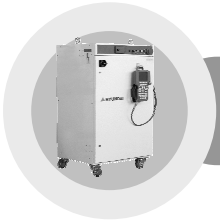
WARNING

THE INSTALLATION SHALL BE MADE BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES

Hyundai Robot

Hi4aSH071001FMEN3



Hi4a Controller Function Manual

Servo Hand

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

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HEAVY INDUSTRIES CO.,LTD.

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- Stroke(Max., Min.)
- Maximum Squeeze Force

(5) Controlling Specifications

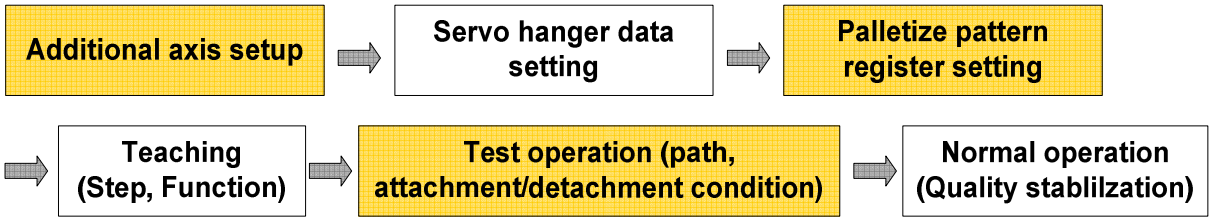
Item	Data	Remarks
Squeeze Force Error	±4%	
Set Value of Practical Minimum Squeeze Force	50kgf	It may change depending on servo hand specifications.
Set Value of Maximum Squeeze Force	999kgf	
resolving power of Practical Squeeze Force	1kgf	
Maximum Stroke Setting	3000mm	

1.2. Flowchart of Servo Hand Operation

Flowchart for the use of servo hand, in comparison with Air-Hand, is as follows.

Air-Hand

Servo Hand



(1) For the driving of servo hand by motor, refer to 『Additional axes Function Manual』, and set up a mechanical constant of additional axis.

(2) Set up servo hand data for the attachment/detachment of workpiece.

(3) Set up information on Palletize. (Palletize Function Manual』.)

(4) Teach the Palletize program.

(5) Check the locus and attachment/detachment conditions of program you performed the teaching.

(6) Operate it normally.

1.3. Before Teaching

Be sure to perform the following instructions before teaching.

(1) Check if robot manipulator data(robot & additional axis) is set.

(2) Check if reference position of servo hand is set.

(3) Check if servo hand data is correctly set to the using environment(distance of attachement/detachment , Squeeze force, etc.).

(4) Check if Palletize pattern information is normally set.

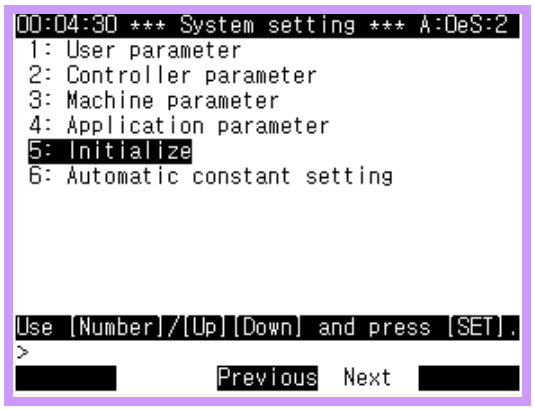
(5) Be sure to have thorough knowledge on how to write the Palletize program , through 『Palletize Function Manual』, before teaching a step.

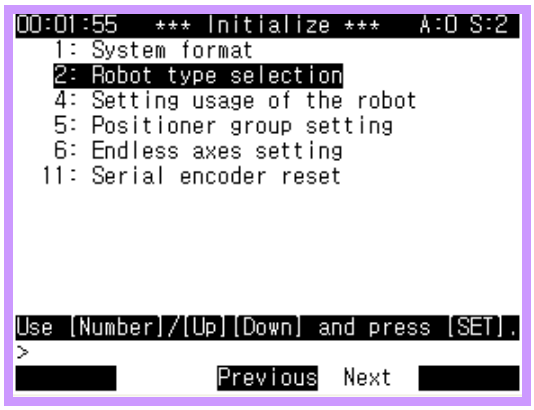
2
Constant Setting

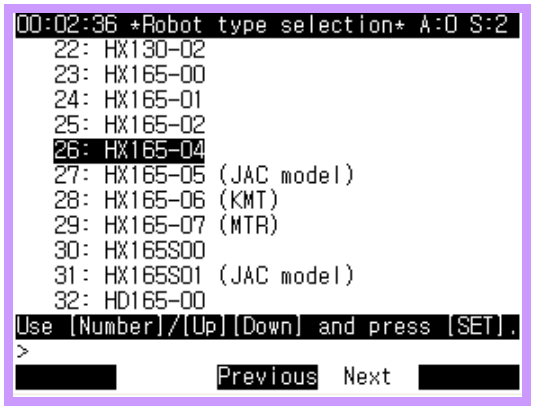
2.1. Register of Robot Type & Additional Axis Constant

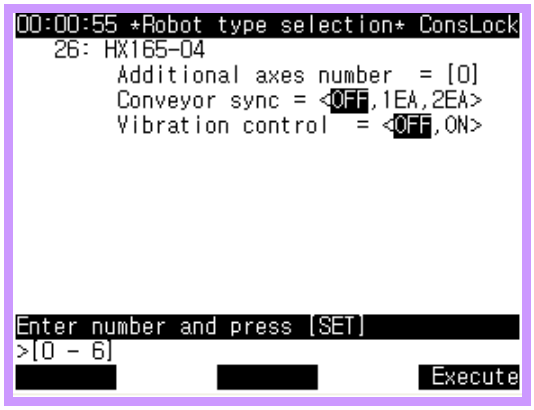
2.1.1. Robot Type & Additional Axis Setting

(1) Select 『[PF2]: system』 → 『5: Initialize』 → 『2: robot type selection』 in a manual mode.

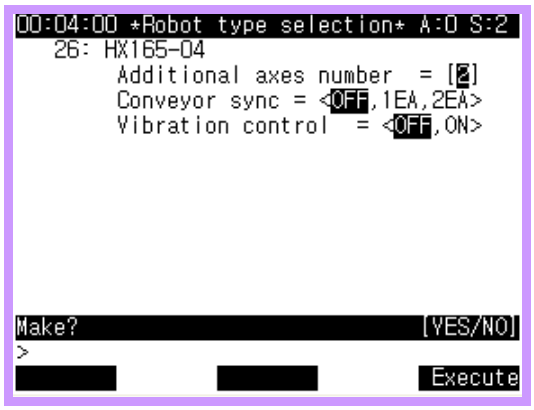






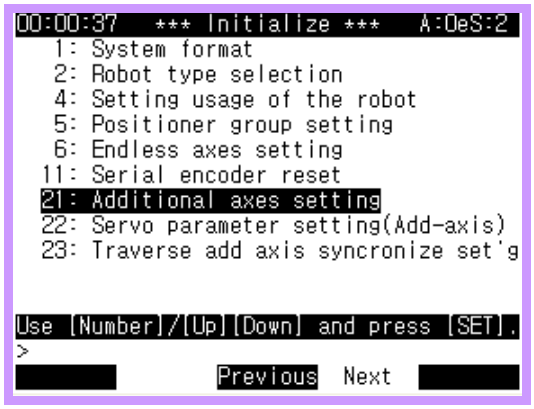


(2) Enter the number of additional axis and press the 『[PF5]: Execute』 key to see the message frame showing 『Make? [Yes]/[No]』.



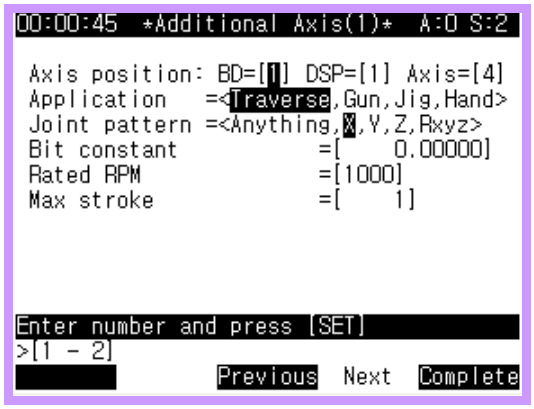
2.1.2. Additional Axes Setting

(1) Select 『[PF2]: System』 『5: Initialize』 『21: Additional axes setting』.



※ You can select menu 21 above in the following cases.
- When the engineering code (R314) in manual mode is entered.
- When the state of the motors is off.
- When there is an additional axis.

(2) Set the additional axis constants.(Maximum of 6 axes)



(3) Press『[PF5]: Complete』 to end entry.

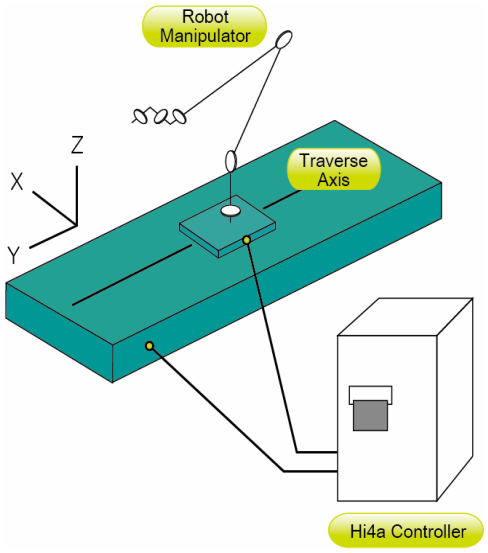
Reference

- Total of 6 axes may be set up, but only 1 axis can be set up for servo hand.

◆【Additional-Axis Constant Explanation 】◆

① Axis position
Users can use it by designating physical configuration of Additional-Axis.
BD=[1](1~2) => Designate the number of BD440 Board.(2DSP/1Board)
DSP=[1](1~2) => Save the number of DSP in BD440 Board.(4 Axis/1DSP)
Axis=[4](1~4) => Designate Axis No.

Ex) In case of designating it as 1,1,4 to set up 7th Additional-Axis,
Basic axis 6 axis – Main 3 axis (1st BD440, 1st DSP, 1~3 axis)
Wrist 3 axis (1st BD440, 2nd DSP, 1~3 axis)
Additional 1 axis (1st BD440, 1st DSP, 4th axis)



② Application
Select a kind of Additional-Axis between <Traverse, GUN, JIG,Hand>.
When deciding Additional-Axis spec. , you should follow Traverse → GUN → JIG → Hand followed by logical Additional-Axis order.

③ Gun Change
Select the number of gun change <DSBL, 1, 2, 4, 6, 8>.
In case of GUN axis, you can select whether use of servo-gun change function or not. If you select DSBL, servo-gun change function will not be activated. Or you might select the number of changeable guns.

④ Bit constant [-9999.99999 ~ 9999.9999] :
Register moving quantity according to Encoder pulse process of 10000bit.
Register rotation axis as deg/10000bit, and direct-acting axis as mm/10000bit.

Encoder pulse per 1 rotation used inside Hi4a controller is fixed as 8192bit.

Please refer to below example.
However, the code of value is fixed as below.
In case forward direction of motor is correspond with the rotation direction of speed reducer, fix it as “+” if coordinate value is increased, and reversely fix it as “-“ if coordinate value is decreased.

Ex 1) If this is the rotation axis using 1/100 speed reducer only,
the axis rotates 360deg by 100 rotations of motor.
Therefore Bit Constant = 360[deg] / (100[rev] X 8192[bit]/[rev]) X 10000[bit] = 4,39453

Ex 2) If it is the direct-acting axis using 1/20 speed reducer and rack pinion of PCD

110mm,
110xPhi(=3.14159)[mm] is moved by 20 rotation of motor.
Bit Constant = 110xPhi[mm] / (20[rev] x 8192[bit]/[rev]) X 10000[bit] = 21.09223

Ex 3) If it is the direct-acting axis using speed reducer and ball screw of Lead 5mm,
The axis moves 5mm by 5 rotation of motor.
Therefore, Bit Constant = 5[mm] / (5[rev] × 8192[bit/rev]) = 1.22070

⑤ Rated RPM [1000 - 5000] :
Fix rotation speed of motor used in Additional-Axis. Decide it in the range of not exceeding nominal speed of motor. By the speed and bit constant, max speed of additional axis is set up automatically in 『[PF2]: System』 → 『3: Machine Parameter』 → 『6: Accel & Decel parameters』.
It is possible to change the speed of axis directly in Accel & Decel Parameters menu.
However, users should reset accelerating time and decelerating rate in the process of system tuning because accel/decelerating time is designated by minimum value.

⑥ Max. Stroke [1 - 30000] :
This is the information to set up Robot valid moving region (Additional-Axis soft limit) of 『[PF2]: System』 → 『3: Machine Parameter』 → 『3: Softimit』automatically.

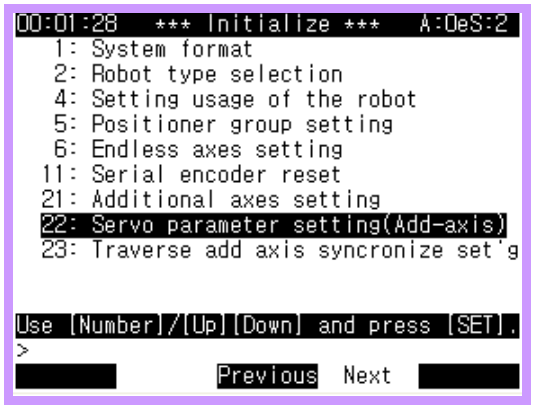
2.1.3. Servo parameter setting(Add-axis)

Set up the servo parameter to meet the drive conditions of additional axis(servo loop control).

Among the 2 ways of setting is that users refer to motor specification and simply input data collected without calculation. And another way is that users input data with calculation according to servo parameters.

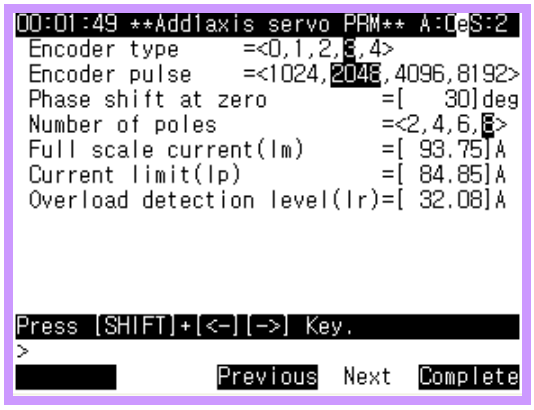
For more details, refer to 『Hi4a Additional Axis Fuction Manual』. The first method is explained in the following.

(1) Select 『[PF2]: System』 → 『5: Initialize』 → 『22: Servo parameter setting(Add-axis)』 from manual mode.



※ You can select menu 22 above in the following cases.
- When the engineering code (R314) in manual mode is entered.
- When the state of the motors is off.
- When there is an additional axis.

(2) Set the additional axis servo parameter. (Maximum of 6 axis)



(3) Press the 『[PF5]: Complete』 key when you have complete entering.

(4) After power is re-applied in the completion of parameter setting, do not detect an offset length error by setting up the set value of servo hand axis as 0 in the 『[PF2]: system』→『3: Machine parameter』→『12: Servoparameter setting』→『2: Position error level』 menu.

◆【Additional-Axis Servo Parameter Explanation】◆

- Please use it for reference only because written as Commonly below the explanation can be changed by manufactures.
- After setting up each items, followed by load state 『[PF2]: System』 → 『3: Machine Parameter』 → 『6: Accel & Decel parameters』 → Accel/decelerating information, 『[PF2]: Service』 → 『3. Machine parameter』 → 『12: Servo Parameter Setting』 → 『1: Servo Loop Gain』 → Use it adjusting Position Loop Proportional Gain(Kp) of and Speed Loop Proportional Gain (Kv).

① Encoder Type
0 : Yaskawa, 1 : Tamakawa, 2 : Panasonic, 3 : PanasonicCompact
In Hi4a controller, it corresponds with absolute value encoder only.
Currently the encoder of motor used in our mass production(MP) model robot corresponds to 『3 : PanasonicCompact』.
Motors are supplied by Tamagawa is supplied to our company mounting the encoder of 『3 : PanasonicCompact』 Type.

② Encoder Pulse
< 1024, 2048, 4096, 8192 >
This is the number of Incremental Purse outputted by the encoder per motor 1 rotation.
Setting up the encoder pulse outputted by motor, the inside of Hi4a controller calculates it by converting all encoders to 8192 pulse automatically. Therefore, when calculating Additional-Axis Bit Constant, it is always calculated in the basis of 8192 pulse regardless of encoder pulse setting value.
Commonly Yaskawa 12bit Encoder is 1024, Yaskawa 15bit Encoder is 8192, Panasonic is 2048, and Tamakawa is 4096.
Currently the encoder of motor used by our MP model robot same as encoder type is 2048 pulse, and motors supplied by Tamagawa are supplied by mounting encoder of 2048 pulse.

③ Phase shift at zero
θ [deg]
Input current phase angle at encoder zero point.
Commonly Yaskawa & Tamakawa are 0, and Panasonic is 30.
Current phase angle at encoder zero point of the motors used by our MP model robot currently same as encoder type is 30deg, and motors supplied by Tamagawa are supplied by fitting in the phase angle of 30 deg.

④ Number of poles
< 2, 4, 6, 8 >
Input the number of motor pole.
Currently the number of motor pole used by our MP model robot is 8 pole.

⑤ Full Scale Current
Im [Apeak]
This is the current value corresponded to full scale of current variable(torque command) when calculating S/W Servo Controller. Full Scale Current Value is saved by Formula 1) and it is changed by Shut Resistance and Hall Sensor Output Spec.

$$Fullscale\ Current = Current\ value\ in\ case\ of\ current\ feedback\ Voltage\ 8Volt \times \frac{7.5}{8}$$ --------- Formula 1)

AMP Model	Hall Sensor Signs (Specifications)	ShuntResistance Sign (Resistance Value)	Full Scale Current(Im)	Usable IPM (rated Current)
Large-sized 6Axis /Additional-Axis AMP	0 (4V/75A)		**140.62Apeak**	PM150CSD060 (150A)
	1 (4V/50A)		**93.75Apeak**	PM150CSD060 (150A) PM100CSD060 (100A) PM75CSD060 (75A)
	2 (4V/25A)		**46.87Apeak**	
	3 (4V/15A)		**28.12Apeak**	
	4 (4V/10A)		**18.75Apeak**	
	5 (4V/5A)		**9.37Apeak**	
Medium-sized 6 Axis /Additional-Axis AMP		1 (2mΩ)	**93.75Apeak**	PM100CSD060 (100A) PM75CSD060 (75A)
		2 (4mΩ)	**46.87Apeak**	
		3 (8mΩ)	**23.44Apeak**	
		4 (12mΩ)	**15.58Apeak**	
		5 (16mΩ)	**11.72Apeak**	
Small-sized 6 Axis /Additional-Axis AMP	1 (4V/15A)		**28.12Apeak**	PM30CSJ060(30A)
	2 (4V/10A)		**18.75Apeak**	PM30CSJ060(30A)
	3 (4V/5A)		**9.37Apeak**	PM30CSJ060(30A) PM10CSJ060(10A)

⑥ Current limit
Ip [Apeak]
This means Motor Output Max. Current. The setting of current limit value sets up necessary current value from motor to satisfy working spec of applied equipment. Available range for setting should satisfy three conditions as below, and for improvement of control performance, set up to use Full Scale Current nearby as possible as it can.

Condition 1) Within Instantaneous Max. Current on Motor Catalog
Condition 2) Within AMP Max. Output Current
Condition 3) Full Scale Current(Im) 97%≥ Current Limit (Ip)≥ Full Scale Current(Im) 40%

※ AMP Max./Continuous Output Current(IPM Max. rated)

AMPMax. Output Current is limited as Formula 2) by the rated of use IPM. Also for the continuously used current, the range of use calculated through the evaluation test with the junction temperature within the permitted range by the heating condition of IPM (Heat sink, forced cooling etc.) and operating condition (Switching loss, on resistance etc.), is about within 60% of the rated current of IPM.

However, instantaneous Max. Output of Large-sized AMP is limited as allowable current of below table related to the structure of AMP regardless of Formula 2).

$$IPM\ Rated\ Current \geq MaxCurrent \times 1.1(10\%\ m\arg in\ of\ Current)$$---------- Formula 2)

IPM Type	Rated Current[Sign]	Item	Allowable Current(Apeak)	Use Model
PM150CSD060	150A [L]	**AMP Max. OutputCurrent**	**125**	Large-sized 6 Axis AMP
		AMP Continuous OutputCurrent	**60**	
PM100CSD060	100A [X]	**AMP Max. OutputCurrent**	**90.9**	Large-sized 6 Axis AMP, medium-sized 6 Axis AMP, Large-sized Additional-Axis medium-sized Additional-Axis
		AMP Continuous OutputCurrent	**60**	
PM75CSD060	75A [Y]	**AMP Max. OutputCurrent**	**68.18**	
		AMP Continuous OutputCurrent	**45**	
PM30CSJ060	30A [A]	**AMP Max. OutputCurrent**	**27.27**	Small-sized 6 Axis AMP, Small-sized Additional-Axis
		AMP Continuous OutputCurrent	**18**	
PM10CSJ060	10A [D]	**AMP Max. OutputCurrent**	**9.09**	
		AMP Continuous OutputCurrent	**6**	

■ The case below 40% of Full Scale Current(Im) corresponds with changing Shunt Resistance/ Hall Sensor.

AMP Model	IPM Sign	Hall Sensor/ Shunt Resistance Sign	Available Range for Current Limit Settings (Apeak)
Large-sized 6 Axis/ Additional-Axis AMP	L	0	125 ~ 70.31
	L,X	1	90.90 ~ 37.50
	Y		68.18 ~ 37.50
	L,X,Y	2	45.46 ~ 18.75
	L,X,Y	3	27.27~11.25
	L,X,Y	4	18.19~7.50
	L,X,Y	5	9.08 ~ 3.75
medium-sized 6 Axis / Additional-Axis AMP	X	1	90.90 ~ 37.50
	Y		68.18 ~ 37.50
	X,Y	2	45.46 ~ 18.75
	X,Y	3	22.75 ~9.38
	X,Y	4	15.11~6.23
	X,Y	5	11.37~4.69
Small-sized 6 Axis / Additional-Axis AMP	A	1	27.27~11.25
	A	2	18.19~7.50
	A,D	3	9.08 ~ 3.75

⑦ Overload detection level
Is [Apeak]
This means Motor Output Continuous Current. The setting of overload detecting level sets up current value corresponded by calculating or measuring Trms(Max. Load, Max. Speed, torque mean value of Max. repeat working pattern). Available range for setting should satisfy below two conditions.

Condition 1) Within rated Current on Motor Catalog
Condition 2) Within AMP Continuous OutputCurrent

◆【Reference】◆

- When setting up the drive axis and servo hand axis simultaneously, register the additional axis for drive axis first, and then the one for servo hand axis.
- 6 additional axes can be registered at maximum.
- Only 1 additional axis can be registered for servo hand axis.

Additional axis setting is exemplified in the following.

[Example 1] In case of setting only for servo hand :

Additional Axis	Axis Specification	Hand No.
1st Axis	Hand	1

[Example 2] In case of set up for Traverse axis + Servo Hand Axis

Additional Axis	Axis Specification	Hand No.
1st Axis	Traverse	-
2nd Axis	Hand	1

- Multi-servo hand is not supported.
- When the additional axis and servo parameter setting is completed, re-apply primary power of controller to check if any encoder relevant errors are occurred. Here, if there is an error, refer to 『Hi4a Controller Maintenance Manual』.
- Perform the encoder calibration when servo hand axis is normal without any error. After the completion of encoder calibration, supply power to motor(MOTOR ON), and check if Bit-constant is correct by moving the additional axis at low speed. Bit-constant check is to compare the actual moving distance of servo hand with the data of servo hand axis displayed on the axis data of monitoring function.
- If vibration and shaking in a manual speed and auto-run, inspection and tuning(Accel & Decel, gain) are needed in equipmental assembly.

2.2. Reference position Setting of Servo Hand

(1) Check the normal operation of servo hand first before the reference position setting for servo hand axis.

(2) Select and execute『[PF2]: system』 → 『3: Machine parameter』 → 『2: axis constant』 in a manual mode.

(3) When setting up the reference position, move toward a forcing direction(moving hand-> fixed hand) to the stopper of fixed hand, and then record the axis data.

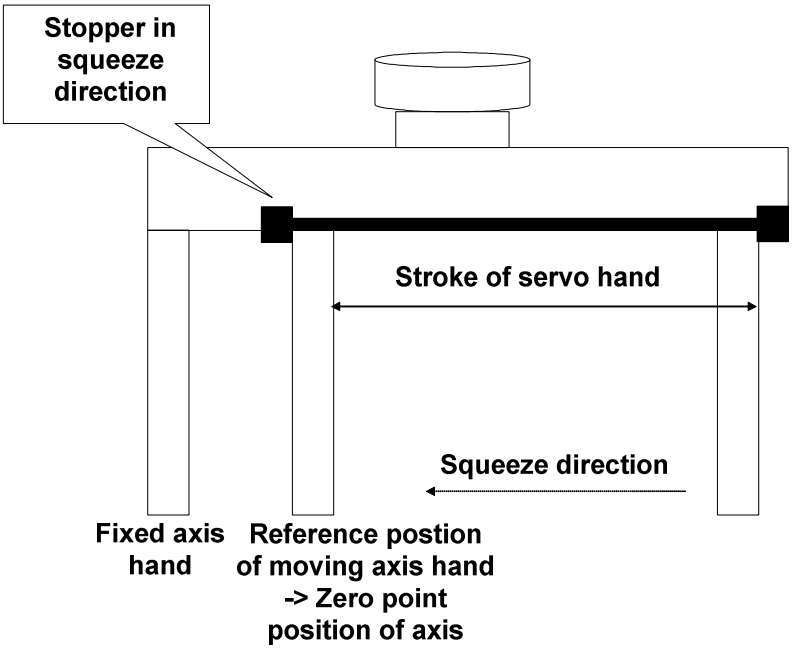


Fig. 2.1 Reference position Setting of Servo Hand

2.3. Parameter Setting of Servo Hand

Set up the parameter for servo hand in the menu of 『[PF2]: system』 → 『4: application parameter』 → 『3: Palletizing』 → 『3: servo hand parameter setting』. If additional axis is registered as servo hand, an initial value will be set up in writing a constant file. Thus, change it according to the force conditions.

2.3.1. Parameter

(1) Max. close position=[0 - 3000]mm
It is the maximum Pressurizing distance in pressurizing of servo hand, and the Pressurizing target position in manual and automatic pressurizing.

(2) Max. open position=[0 - 3000]mm
It is the maximum open distance in opening of servo hand, and the open target position in a manual opening and the information applying as opening restriction value in an automatic opening. If the open distance value of M39 is in excess of open stroke, “E1327 Servo hand opening limit is over” will occur.

(3) Close speed=[1 - 1000]mm/s
Specify the moving speed of servo hand in pressurizing(manual pressurizing, automatic pressurizing) of servo hand.

(4) Squeeze match rate=[1 - 100]%
When the actual force, compared to instructed force, reaches the range of force during the detection of pressurizing match, detect it as apressurizing matched.

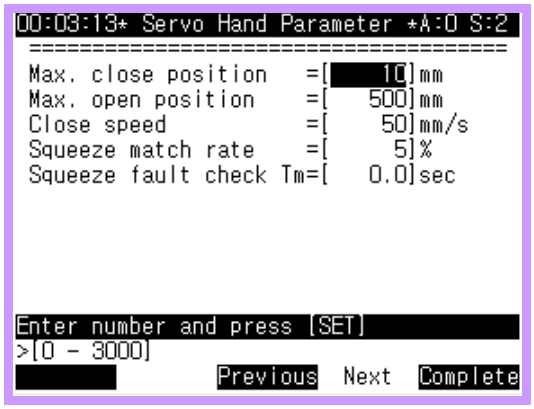
(5) Squeeze fault check tm=[0.0 - 9.9]sec
Set up the time ranged from an initial pressurizing to a pressurizing match. If the pressurizing match fails to be acquired within this time, error message “E1329 detection overtime of servo hand sqeeze match” is output and finally it stops.

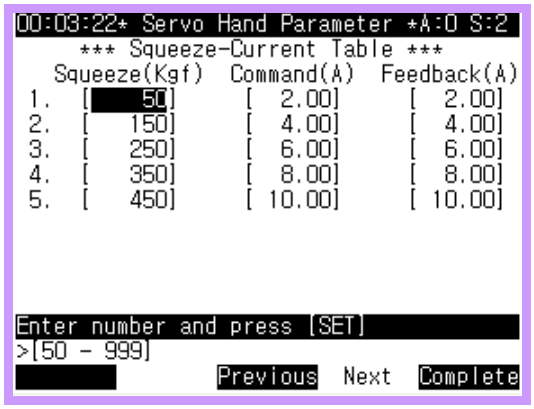
(6) Squeeze - Current Table
Set up the relations between force generated in servo hand and current level applied to motor. This force-current table may set up a current value for 5 random forces.
Besides, the maximum value and minimum value of force input here become a range of force restriction in a manual operation.
Measure both instructed current and actual current when writing the force table because there is a difference between them.

2.3.2. How To Operate Servo Hand Parameter

(1) Select 『[PF2]: system』 → 『4: application parameter』 → 『3: Palletizing』 → 『3: servo hand parameter setting』.

(2) The following screen is displayed.





(3) Enter the number and press [SET]key.

2.4. Completion

When a constant file is completed, enter an editing mode and make a copy of auxiliary memory unit(PC card, PC) and constant file(ROBOT.C00, ROBOT.C01).

3
Teaching

Record a step and input the function(M38, M39), making it possible to perform an attachment/detachment of workpiece manually and automatically by using servo hand.
Check the following instructions before teaching.

(1) Check if a constant setting of robot manipulator is completed.

- Additional axis registration(servo hand axis, servo parameter)
- Encoder Calibration, axis constant, soft limit, servo hand parameter…

(2) Check if user's key is assigned.

- Manual pressurizing of servo hand, manual opening of servo hand

(3) Check if a basic operation(jog) of servo hand axis and servo tuning are completed.

3.1. Manual Squeeze/Open

Manual pressurizing and opening of servo hand axis are available in a teaching mode. It moves the servo hand to the position of pressurizing and maximum opening with a simple operation, and thus provides a convenient teaching method.

3.1.1. How To Operate

Assign 『530: Servo hand manual squeeze』 and 『531: Servo hand manual open』 to a proper f key in 『[PF2]: system』 → 『2: Controller parameter』 → 『11: f-key setting』 before squeeze/open the servo hand axis manually.

(1) Select a manual mode, and apply MOTOR ON.

(2) Press [f] key assigned 『Servo hand manual squeeze』 or 『Servo hand manual open』 and [Shift] key of teach pendant at the same time.

(3) Perform a manual squeeze/open of servo hand as shown in the below figure.

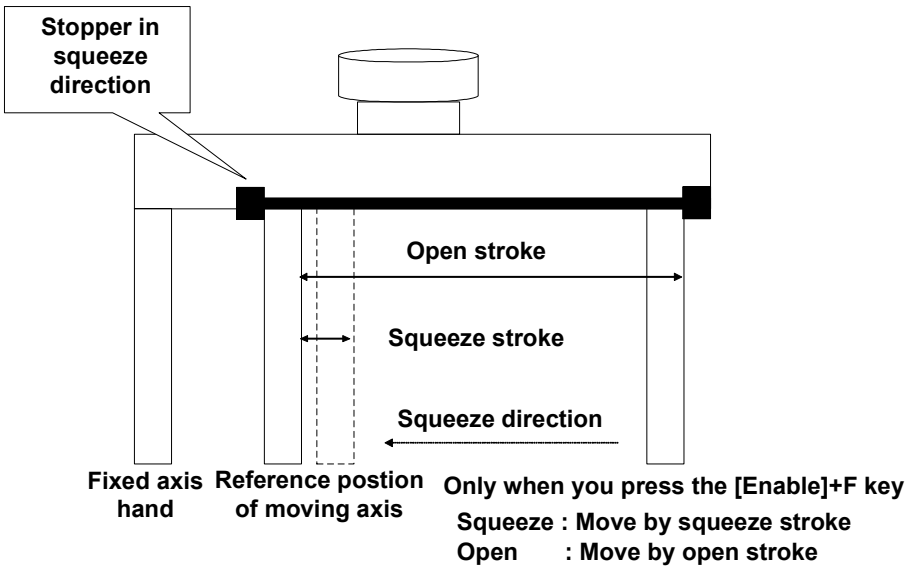


Fig. 3.1 Manual squeeze/open

◆【Note】◆

- When a pressurizing match is achieved during pressurizing, SH-On is flickering in the upper side of teach pendant, and the operation stops. And when reaching the maximum opening position during a opening, it stops.
- The pressurizing speed of servo hand axis moves to the pressurizing speed of servo hand parameter, and the opening speed moves to the maximum speed of servo hand axis.
- If [f]key is released during squeeze/open, it(squeeze/open) stops, but if only [SHIFT]key is released, it does not stop. If pressing again after stop, it operates in the position where it has stopped.

3.2. Jog Operation of Servo Hand

If pressing [auxiliary axis]key of teach pendant, auxiliary axis LED will be ON in the upper side of teach pendant. If pressing [left/T1(positive)], [right/T1(negative)] key, servo hand axis will be manually operated. Here, if the auxiliary axis LED is ON, jog operation is not available for the robot because only the jog key of auxiliary axis will be operated.
Jog operation of servo hand axis is perfermed regardless of coordinate system.
Jog operating speed (based on H4) is 25% of the maximum speed of auxiliary axis.(But, it is restricted by max 250mm/sec)

3.3. Step Recording

(1) Like the robot axis, the position of servo hand axis is recorded as auxiliary axis by [Record]key of teach pendant.

(2) Record the pressurizing position of workpiece temporarily.

(3) Perform a manual squeeze/open, and check the pressurizing position for a safe workpiece handling.

(4) Determine the step position for the last.

3.4. Record of Squeeze/open Function

3.4.1. Function of Servo hand squeeze(M38)

Function of Servo hand squeeze sets the 2 parameters.

M38[Offset Length, Squeeze Force]

(1) Offset Length [-2000 - 2000]mm
Specify the starting position to pressurize of servo hand. The starting position of pressurizing is a sum of teaching position and offset length. When the offset length has – value, the starting position of pressurizing is located in a more inner position than teaching position.

(2) Hand Squeeze Force [50 - 999]kgf
It is a factor determining a strength of force to grasp a workpiece. When input the squeeze force, be sure to review thoroughly in advance to avoid a damage on an actual workpiece.

◆【Note】◆

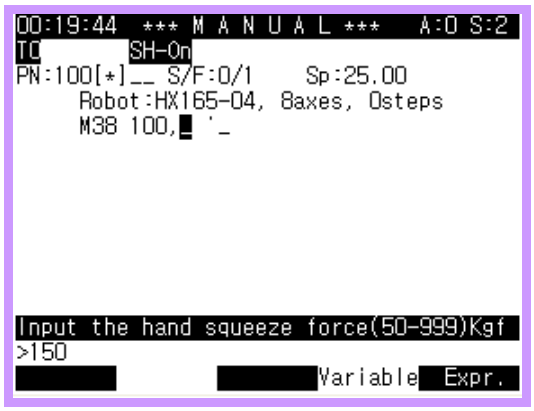
- Be sure to record the servo hand squeeze function with the first function of step. Otherwise, it won't be executed.
- The target position of step with servo hand squeeze function(M38) could be smaller or bigger than the recorded position that has a teaching along the offset length which is set in this function. It is to shorten a cycle time by making the pressurizing start point different depending on the size of handling products.
- If the position value of pressurizing start which is calculated depending on the offset length is smaller than the maximum pressurizing position of servo hand, an error "E1328 Excessive maximum pressurizing position of servo hand" will occur.

3.4.2. How To Operate

(1) Select a manual mode.

(2) Move the robot/servo hand axis to the starting point of pressurizing, and press [Record]key to record the step.

(3) Press Cmd.No=33, and set a M38, and then input 『Offset length』, 『Squeeze Force Parameter』.



3.4.3. Function of Servo Hand Open

Function of servo hand open sets 1 parameter.

M39[Offset Length]

(1) Offset length [0 - 2000]
Specify the position to open in the servo hand. The opening position is a sum of a teaching position and an opening offset length.

◆【Note】◆

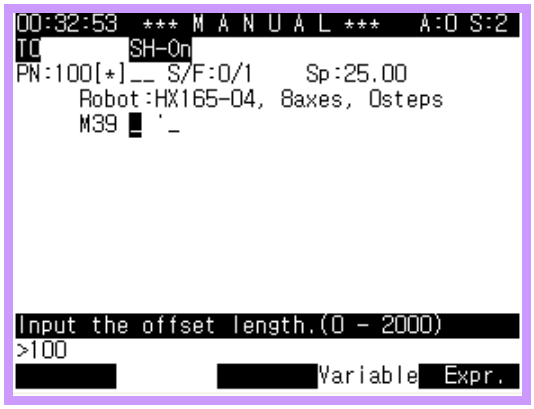
- It does not matter if function of servo hand open is positioned anywhere of steps.
- The target position of step with function of servo hand open(M38) is the position recorded in memory during teaching, and opening starts after the completion of step arrival. For a safe workpiece handling, set the accuracy level of step conditions to be 0.
- If the opening position calculated depending on the opening offset length is bigger than the opening stroke of servo hand, an error 『E1327 Excessive maximum opening position of servo hand』 will occur.

3.4.4. How To Operate

(1) Select a manual mode.

(2) Move the robot/servo hand axis to the starting position of opening, and press [REC] key to record a step.

(3) Press Cmd.No=33, and set a M39, and then input 『Opening Offset length』 parameter.



4
Auto-run

4.1. Movement of Step

The operation of robot axis and servo hand axis in a step(position) movement is explained.

(1) Interpolation Off
Servo hand axis and robot axis start at the same time, and arrive at the target position simultaneously.

(2) Linear Interpolation
The fixed hand arrives at the target position with a linear interpolation(locus, posture maintained).
Like the interpolation OFF, it starts and arrives at the target position simulateneously.

(3) Circular Arc Interpolation
The fixed hand arrives to the target position with a circular arc interpolation(locus, posture maintained).
Like the interpolation OFF, it starts and arrives at the target position simulateneously.

(4) Shift
All functions for shift(offline, online, search, palletize) are applied only to robot, and the servo hand axis moves only to the recorded position.

(5) Coordinate Transformatin
Transform the movement elements on robot alone, and shift the target value of servo hand axis as its recorded value.

(6) Application of call function for relative program
When writing a relative program, apply only a relative position on robot, and shift the target value of servo hand axis as its recorded value.

(7) Mirror Image
It is applied only when the drive axis is selected as an additional axis specification, and servo hand axis is not applicable.

4.2. Servo Hand Squeeze/open

Servo hand pressurizing & opening for workpiece handling is operated as follows.

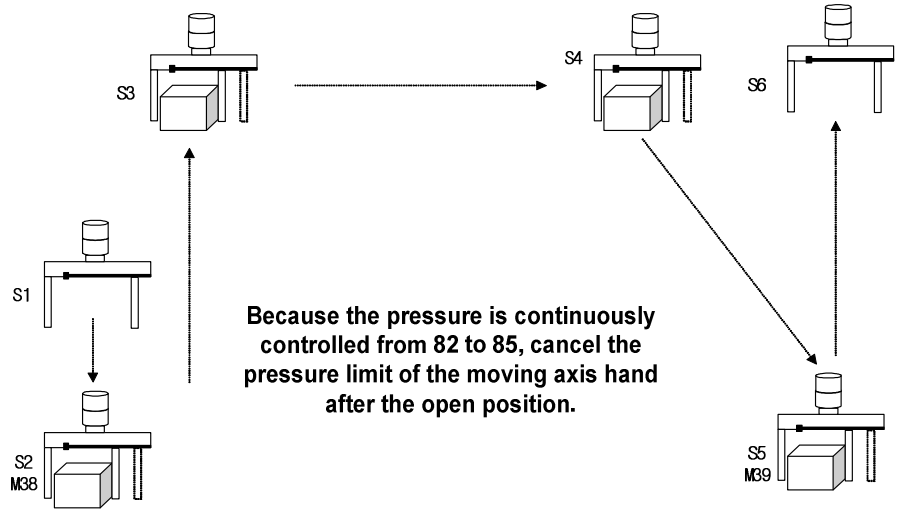


Fig. 4.1 Servo Hand Squeeze/open for Workpiece Handling

(1) When a step in which M38 function is recorded is moving, robot moves to the recorded position, in its position of previous step, and moving axis of servo hand moves to a sum position of offset lengths of M38 functions in the recorded position. Here, both robot axis and servo hand axis arrive at the target position simultaneously.

(2) Start pressurizing with the set force. Here, move in the pressurizing speed of servo hand.

(3) When the force match is achieved, grasp a workpiece and move to the step to load it.

(4) Move to the step in which M39 function is recorded, and open it to the set opening position. Here, the speed of servo hand axis is maximum speed.

(5) Move to the next step right after the completion of opening.

◆【Reference】◆

- When operating a step forward/backward in a manual mode, it is always executed regardless of selecting a function execution in the step forward/backward of condition setting.
- Be sure to the squeeze/open position of servo hand axis is within a range of soft limit.
- If servo hand axis force is too small, you may not perform a desired work.
- Accuracy leve of step with M38 function should be adjusted considering the distance between workpiece and pressurizing starting position.

5

Application Condition Setting

5.1. Execution of Servo Hand Axis Squeeze/open

It is a function to restrict a squeeze/open so as to make a teaching position check more convenient in workpiece handling which uses servo hand axis.

- Off
  Restrict the squeeze/open of servo hand axis in a program playback. Here, robot moves to the position in which step is recorded, and then immediately moves to the next step. SHOFF is displayed in the upper side of teach pendant.

- On
  Allow the squeeze/open of servo hand axis in a program playback. SH-On is displayed in the upper side of teach pendant.

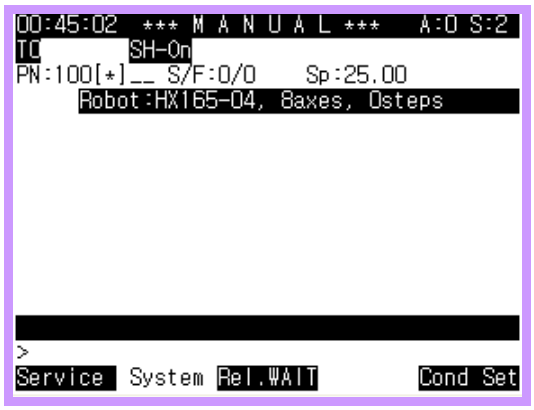
5.1.1. How To Operate

(1) Select a manual mode.

(2) Select『[PF5]: Cond Set』, and then select『[PF1]: AppliCnd』, and the following screen will be displayed.

(3) Select a condition in 『9: Servo hand squeeze command』, and exit by pressing 『ESC』key.

(4) If selecting『ENBL』, its status will be displayed in the next screen.



(5) Playback the step.

(6) Check the squeeze/open position.

◆【Reference】◆

- In case of playback with 『Off』 setting, it does not have the pressurizing operation as follows, but moves to the next step.

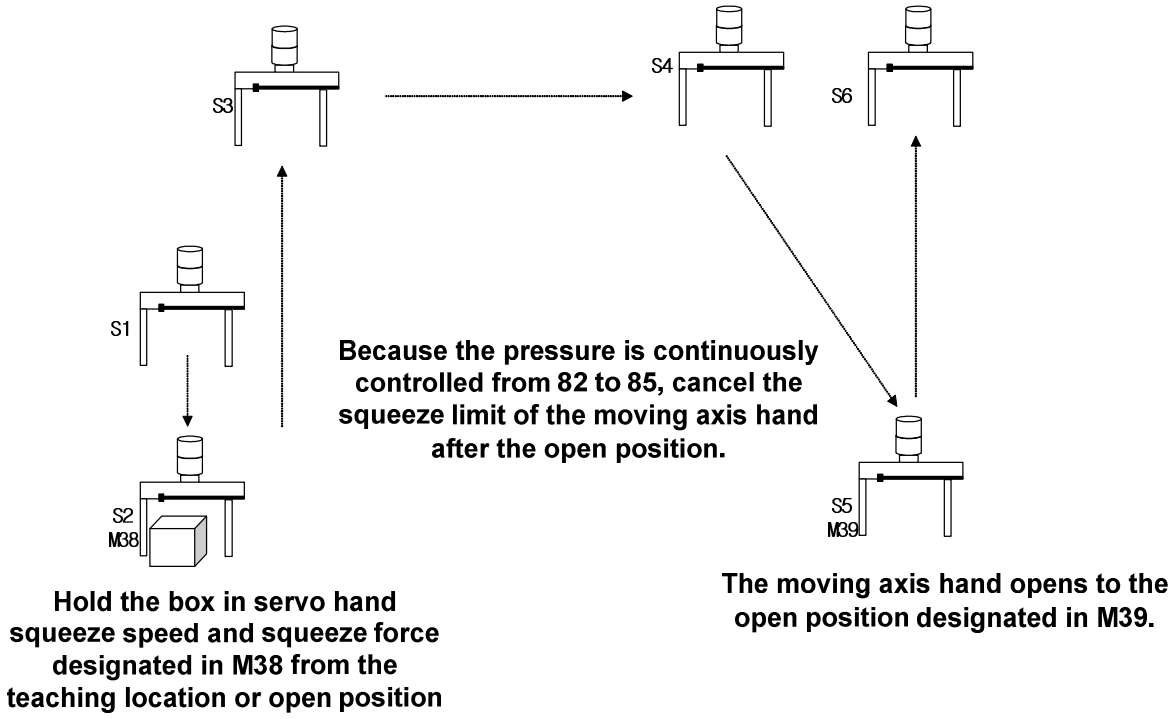


Fig. 5.1 Playback with SH-Off Setting

6 Monitoring Function

6.1. Monitoring Functin of Servo Hand Axis

6.1.1. Display Items

The real-time instruction value of servo hand axis and the encoder, force, current, and distance of current value are displayed.

(1) Encoder Data : display of encoder value in servo hand axis(bit)

(2) Current Data : Display of currnet and instructed current value in servo hand axis(A)

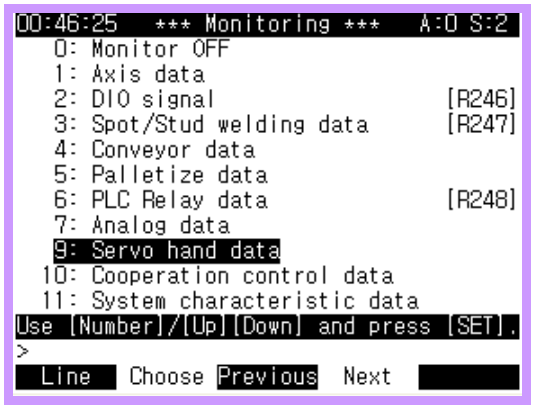
(3) Force Data :Display of instructed force and actual force calculated from feedback current(Kgf)

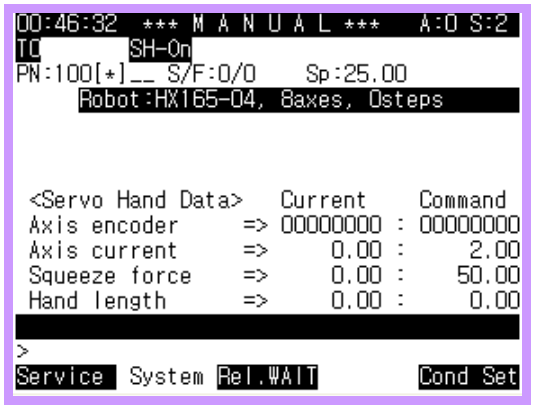
(4) Distance between hands : Display of servo hand axis distance from reference position(mm)

6.1.2. How To Operate

(1) Select 『[PF1]: service』 → 『1: monitoring』 → 『9: servo hand data』.

(2) The following screen is displayed.





7
Troubleshooting

7.1. Error Message

The following errors are the ones occurring when using the functions of servo hand axis.

Code	E1327 Servo hand opening limit is over
Cause	The open position of servo hand open step is in excess of the maximum open position in a system/applied parameter/palletizing/servo hand parameter setting menu.
Action	Shorten the offset length of servo hand open step, or increase the maximum open position in a servo hand parameter setting menu.

Code	E1328 Servo hand squeezing limit is over
Cause	The force position of servo hand force step is smaller than the maximum force position in a system/applied parameter/palletizing/servo hand parameter setting menu.
Action	Lenghten the offset length of servo hand force step, or reduce the maximum force position in a servo hand parameter setting menu.

Code	E1329 Servo hand squeezing time is over
Cause	Force is not within the set range even after the force error detection delaying time is exceeded in a system/applied parameter/palletizing/servo hand parameter setting menu.
Action	1) Adjust the force position of servo hand 2)Set the force-current table in a system/applied parameter / palletizing / servo hand parameter. 3) Adjust the degree of force. 4) Adjust the delaying time in force error detection.

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