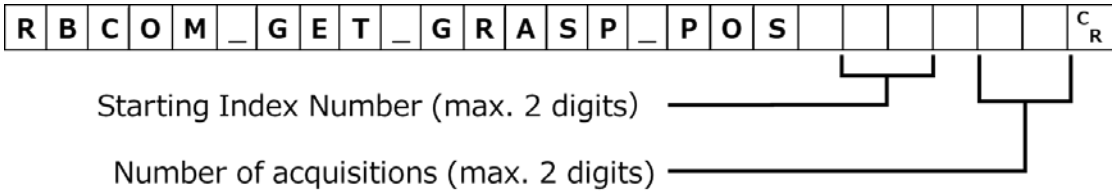
5	C_R

2.3.6. RBCOM_GET_GRASP_POS

■ Function

Gets the position information of the grasp candidates from the *Grasp Planning* processing unit of the current scene.

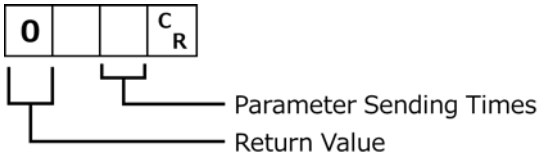
■ Command format



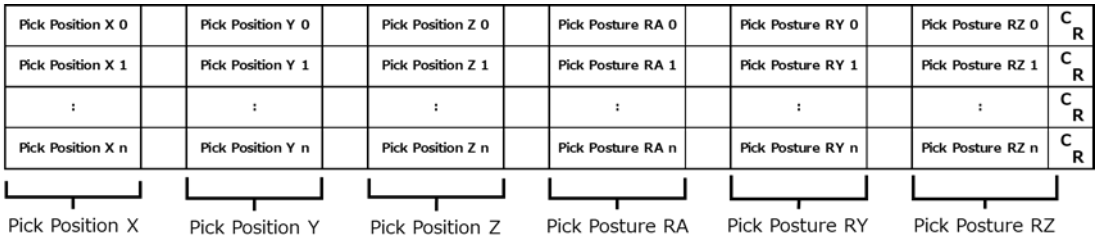
■ Response format

• When the process is done normally:

Header part

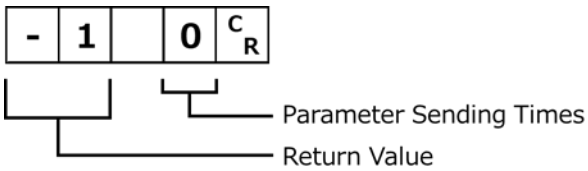


Parameter part



• When the process is not done normally:

Header part



■ Parameter description

Starting Index Number	Specify the number to start data acquisition. (0 to 31)
Number of Acquisitions	Specify the number of data to be acquired. (1 to 10)
Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed

Parameter Sending Times	Returns sending times of the parameter part. (0 to 10) When the process is done normally. the value specified as the number of acquisitions is returned.
Pick Position X	Returns the X element of the pick position of grasp candidate. A value corresponding to the start index number and number of acquisitions can be acquired.
Pick Position Y	Returns the Y element of the pick position of grasp candidate. A value corresponding to the start index number and number of acquisitions can be acquired.
Pick Position Z	Returns the Z element of the pick position of grasp candidate. A value corresponding to the start index number and number of acquisitions can be acquired.
Pick Posture RA	Returns the RA (RX or RZ) element of the pick posture of grasp plan. A value corresponding to the start index number and number of acquisitions can be acquired.
Pick Posture RY	Returns the RY element of the pick posture of grasp plan. A value corresponding to the start index number and number of acquisitions can be acquired.
Pick Posture RZ	Returns RZ element of the pick posture of grasp plan. A value corresponding to the start index number and number of acquisitions can be acquired.

■ Example

When acquiring the pick posture of the following grasp candidate:

Pick posture of the index No. 9 (300.000,100.000,200.000,180.000,15.000,90.000)

Pick posture of the index No. 10 (400.000,150.000,250.000,180.000,-5.000,80.000)

<Command>

R	B	C	O	M	_	G	E	T	_	G	R	A	S	P	_	P	O	S		9		2	C_R

<Response>

0		2	C_R

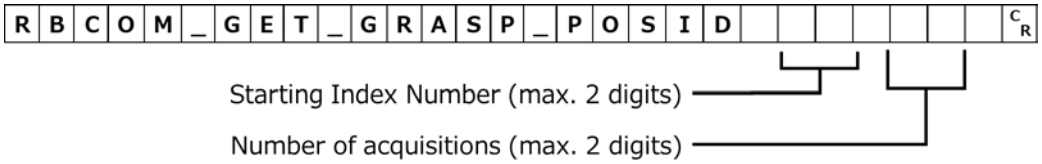
											C_R
300.000		100.000		200.000		180.000		15.000		90.000	
400.000		150.000		250.000		180.000		-5.000		80.000	

2.3.7. RBCOM_GET_GRASP_POSID

■ Function

Gets the ID information of the grasp candidates from the *Grasp Planning* processing unit of the current scene.

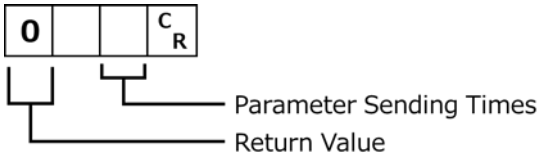
■ Command format



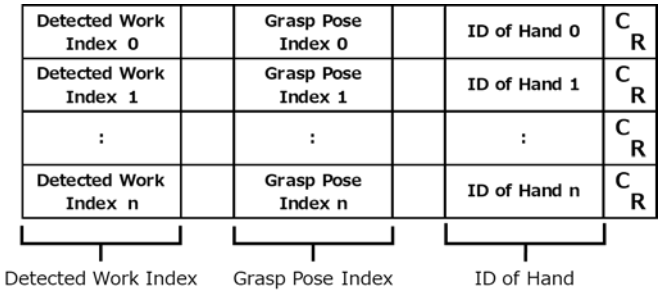
■ Response format

• When the process is done normally:

Header part

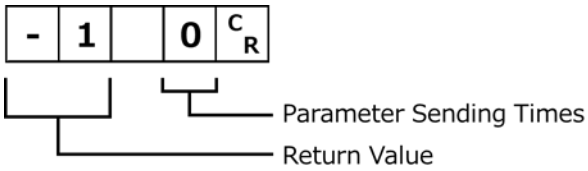


Parameter part



• When the process is not done normally:

Header part



■ Parameter description

Starting Index Number	Specify the number to start data acquisition. (0 to 31)
Number of Acquisitions	Specify the number of data to be acquired. (1 to 10)
Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Parameter Sending Times	Returns sending times of the parameter part. (0 to 10) When the process is done normally. the value specified as the number of acquisitions is returned.

Detected Work Index	Returns the detected work index of the grasp candidate (*1). A value corresponding to the start index number and number of acquisitions can be acquired. (*1): Index number of the work detection result of *3D Search* processing item
Grasp Pose Index	Returns the grasp pose index of the grasp candidate (*2). A value corresponding to the start index number and number of acquisitions can be acquired. (*2): Index number of the pose of grasping registered with the grasp registration tool **GraspTeachGUI**.
ID of Hand	Returns the ID of hand of the grasp candidate (*3). A value corresponding to the start index number and number of acquisitions can be acquired. (*3): ID number of the hand data created with the hand data generation tool **HandMaker**.

■ Example

When acquiring the ID information of the following grasp candidate:

ID information of the index No. 5:

(Detected work index, Grasp pose index, ID of hand) = (2, 0, 0)

ID information of the index No. 6:

(Detected work index, Grasp pose index, ID of hand) = (1, 1, 0)

ID information of the index No. 7:

(Detected work index, Grasp pose index, ID of hand) = (3, 3, 0)

ID information of the index No. 8:

(Detected work index, Grasp pose index, ID of hand) = (4, 2, 0)

<Command>

R	B	C	O	M	_	G	E	T	_	G	R	A	S	P	_	P	O	S	I	D		5		4	C_R

<Response>

0		4	C_R

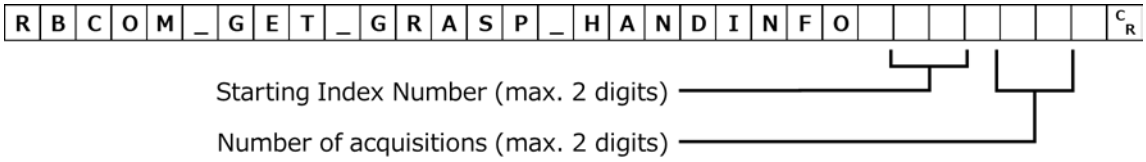
2		0		0	C_R
1		1		0	C_R
3		3		0	C_R
4		2		0	C_R

2.3.8. RBCOM_GET_GRASP_HANDINFO

■ Function

Gets the hand information of the grasp candidates from the *Grasp Planning* processing unit of the current scene.

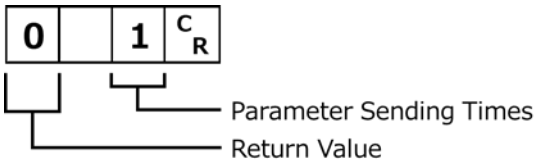
■ Command format



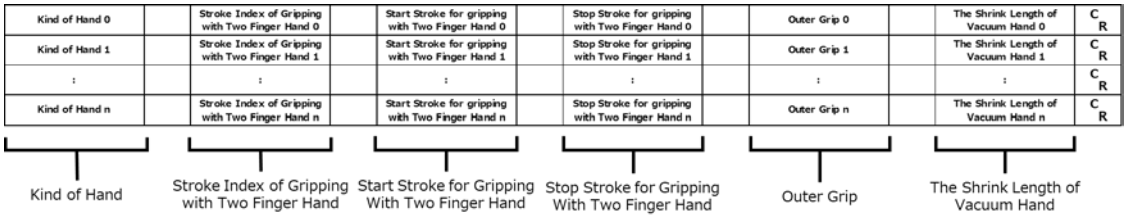
■ Response format

• When the process ended normally

Header part

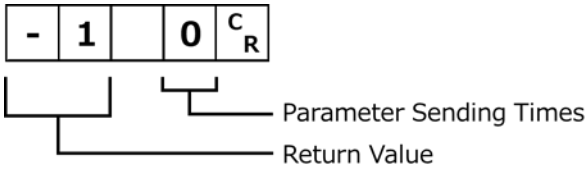


Parameter part



• When the process did not end normally:

Header part



■ Parameter description

Starting Index Number	Specify the number to start data acquisition. (0 to 31)
Number of Acquisitions	Specify the number of data to be acquired. (1 to 10)
Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Parameter Sending Times	Returns sending times of the parameter part. (0 to 10) When the process is done normally. the value specified as the number of acquisitions is returned.
Kind of Hand	Returns the hand type value of the grasp candidate. A value corresponding to the start index number and number of acquisitions can be acquired. 0: Vacuum hand 1: Two finger hand

Stroke Index of Gripping with Two Finger Hand	When *Kind of Hand* is two finger hand, returns the grasping stroke index (*1) of the grasp candidate. A value corresponding to the start index number and number of acquisitions can be acquired. (*1): Index number of stroke (opening width) list for two finger hand, created with the hand data generation tool **HandMaker**.
Start Stroke for Gripping with Two Finger Hand	Returns the start stroke for gripping with two finger hand (*2) of the grasp plan. A value corresponding to the start index number and number of acquisitions can be acquired. (*2): Stroke (opening width) of the hand at the start of grasping
Stop Stroke for Gripping with Two Finger Hand	Returns the stop stroke for gripping with two finger hand (*3) of the grasp plan. A value corresponding to the start index number and number of acquisitions can be acquired. (*3): Stroke (opening width) of the hand at the end of grasping
Outer Grip	When *Kind of Hand* is two finger hand, returns whether the grasp candidate is outer grasping. A value corresponding to the start index number and number of acquisitions can be acquired. 0: Inner grasping 1: Outer grasping
The Shrink Length of Vacuum Hand	When *Kind of Hand* is vacuum hand, returns the shrink length of vacuum hand (*4) of the grasp candidate. A value corresponding to the start index number and number of acquisitions can be acquired. (*4): Shrink length of the bellows of the vacuum hand when grasping

■ Example

When acquiring the hand information of the following grasp candidate:

Index No.	Kind of Hand	Stroke Index of Gripping with Two Finger Hand	Start Stroke for Gripping with Two Finger Hand	Stop Stroke for Gripping with Two Finger Hand	Outer Grip	The Shrink Length of Vacuum Hand
11	1	3	40	20	1	0
12	1	5	100	80	1	0
13	1	2	30	15	1	0

<Command>

R	B	C	O	M	_	G	E	T	_	G	R	A	S	P	_	H	A	N	D	I	N	F	O		1	1		3	C_R

<Response>

0		3	C_R

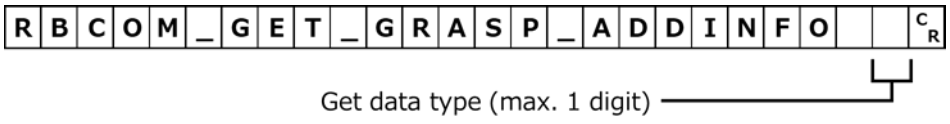
1		3		40		20		1		0	C_R
1		5		100		80		1		0	C_R
1		2		30		15		1		0	C_R

2.3.9. RBCOM_GET_GRASP_ADDINFO

■ Function

Gets the detailed information of the top grasp candidate from the *Grasp Planning* processing unit of the current scene.

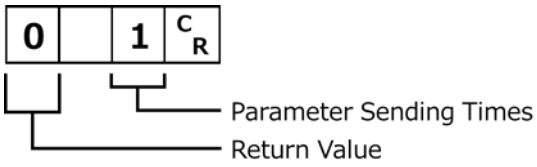
■ Command format



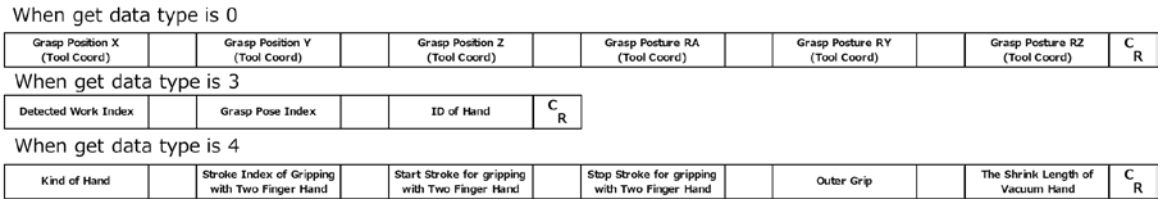
■ Response format

• When the process ended normally

Header part

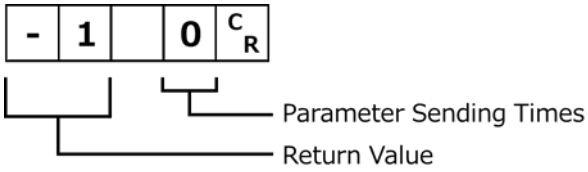


Parameter part



• When the process did not end normally:

Header part



■ Parameter description

Get Data Type	Specify the type of data to be acquired. 0: Grasping position of the top grasp candidate (tool coordinate system) (*1) 1: Unavailable (reserved) 2: Unavailable (reserved) 3: ID information of the top grasp candidate 4: Hand information of the top grasp candidate (*1): Position and orientation of the grasp target workpiece viewed from the tool coordinate system of the robot
Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Parameter Sending Times	Returns sending times of the parameter part. (0 to 1)

Grasp Position X (Tool Coord)	Returns the X element of the grasp position of the top grasp candidate (tool coordinate system).
Grasp Position Y (Tool Coord)	Returns the Y element of the grasp position of the top grasp candidate (tool coordinate system).
Grasp Position Z (Tool Coord)	Returns the Z element of the grasp position of the top grasp candidate (tool coordinate system).
Grasp Position RA (Tool Coord)	Returns the RA (RX or RZ) element of the grasp position of the top grasp candidate (tool coordinate system).
Grasp Position RY (Tool Coord)	Returns the RY element of the grasp position of the top grasp candidate (tool coordinate system).
Grasp Position RZ (Tool Coord)	Returns the RZ element of the grasp position of the top grasp candidate (tool coordinate system).
Detected Work Index Grasp Pose Index ID of Hand	Returns the ID information of the top grasp candidate.
Kind of Hand Stroke Index of Gripping with Two Finger Hand Start Stroke for Gripping with Two Finger Hand Stop Stroke for Gripping with Two Finger Hand Outer Grip The Shrink Length of Vacuum Hand	Returns the hand information of the top grasp candidate.

■ Example

When acquiring grasp position and orientation (tool coordinate system) (X, Y, Z, RA, RY, RZ) = (300, 200, 100, 180, 0, 90):

<Command>

R	B	C	O	M	_	G	E	T	_	G	R	A	S	P	_	A	D	D	I	N	F	O		0	C_R

<Response>

0		1	C_R

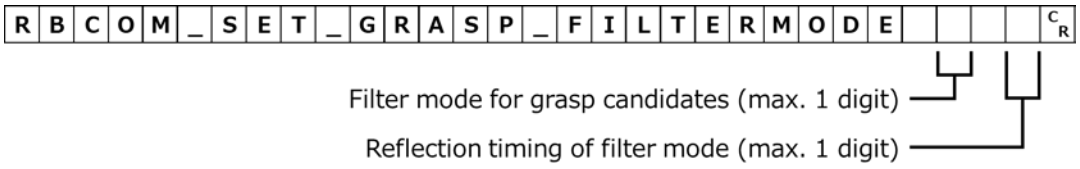
300.000		200.000		100.000		180.000		0.000		90.000	C_R

2.3.10. **RBCOM_SET_GRASP_FILTERMODE**

■ Function

Set the filter mode of the grasp candidates from the *Grasp Planning* processing unit of the current scene.

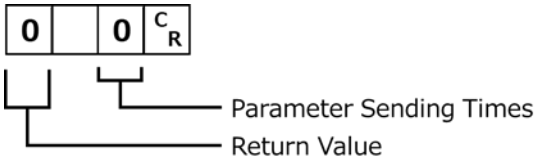
■ Command format



■ Response format

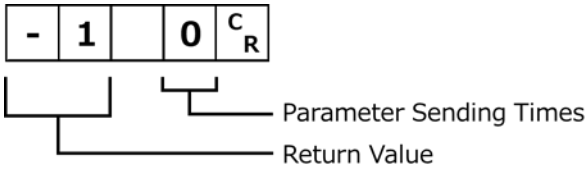
• When the process ended normally:

Header part



• When the process did not end normally:

Header part



■ Parameter description

Filter Mode for Grasp Candidates	Specify the filter mode for grasp candidates. (0 to 15) Specify a value of 4-bit data converted to decimal value. Functions of each bit are as follows. First bit: Keep only the grasp candidates which passed the success judgment Second bit: Keep only one grasp candidate for each workpiece Third bit: Delete all grasp candidates which belong to the same workpiece as the top grasp candidate, except the top grasp candidate Fourth bit: Delete only the top grasp candidate

Reflection Timing of Filter Mode	Specify the timing to apply filter mode settings to the *Grasp Planning* processing unit. 0: Apply at the next measurement 1: Apply immediately * When **1: Apply immediately** is selected, the filter is immediately applied to the current grasp candidate, and information regarding the grasp candidate filtered with commands such as RBCOM_GET_GRASP_POS can be acquired right after executing this command.
Return Value	Returns whether the custom command execution has succeeded. 0: Success -1: Failed
Parameter Sending Times	Returns sending times of the parameter part. (0)

■ Example

When you want to apply a filter, which keeps only one grasp candidate for each workpiece and exclude any remaining grasp candidates whose success judgment is NG, to the current grasp results immediately:

<Command>

R	B	C	O	M	_	S	E	T	_	G	R	A	S	P	_	F	I	L	T	E	R	M	O	D	E		3		1	C_R

<Response>

0		0	C_R

3. Related Manuals

Man.No.	Model	Manual Name
Z365	FH/FHV Series	Vision System FH/FHV Series User's Manual
Z445	FH Series	Vision System FH Series Processing Item Function Reference Manual for 3D Robot Vision
Z342	FH/FHV Series	Vision System FH/FHV Series User's manual for Communications Settings
Z446	FH Series	Vision System FH series 3D Robot Vision Application Construction Guide

4. Revision History

Rev. Code	Rev. Date	Revised Contents
01	Feb. 2021	Original production

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