



# **FD CONTROLLER INSTRUCTION MANUAL Palletize function**

**5th edition**

- Before attempting to operate the robot, please read through this operating manual carefully, and comply with all the safety-related items and instructions in the text.
- The installation, operation and maintenance of this robot should be undertaken only by those individuals who have attended one of our robot course.
- When using this robot, observe the law related with industrial robot and with safety issues in each country.
- This operating manual must be given without fail to the individual who will be actually operating the robot.
- Please direct any queries about parts of this operating manual which may not be completely clear or any inquiries concerning the after-sale service of this robot to any of the service centers listed on the back cover.

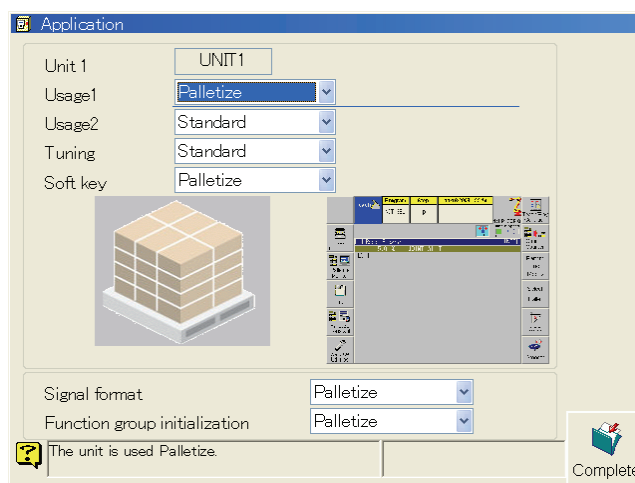
**NACHI-FUJIKOSHI CORP.**



# Introduction

Before starting the teaching (programming) operation, please perform an initial setting in <Constant Setting> - [12 Format and Configuration] - [7 Application] screen in advance. This setting must be performed before the all setting steps and teaching operations.

Usage1	: Palletize
Usage2	: Standard
Tuning	: Standard
Soft key	: Palletize
Signal format	: Palletize
Function group initialization	: Palletize



For this setting, an operator class **EXPERT** or higher is required. Concerning the operation to change the operator class, refer to the instruction manual "SETUP MANUAL".

**For customers of AX CONTROLLER**

To use the following functions with FD CONTROLLER, please refer to the instruction manual of "PALLET2 Palletize function".

FN47 PALLET2

FN48 PALLET2\_END

FN49 PALLET2\_RESET

FN65 DSPALLET

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NOTE



# Chapter 1      Outline

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The term "palletizing" refers to the task involved in arranging objects in an orderly manner. By merely teaching the loading (or unloading) operations for one work-piece and by specifying the number of work-pieces and the way in which they are to be loaded (unloaded) and positioned, it is possible to teach the loading (or unloading) operations for all work-pieces.

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## 1.1 What the palletize function does

### 1.1.1 Outline

The term "palletizing" refers to the tasks involved in arranging objects (hereafter referred to as work-pieces) in an orderly manner. The palletize function of this controller enables the loading (or unloading) operations for all work-pieces to be easily taught merely by teaching the loading (or unloading) operations for one work-piece and by specifying the number of work-pieces, and the way in which they are to be loaded (or unloaded) and positioned. Conversely, the term "de-palletizing" refers to the tasks involved in unloading in sequence work-pieces which have been loaded.

### 1.1.2 Frequently used terms

Brief definitions of some of the terms which are used by the palletizing function are given below.

Table 1.1.1 List of terms

Terms	Significance
Work-piece	This term is a generic name of objects that are handled by an industrial robot.
Work information	This refers to defining the information of one work-piece such as length, width and height.
Pallet	The name of an area where work-pieces are lined or the pallet itself.
Layer	The name of the completed shape of palletized work-pieces.
Station	The name where work-piece is delivered.
Pallet coordinate System	Coordinate system defined on the pallet. This is same as the user coordinate system.
Palletize pattern	This refers to specifying the regulation of whole of layer that consists of following data. - Work information - Grasping offset - Layer pattern - Plane pattern
Grasping offset	This refers to defining the offset between the rotating center of gripper (tool top axis) and the center of grasped work-piece.
Layer pattern	This refers to defining the plane pattern for each plane.
Plane pattern	This refers to defining the work-piece arrangement of one plane.
Palletize number	The number to identify the palletize pattern.
Palletize register	An internal variable that manages the palletizing work.
Palletize counter	Work-piece counter number to be executed currently in the palletizing work. This is efficient to know the progress of the palletizing work. Palletize counter consists of following data. - Layer counter - Work counter
Layer counter	Layer number to be executed currently in the palletizing work.
Work counter	Work-piece number to be executed currently in the palletizing work.
De-palletize	This refers to executing opposite operation of the palletizing.
Simultaneous palletizing	This refers to executing more than one palletizing task at the same time. (When one palletizing task ends, the next one begins.)
Multiple palletizing	This refers to executing another palletizing task while a palletizing task is already being performed. It involves adding each palletizing shift amount and performing the shift operations.

Approach	This is the robot moving to be closing to the pallet with slant direction in order to avoid the interference with the already loaded work-piece and to make small clearance between the already loaded work-piece.
Shift	This is the robot moving temporary to the position where is different from the taught position without modifying the data recorded in the step. In palletizing, taught position is shifted according to the information of palletize pattern to execute loading (unloading) whole of work-piece.

### 1.1.3 Performance

Table 1.1.2 Specifications and performance of palletizing function

Terms	Significance
Palletize pattern	<ul style="list-style-type: none"> <li>Up to 255 patterns can be registered (using palletizing numbers 1 to 255), shared by the unit</li> <li>Work-pieces can be loaded up to 50 layers</li> </ul>
Grasping offset	<ul style="list-style-type: none"> <li>Up to 4 can be registered per 1 palletize pattern</li> </ul>
Plane pattern	<ul style="list-style-type: none"> <li>Up to 8 can be registered per 1 palletize pattern</li> </ul>
Number of work-piece	<ul style="list-style-type: none"> <li>Up to 99 can be registered per 1 plane pattern</li> </ul>
Pallet (coordinate system)	<ul style="list-style-type: none"> <li>Up to 100 can be registered, shared by the unit</li> </ul>
Number of simultaneous palletizing operations	<ul style="list-style-type: none"> <li>Up to 32 palletizing operations can be executed at the same time</li> <li>The status of these operations while they are being executed can be monitored by the palletizing monitor</li> </ul>
Number of multiple palletizing operations	<ul style="list-style-type: none"> <li>Up to 8 multiple operation can be executed</li> </ul>
Shift function	Normal shift functions (FN58 and others) are available except the palletizing function (started from PALLET3). When these functions are executed, shift amount is calculated by the palletizing function at first, and then by the shift functions.

## 1.2 Task stages from teaching to operation

This section describes the work flow up to the stage where the robot executes the palletizing (or de-palletizing) task.

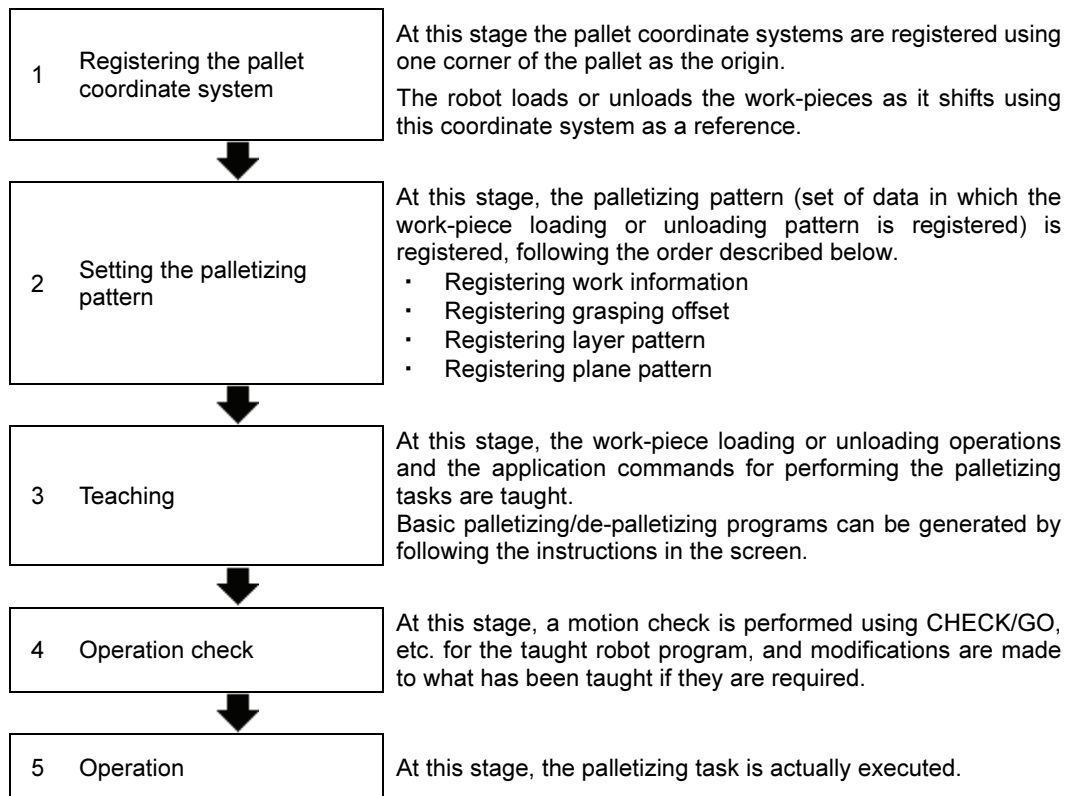
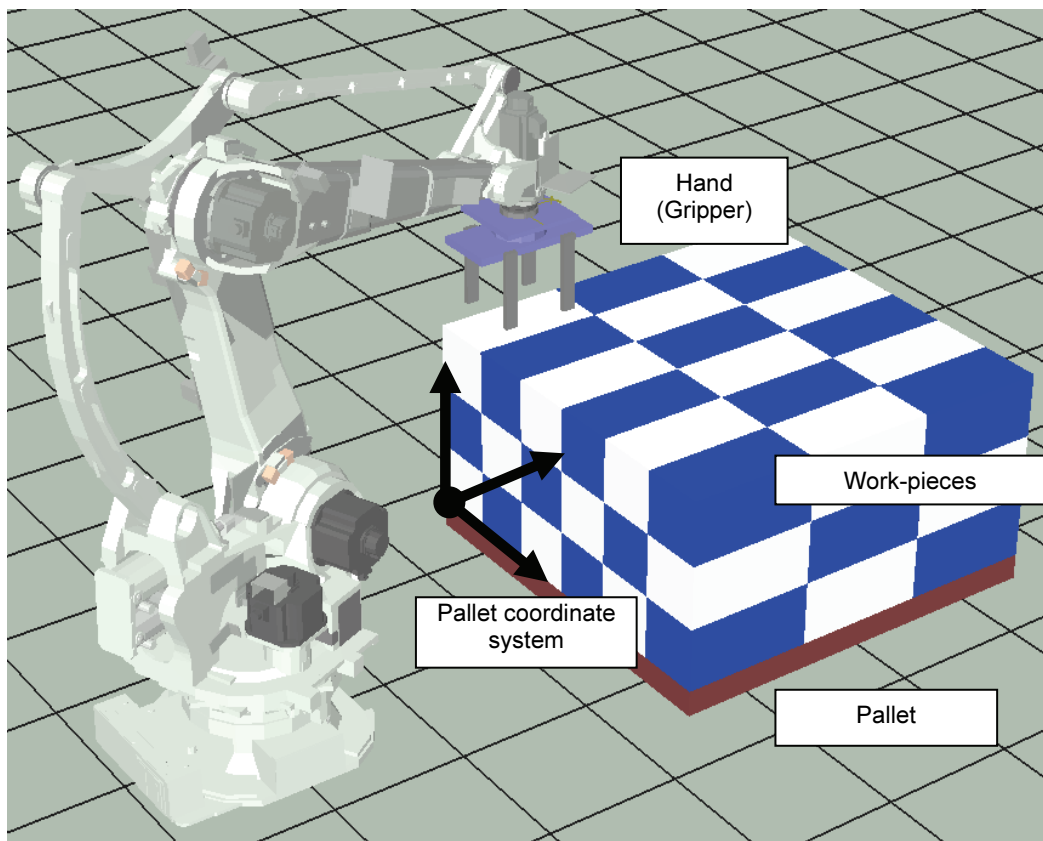


Fig. 1.2.1 Tasks from teaching to operation



### 1.2.1 Registering the pallet coordinate systems

Because the palletize motion is generated using shift motion based on the respective pallet coordinate system, it is necessary to register those pallet coordinate systems in advance.

Register the pallet coordinate system regarding its corner point as the origin of the coordinate system.

The registration work for the pallet coordinate system can be done in Palletize constant [1 Register pallet].

For details, refer to Chapter 3.

### 1.2.2 Registering palletize pattern

"Palletize pattern" refers to the set of data in which the work-piece loading and unloading patterns have been registered.

The registration of palletize pattern can be done in Palletize constant [2 Register pattern]. Follow the instructions in the screen to set the required parameters. Select a pattern from the ready-made patterns ("interlock" or "pin hole") in the layer pattern setting screen. Or, it is also possible to set up the position of all the work-pieces one by one.

For details, refer to Chapter 4.

### 1.2.3 Teaching

To use the palletize function, use the application commands (FN functions).

Basic programs can be generated in Palletize constant [3 Program creation]. And, it is also possible to modify the basic items of the generated program in this setting menu.

How to generate the program is described in Chapter 5.

Concerning the procedure to modify the program is mentioned in Section 5.3.6.

Application commands (FN functions) to having the robot make complicated palletize motion are also available. It is possible to display or set the value of the register (internal variable) that is being used in the actual palletize function.

If you want to refer to the palletize register, See Section 6.3.1.

If you want to set the palletize register, See Section 6.3.2.

### 1.2.4 Motion check and initiating operation

Check the generated robot program using CHECK GO or 1-step playback, ascertain whether the robot will be performing the desired operations and, if necessary, modify what has been taught. Upon completion of the motion check of the robot program, actually play back the program in the 1-cycle or continuous playback mode.

If it is necessary to modify the palletize counter while the checking operation, refer to Section 6.2.2.

It is possible to place the robot TCP (Tool Center Point) to the position of the loading position of certain work-piece to reflect the position to the palletize pattern. (This is called as "Palletize direct modification")

If it is necessary to execute a direct modification for palletize pattern, refer to Section 6.2.3.

How to display the number of the current work-piece that is being palletized now in the monitor window is described in Chapter 7.

If the palletizing operation is terminated in halfway and if it is necessary to cancel the shift amount (e.g. it is necessary to move the robot to the home position), enter [R] [0] [ENTER] to cancel the shift amount set by the palletize function.

When restarting the program, confirm that the palletize counter is proper number. To reset or modify the palletize counter, refer to the section 6.1.

## Chapter 2      Setup

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This chapter describes the setup procedure for using the palletizing function.

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## 2.1 Setup

This palletize function is an option software. If this function is not installed at the timing of shipping, this function is not available. And, it is also necessary to set the application type (Usage) to "Palletize".

### 2.1.1 Tool constants

The position of the Tool Center Point (TCP) is defined by the tool length and the tool angle. The robot moves referring to the TCP position and the "Grip point" for the palletizing motion is set using the TCP as a reference point.

It is not necessary to modify the setting for this TCP (leave the initial setting of "flange center" as it is). But if the setting is changed, the motion locus of the robot is generated by referring to the new (modified) TCP position.

#### Tool mass (weight)

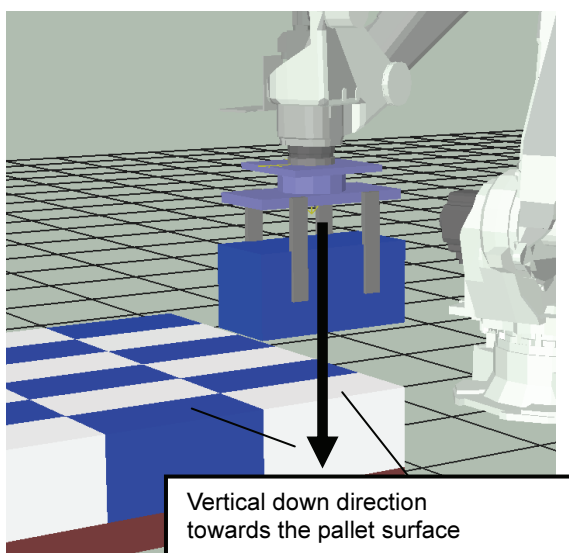
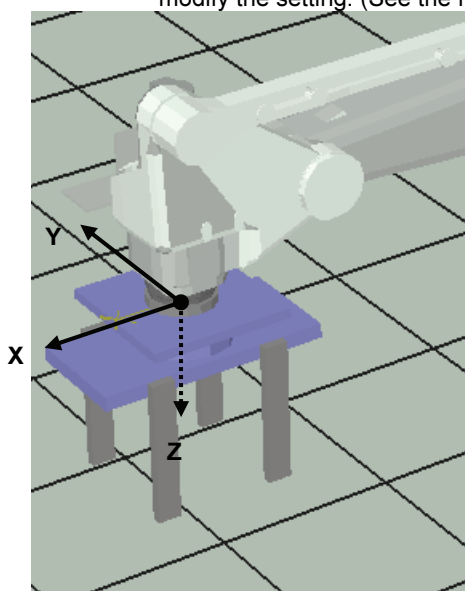
In the "tool mass" setting value, the mass of the work-piece that is to be held by the tool (gripper) must be included.

#### Tool angle

The direction of the tool coordinate system is determined referring to the tool angle setting. The offset position that is set from the "Grip point" is calculated following this tool coordinate system.

Determine the tool angle setting so that the vertical down direction towards the pallet surface and the +Z direction of the tool coordinate system become the same when the hand (gripper) that is holding the work-piece is placing the work-piece onto the pallet.

But, because those directions are the same when using initial setting, it is not necessary to modify the setting. (See the following figures)



Initial setting of the TCP and the Tool coordinate system      Setting of the tool angle

If a program generating function is used (Refer to Section 5.3);

Steps that use both Tool 1 (T1) and Tool 2(T2) will be generated.

In case of Tool 1 (T1), it is supposed that the work-piece is being held. (Heavier)

In case of Tool 2 (T2), it is supposed that the work-piece is not being held. (Lighter)

Therefore,

For T1, the tool mass setting value and the "C of G" setting values must include both of the gripper and the work-piece. For T2, the tool mass setting value and the "C of G" setting values must include only gripper itself. The tool length setting for T1 and T2 should be the same.

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### 2.1.2 Shift amount limit

In this palletize function, the robot will move to the position that is different from the originally recorded position by referring to the shift amount that is calculated via the arrangement information of the work-piece of the palletize pattern. At this time, if an extremely large value is stored in the shift amount because of some reasons, the robot will extremely deviate from a position that is intended.

To avoid this, the shift amount limit value can be set in advance.

The limit value can be modified in [Constant Setting] [3 Machine Constants] [6 Shift amount limit] menu.



**CAUTION**

If the shift amount limit values are changed, the robot may make unexpected motion.  
If the limit values are changed, do not forget to confirm the motion of the program that is to be played back.

## 2.2 Input/output signals dedicated to palletize function

Signals to modify the palletize register via external devices can be set.

### 2.2.1 Input signal

To reset the palletize counter, the signals of "Palletize reset" and "Palletize No." are required.  
And, to reset the palletize counter, the signals of "Palletize preset", "Palletize No.", "Layer No." and "Work No." are required.



- 1 Enter [4 Signals][1 Palletize inputs] menu from the <Palletize Constant> key.  
Or, enter <Constant Setting> - [6 Signals] - [1 Palletize inputs] menu.  
>> The following setting screen will appear.

Table 2.2.1 Input signals for palletize function

Signal name	Function	Remark
Palletize No. (8 bits)	This signal is used to designate the "palletize number". This signal is used in a combination with other signals. The palletize number (from 1 to 255) is to be designated via 8-bit binary signals.	Per UNIT
Palletize reset	This is a signal to reset the palletize counter of a designated palletize number at the timing of rising edge of the signal. However, if the target palletize number is "being played back" and "being executed", this signal is ignored. When the reset process is normally executed, "Reset ACK signal" is outputted.	Per UNIT
Palletize preset	This is a trigger signal to pre-set the palletize counters ("Layer No." and the "Work No.") for the designated palletize number at the timing of rising edge of the signal.	Per UNIT
Layer No. (6 bits)	These are signals to designate the layer number for the palletize counter pre-set. Input the layer number (from 1 to 50) via 6-bits binary signals.	Per UNIT
Work No. (7 bits)	These are signals to designate the work-piece number for the palletize counter pre-set. Input the work-piece number (from 1 to 99) via 7-bits binary signals.	Per UNIT



**CAUTION**

To make a palletize reset or palletize preset operation using input signals, please execute the operation while the robot is stopping or waiting for I signal. If the operation is executed while the robot is moving, the palletize counter may not be changed.  
And, if one palletizing number is shared with plural units, unexpected motion may occur when the palletize counter under use is modified.

## 2.2.2 Output signals



- 1 Enter [6 Signals][2 Palletize outputs] menu from the <Palletize Constant> key.  
Or, enter <Constant Setting> - [6 Signals] - [2 Palletize outputs] menu.  
>> The following setting screen will appear.

Table 2.2.2 Output signals for palletize function

Signal name	Function	Remark
Reset ACK signal	This is a signal which turns ON when "Palletize reset" input signals is received and the palletize counter is reset. This signal will turn OFF when the next palletize starts.	Per UNIT
Palletizing	This is a signal which turns ON while in palletizing. This signal will turn OFF when palletizing is completed or palletize reset is executed. If more than 2 palletizing are executed at the same time, this signal will turn OFF when all of then is completed or reset is executed.	Per UNIT
Preset ACK signal	This is a signal which turns ON when palletize counter value is preset by receiving "Palletize preset" input signal. This signal turns OFF when starting the next palletizing operation.	Per UNIT

## 2.2.3 Palletize counter value binary output signals

This is a set of output signals that outputs a "palletize counter value" via binary signals in real-time.

It is not necessary to assign these signals before use. To use this signal, please designate a set of general output signals as a parameter of "FN249 palletize start" function.

Concerning "FN249 Palletize start", refer to the section 5.2.1.

## 2.2.4 Palletize completion signal

This is an output signal that shows the completion of a pattern of the palletize / de-palletize process. Please use this signal to confirm that the loading/unloading is completed normally.

It is not necessary to assign this signal before use. To use this signal, please designate one general output signal as a parameter of "FN250 palletize end" function.

Concerning "FN250 Palletize end", refer to the section 5.2.1.

### POINT

In case of default setting, the all general signals will be turned OFF when the first step of a program is executed. If it is necessary to keep the condition of these signal mentioned above even if the first step of a program is executed, please change the setting of "5 Output signals in step 0" to "Hold" in [Constant Setting][6 Signals][1 Signal condition] menu.

## 2.3 Palletizing condition

Here conditions for palletizing function are set.



- 1 **Select [5 Condition] menu from the "Palletize Constant" key.  
Or, enter <Constant Setting> - [40 Palletize constant] - [5 Condition] menu.  
>> The following setting screen will appear.**

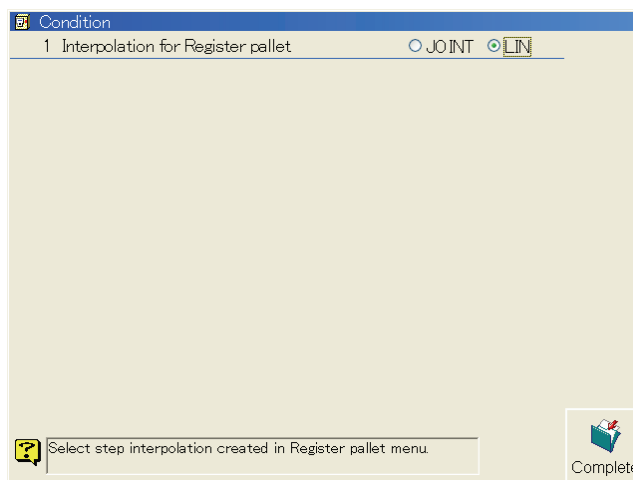


Table 2.3.1 Setting items in [5 Condition]

Item	Factory setting	Input range	Description
Interpolation for Register pallet	LIN	JOINT/LIN	This is to selecting the interpolation type when registering the pallet.

NOTE

## Chapter 3      Registration of a pallet

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In this chapter, how to register a pallet (coordinate system) that is used as a reference coordinate system for the palletize motion is described.

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## 3.1 Registration of a pallet coordinate system

A pallet coordinate system that is treated as "a reference coordinate system" for palletize motion is registered here.

### 3.1.1 Outline

The palletize motion is necessary to register a pallet coordinate system in advance.

The corner edge of a pallet which is used for loading the work-pieces is to be registered as an origin of the coordinate system.

The pallet (coordinate system) can be defined via 3 points listed below;

- (1) An origin (The corner point of the pallet)
- (2) A point to define the +X direction of the coordinate system in combination with the origin.
- (3) A point to define the +Y direction of the coordinate system in combination with the origin.

The registration work is performed in [1 Register pallet] screen. And, it is also possible to register a pallet using a program that has 3 points described in the above explanation.

The important point is, (not the position of the origin) the direction of each axis. The direction of each axis determines the positions of the work-pieces that will be loaded / unloaded.

Please be sure to record the points of (2) and (3) aligning them precisely seeing from the origin point so that each direction of +X and +Y axis becomes precise.

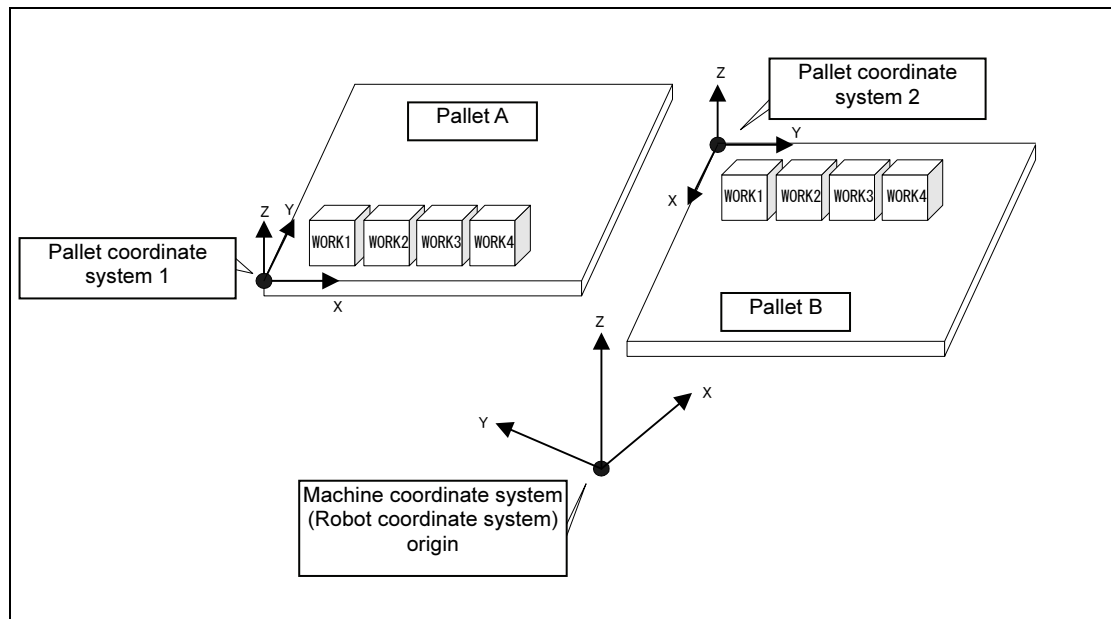
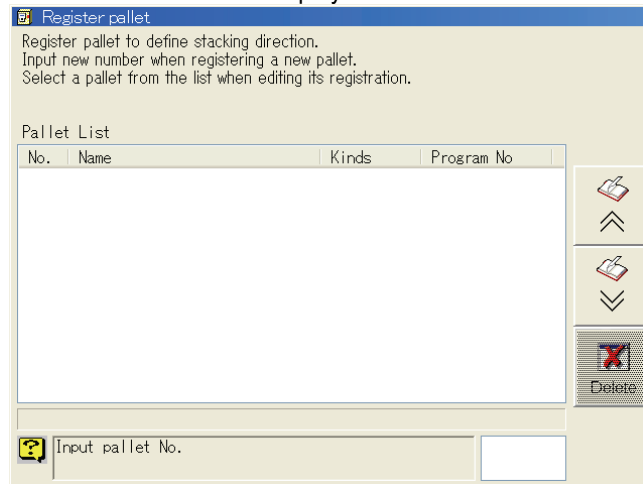


Fig 3.1.1 Pallet coordinate system

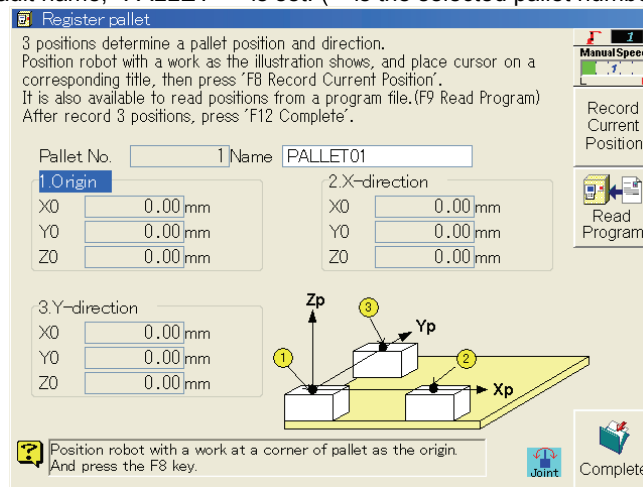
### 3.1.2 Registering a pallet coordinate system

A registration of a pallet (coordinate system) using 3 points should be done here. When registering the pallet, a program will be generated.

- 1 **Select Teach mode.**
- 2 **Select [1 Register pallet] from <Palletize Constant>.**  
>>A list of pallet like shown below is displayed.



- 3 Input a pallet number to register and press [Enter] key.**  
 >>Pallet registration screen will be displayed.  
 >>As a default name, "PALLET \*\*" is set. (\*\* is the selected pallet number)



[INTERP/COORD]



[Manual speed.]

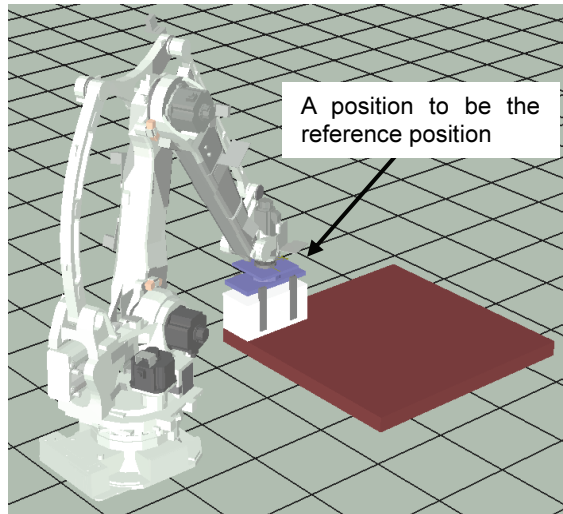


- 4** Make the robot hold a work-piece and move it to the position to be reference position on the pallet. For example, align the edges of the pallet and the work-piece.

At this time,

-Manual operation speed of the robot can be change with F7 key.

-Manual operation coordinate system can be changed with [INTERP/COORD.] key.



Record  
Current  
Position

- 5** Move the cursor to [1.Origin] and press f8<Record Current Position>  
>>In X0, Y0, and Z0 of [1. Origin], the current TCP position is displayed.

**Register pallet**

3 positions determine a pallet position and direction.  
Position robot with a work as the illustration shows, and place cursor on a corresponding title, then press 'F8 Record Current Position'.  
It is also available to read positions from a program file.(F9 Read Program)  
After record 3 positions, press 'F12 Complete'.

Pallet No.  1 Name  PALLET01

**1.Origin**

X0	1501.20mm
Y0	626.52mm
Z0	519.95mm

**2.X-direction**

X0	0.00mm
Y0	0.00mm
Z0	0.00mm

**3.Y-direction**

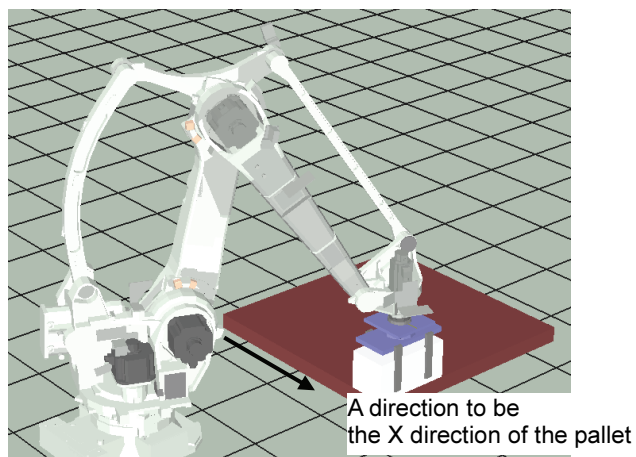
X0	0.00mm
Y0	0.00mm
Z0	0.00mm

**Diagram:** A 3D coordinate system (Xp, Yp, Zp) is shown with a pallet and a work-piece. The origin (1) is at the corner of the pallet. The X-direction (2) is along the Xp axis, and the Y-direction (3) is along the Yp axis.

**Buttons:** Record Current Position, Read Program, Complete

**Help:** ? Position robot with a work at a corner of pallet as the origin. And press the F8 key.

- 6** Move the robot that is holding the work-piece towards the direction that is to be the X direction of the pallet. At this time, keep the angle of the work-piece against the pallet. And, align the edge of the work-piece and that of the pallet.



Record  
Current  
Position

- 7** Move the cursor to [2. X-direction] and press **f8**<Record Current Position>  
 >>In X0, Y0, and Z0 of [2. X-direction], the current TCP position is displayed.

**Register pallet**

3 positions determine a pallet position and direction.  
 Position robot with a work as the illustration shows, and place cursor on a corresponding title, then press 'F8 Record Current Position'.  
 It is also available to read positions from a program file.(F9 Read Program)  
 After record 3 positions, press 'F12 Complete'.

Pallet No.  1 Name

**1. Origin**

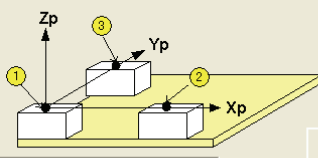
X0	1501.20 mm
Y0	626.52 mm
Z0	519.95 mm

**2. X-direction**

X0	1501.19 mm
Y0	-626.40 mm
Z0	519.95 mm

**3. Y-direction**

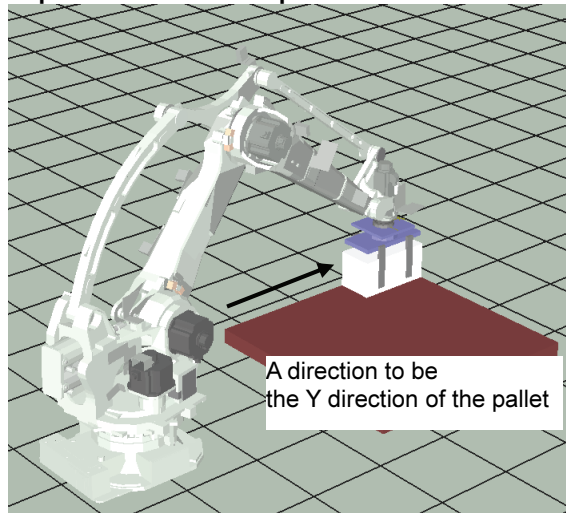
X0	0.00 mm
Y0	0.00 mm
Z0	0.00 mm



**Position robot along X-direction of the pallet. And press the F8 key.**

ManualSpeed  
Record Current Position  
Read Program  
Joint  
Complete

- 8** Move the robot that is holding the work-piece towards the direction that is to be the Y direction against the position that is registered at [1. Origin]  
 At this time, keep the angle of the work-piece against the pallet. And, align the edge of the work-piece and that of the pallet.

Record  
Current  
Position

- 9** Move the cursor to [3. Y-direction] and press **f8**<Record Current Position>  
 >>In X0, Y0, and Z0 of [3. Y-direction], the current TCP position is displayed.

**Register pallet**

3 positions determine a pallet position and direction.  
 Position robot with a work as the illustration shows, and place cursor on a corresponding title, then press 'F8 Record Current Position'.  
 It is also available to read positions from a program file.(F9 Read Program)  
 After record 3 positions, press 'F12 Complete'.

Pallet No.  1 Name

**1. Origin**

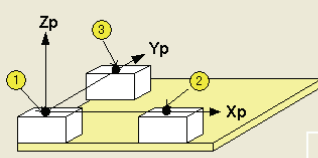
X0	1501.20 mm
Y0	626.52 mm
Z0	519.95 mm

**2. X-direction**

X0	1501.19 mm
Y0	-626.40 mm
Z0	519.95 mm

**3. Y-direction**

X0	2502.59 mm
Y0	626.54 mm
Z0	519.95 mm



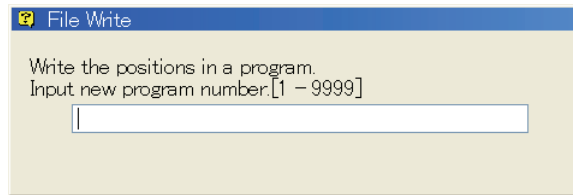
**Position robot along Y-direction of the pallet. And press the F8 key.**

ManualSpeed  
Record Current Position  
Read Program  
Joint  
Complete

**10 Press f12<Complete> key.**

>>A following message window will be displayed.

This window is for designating the number of the program in which the information of the coordinate system is recorded. In the designated program, the 3 positions (= 3 steps) will be recorded.

**11 Input the program number for recording 3 positions and press [Enter] key.**

>>Now the pallet coordinate system is saved.



The program generated when registering the pallet coordinate system does not have an influence on the motion of the palletize function. But the program is necessary when modifying the pallet coordinate system after registering the pallet coordinate system.

### 3.1.3 Registering a pallet coordinate system (by a pre-recorded program)

It is also possible to register a pallet coordinate system using a pre-recorded program that has 3 positions for the reference point.

**1 Select Teach mode.**

**2 Make a program that has 3 steps like shown below.**

**STEP 1: The origin**

**STEP 2: A position to define X direction with the origin (STEP1)**

**STEP 3: A position to define Y direction with the origin (STEP1)**  
(In these steps, the tool number must be the same.)

**3 Select [1 Register pallet] from "Palletize Constant".**

>>A list of pallet like shown below is displayed.



**4 Enter a pallet number to register and press [Enter] key.**

>>Pallet registration screen will be displayed.





- 5 Press f9<Read Program> key.**  
 >>A list of program like shown below is displayed.

Program list display

Program list

Name	No.	Steps	Comment
LP130-01	002	2	
LP130-01	100	5	PALLET01
LP130-01	1000	1	

PALLET01

Please push "Enter" after selecting the program.

- 6 Select the desired program and press [Enter] key.**  
 >> The selected program is loaded.

Register pallet

3 positions determine a pallet position and direction.  
 Position robot with a work as the illustration shows, and place cursor on a corresponding title, then press 'F8 Record Current Position'.  
 It is also available to read positions from a program file.(F9 Read Program)  
 After record 3 positions, press 'F12 Complete'.

Pallet No. 1 Name PALLET01

1. Origin

X0 1501.20mm  
 Y0 626.52mm  
 Z0 519.95mm

2. X-direction

X0 1501.19mm  
 Y0 -626.40mm  
 Z0 519.95mm

3. Y-direction

X0 2502.59mm  
 Y0 626.54mm  
 Z0 519.95mm

Position robot with a work at a corner of pallet as the origin.  
 And press the F8 key.

Complete

### 3.1.4 Modifying the pallet

In the pallet list screen, it is possible to modify a pallet by selecting one pallet from the list.

**1 Select Teach mode.**

**2 Select [1 Register pallet] from "Palletize Constant".**

>>A list of pallet like shown below is displayed.



Register pallet

Register pallet to define stacking direction.  
Input new number when registering a new pallet.  
Select a pallet from the list when editing its registration.

No.	Name	Kinds	Program No
1	PALLET01	UNIT1	1

Input pallet No.

**3 Set the cursor to the desired Pallet and press [Enter] key.**

>> The coordinates of the 3 points (X0, Y0, Z0) are displayed in the [1 Register Pallet] screen.



Register pallet

3 positions determine a pallet position and direction.  
Position robot with a work as the illustration shows, and place cursor on a corresponding title, then press 'F8 Record Current Position'.  
It is also available to read positions from a program file.(F9 Read Program)  
After record 3 positions, press 'F12 Complete'.

Pallet No. 1 Name PALLET01

1. Origin

X0 1501.20mm  
Y0 626.52mm  
Z0 519.95mm

2. X-direction

X0 1501.19mm  
Y0 -626.40mm  
Z0 519.95mm

3. Y-direction

X0 2502.59mm  
Y0 626.54mm  
Z0 519.95mm

Position robot with a work at a corner of pallet as the origin.  
And press the F8 key.

Record Current Position  
Read Program  
Complete

**4 Select the point that you want to modify and press f8<Record Current Position>.**

>>The current position of the TCP is overwritten to (X0, Y0, Z0) of the selected point instead of the original values.



**5 Press f12<Complete> key.**

>>A message like shown below will be displayed.

>>In the edit box, a program number in which the coordinates information was stored when the pallet was registered is set as a default value.



File Write

Write the positions in a program.  
Input new program number:[1 - 9999]

**6 Input the program number for saving the pallet data and press [Enter] key.**

>>Now the pallet coordinate system is saved.



### 3.1.5 Deleting the pallet

A pallet coordinate system defined previously can be deleted using a pallet list screen.

**1 Select Teach mode.**



**2 Select [1 Register pallet] from "Palletize Constant".**

>>A list of pallet like shown below is displayed.

Register pallet to define stacking direction.  
Input new number when registering a new pallet.  
Select a pallet from the list when editing its registration.

No.	Name	Kinds	Program No
1	PALLET01	UNIT1	1

Input pallet No.



**3 Select one pallet in the list and press [Enable] + f11<Delete>.**

A following confirmation message window will be displayed.

Confirmation

Pallet [1] is deleted.

OK CANCEL

**4 If [OK] is selected, the pallet will be deleted.**

**If [CANCEL] is selected, the pallet will not be deleted and the screen will return to the list screen.**

(Even if a pallet is deleted, the program that has the coordinate information will not be deleted.)



When deleting a pallet, please confirm that the pallet is not used in any palletize pattern. If a palletize pattern that uses a pallet which does not exist is used, an error will occur and the robot will stop when executing palletize function.

NOTE

## Chapter 4     Registration of a palletize pattern

---

This chapter describes how to set-up a palletize pattern.

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## 4.1 Outline

### 4.1.1 Registration procedures

The registration of a palletize pattern is done by the following procedure.

The procedure is a continuous sequence. So it is not possible to execute only 1 step of them one by one. In the respective screen, press F10<Next> key after setting the parameters. And, if it is necessary to return to the previous screen, press F9<Back> key.

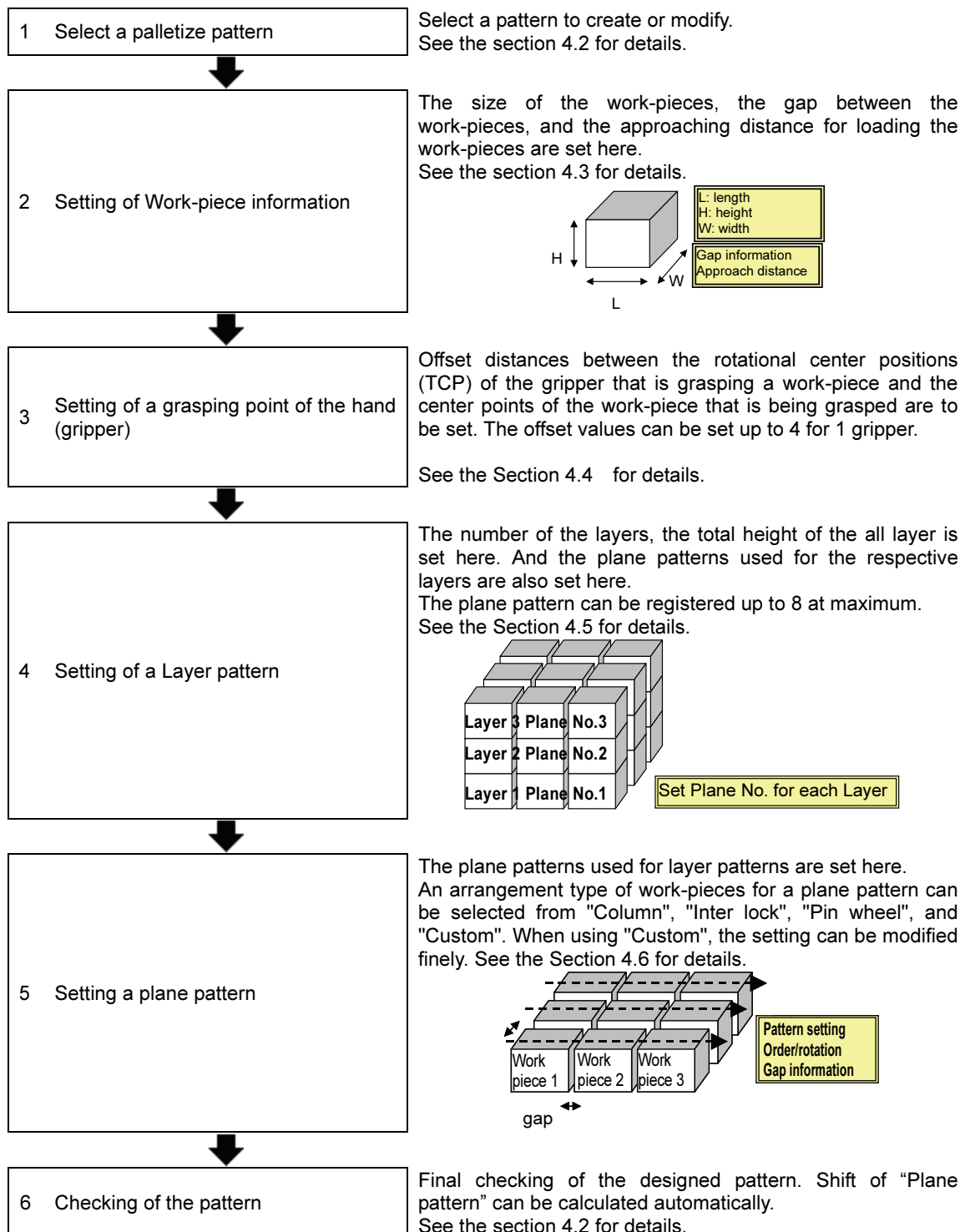


Fig. 4.1.1 Setting procedure for a palletize pattern

It is possible to define the palletize patterns up to 255 at maximum. The contents that were set will be stored to the palletize data file "Ac00Pltz.CON".

## 4.2 Selecting a palletize pattern (to create/modify)

Select a palletize pattern to newly create or to modify from a list.

In the palletize pattern list screen, the following operations are available.

- Create a new pattern / Modify a pattern
- Export a palletize pattern to a file.
- Import a palletize pattern from a file
- Copy a palletize pattern
- Delete a palletize pattern

### 4.2.1 Selecting a palletize pattern



**1 Select Teach mode.**

**2 Select [2 Register pattern] from "Palletize Constant".**

>>A list screen shown below is displayed.

Register pattern  
[Register pattern] Set palletize pattern number. [1-100]

Palletize pattern list

No.	Name	Pallet No.	Layer Num
1	Palletize01	1	5
2	Palletize02	1	3
3	Palletize03	1	4

Buttons: Import, Copy

Select or input palletize pattern number.



**3 Input a number to register and then press [Enter].**

**To modify a pattern, select the desired pattern using cursor key and then press [Enter].**

>>A setting screen for work-pieces information like shown below will be displayed.

Register pattern 1

[Work information] Works are placed in the pallet. L,W,dXp and dYp are necessary when using template. H is necessary when stacking more than 2 layers.

Palletize pattern No. 1  
Name Palletize01  
Pallet No. 0

Work

Size	L	0.00 mm
	W	0.00 mm
	H	0.00 mm
	dXp	0.00 mm
	dYp	0.00 mm

Approach dist.

Length	Xa	0.00 mm
	Ya	0.00 mm

Buttons: Cancel, Next

Input pattern name [1-20 characters or less] Press ENABLE+EDIT key to show the soft-keyboard.

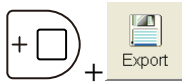
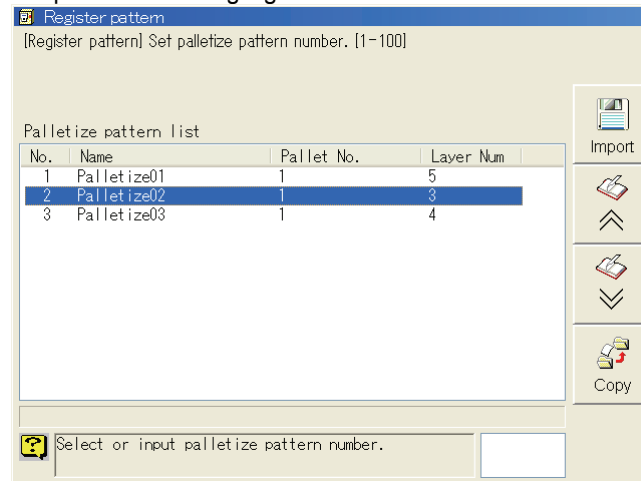
To proceed with "Setting the Work-piece information", refer to the section 4.3 .

## 4.2.2 Exporting a palletize pattern to a file

It is possible to export a palletize pattern to a file to use the same pattern for other robots.

### 1 Select a pattern to export in the list screen.

>>The selected pattern will be highlighted.

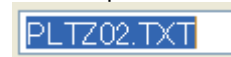


### 2 Press [Enable] + f8<Export> in the list screen.

>>File export screen will be displayed.

>>The file name "PLTZ\*.TXT" is set as default. (For "\*\*", the number of the palletize pattern to be exported is automatically set.)

An example of file name:



### 3 Select a folder to save the file and then press <f12 Execute> key.

>>If the export process is finished normally, the screen will return to the pattern list screen.

To change the file name, select the "File Name" edit box and then press [Enable] + [EDIT] key to display a software keyboard screen.



When changing the export file name, do not change the part of ".TXT". If this part is changed, it becomes impossible to read the file from the robot controller.

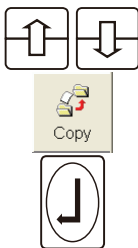
### 4.2.3 Importing a palletize pattern from a file



It is possible to import a palletize pattern from a file exported from other robots.

- 1 Press f8<Import> key in the list screen.**
- 2 File selection screen will show up.**  
Select a file of "PLTZ\*.TXT" and then press f12<Execute> key.
- 3 A window to input the palletize pattern number to import the file will be displayed. Input the desired palletize pattern number to import the file and then press [Enter] key.**  
 >>The palletize pattern in the file is read and stored to the designated number of the palletize pattern and the pattern is displayed in the list.  
 >>If a number which is already exist is inputted, a confirmation message will be displayed. Select [OK] and press [Enter] to over-write.

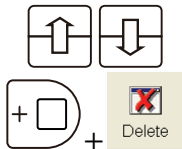
### 4.2.4 Copying a palletize pattern



A palletize pattern in the list can be copied to the different number.

- 1 Select a pattern to copy in the list screen.**  
 >>The selected pattern will be highlighted.
- 2 Press f11<copy> key.**
- 3 "Palletize pattern copy" window will show up. Input the destination number for copy and press [Enter].**  
 >>The pattern data is copied to the designated palletize pattern number and the pattern is added to the list.  
 >>If a number which is already exist is inputted, a confirmation message will be displayed.

### 4.2.5 Deleting a palletize pattern



A palletize pattern in the list can be deleted.

- 1 Select a pattern to delete in the list screen.**  
 >>The selected pattern will be highlighted.
- 2 Press [Enable] + f11<Delete>**  
 >>A confirmation message will be displayed.
- 3 To delete the file, select [YES] and press [Enter].**  
 >>The pattern is deleted and disappears from the list.



## 4.3 Setting the work-piece information

The size of the work-pieces, the gap between the work-pieces, and the approaching distance for loading the work-pieces are set here.



The Work-piece's size L/W and the gap dXp/dYp are necessary in the plane pattern setting only when using "Column", "Inter lock", or "Pin wheel". When using "Custom", these parameters are not referred.

### 1 Input the palletize pattern's Name.

>>To display a software keyboard, press [Enable] + [EDIT].

### 2 Input the "Pallet No."

>>When the cursor is placed on the "Pallet No.", f8<List> key appears and it becomes possible to select a pallet from a pallet list.

List

### 3 Input the parameters in the "Work".

### 4 Input the "Approach distance".

Concerning the "Approach", refer to the section 5.2.3

### 5 After setting each data, press f10<Next> key.

>>The next screen "[Grasping offset]" will be displayed.  
Concerning "[Grasping offset]", refer to the Section 4.4

Next

Table 4.3.1 Setting parameters in [Work information] screen

Item	Initial value	Range	Description
Palletize pattern No.	---	----	The palletize pattern number selected in the list is displayed. This value cannot be changed.
Name	Palletize01	20 letters or less	Name of the pattern.
Pallet No.	1	1~100	Select a pallet which is treated as a reference coordinate system for shift motion. When the cursor is set here, f8<List> key will appear and it becomes possible to select a pallet from the list.
Work size L	0.0	0.0~999.9	The length (along the X-direction) of the 1st work-piece when it is placed on the pallet.  This value is used when the plane pattern setting is "Column", "Inter lock", or "Pin wheel".
W	0.0	0.0~999.9	The length (along the Y-direction) of the 1st work-piece when it is placed on the pallet. This value is used when the plane pattern setting is "Column", "Inter lock", or "Pin wheel".
H	0.0	0.0~999.9	The height of one work-piece.
dXp	0.0	0.0~999.9	The gap (distance) between the work-pieces in X-direction of a pallet. This value is used when the plane pattern setting is "Column", "Inter lock", or "Pin wheel".
dYp	0.0	0.0~999.9	The gap (distance) between the work-pieces in Y-direction of a pallet. This value is used when the plane pattern setting is "Column", "Inter lock", or "Pin wheel".
Approach distance Xa	0.0	0.0~9999.9	Input the X-direction distance for an approach motion based on the pallet coordinate system.
Ya	0.0	0.0~9999.9	Input the Y-direction distance for an approach motion based on the pallet coordinate system.

## 4.4 Registration of a grasping offset

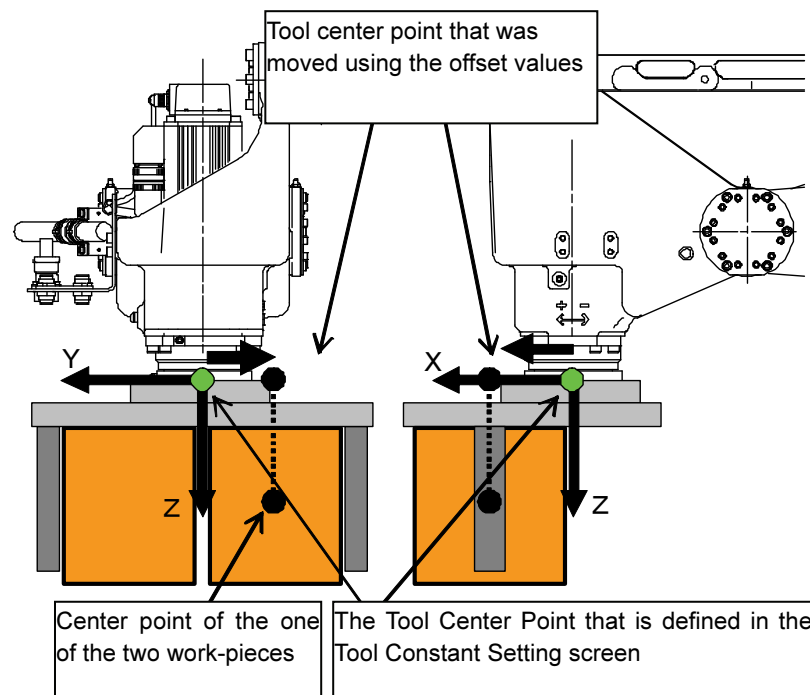
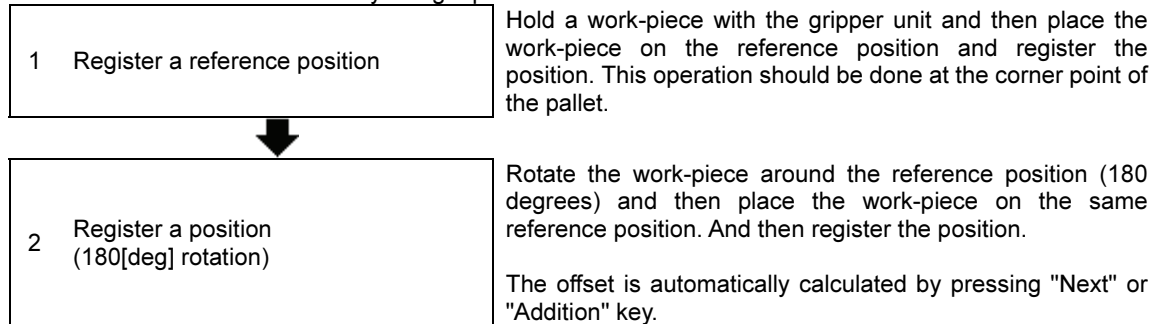
Offset distances between the rotational center position (TCP) of the gripper that is grasping a work-piece and the center point of the work-piece that is being grasped should be set.

If this setting is incorrect, the work-pieces that are rotated will not be placed correctly.

The setting of "Grasping position" can be registered up to 4 at maximum. When grasping 2 or more work-pieces by a gripper unit and placing those work-pieces one by one, the playback should be done by switching the setting of Grasping positions.

Two input methods for the setting operation are available; (1) automatic calculation using 2 position data and (2) manual (direct) input.

How to calculate automatically using 2 postures



When FN376 (Palletize select grasp position) is executed, the offset value selected via the parameter is added to the current TCP position. By this operation, the rotation center of the tool can be changed from the original TCP to the work-piece center.

Fig. 4.4.1 Overview of the Grasping position of the work-piece

### 4.4.1 Calculating the grasping position automatically

#### 1 Set the cursor to "X" of the "(1)Base position".

**Register pattern** 2-1

[Grasping offset] This value is the gap of between work center and hand center. It is possible to calculate automatically from 2 positions. More settings can be registered up to 4.(enable + F11)

Palletize pattern No. 1 Name Palletize01

Grasping position 1

(1)Base position

X	0.00 mm
Y	0.00 mm
Z	0.00 mm

(2)Position(turned 180deg)

X	0.00 mm
Y	0.00 mm
Z	0.00 mm

Offset Xh 0.00 mm Yh 0.00 mm

Grasping a work and arrange on the pallet. Press the F8key. [-9999.90~9999.90]

Record Current Position

Back

Next

Addition

Record  
Current  
Position

#### 2 Move the robot which is holding a work-piece to the reference position on a pallet and press f8<Record Current Position> key.

>>The center point of the robot hand (TCP: Tool Center Point) is displayed on (X,Y,Z) of the (1)Base position.

**Register pattern** 2-1

[Grasping offset] This value is the gap of between work center and hand center. It is possible to calculate automatically from 2 positions. More settings can be registered up to 4.(enable + F11)

Palletize pattern No. 1 Name Palletize01

Grasping position 1

(1)Base position

X	1709.85 mm
Y	-21.27 mm
Z	902.75 mm

(2)Position(turned 180deg)

X	0.00 mm
Y	0.00 mm
Z	0.00 mm

Offset Xh 0.00 mm Yh 0.00 mm

Grasping a work and arrange on the pallet. Press the F8key. [-9999.90~9999.90]

Record Current Position

Back

Next

Addition

#### 3 Set the cursor to "X" of the "(2)Position (turned 180deg)".

Record  
Current  
Position

- 4 Rotate the work-piece around the reference position (180 degrees) and then place the work-piece on the same reference position. Then press f8<Record Current Position> key.**

>>The current TCP position of the robot will be displayed on (X,Y,Z) of the (2)Position (turned 180 deg).

Register pattern 2-1

[Grasping offset] This value is the gap of between work center and hand center. It is possible to calculate automatically from 2 positions. More settings can be registered up to 4.(enable + F11)

Palletize pattern No. 1 Name Palletize01

Grasping position 1

(1)Base position

X	1709.85 mm
Y	-21.27 mm
Z	902.75 mm

(2)Position(turned 180deg)

X	1742.84 mm
Y	-21.27 mm
Z	902.74 mm

Offset Xh 0.00 mm Yh 0.00 mm

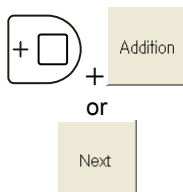
Rotate the work and arrange on the same position of (1). Press the F8key. [-9999.90-9999.90]

Record Current Position

Back

Next

Addition



- 5 To add a grasping position, press [Enable] + f11<Addition> key. To finish the registration of the grasping position, press f10<Next> key.**
- >>The calculated result will be displayed.

Confirmation

The result is

Xh: 0.00

Yh: 0.00

OK CANCEL

- 6 If the result is good, select [OK] and then press [Enter] key.**
- >>If [Enable] + f11<Addition> key is pressed, a screen of "Grasping offset" will be displayed again.
- >>If f10<Next> key is pressed, [Layer setting] screen will be displayed. Concerning [Layer setting], refer to the Section 4.5 .
- 7 When selecting [CANCEL] at 6, please restart the setting from the recording of the reference position.**

**POINT**

To stop the automatic calculation in halfway, input the offset values directly. The recorded positions will be reset.

### 4.4.2 Setting the grasping position manually



- 1 Set the cursor to "Offset Xh" or "Yh" and then input values. Then press [Enter].  
 >>If both "(1) Base position" and "(2)Position (turned 180deg)" are set already via position record operation, those values will be cleared to 0.0.

Register pattern 2-1

[Grasping offset] This value is the gap of between work center and hand center. It is possible to calculate automatically from 2 positions. More settings can be registered up to 4.(enable + F11)

Palletize pattern No. 1 Name Palletize01

Grasping position 1

(1)Base position

X 0.00 mm

Y 0.00 mm

Z 0.00 mm

(2)Position(turned 180deg)

X 0.00 mm

Y 0.00 mm

Z 0.00 mm

Offset Xh 25.00 mm Yh 0.00 mm

Offset value X from hand center: [-999.90 - 999.90]

Back

Next

Addition

Joint

Table 4.4.1 Setting parameters in [Grasping offset] screen

Item	Initial value	Range	Description
Palletize pattern No.	---	----	The palletize pattern that is being edited now. This value cannot be changed.
Name	---	----	The name of the pattern. This value cannot be changed.
Grasping position	1	1 - 4	Registration number of the Grasping position. This value will increase up to 4 by adding grasping positions.
(1) Base position X, Y, Z	0.0	----	A reference data to calculate the Grasping position automatically. The values of this item will change when pressing f8<Record Current Position> key. It is not possible to modify this setting manually one by one.
(2)Position (turned 180deg) X, Y, Z	0.0	----	A position data of 180 [deg] rotation to calculate the Grasping position automatically. The values of this item will change when pressing f8<Record Current Position> key. It is not possible to modify this setting manually one by one.
Offset Xh	0.0	-999.9 - 999.9	An offset distance along X direction between the rotational center position (TCP) of the gripper that is grasping a work-piece and the center point of the work-piece that is being grasped. This value can be changed by automatic calculation or manual input.
Offset Yh	0.0	-999.9 - 999.9	An offset distance along Y direction between the rotational center position (TCP) of the gripper that is grasping a work-piece and the center point of the work-piece that is being grasped. This value can be changed by automatic calculation or manual input.

## 4.5 Registration of a layer pattern

### 4.5.1 Setting a layer pattern

A number of the layers or a "Plane No." that is used for respective layer (plane) can be set here.

- Input the "Layer Num".**  
>>Following the inputted value, the number of the displayed "Layer pattern" will change.

**Register pattern** 3

[Layer Setting] Set number of layers. And set plane pattern No. at every layer. Set total stack height considered compression in Layer height.

Check Display

Palletize pattern No. 4 Name Palletize04

Layer Num. 5

Layer height 0.00 mm

Layer type single

Layer pattern

	Plane No.	Height adjust.	mm
Layer 1	1	0.00	
Layer 2	1	0.00	
Layer 3	1	0.00	
Layer 4	1	0.00	
Layer 5	1	0.00	

Back

Next

? Select type of layer.

- Input the "Layer height".**  
Concerning the adjustment of the height, refer to the Section 4.8 .

- Select the "Layer type".**  
>>Following the selected layer type, the displayed contents for "Layer pattern" will change.

Layer type single

	Plane No.	Height adjust.	mm
Layer 1	1	0.00	
Layer 2	1	0.00	
Layer 3	1	0.00	
Layer 4	1	0.00	
Layer 5	1	0.00	

Layer type "alternate"

	Plane No.	Height adjust.	mm
Layer 1	1	0.00	
Layer 2	2	0.00	
Layer 3	1	0.00	
Layer 4	2	0.00	
Layer 5	1	0.00	

Layer type "custom"

	Plane No.	Height adjust.	mm
Layer 1	1	0.00	
Layer 2	2	0.00	
Layer 3	1	0.00	
Layer 4	2	0.00	
Layer 5	1	0.00	

- Input the "Plane No.".**  
But, this setting cannot be changed if the layer type is "single" or "alternate". In case of "custom", repeat setting of the Layer pattern is available. For details, refer to the Section "4.5.2 Repeating the layer pattern".

- After completion of all data, press f10<Next> key.**  
>>The next screen "Register pattern" will be displayed.  
For details, refer to the Section 4.6.

Next

Table 4.5.1 Setting parameters in [Layer setting] screen

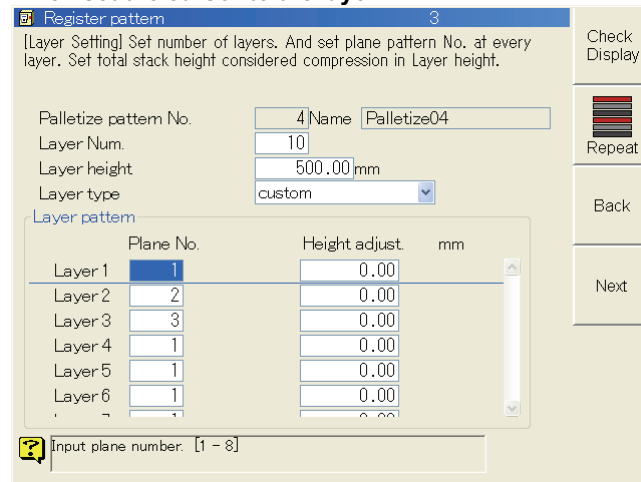
Item	Initial value	Range	Description
Palletize pattern No.	---	----	The palletize pattern that is being edited now. This value cannot be changed.
Name	---	----	The name of the pattern. This value cannot be changed.
Layer Num.	1	1 - 50	Total number of the layers to be palletized.
Layer height	0.0	0.0 - 9999.9	Total height of the loads when the palletize is finished.
Layer type	single	single / alternate / custom	Select a layer type from the following types.
			single Only 1 Plane No. is used for all the layers. The Plane No. for each layer is forcibly set to "1" and it becomes impossible to change the number.
			alternate 2 Plane No. are used alternately. The Plane No. of each layer is forcibly set to "1" or "2" and it becomes impossible to change the number.
			custom The layer pattern can be edit freely.
Layer pattern Plane No.	1	1 - 8	This is a plane pattern No. to be used for the layer. This setting is available only for "Custom".
Height adjust. mm	0.0	-9999.9 - 9999.9	Adjustment parameters for the respective layers. For details, refer to the Section 4.8



## 4.5.2 Repeating the layer pattern

When using "custom" for the "Layer type", it is possible to repeat the Layer pattern of from Layer 1 to Layer n for the following Layers (from n+1).

- 1 After selecting "Custom" for the Layer type, set the Plane No. for each layer from 1 to n. Then set the cursor to the layer "n+1".



**Register pattern** 3

[Layer Setting] Set number of layers. And set plane pattern No. at every layer. Set total stack height considered compression in Layer height.

Palletize pattern No. 4 Name Palletize04

Layer Num. 10

Layer height 500.00mm

Layer type custom

**Layer pattern**

	Plane No.	Height adjust	mm
Layer 1	1	0.00	
Layer 2	2	0.00	
Layer 3	3	0.00	
Layer 4	1	0.00	
Layer 5	1	0.00	
Layer 6	1	0.00	

Input plane number: [1 - 8]

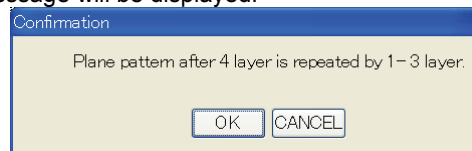
Check Display

Repeat

Back

Next

- 2 Press f8<Repeat> key.  
>>The following message will be displayed.

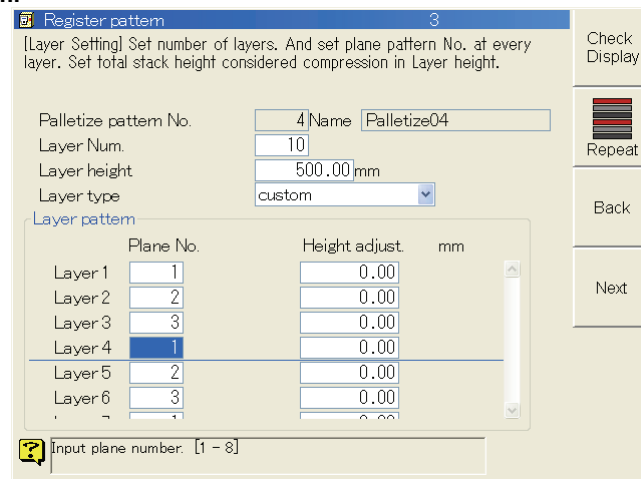



Confirmation

Plane pattern after 4 layer is repeated by 1-3 layer.

OK CANCEL

- 3 If [OK] is selected, the following layers (from n+1) will change to make the repeat form.



**Register pattern** 3

[Layer Setting] Set number of layers. And set plane pattern No. at every layer. Set total stack height considered compression in Layer height.

Palletize pattern No. 4 Name Palletize04

Layer Num. 10

Layer height 500.00mm

Layer type custom

**Layer pattern**

	Plane No.	Height adjust	mm
Layer 1	1	0.00	
Layer 2	2	0.00	
Layer 3	3	0.00	
Layer 4	1	0.00	
Layer 5	2	0.00	
Layer 6	3	0.00	

Input plane number: [1 - 8]

Check Display

Repeat

Back

Next

### 4.5.3 Superimposed display of Plane pattern

Work-piece arrangement under editing can be checked by graphics display. Work-piece arrangement of plural layers can be checked, because they are displayed with superimposed graphics.

**POINT**

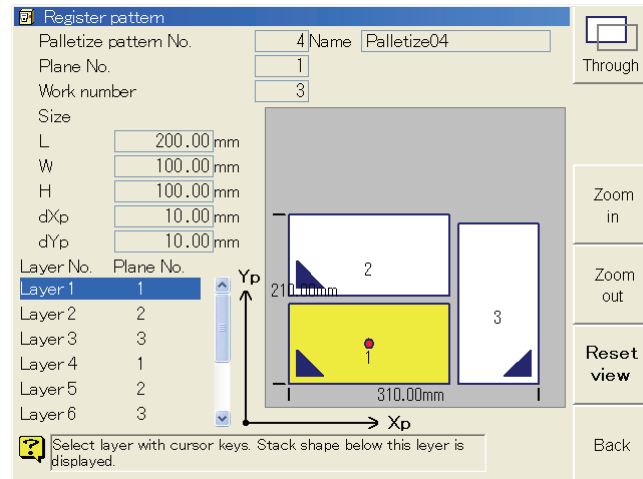
Explanations here is based on that work-piece arrangement is completed by plane pattern setting. At the first time to set palletize pattern, this display has no meaning because plane pattern is not fixed in this moment. Please set the plane pattern.

Please refer to 4.6 Plane pattern setting for the detail.

Check  
Display

#### 1 Press f7<Check display> at plane pattern setting screen.

» The plane pattern of bottom layer to be edited right now is displayed by graphics as followed.

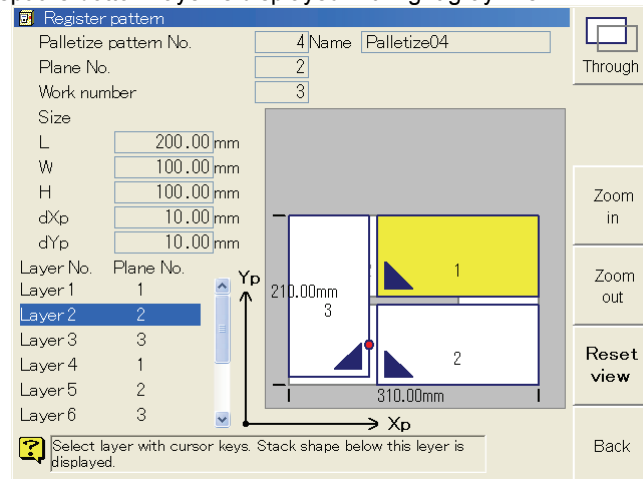


Also, work-piece size calculated by the work-piece arrangement is displayed here.



#### 2 Select layer by up/down key.

» All of layers under the selected layer is displayed with superimposed graphics. Layers except the bottom layer is displayed with light gray line..

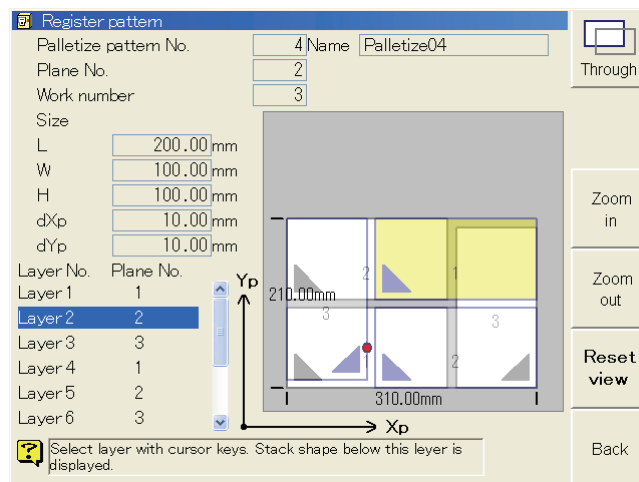


Work-piece size is calculated by the work arrangement all displayed layers.

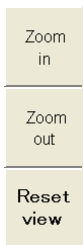


### 3 Press f7<Through>.

» Top layer becomes semi-transparent display in order to check the superimposing shape.



Press f7 <Through> again or press up/down key to return back to the original display.



### 4 Press f9<Zoom in>.

» Zoom in graphics is displayed.

### 5 Press f10<Zoom out>.

» Zoom out graphics is displayed.

### 6 Press f11<Reset view>

» The graphics display conditions (translation, zoom in, and zoom out) will be initialized.

### 7 Press f12<Back>.

» Graphics display is cleared and back to the layer pattern setting screen.



Displayed item indicates the layer information selected by up/down key.

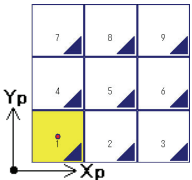
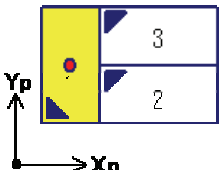
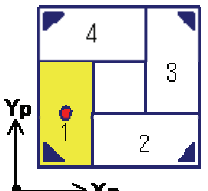
Refer to 4.6.4Check display for plane pattern for detail of them.

## 4.6 Plane pattern setting

How the work-pieces are arranged can be set here.

- 4 arrangement types can be selected.
- Up to 99 work-pieces can be registered per 1 plane pattern.
- Parallel shift can be applied to the plane pattern.

Table 4.6.1 Arrangement patterns that are available for plane pattern

Item	Description	Example
Column	<p>Arrange the work-pieces in X and Y direction in turn. Set the number of the work-pieces for X and Y direction respectively.</p> <p>The work-pieces are arranged in a shape of grid by following the parameters of Size L, Size W, gap dXp, and gap dYp.</p>	
Inter lock	<p>Select an arrangement type of work-pieces from the pre-defined templates.</p> <p>The positions and the directions of the work-pieces are determined by following the parameters of Size L, Size W, gap dXp, and gap dYp.</p>	
Pin wheel	<p>Select an arrangement type of work-pieces from the pre-defined templates.</p> <p>The positions and the directions of the work-pieces are determined by following the parameters of Size L, Size W, gap dXp, and gap dYp.</p>	
Custom	<p>All the work-pieces can be placed freely. The X, Y, Z positions and the Z-axis rotation angle of the work-piece can be set.</p> <p>And, approach direction can be set also.</p>	



It is possible to check the setting visually by using f7<Check Display> key.  
For Check Display function, refer to the Section "4.6.4Check display for plane pattern"



If it is necessary to modify the arrangement pattern of "Column", "Inter lock", and "Pin wheel" respectively, press f11<Modify> key. The setting data is developed (converted) to a format of "Custom".

However, once the development operation has been performed, it becomes impossible to return the data to the format of original arrangement types. (If an arrangement type is re-selected, the data will be initialized)

### 4.6.1 Setting of "column"

The number of work-pieces along the X-direction and the Y-direction of the pallet can be set in the following screen.

The arrangement order is set like the following figures.

**1 Select "column" in the "Plane type".**

>>A layout diagram of work-pieces for "column" is displayed on the screen.

**2 Input the "Work number".**

**3 Input the "Parallel trans(X and Y)".**

For details, refer to "4.6.5Parallel translation of plane pattern"

**4 To check the layout visually, press f8<Check Display> key.**

>>The layout will be displayed graphically on the screen.

For details, refer to "4.6.4Check display for plane pattern".

**5 To modify the settings, press f11<Modify> key.**

>>"Plane type" will be changed to "Custom" and the settings will be developed to the custom display. For the setting procedure of "Custom", refer to "4.6.3Setting of "Custom""

Check  
Display

Modify

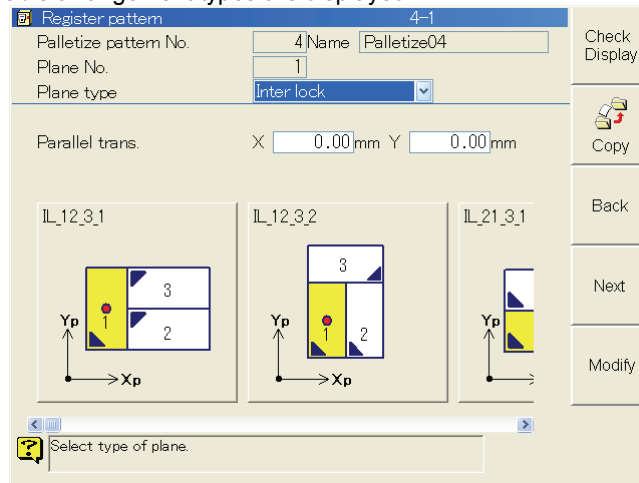


Once this operation (Modify) has been done, the "Plane type" can not return to "Column" keeping the setting values. If "Plane type" is changed, the settings in this screen will be reset.

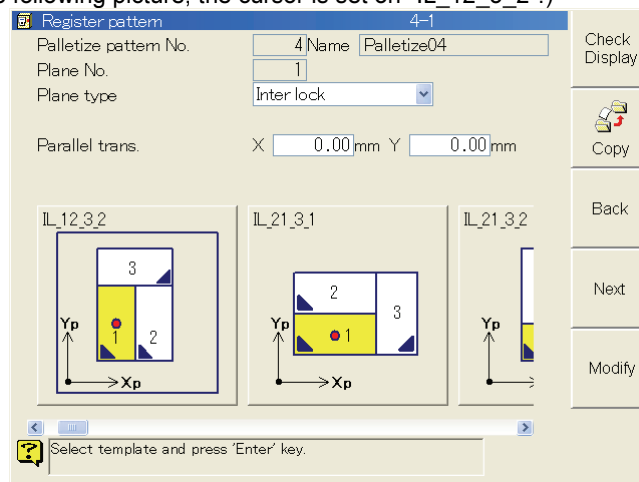
## 4.6.2 Setting of "Inter lock" / "Pin wheel"

The setting procedure for "Inter lock" and "Pin wheel" is the same.  
The setting procedure for "Inter lock" is described here.

- 1 **Change the "Plane type" to "Inter lock" (or "Pin wheel").**  
>>The available arrangement types are displayed.

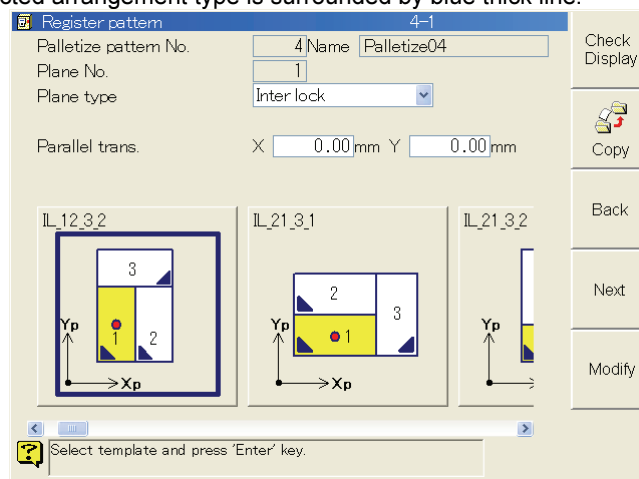


- 2 **Set the cursor to the desired arrangement type.**  
>>On the position where the cursor is set, blue thin line will surround the arrangement type. (In the following picture, the cursor is set on "IL\_12\_3\_2".)



**3 Select the desired arrangement type using the cursor keys and press [Enter].**

>>The selected arrangement type is surrounded by blue thick line.

**4 Input the "Parallel trans(X and Y)".**

For details, refer to "4.6.5Parallel translation of plane pattern"

**5 To check the layout visually, press f8<Check Display> key.**

>>The layout will be displayed graphically on the screen.

For details, refer to "4.6.4Check display for plane pattern".

**6 To modify the settings, press f11<Modify> key.**

>>"Plane type" will be changed to "Custom" and the settings will be developed to the custom display. For the setting procedure of "Custom", refer to "4.6.3Setting of "Custom""



**IMPORTANT**

The actual directions and the positions of the work-pieces depend on the size setting for the work-piece and the arrangement types. Because the pictures shown on the previous page s are just template (sample) graphics, the actual arrangement of the work-pieces may look differ from those template graphics. Therefore, please do not forget to check the arrangement of the work-pieces using f8<Check Display> key all the time.

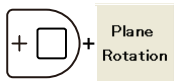
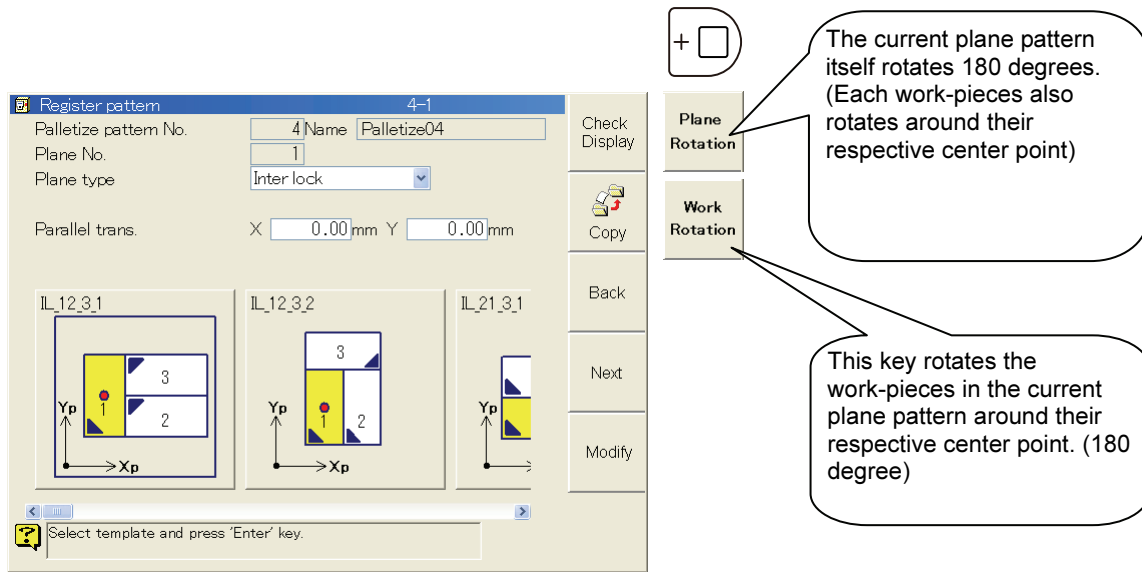


**IMPORTANT**

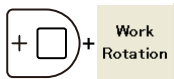
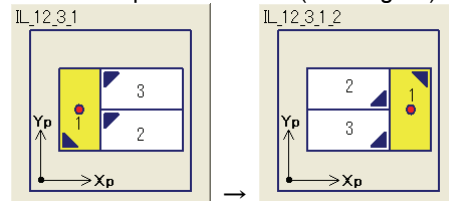
Once this operation (Modify) has been done, the "Plane type" can not return to "Inter lock" (or "Pin wheel") keeping the setting values. If "Plane type" is changed, the settings in this screen will be reset.

## Rotation of the plane pattern and the work-pieces

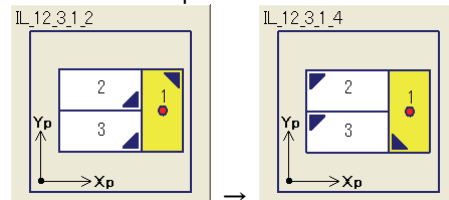
It is possible to rotate the plane pattern and the work-piece.



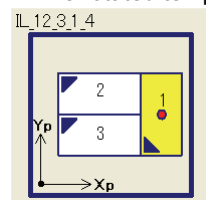
- 1 In the screen of "Register pattern", select a desired template and then press [ENABLE] + f7<Plane Rotation>.  
 >> The template will rotate (180 degree).



- 2 Press [ENABLE] + f8<Work Rotation>.  
 >> The all work-pieces in the selected template will rotate (180 degree).



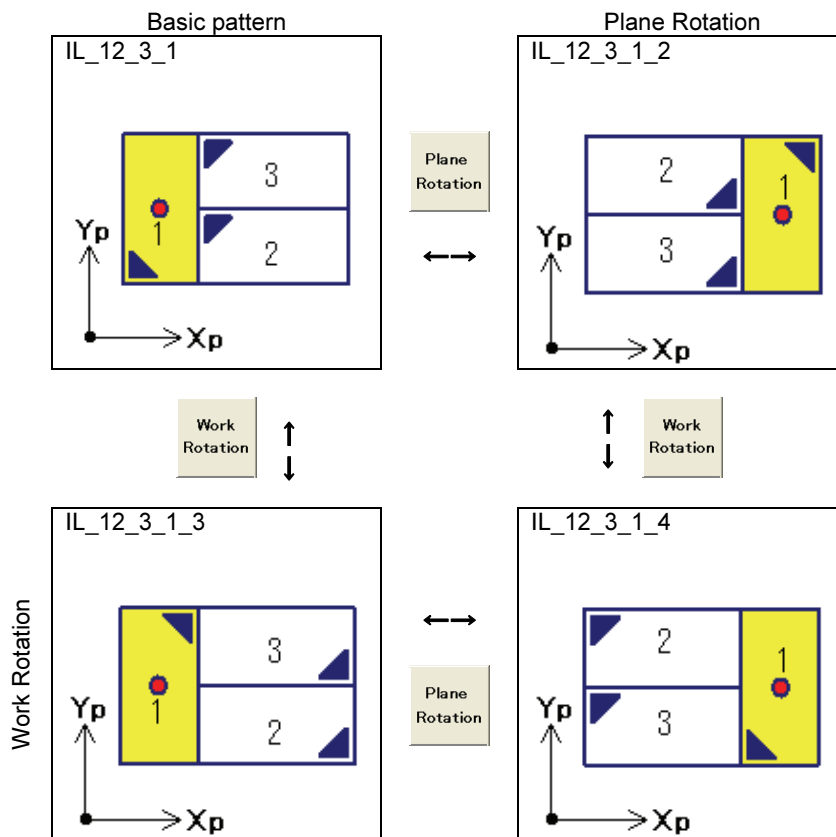
- 3 Press [Enter].  
 >> The rotated template will be selected and the picture will be surrounded by thick line.





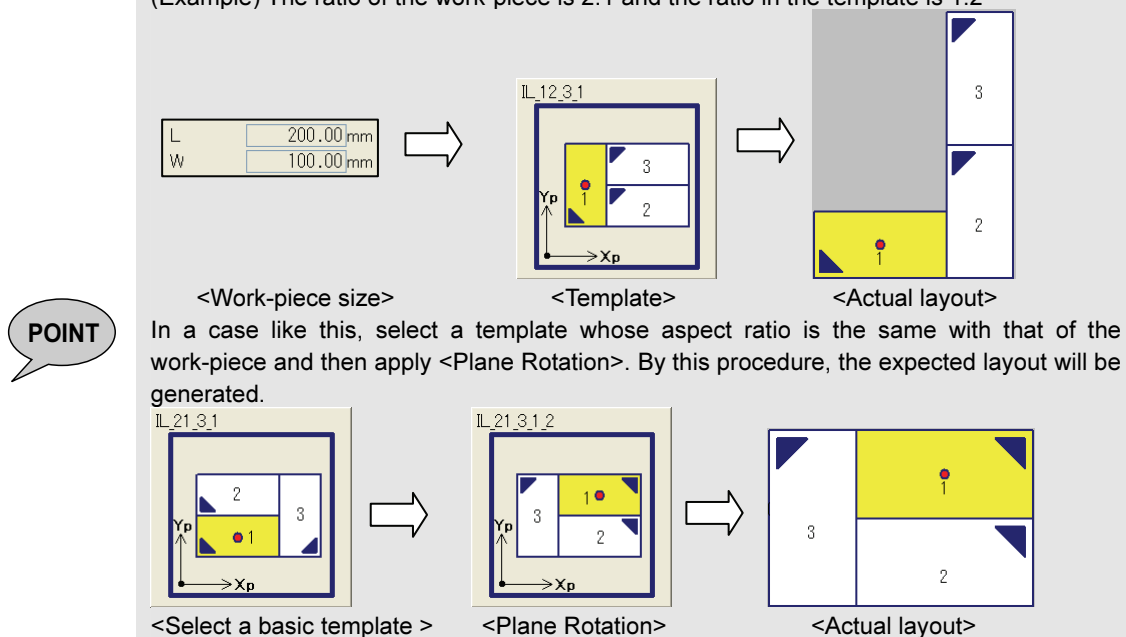
**Transition of the template display**

At first time, the basic pattern is displayed. The displayed pattern will be changed (rotated) by <Plane Rotation> and <Work rotation> keys. After pressing [Enter] key, if the screen is re-opened, the selected pattern (= already rotated pattern) will be displayed instead of the basic pattern.



If the aspect ratio of the work-piece size and the work-piece size in the template do not match each other, the displayed picture does not become the expected layout.

(Example) The ratio of the work-piece is 2:1 and the ratio in the template is 1:2



In addition, to change the order of the work-pieces or to rotate the work-pieces one by one, use f11<Modify>. By using this key, the "Plane type" will be changed to "custom" and it becomes possible to edit the data respectively.

## POINT

- In case of plane pattern rotation, the teach point position will change. Therefore, it is necessary to make a setting of parallel shift via manual operation or "Arrange edge" operation (automatic calculation)
- The angle values of the all work-pieces (Rz) are set so that those values become less than +/- 180 degrees. So, not the all work-piece's angle will not rotate towards the same direction when applying "Plane Rotation" or "Work Rotation".
- In case of "Interlock" and "Pin wheel", the layout can be selected only from pre-defined templates. To rotate the work-pieces one by one or to change the stacking order, please use "Modify" key to change the Plane Type to "custom".

### 4.6.3 Setting of "Custom"

If "Plane type" is set to "Custom", it becomes possible to set the arrangement of the work-pieces freely. If f11<Modify> key is pressed with "Column", "Inter lock", or "Pin wheel" is selected, the setting data will be converted for "Custom" and displayed on the screen.

**i**  
IMPORTANT

If "Plane type" is set to "Custom", the parameters of "Work size L", "Work size W", "dXp", and "dYp" are not used. But "Work size L" and "Work size W" are used for "Check Display".

#### 1 Change the "Plane type" to "Custom".

>>The arrangement data for work-piece is displayed like the figure shown below.

Register pattern 4-1

Palletize pattern No. 4 Name Palletize04

Plane No. 1

Plane type Custom

Work number 1

Parallel trans. X 0.00mm Y 0.00mm

No.	X	Y	Z	Rz	Approach
1	0.00	0.00	0.00	0.00	0

Select type of plane.

Check Display

Copy

Back

Next

3 2 1  
4 8  
5 6 7

#### 2 Input the "Work number".

>>The arrangement data is displayed for the respective work-pieces.

Register pattern 4-1

Palletize pattern No. 4 Name Palletize04

Plane No. 1

Plane type Custom

Work number 10

Parallel trans. X 0.00mm Y 0.00mm

No.	X	Y	Z	Rz	Approach
1	0.00	0.00	0.00	0.00	0
2	100.00	0.00	0.00	0.00	0
3	0.00	100.00	0.00	90.00	0
0	0.00	0.00	0.00	0.00	0
0	0.00	0.00	0.00	0.00	0
0	0.00	0.00	0.00	0.00	0
0	0.00	0.00	0.00	0.00	0
0	0.00	0.00	0.00	0.00	0
0	0.00	0.00	0.00	0.00	0
0	0.00	0.00	0.00	0.00	0

[0 - 99]

Check Display

Copy

Back

Next

3 2 1  
4 8  
5 6 7

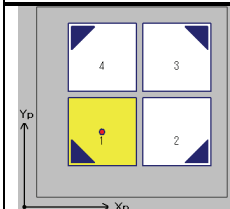
When entering this screen by pressing f11<Modify> key from "Column", "Inter lock", or "Pin wheel", the setting data will be developed(converted) for "Custom" and automatically set and displayed.

- 3 Input the respective work-piece numbers and the positions (X,Y,Z,Rz).**  
In case of (0,0,0,0), the teaching point is played back as it is. (=no shift motion)  
Concerning the height (Z), refer to the Section "4.8 Adjusting the height".
- 4 Input the Approach direction.**  
Concerning the Approach direction, refer to the Section "5.2.3 FN374 Palletize approach selection".
- 5 Input the "Parallel trans(X and Y)".**  
For details, refer to "4.6.5 Parallel translation of plane pattern"
- 6 To check the setting visually, press f8<Check Display> key.**  
>>The layout will be displayed graphically on the screen.  
For details, refer to "4.6.4 Check display for plane pattern".

Table 4.6.2 Setting parameters in [Plane type "Custom"] screen

Item	Initial value	Range	Description
No.	0	1 - 99	The order to arrange the work-piece.
X	0.0	-9999.9 - 9999.9	Work-piece center position along X-direction of the pallet coordinate system. Set the distance from the teach point.
Y	0.0	-9999.9 - 9999.9	Work-piece center position along Y-direction of the pallet coordinate system. Set the distance from the teach point.
Z	0.0	-9999.9 - 9999.9	Work-piece center position along Z-direction of the pallet coordinate system. This height can be tweaked for each work-pieces respectively. Concerning the height, refer to the Section "4.8 Adjusting the height".
Rz	0.0.	-360 to 360	Rotation angle around the Z axis. The angle in the teach point itself is "0 [deg]".
Approach (direction)	0	0 - 8	A value to set the Approach direction. In case of "0", approach motion is not be made. For details, refer to the Section 5.2.3.

## Example

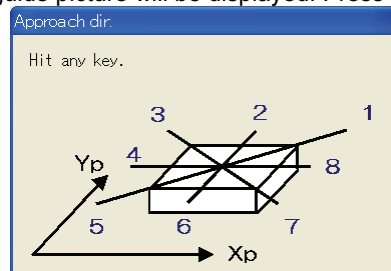
Arrangement	Work-piece	No.	X	Y	Z	Rz	Approach direction
	L : 100 W : 100 H : 100	1	0.0	0	0.0	0	0
		2	110.0	0.00	0.0	90	0
		3	110.0	110.0	0.0	180	0
		4	0.0	110.0	0.0	-90	0

## Guide display

If <Approach direction guide> key is pressed, a guide picture will be displayed. While this picture is displayed, it is not possible to edit the data. To close this picture and return to the edit screen, press [R/RESET] key.

- 1 Press <f11>.**

>>The guide picture will be displayed. Press [R/RESET] key to return.



## Rotation of "Plane pattern" and "Work-piece"

The palletize pattern can be rotated.

Register pattern 4-1

Palletize pattern No. 4 Name Palletize04

Plane No. 1

Plane type Custom

Work number 4

Parallel trans. X 0.00mm Y 0.00mm

No.	X	Y	Z	Rz	Approach
1	0.00	0.00	0.00	0.00	0
2	0.00	0.00	0.00	0.00	0
3	0.00	0.00	0.00	0.00	0
0	0.00	0.00	0.00	0.00	0

Select type of plane.

Check Display

Copy

Back

Next

3 2 1  
4 8  
5 6 7



Plane Rotation

This key rotates the plane pattern at 90 degrees around (0.0, 0.0). The work-pieces also rotate at 90 degree.

Work Rotation

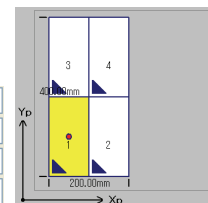
The all work-pieces rotate at 90 degrees around their own center. The plane pattern does not rotate.

Rotate Direction Plus

This key changes the rotational direction. (+/-) The setting is common to Plane and Work-piece.

### 1 Select "Custom".

1	0.00	0.00	0.00	0.00	5
2	100.00	0.00	0.00	0.00	7
3	0.00	200.00	0.00	0.00	3
4	100.00	200.00	0.00	0.00	1

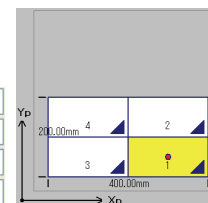


Plane Rotation

### 2 Press [ENABLE] + f7<Plane Rotation>

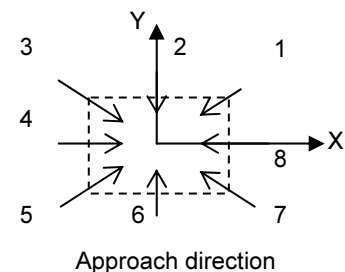
>>The layout of the all work-pieces will rotate at +90 degrees around the teach point. At this time, the work-piece itself will also rotate at +90 degrees around their own center. And, the approach direction parameters will also be changed following the rotation.

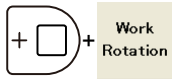
1	0.00	0.00	0.00	90.00	7
2	0.00	100.00	0.00	90.00	1
3	-200.00	0.00	0.00	90.00	5
4	-200.00	100.00	0.00	90.00	3



### Rotation of the Approach direction

-90 deg	original	+90 deg
7	1	3
8	2	4
1	3	5
2	4	6
3	5	7
4	6	8
5	7	1
6	8	2



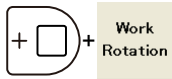
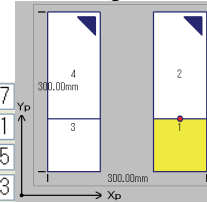


3

**Press [ENABLE] + f8<Work Rotation>.**

>>The all work-pieces rotate around their own center at +90 degrees.

1	0.00	0.00	0.00	180.00	7
2	0.00	100.00	0.00	180.00	1
3	-200.00	0.00	0.00	180.00	5
4	-200.00	100.00	0.00	180.00	3

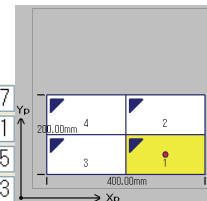


4

**Press [ENABLE] + f8<Work Rotation> again.**

>>The all work-pieces rotate around their own center at +90 degrees.

1	0.00	0.00	0.00	270.00	7
2	0.00	100.00	0.00	270.00	1
3	-200.00	0.00	0.00	270.00	5
4	-200.00	100.00	0.00	270.00	3



### POINT

In case of "Plane Rotation", the rotation is made using (0.0, 0.0) of the work-piece's placement. In case of "Work Rotation", the rotation is made using each work-piece's center. And in case of "Plane Rotation", the approach directions also rotate.



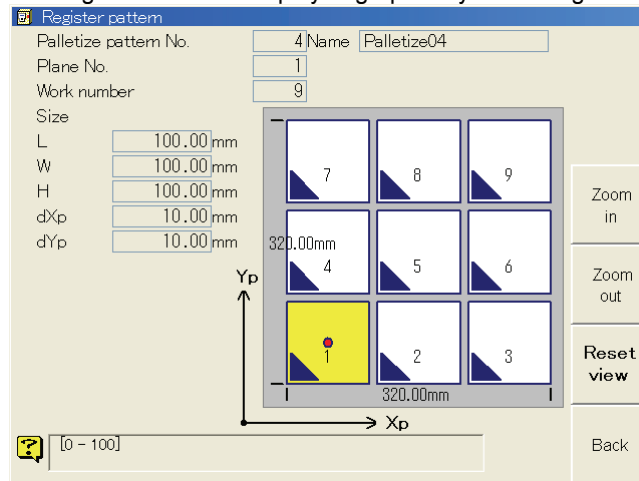
When making "Plane Rotation" with +90 degrees, the angle of all work-pieces also rotates at 90 degrees. Therefore, in some cases, it might be better to rotate the work-pieces at -360 degrees after making the "Plane Rotation" depending on the installation position or angle of the tool or its peripheral cable.

#### 4.6.4 Check display for plane pattern

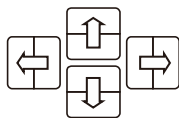
The plane pattern being edited can be checked graphically.



- 1 Press **f7**<Check Display> key in the plane pattern setting screen.  
 >>The pattern being edited will be displayed graphically like the figure shown below.






Also, work-piece size calculated by the work-piece arrangement is displayed here.



- 2 Press **up/down/left/right** cursor keys.  
 >>The graphic will move to the respective directions.
- 3 Press **f9**<Zoom in> key.  
 >>The graphic will be zoomed in.
- 4 Press **f9**<Zoom out> key.  
 >>The graphic will be zoomed out.
- 5 Press **< Reset view>**  
 The graphics display conditions (translation, zoom in, and zoom out) will be initialized.
- 6 Press **f12**< Back> key.  
 >>The graphical display will be closed and the screen will return to the plane pattern setting screen.

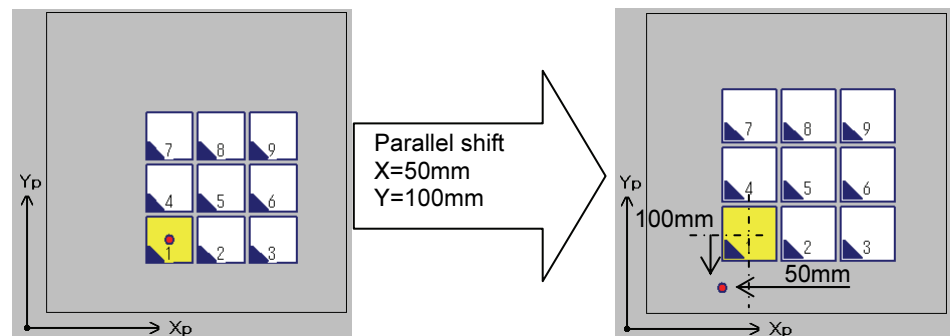
Table 4.6.3 Items displayed on [Check Display] screen

Item	Description
Palletize pattern No.	The number of the palletize pattern currently being edited.
Name	Name of the palletize pattern.
Plane No.	The number of the plane pattern currently being edited.
Work number	The number of the work-pieces being edited in the current plane pattern edit screen.
Size L	The size of the work-piece(L)
W	The size of the work-piece(W)
H	The size of the work-piece(H)
dXp	The gap between the work-pieces in X-direction (dXp).
dYp	The gap between the work-pieces in Y-direction (dYp).
	The 1st work-piece is displayed in yellow. The other work-pieces are displayed in white. The number in the work-piece shows the order in which the work-piece is stacked. The filled triangle on the lower left-hand is used to show the rotation angle.

Item	Description
	This mark shows the teach point of the palletize program. Normally, the teach point is placed at the center point of the 1st work-piece. But when setting parallel translation, the position will follow the setting. Refer to the Section "4.6.5 Parallel translation of plane pattern".
	Maximum size of each X and Y direction is displayed when work-pieces are arranged on this plane.

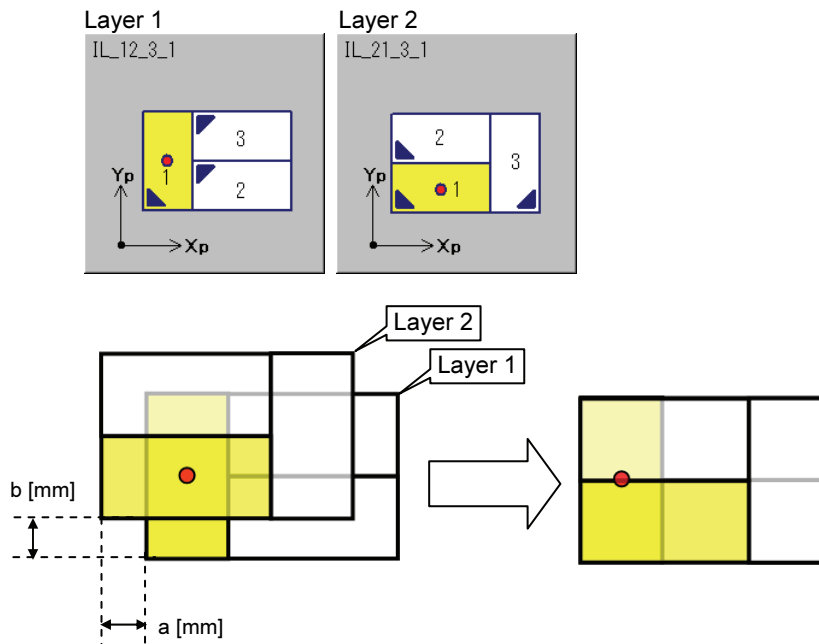
### 4.6.5 Parallel translation of plane pattern

The all work-pieces included in a plane pattern can be shifted parallel together to adjust their positions against the upper/lower layers. By executing parallel shift, the all work-pieces in the plane pattern will move parallel from the shift reference point (teach point) like the figure shown below.



If parallel shift is set, the teach point is not the center point of the 1st work-piece on the plane pattern.

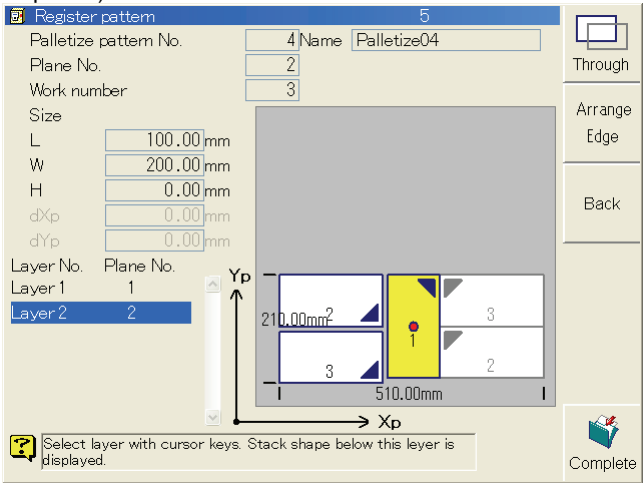
#### An example in which the parallel shift setting is necessary



In a case like this, apply parallel shift for Layer 2.  
 $X = +a \text{ [mm]}$ ,  $Y = -b \text{ [mm]}$

# 4.7 Checking the pattern

At the end of the palletize pattern registration screens, check screen for the pattern will be displayed.  
This check screen can display the same content with "Superimposed display of Plane pattern" (See 4.5.3). And it is possible to check the pattern used in each layer. And, it is also possible to calculate the parallel shift amount of the plane pattern automatically. (Refer to the following descriptions)



## How to calculate the amount of parallel shift of the plane pattern automatically

It is possible to calculate the parallel shift amount of each plane pattern automatically. The automatic calculation will be made so that the edge of the target plane pattern matches the edge of the Base Plane (reference plane) pattern. This setting can be made in "Check Display" screen. The following explanation shows an example in which the "Plane pattern 1" is the target plane and the "Plane pattern 2" is the base plane (reference plane).

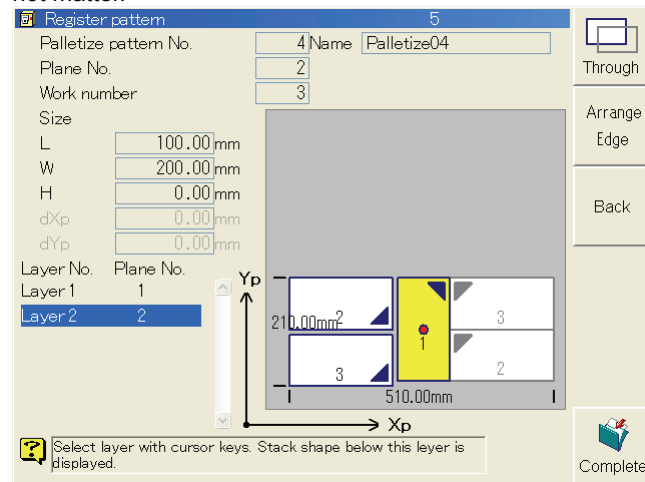
Plane pattern 1	Plane pattern 2	Reference edge
These 2 patterns (1 and 2) look like the picture shown as right.		
Now, move the teach point of the plane pattern 2 by executing automatic calculation. (parallel shift)		
As a result, the position of the plane pattern 1 and 2 match each other.		





**1** Select the layer number which is using the plane pattern that you want to apply the automatic calculation.

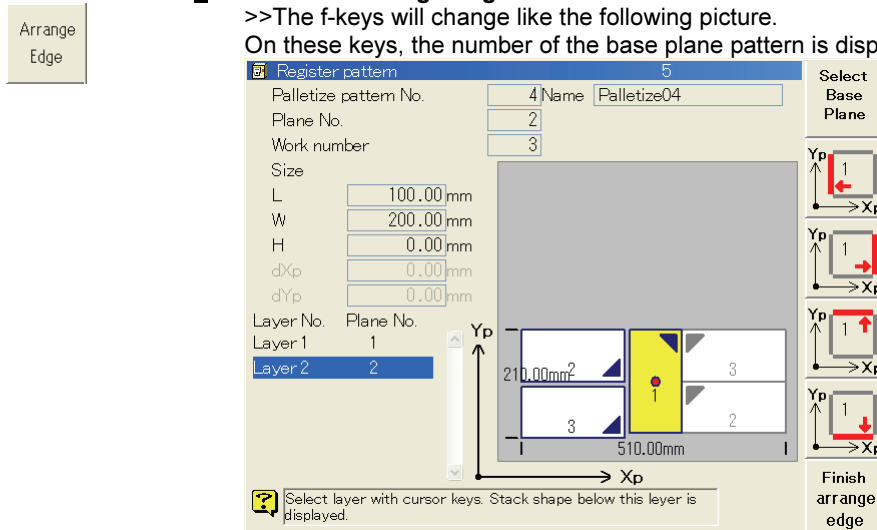
As long as the layer is using the concerned plane pattern, the layer number itself does not matter.







**2** Press f7<Arrange Edge>.

>>The f-keys will change like the following picture.

On these keys, the number of the base plane pattern is displayed.



### "Arrange edge" f-keys

	<p><b>Left edge arrangement</b></p> <p>This key will calculate the X-direction shift amount so that the edge of the work-piece whose Xp coordinate is the smallest in the reference plane pattern and the Xp coordinate of the work-piece whose Xp coordinate is the smallest in the target plane pattern become the same.</p>
	<p><b>Right edge arrangement</b></p> <p>This key will calculate the X-direction shift amount so that the edge of the work-piece whose Xp coordinate is the largest in the reference plane pattern and the Xp coordinate of the work-piece whose Xp coordinate is the largest in the target plane pattern become the same.</p>
	<p><b>Upper edge arrangement</b></p> <p>This key will calculate the Y-direction shift amount so that the edge of the work-piece whose Yp coordinate is the largest in the reference plane pattern and the Yp coordinate of the work-piece whose Yp coordinate is the largest in the target plane pattern become the same.</p>
	<p><b>Lower edge arrangement</b></p> <p>This key will calculate the Y-direction shift amount so that the edge of the work-piece whose Yp coordinate is the smallest in the reference plane pattern and the Yp coordinate of the work-piece whose Yp coordinate is the smallest in the target plane pattern become the same.</p>



### 3 Press <Arrange Edge> key.

>>The automatic calculation of the shift amount of the selected plane pattern is made and the result is applied to the display.

Register pattern 5

Palletize pattern No. 4 Name Palletize04

Plane No. 2

Work number 3

Size

L 100.00 mm

W 200.00 mm

H 0.00 mm

dXp 0.00 mm

dYp 0.00 mm

Layer No.	Plane No.
Layer 1	1
Layer 2	2

Select layer with cursor keys. Stack shape below this layer is displayed.

Finish arrange edge

Finish  
arrange  
edge

### 4 After completing the arrange operation, press f12<Finish arrange edge> to close.

#### POINT

The parallel shift amount can be set for each plane pattern. If one plane pattern is used in plural layers, the calculation result will be applied to the all those layers. The setting can not be applied to the layers one by one separately.

## Changing the Base Plane (reference plane)

Select  
Base  
Plane

### 1 Press f7<Select Base Plane> key.

>>The following message will be displayed.

Select Base Plane

Please input plane pattern number:[1 - 8]

### 2 Input the number of the plane pattern that is to be used as a Base Plane (reference plane) and the press [Enter].

>>The Base Plane number displayed in the f-keys will be changed.

Register pattern 5

Palletize pattern No. 4 Name Palletize04

Plane No. 2

Work number 3

Size

L 100.00 mm

W 200.00 mm

H 0.00 mm

dXp 0.00 mm

dYp 0.00 mm

Layer No.	Plane No.
Layer 1	1
Layer 2	2

Select layer with cursor keys. Stack shape below this layer is displayed.

Finish arrange edge

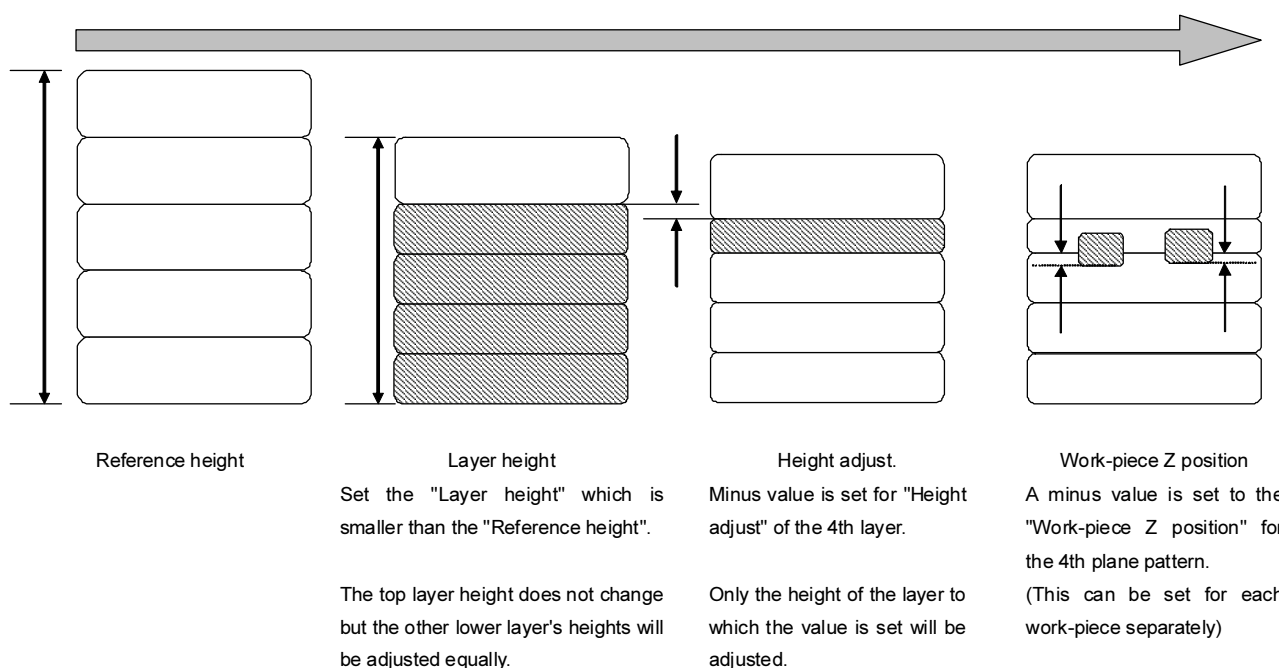
The Base Plane  
number is  
displayed here.

## 4.8 Adjusting the height

The height of the work-pieces of each plane (layer) is determined using the following parameters.

Table 4.8.1 Setting items for height

Item	Setting screen	Target	Description
Reference height		All layers	Reference value for the total height of the stacked work-pieces. The calculation will be done like following;  "Work size H" x "Layer Num."
Work size H	[Work information]		
Layer Num.	[Layer setting]		
Layer height	[Layer setting]	All layers	If this value is smaller than the "Reference height", each layer's height except for the top layer will be adjusted.
Height adjust.	[Layer setting]	Each Layer	The height of each layer can be adjusted one by one. This adjustment value will be added to the adjustment value calculated from "Layer height"
Work Z	Plane pattern setting screen	Per Work-piece	The height of each work-piece can be adjusted one by one. This adjustment value will be added to that of "Layer height" and "Height adjust".



### Height adjustment

NOTE

## Chapter 5 Teaching

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This chapter describes the teaching procedures for palletizing. Palletizing is accomplished by combining a number of application commands (functions).

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## 5.1 General description of teaching

The palletizing is recorded in work programs using application commands (functions). Palletizing start, end, etc. are specified, using parameters such as the palletizing numbers.

The application commands which are used are listed in the table below. Details on each command can be found on the following pages.

And, it is also possible to use application commands (functions) that can modify palletize registers to make a high-level motion. For details, refer to the Section 6.3.

Table 5.1.1 Application commands used by palletizing

FN code No.	Name of FN command	Outline
249	Palletize start	Start palletizing based on the pre-designed palletizing pattern.
250	Palletize end	Finish palletizing based on the pre-designed palletizing pattern.
251	Palletize reset	The palletize counters (Layer and Work-piece) are forcibly reset. (palletizing operation is forcibly terminated)
374	Palletize approach selection	Starts approaching motion.
375	Palletize optimize path	Optimize Step position based on the locus of previous step and following step.
376	Palletize select grasp position	Select work grasp position from registered by Palletize pattern.
388	Palletize select height(Z)	Adjust the height automatically by considering to the previous / next motion locus.

## 5.2 Application commands (functions)

### 5.2.1 FN249 Palletize start, FN250 Palletize end

FN249 is the palletize start command.

Palletizing is started with this application command. "Palletizing operations" involve calculating the shift amount based on the specified palletizing number and palletize counter and playing back the positions which have been offset from the original positions by the shift amount. These shift operations continue until the next "FN250 Palletize end" application command is executed.

The 3rd parameter and the 4th parameter are used to designate the output signal number for "Layer counter" and "Work-piece counter". Those output signals are refreshed at the timing of executing "Palletize start" / "Palletize end" application commands.

Mnemonic	Number	Command
PALLET3	FN249	Palletize start

Parameter	Data	Description, setting range
1st parameter	Palletize No.	The number of the palletize to start (1-255)
2nd parameter	Type	Designate "Palletize" or "De-palletize". (0:Palletize / 1:De-palletize)
3rd parameter	Layer count signal number	This is a first number of the signals to output the Layer counter value. (0-2048) The counter value is outputted in binary form and this signal number is handled as the LSB. Continuous 6 signals (6 bits) from this signal number are used at maximum (from 1st to 50th layer) If "0" is designated, the signals are not outputted.
4th parameter	Work-piece count signal number	This is a first number of the signals to output the Work-piece counter value. (0-2048) The counter value is outputted in binary form and this signal number is handled as the LSB. Continuous 7 signals (7 bits) from this signal number are used at maximum (from 1st to 99th work-piece) If "0" is designated, the signals are not outputted.

FN250 is the palletize end command. This is paired with the "FN249 Palletize start" command.

It ends the palletizing pattern being executed, and increments the Work-piece counter by 1. If, as a result of the increment, the Work-piece counter has exceeded the total number of Work-pieces for the layer, the Layer counter is incremented and the Work-piece counter is returned to 1. If the Layer counter has exceeded the total number of Layers for the palletize pattern, the Layer counter is returned to 1 and the completion signal will be turned ON.

In case of de-palletize, the counter will be decremented by 1 from the maximum number of Work-pieces.

Mnemonic	Number	Command
PALLET3_END	FN250	Palletize end

Parameter	Data	Description, setting range
1st parameter	Palletize No.	The number of the palletize to finish (1-255)
2nd parameter	Completion signal	When the designated palletize is completely finished, the designated output signal will turn ON. (from 0 to 2048) If "0" is designated, the signals are not outputted.



Record "PALLET3 : Palletize start(FN249)" at STEP N and "PALLET3\_END : Palletize end(FN250)" at STEP N+3

When playing back the work program, after reaching the STEP N, the robot will start shift motion by calculating the shift amount based on the palletize number designated in FN249 and the palletize counter (Layer counter and the Work-piece counter). For example, the robot will go thorough the dotted line in the picture shown below. After reaching STEP N+3, FN250 is executed and the palletize motion will be finished and then the robot will go towards the record point (teach point) of the STEP N+4.

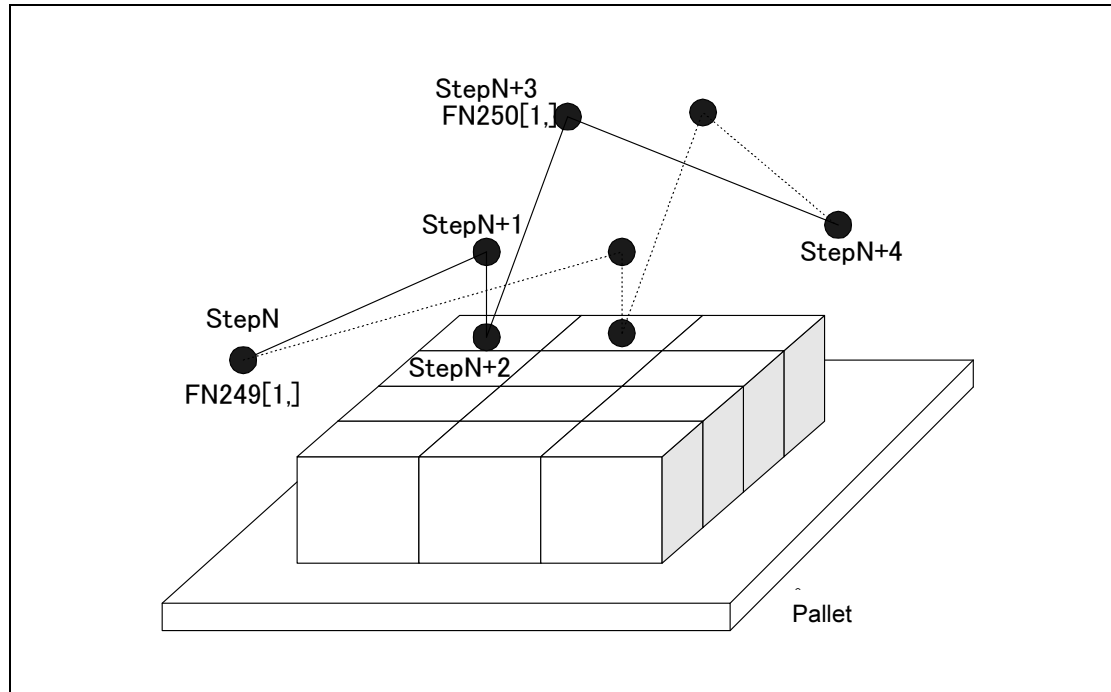


Fig. 5.2.1 Example of operations from "FN249 Palletize start" and "FN250 Palletize end"

**POINT**

If the palletizing operation is terminated in halfway and if it is necessary to cancel the shift amount (e.g. it is necessary to move the robot to the home position), enter [R] [0] [ENTER] to cancel the shift amount set by the palletize function.

When restarting the program, confirm that the palletize counter is proper number. To reset or modify the palletize counter, refer to the section 6.1.

## 5.2.2 FN251 Palletize reset

Using this application command, the palletize counter (both "Layer counter" and "Work-piece counter") can be forcibly reset. (Cleared to zero)

The palletize that has been reset will re-start from the 1st work-piece of the 1st layer.

The reset operation is available even if the palletize operation is being executed or has been already finished. If the reset is done while the palletize operation is being executed, the palletize condition is forcibly set to "Finished".

When resetting the palletize, if the palletize has been started, the output signals for "Layer counter" and the "Work-piece counter" will be cleared.

When resetting, an output signal "Reset ACK signal" will be turned ON.

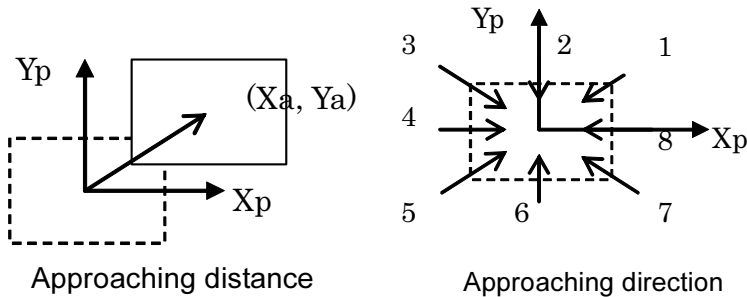
Mnemonic	Number	Command
PALLET3_RESET	FN251	Palletize reset

Parameter	Data	Description, setting range
1st parameter	Palletize No.	The number of the palletize to reset the counters (Layer and the Work-piece) (1-255)

### 5.2.3 FN374 Palletize approach selection

“Approach” is the robot moving to be closing to the pallet with slant direction in order to avoid the interference with the already loaded work-piece and to make small clearance between the already loaded work-piece. Normally approaching direction has to be changed according to the palletizing direction, so simple shift is not enough to realize this movement.

One approach distance is defined by palletize pattern, and approach direction is designated for each work-piece. By this command, approach movement can be changed from the next step.



Mnemonic	Number	Command
PALLET3_APR	FN374	Palletize approach selection

Parameter	Data	Description, setting range
1st Parameter	Palletize No.	The target palletize number (1-255)
2nd parameter	Route selection	0:appr-down 1:down-appr

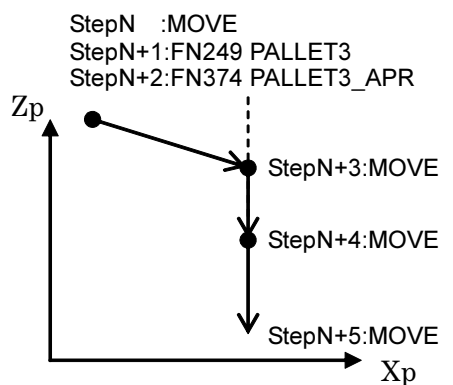
#### Approaching movement

Approach shift is added on the next move step of PALLET3\_APR step (In case that down-appr is designated, this includes next of next move step). Pay much attention when adding move step.

As written in the following figure, FN249 (PALLET3) is recorded in step N+1. FN374 (PALLET3\_APR) is recorded in step N+2, and move step N+2, N+3 and N+4 continues.

Robot will start palletizing shift movement according to the palletize pattern designated by FN249 and the palletize counter in this moment.

At the next move step of FN374 (PALLET3\_APR), approach shift amount designated to this work-piece is added on the palletize shift amount.



Example of approaching movement

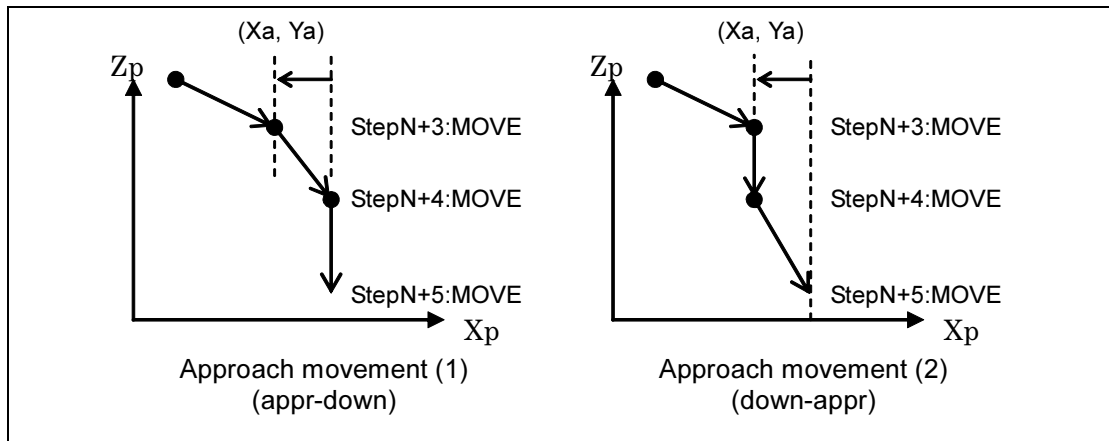


Fig 5.2.2 Example of approaching movement

### 5.2.4 FN375 Palletize optimize path

If the total height of the stacked work-pieces is large, if the teaching program is made to avoid the stacked work-pieces or the other hurdles, redundant motion may occur in the program.

This is an application command to adjust the move step position automatically by referring the motion locus before/after the step.

Mnemonic	Number	Command
PALLET3_OPT	FN375	Palletize optimize path

Parameter	Data	Description, setting range
1st Parameter	Palletize No.	The target palletize number (1-255)
2nd parameter	Reference step No.	The number of a move step which is referred to. (from 1 to 9999)

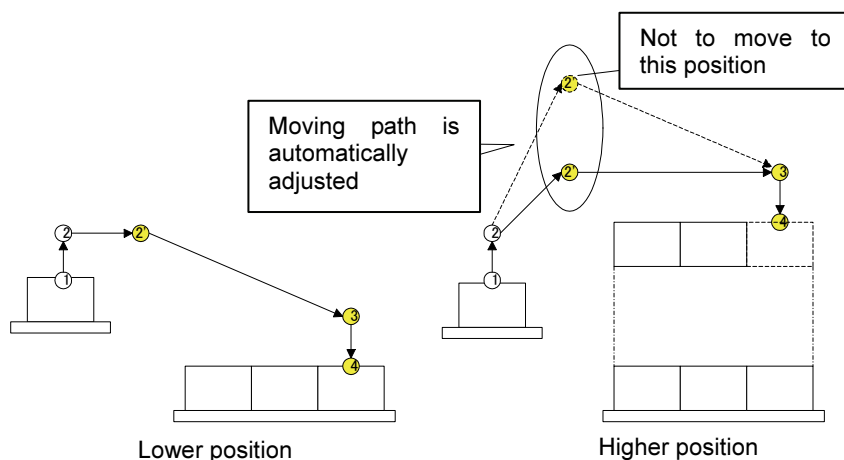
Specifically, the target position of 2 following move steps are compared and the one of which the Z coordinate is higher

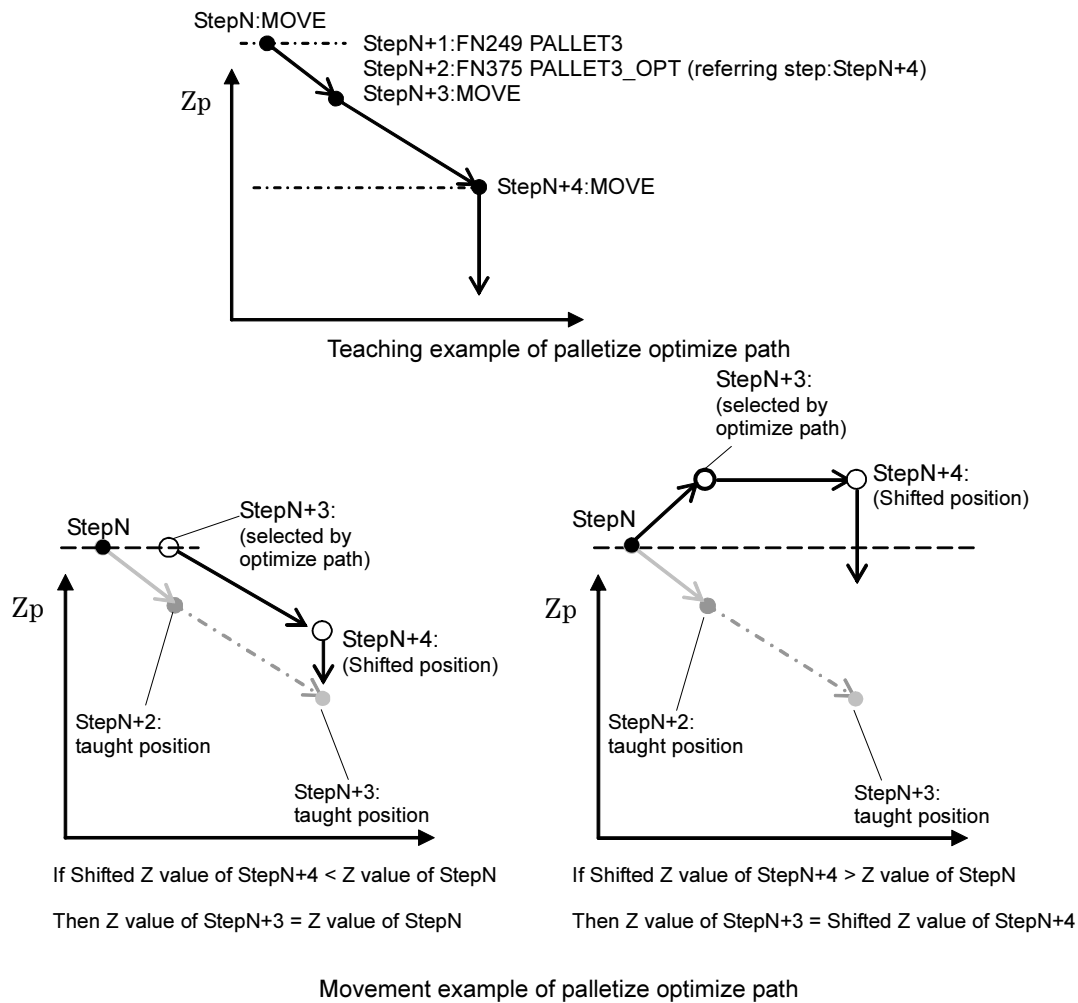
Z coordinate following move command is modified so that the value becomes the same with the higher one.

Concretely, Z coordinate value of "next move step" is aligned to the higher Z value of two move step target position.

Two move steps are "previous move step" of this function and "referred move step" designated by parameter.

Z coordinate value is calculated on the base of the pallet coordinate system that is currently used in this palletize pattern.





### 5.2.5 FN376 Palletize select grasp position

Select one of the "Grasping position"(up to 4 at maximum) registered in the palletize pattern.

For example, please suppose that several work-pieces are grasped by a hand (gripper) at one time and the robot will release (put) those work-pieces one by one on the pallet. Although the robot move to the position of the work-piece registered to the palletize pattern, the robot cannot put those work-pieces precisely because the grasping position will change every time per the work-piece

Using this function, grasping position can be adjusted to the adequate position for each work-piece in order to put the target position of the robot on the center of work-piece..

If this function is not executed, robot moves just like that "Grasping position" is registered as 1.

If this function is executed once or more and "Grasping position" is changed, this will be kept until the palletize number is reset.

Mnemonic	Number	Command
PALLET3_SELGR	FN376	Palletize select grasp position

Parameter	Data	Description, setting range
1st Parameter	Palletize No.	The target palletize number (1-255)
2nd parameter	Grasp position	Grasping position number of the work-piece to be selected (1-4)

### 5.2.6 FN388 Palletize select height (Z)

Although "FN375 Palletize optimize path" can make the adjustment along the height direction (Z direction) like the Fig. 5.2.3, X-Y direction shift is applied because the target step belongs to the palletize section. Therefore, there are some cases where redundant motion along X-Y direction is generated. And, if the robot arm's motion range is restricted by wall etc., the robot may hit the wall etc. because of X-Y direction shift motion.

When using this "FN388 Palletize select height (Z)", the target step is recorded outside the palletize section and only the Z coordinate is adjusted. This application command FN388 is convenient when you want to apply the shift motion only along height (Z) direction not along X-Y direction.

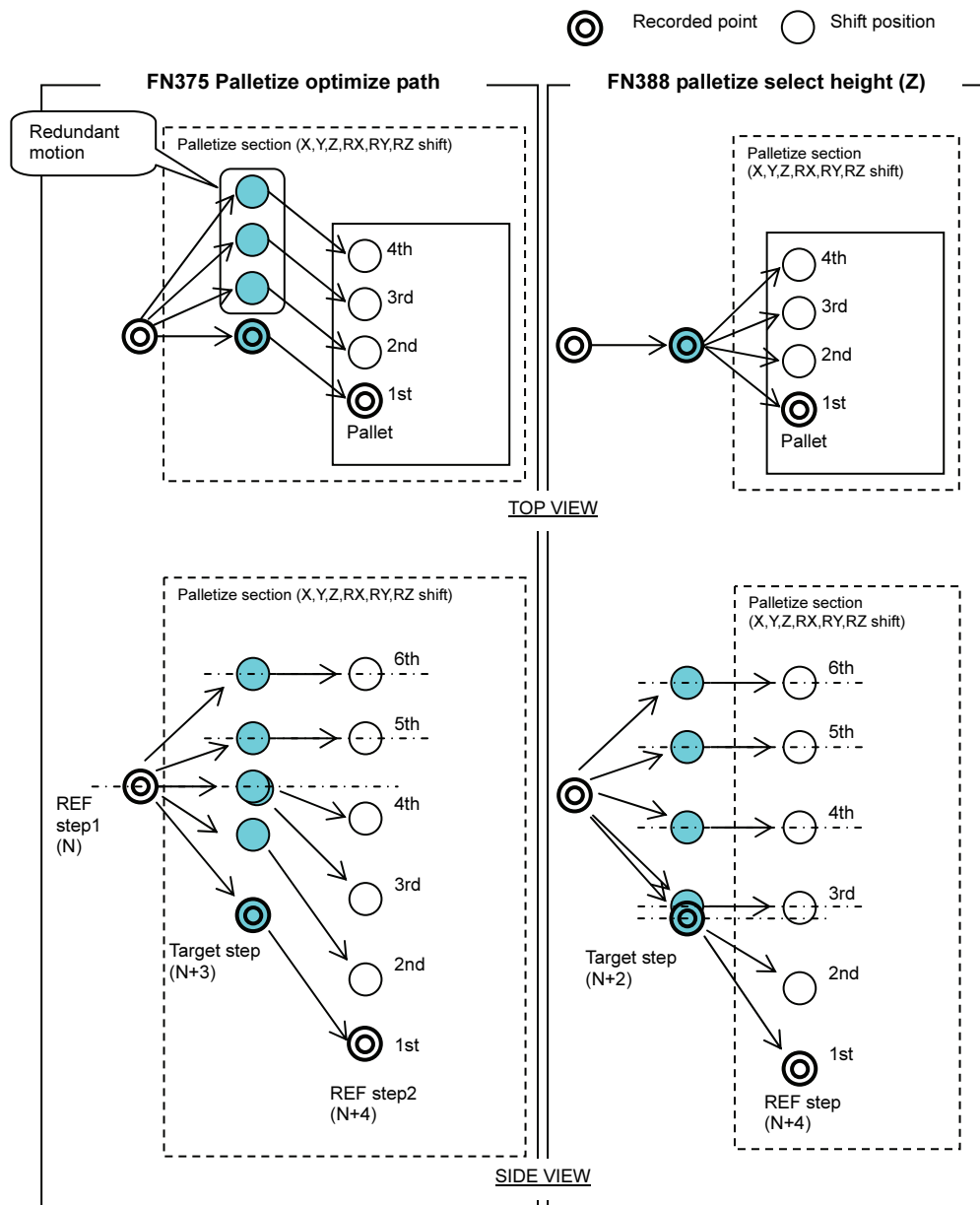


Fig. 5.2.3 "FN375 Palletize optimize path" and "FN388 Palletize select height(Z)"

Mnemonic	Number	Command
PALLET3_SELZ	FN388	Palletize select height (Z)
Parameter		
	Data	Description, setting range
1st parameter	Palletize No.	The target palletize number (1-255)
2nd parameter	REF step No.	Move command step that is to be compared (1-9999)

The move command recorded next to this application command is regarded as a target step for the height adjustment.

The Z coordinate of the target step and the Z coordinate of the REF step (that is made with the palletize shift based on the designated palletize number) will be compared and the higher value is used as the actual Z coordinate value for the target step.

The following points are different compare with "FN375 Palletize optimize path".

- Z coordinate calculation is based on only the machine coordinate system (robot coordinate system).
- Because this operation is executed outside the palletize section, the X coordinate and Y coordinate of the recorded position will not change.

**POINT**

Record the target step outside the palletize section.

If the step is recorded inside the palletize section, palletize shift amount is applied after applying the height adjustment.



**CAUTION**

When retrieving the Z position of the REF step, the shift value based on the palletize number that was designated in the function parameter is considered. Even if the REF step is not included in the palletize section of the designated palletize number, the calculation is executed considering that the shift motion is being applied to the step. Therefore, in a case like that, an unexpected motion may happen. Please be careful.



**CAUTION**

This application command FN388 calculates the Z coordinate using the palletize register. If the register value is modified via "FN378 PALLET3\_SETREG" etc., please pay special attention because there are some cases where the height of the step that is to be adjusted and the height of the palletize section are different each other.

## 5.3 Creating a palletize program

### 5.3.1 Outline

It is possible to create a basic palletizing/de-palletizing program only by setting parameters following the setting in the screens. The setting procedure is a sequential work.

Please make a program following the procedures shown as below.

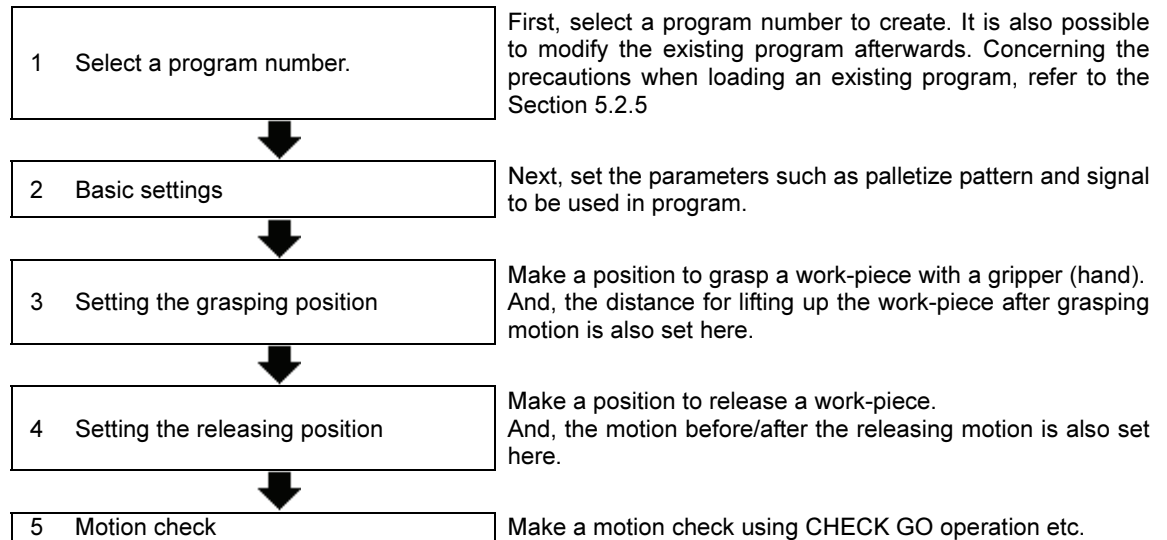


Fig. 5.3.1 Palletize program creating procedure

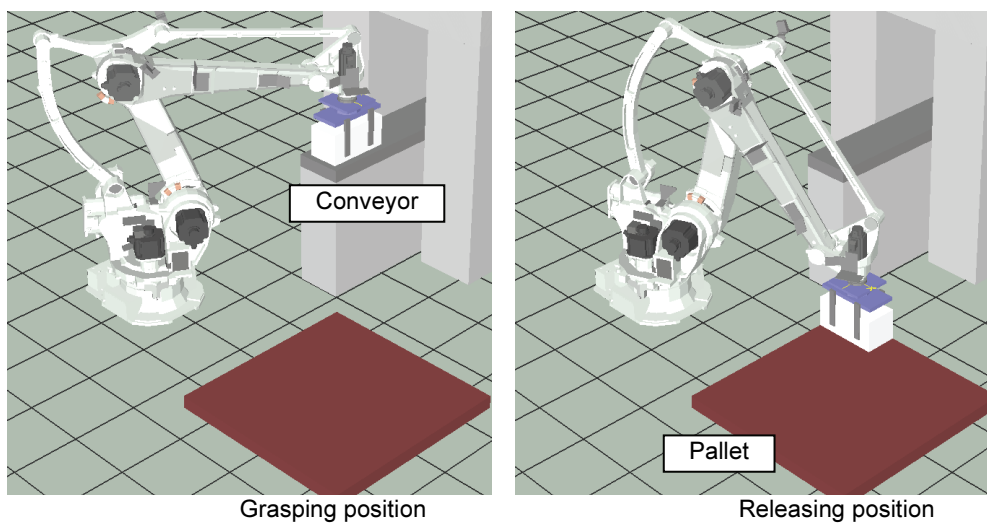


Fig 5.3.2 The grasping position and the releasing position for the palletize

Palletize program

The motion of the program to be created would be like the figure shown as below. The robot will pick the work-pieces up using (2) as a grip point and then start an approach motion from (4). And the work-piece is placed (released) at (6) on the pallet and the robot moves to (7). The palletize function is started at the position of (3) and finished at the position of (7).

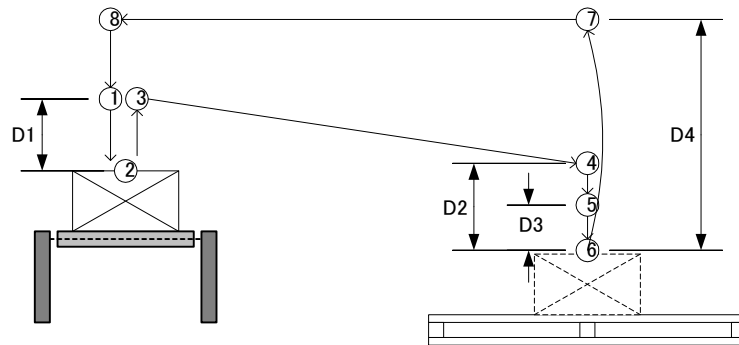


Fig. 5.3.3 The motion of the program to be generated (palletize)

1	REM[""]	PROGRAM_NAME	Program name
2	*TOP	PLT_P0_TOP	Loop tag
3	SETM[O2,0]	PLT_P0_OFF_HC	"Hand close" signal OFF
4	SETM[O1,1]	PLT_P0_ON_HO	"Hand open" signal ON
5	100% LIN A8 T2	PLT_P1_P	
6	WAITI[I3]	PLT_P1_WAIT_WK	Wait "Work wait" signal
7	WAITI[I1]	PLT_P1_WAIT_HO	Wait "Hand open" signal
8	30% LIN A1 T2	PLT_P2_P	
9	SETM[O1,0]	PLT_P2_OFF_HO	"Hand open" signal OFF
10	SETM[O2,1]	PLT_P2_ON_HC	"Hand close" signal ON
11	WAITI[I2]	PLT_P2_WAIT_HC	Wait "Hand close" signal
12	100% LIN A8 T1	PLT_P3_D1=100	
13	PALLET3[1,0,O3,O4]	PLT_START	Palletize
14	PALLET3_APP [1,1]	PLT_APR	Approach
15	100% LIN A8 T1	PLT_P4_D2=200	
16	100% LIN A8 T1	PLT_P5_D3=100	
17	30% LIN A1 T1	PLT_P6_P	
18	SETM[O2,0]	PLT_P6_OFF_HC	"Hand close" signal OFF
19	SETM[O1,1]	PLT_P6_ON_HO	"Hand open" signal ON
20	100% LIN A8 T2	PLT_P7_D4=2000	
21	PALLET3_END [1,O5]	PLT_END	Palletize end
22	100% LIN A8 T2	PLT_P8_P	
23	GOTO *TOP	PLT_P8_JP	To the loop top
24	END	PROGRAM_END	Program end

**POINT**

Tool number recorded in move step is as followed.

T1 (tool 1) is while grasping work-piece with hand.

T2 (tool 2) is not while grasping work-piece with hand.



De-palletize program

The motion of the program to be created would be like the figure shown as below. The robot will pick the work-pieces up using (2) as a grip point and raise up to (3). Then robot releases the work-piece at the position of (6) on the pallet and takes shelter to the position of (5). No approach motion executed. The palletize function is started before going to the position of (1) and finished at the position of (3).

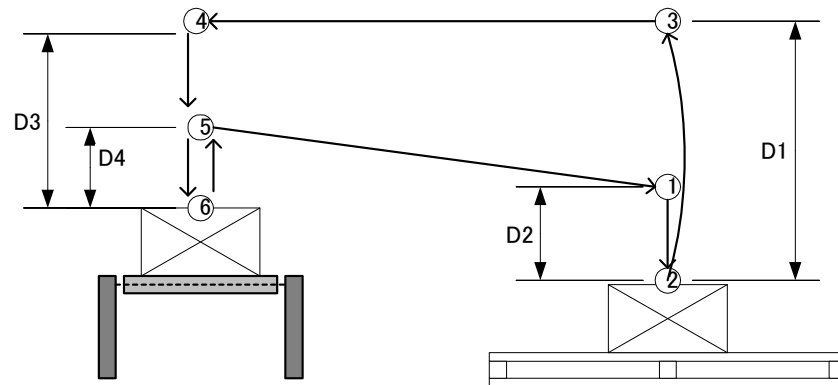


Fig 5.3.4 The motion of the program to be generated (de-palletize)

1	REM[""]	PROGRAM_NAME	Program name
2	*TOP	PLT_P0_TOP	Loop tag
3	PALLET3[5,1,O3,O4]	DPLT_START	
4	100% LIN A8 T2	DPLT_P1_D1=200	
5	SETM[O1,0]	DPLT_P1_OFF_HO	"Hand open" signal OFF
6	SETM[O2,0]	DPLT_P1_OFF_HC	"Hand close" signal OFF
7	SETM[O1,1]	DPLT_P1_ON_HO	"Hand open" signal ON
8	10% LIN A1 T2	DPLT_P2_P	
9	SETM[O1,0]	DPLT_P2_OFF_HO	"Hand open" signal OFF
10	SETM[O2,1]	DPLT_P2_ON_HC	"Hand close" signal ON
11	WAITI[I2]	DPLT_P2_WAIT_HC	Wait "Hand close" signal
12	100% LIN A8 T1	DPLT_P3_D2=500	
13	PALLET3_END[5,O5]	DPLT_END	Palletize end
14	WAITI[I3]	DPLT_P3_WAIT_WK	Wait "waiting to put a work" signal
15	100% LIN A8 T1	DPLT_P4_D3=500	
16	100% LIN A8 T1	DPLT_P5_D4=200	
17	SETM[O2,0]	DPLT_P5_OFF_HC	"Hand close" signal OFF
18	10% LIN A1 T1	DPLT_P6_P	
19	SETM[O1,1]	DPLT_P6_SET_HO	"Hand open" signal ON
20	WAITI[I1]	DPLT_P6_WAIT_HO	Wait "Hand open" signal
21	100% LIN A8 T2	DPLT_P7_P	
22	GOTO[*TOP]	DPLT_P7_JP	
23	END	PROGRAM_END	

**POINT**

Tool number recorded in move step is as followed.  
T1 (tool 1) is while grasping work-piece with hand.  
T2 (tool 2) is not while grasping work-piece with hand.

A palletizing program and a de-palletizing program can be generated in the same procedure. The procedure for palletizing program generation is described hereinafter.

### 5.3.2 Basic setting

Please make a setting for the palletize pattern number, several signals, etc. that will be used in the palletizing program.



#### 1 Select [3 Program creation] from "Palletize Constant".

>>A list of programs like shown below is displayed.

Name	No.	Steps	Comment
MC70-01	001	5	PALLET01
MC70-01	002	4	PALLET
MC70-01	100	1	

UNIT1

Ascending

Refer

PALLET01

Input program number or select program from list. And press Enter key to next step.



#### 2 Input a program number in which the program is generated and press [Enter] key.

>>A basic setting screen like shown below is displayed.

Set the cursor to an existing program and press [Enter] to load the program.

Concerning the precautions for loading an existing program, refer to the Section 5.3.6 Modifying the created program.

Program creation 1/3

Program No. 4 Name

Palletize pattern No. 1 Palletize01

Move kind ☒ Palletize ☐ De-palletize

Approach route ☒ Appr.->Down ☐ Down->Appr.

Program loop ☒ Enabled ☐ Disabled

Layer count signal(O) 0

Work count signal(O) 0

Palletize end signal(O) 0

Hand open signal(O) 0

Hand open wait signal(I) 0

Hand close signal(O) 0

Hand close wait signal(I) 0

Work wait signal(I) 0

List

Next

Input pattern number. Press F8 key to show registered pattern list. [1-100]

When setting the "Move kind" to "De-palletize", or when loading an existing de-palletizing program, the screen will be like the figure shown below. (In this case, "Approach route" cannot be set.)

Program creation 1/3

Program No. 4 | Name

Palletize pattern No. 1 | Palletize01

Move kind ☐ Palletize ☒ De-palletize

Approach route ☒ Appr.->Down ☐ Down->Appr.

Program loop ☒ Enabled ☐ Disabled

Layer count signal(O) 0

Work count signal(O) 0

Palletize end signal(O) 0

Hand open signal(O) 0

Hand open wait signal(I) 0

Hand close signal(O) 0

Hand close wait signal(I) 0

Waiting to put a work(I) 0

Next

? Select program kind to be made.

**3 Set the respective parameters and then press f10<Next> key.**

For details of each parameter, refer to the following Table.

And, if an existing program has been loaded, the setting values of the program are displayed in the screen.



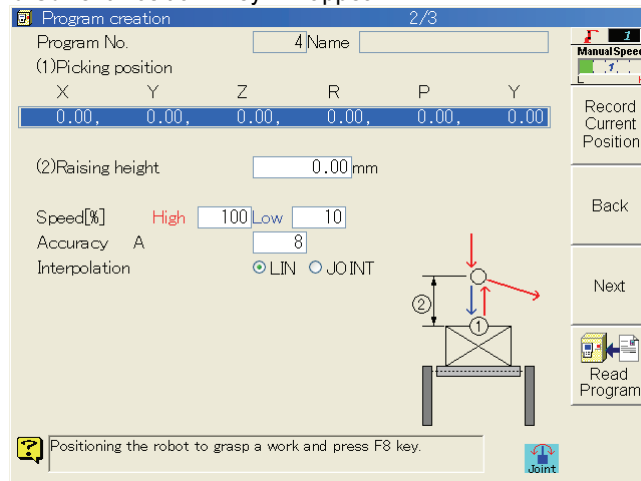
Table 5.3.1 Setting items in [Basic setting] screen (Palletize / De-Palletize)

Item	Initial setting	Range	Description
Program No.	---	----	The program number selected / inputted in the list screen is displayed here. This number cannot be modified in this screen.
Name	None		Name of the program.
Palletize pattern No. (Name)	1	1~255	A palletize pattern number which is used in the program to be generated is inputted here. When a cursor is here, it becomes possible to select a palletize pattern number from the palletize pattern list by pressing f8<List> key.
Move kind	Palletize	Palletize/ de-palletize	Palletize or de-palletize to be used in the program can be selected here.
Approach route (Only for palletize)	Appr.->Down	Appr.->Down / Down->Appr.	This is an approaching route setting.
Program loop	Enabled	Enabled / Disabled	Select whether or not jumping to the top of the program from the end.
Layer count signal (O)	0	0~2048	The signal number for Layer count signal used by the palletize start function FN249.
Work count signal (O)	0	0~2048	The signal number for Work-piece count signal used by the palletize start function FN249.
Palletize end signal (O)	0	0~2048	The signal number for palletize completion signal used by the palletize end function FN250.
Hand open signal (O)	0	0~2048	An output signal to open the hand. When setting "0" here, a step that uses this signal will not be recorded in the program.
Hand open wait signal (I)	0	0~2048	An input signal to wait until the hand opens. When setting "0" here, a step that uses this signal will not be recorded in the program.
Hand close signal (O)	0	0~2048	An output signal to close the hand. When setting "0" here, a step that uses this signal will not be recorded in the program.
Hand close wait signal (I)	0	0~2048	An input signal to wait until the hand closes. When setting "0" here, a step that uses this signal will not be recorded in the program.
Work wait signal (I) (only for palletize)	0	0~2048	An input signal to wait for the work-piece. When setting "0" here, a step that uses this signal will not be recorded in the program.

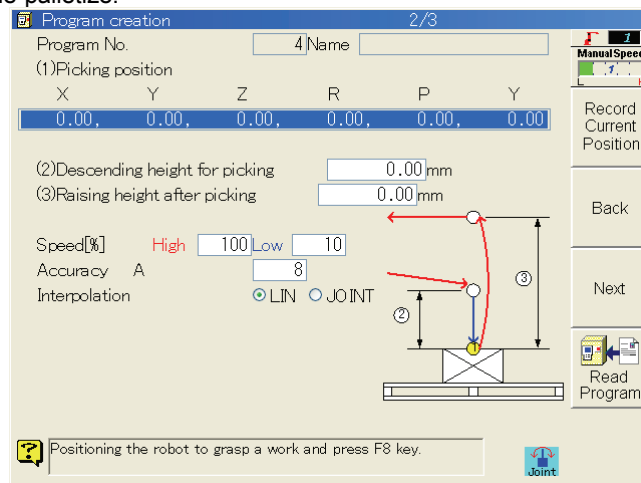
Item	Initial setting	Range	Description
Waiting to put a work (I) (only for de-palletize)	0	0~2048	An input signal to wait for a permission to put the Work-piece. When setting "0" here, a step that uses this signal will not be recorded in the program.

### 5.3.3 Picking position setting

- 1 Set the cursor to "(1)Picking position".  
>> f8<Record Current Position> key will appear.



In case of de-palletize:



- 2 Move the robot to a position of picking a work-piece. (The 1st one on the 1st layer)  
In case of de-palletizing program, put the robot to the position of the No.1 work-piece of the lowest Layer.  
At this time,  
- The manual operation speed can be changed with f7<Manual Speed> key.  
- The manual operation coordinate system can be changed with [INTERP/COORD.] key.

Record  
Current  
Position**3 Press f8<Record Current Position>**

&gt;&gt;The current position and the angle are captured and displayed.

Program creation 2/3

Program No. 4 Name

(1)Picking position

X	Y	Z	R	P	Y
1315.00	0.00	1650.00	0.00	-90.00	-180.00

Record Current Position

Next

**4 Input the respective parameters and then press f10<Next> key.**

For details of each parameter, refer to the following Table.

Table 5.3.2 Setting items in [Picking position setting] screen (Palletize)

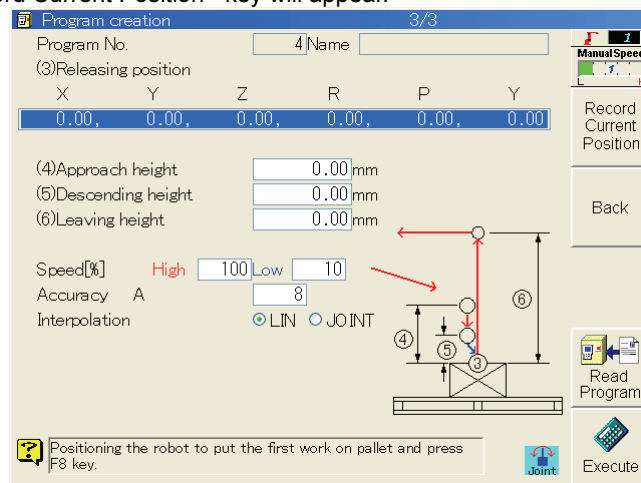
Item	Initial setting	Range	Description
Program No.	---	----	The number of the program that is being edited. This number cannot be modified in this screen.
Name	----	----	The name of the program that is being edited. This name cannot be modified in this screen.
(1) Picking position	---	----	The position and the angle of a picking point are displayed here. It is not possible to edit the values directly in this screen. If f8<Record Current Position> is pressed, the current position and the angle are captured and displayed.
(2) Raising height	0.0	0.0 - 9999.9	The raising height after grasping the work-piece.
Speed[%] High	100	1 - 100	Motion speed after grasping the work-piece. (red arrow)
Low	10	1 - 100	Motion speed to grasp the work-piece. (blue arrow)
Accuracy	8	1 - 8	Motion accuracy setting that is used after grasping the work-piece.
Interpolation	LIN	LIN/JOINT	Selecting the motion from LIN(liner interpolation) or JOINT to move from the upper position of grasping point to the upper position of releasing point.

Table 5.3.3 Setting items in [Picking position setting] screen (De-palletize)

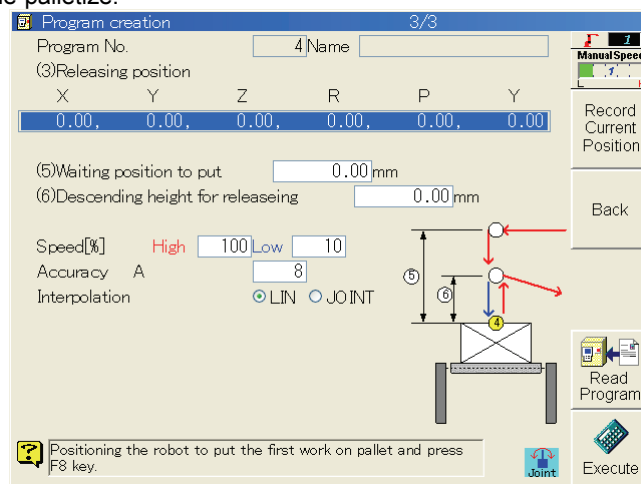
Item	Initial setting	Range	Description
Program No.	---	----	The number of the program that is being edited. This number cannot be modified in this screen.
Name	----	----	The name of the program that is being edited. This name cannot be modified in this screen.
(1) Picking position	---	----	The position and the angle of a picking point are displayed here. It is not possible to edit the values directly in this screen. If f8<Record Current Position> is pressed, the current position and the angle are captured and displayed.
(2) Descending height for picking	0.0	0.0 - 9999.9	The height where the deceleration starts before grasping the work-piece.
(3) Raising height after picking	0.0	0.0 - 9999.9	The raising height after grasping the work-piece.
Speed[%] High	100	1 - 100	Motion speed that is used before/after grasping the work-piece. (red arrow)
Low	10	1 - 100	Motion speed that is used right before grasping the work-piece. (blue arrow)
Accuracy	8	1 - 8	Accuracy setting that is used after grasping the work-piece.
Interpolation	LIN	LIN/JOINT	Selecting the motion from LIN(liner interpolation) or JOINT to move from the upper position of grasping point to the upper position of releasing point.

### 5.3.4 Releasing position setting

- 1 Set the cursor to "(1) Releasing position".  
>> f8<Record Current Position> key will appear.



In case of de-palletize:



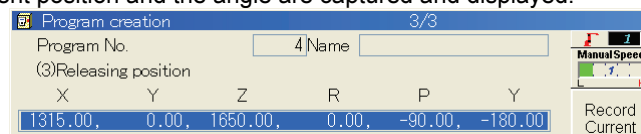
- 2 Move the robot to a position of placing a work-piece. (The 1st one on the 1st layer)

In case of de-palletizing program, put the robot to the position of the No.1 work-piece of the lowest Layer.

At this time,

- The manual operation speed can be changed with f7<Manual Speed> key.
- The manual operation coordinate system can be changed with [INTERP/COORD.] key.

- 3 Press <f8 Record Current Position>  
>>The current position and the angle are captured and displayed.



- 4 Set the respective parameters and then press f12<Execute> key.

>>A program will be generated automatically.

If error messages are displayed, follow the displayed instructions.

For details of each parameter, refer to the following Table.

Record  
Current  
Position

Execute

Table 5.3.4 Setting items in [Releasing position setting] screen (Palletize)

Item	Initial setting	Range	Description
Program No.	---	----	The number of the program that is being edited. This number cannot be modified in this screen.
Name	----	----	The name of the program that is being edited. This name cannot be modified in this screen.
(3) Releasing position	---	----	The position and the angle of a releasing point for the 1st work-piece are displayed here. It is not possible to edit the values directly in this screen. If f8<Record Current Position> is pressed, the current position and the angle are captured and displayed.
(4) Approach height	0.0	0.0~9999.9	The height where approaching motion is started.
(5) Descending height	0.0	0.0 - 9999.9	The height where loading motion is started after approaching.
(6) Leaving height	0.0	0.0 - 9999.9	The height where taking shelter after releasing work-piece.
Speed[%] High	100	1 - 100	Motion speed that is used after approach and putting the work-piece. (red arrow)
Low	10	1 - 100	Motion speed that is used when putting the work-piece. (blue arrow)
Accuracy	8	1 - 8	Accuracy that is used after approach and putting the work-piece.
Interpolation	LIN	LIN/JOINT	Selecting the motion from LIN(liner interpolation) or JOINT to move from the upper position of releasing point to the upper position of grasping point.

Table 5.3.5 Setting items in [Releasing position setting] screen (De-palletize)

Item	Initial setting	Range	Description
Program No.	---	----	The number of the program that is being edited. This number cannot be modified in this screen.
Name	----	----	The name of the program that is being edited. This name cannot be modified in this screen.
(3) Releasing position	---	----	The position and the angle of a releasing point for the 1st work-piece are displayed here. It is not possible to edit the values directly in this screen. If f8<Record Current Position> is pressed, the current position and the angle are captured and displayed.
(5) Waiting position to put	0.0	0.0 - 9999.9	Position that robot waits a signal for permission to put a work.
(6) Descending height for releasing	0.0	0.0 - 9999.9	Height that robot begins deceleration to the releasing position.
Speed[%] High	100	1 - 100	Motion speed to move the work-piece. (red arrow)
Low	10	1 - 100	Motion speed to place the work-piece.(blue arrow)
Accuracy	8	1 - 8	Accuracy to move the work-piece.
Interpolation	LIN	LIN/JOINT	Selecting the motion from LIN(liner interpolation) or JOINT to move from the upper position of releasing point to the upper position of grasping point.

### 5.3.5 Reading a program

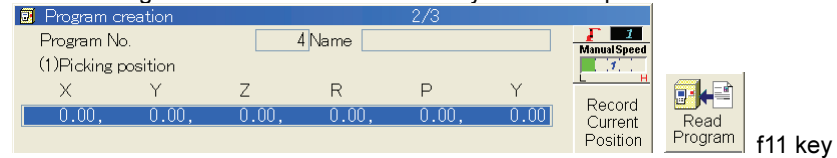
Picking position / Releasing position can be set using an already-made program.

In this case, the position data will be retrieved from the step data of the designated program.

Please be sure that the program used in this "Read Program" operation and the program that will be created from now will not be linked. For example, even if the step position in the original source program is changed after using this operation, the Picking position or Releasing position will not be changed.

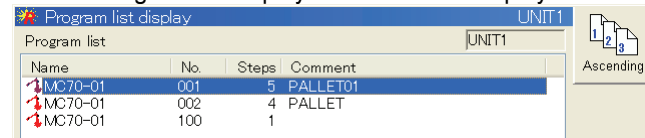
#### 1 Select "Picking position" or "Releasing position".

>>The background turns to blue and f11 key will show up.



#### 2 Press f11<Read Program>

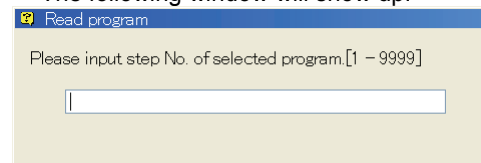
>>The "Program list display" screen will be displayed.



The details of the program can be checked using <Refer> key.

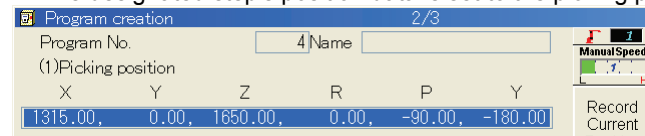
#### 3 Select the program and then press [Enter].

>>The following window will show up.



#### 4 Input the step number and then press [Enter].

>>The designated step's position data is set to the picking position.



If the step data is not correct, an error will be displayed and the position data will not be read.

- There is no step data
- The step is not move command
- The program is for a different mechanism



### 5.3.6 Modifying the created program

It is possible to modify the contents of the created program.

But if the program was modified using screen editor or normal teaching operations, there are some cases where the program cannot be loaded using this menu.

In the steps of a program that was created using this menu, comment data to show the meaning of the step is recorded. (Refer to Fig. 5.3.3, Fig 5.3.4)

When loading the program, the comment data and the contents of the step are compared and their consistency will be checked.

Table 5.3.6 Consistency check for the step data

Check item	Process for loading	Process for saving (after loading)
There is not step for signal output.	The program is loaded regarding the signal setting is "0".	
There are some steps that have no relationship with this "Program creation" menu.	Steps manually inserted are ignored when loading the program.	Those steps will remain after saving the program.
There is an inconsistency between the step comment and the contents of the move command.	A confirmation message for continuing the loading process will be displayed. If the loading process is continued, the setting values of those step comments will be displayed.	The concerned steps will be overwritten with move commands that are newly generated based on the setting value.
A value for certain parameter originally shared in several steps has been modified and is different each other in those steps.	A confirmation message for continuing the loading process will be displayed. If the loading process is continued, a parameter of a step whose step number is the smallest among the concerned steps is used as a valid setting value.	The setting values for the parameter of the 2nd step and the steps following the 2nd step will be overwritten with the setting value.
There are plural step comments that are the same each other.	A confirmation message for continuing the loading process will be displayed. If the loading process is continued, a step of which the step number is the smallest is recognized as a valid step.	The following steps will be deleted.

But in cases listed as below, the loading process will be aborted.

- There is an inconsistency between the step comment and the contents of the step.

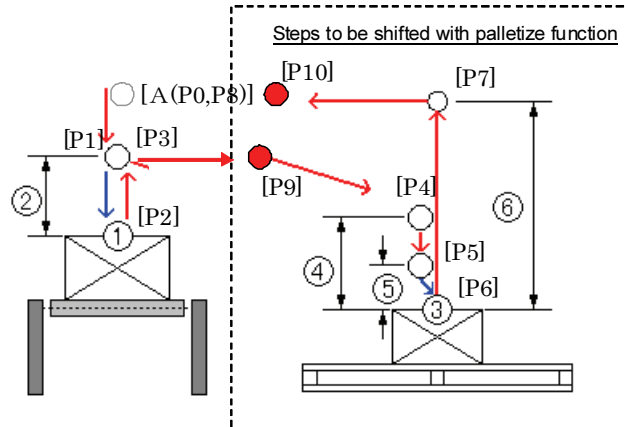
- The following functions do not exist in the program.

Palletize	PALLTIZE START (FN249)
	PALLETIZE END (FN250)
	APPROACH SELECTION (FN374)
De-palletize	PALLTIZE START (FN249)
	PALLETIZE END (FN250)

## 5.4 Another creating program

### 5.4.1 Palletize optimize path

An example of "FN375 Palletize optimize path" is shown as below.



1	REM	Program name
2	*TOP	
3	RESET [O1]	
4	SET[O2]	
5	100% LIN A8 T2	Move to P1
6	WAITI[I3]	
7	WAITI[I2]	
8	30% LIN A1P T2	Move to P2
9	RESET[O2]	
10	SET[O1]	
11	WAITI[I1]	
12	100% LIN A8 T1	Move to P3
13	PALLET3[1,0,O10,O20]	PALLETIZE
14	PALLET3_APR[1,1]	APPROACH ON
15	PALLET3_OPT[1,17]	Optimize path (Reference step : 17)
16	100% LIN A8 T1	Move to P9 (NOTE1)
17	100% LIN A8 T1	Move to P4
18	100% LIN A8 T1	Move to P5
19	30% LIN A1P T1	Move to P6
20	RESET[O1]	
21	SET[O2]	
22	100% LIN A8 T2	Move to P7
23	PALLET3_OPT[1,26]	Optimize path (Reference step : 26)
24	100% LIN A8 T1	Move to P10 (NOTE2)
25	PALLET3_END[1,O30]	PALLETIZE FINISH
26	100% LIN A8 T2	Move to P8
27	GOTO *TOP	To the loop top
28	END	

(NOTE1)

The height (=Z coordinates of the pallet coordinate system) of P9 is optimized referring to the height of P3 and P4. (The higher Z is used)

(NOTE2)

The height (=Z coordinates of the pallet coordinate system) of P10 is optimized referring to the height of P7 and P8. (The higher Z is used)

### 5.4.2 Palletize select grasp position

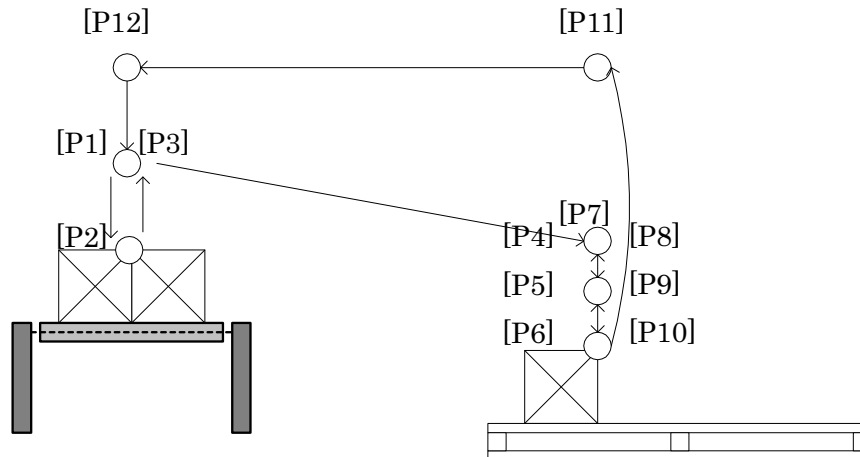
An example of "FN376 Palletize select grasp position" is shown as below. This is an example in which 2 work-pieces are picked up and are placed onto the pallet one by one.

Please make (record) a path for placing a work-piece twice using points that are the same. ([P4, 5, 6] and [P8, 9, 10]) The teaching should be made based on the 1st work-piece.

Just after starting the 1st palletizing, set the grasp position 1 using PALLET3\_SELGR command.

After placing the 1st work-piece, execute PALLET3\_END to increment the work-piece counter.

And then before placing the 2nd work-piece, start the palletizing again using PALLET3. And set the grasp position 2 using PALLET3\_SELGR command.



```

1  REM[]
2  RESET [O1]
3  RESET [O3]
4  SET [O2]
5  SET [O4]
6  *TOP
7  100% LIN A8 T2
8  WAITI[I15]
9  WAITI[I12]
10 WAITI[I14]
11  30% LIN A1P T2
12 RESET [O2]
13 RESET [O4]
14 SET [O1]
15 SET [O3]
16 WAITI[I1]
17 WAITI[I13]
18 100% LIN A8 T1
19 PALLET3[1,0,O10,O20]
20 PALLET3_SELGR[1]
21 PALLET3_APP[1,1]
22 100% LIN A8 T1
23 100% LIN A8 T1
24  30% LIN A1P T1
25 RESET [O1]
27 SET [O2]
28 100% LIN A8 T2
29 PALLET3_END[1,O30]
30 PALLET3[1,0,O10,O20]
31 PALLET3_SELGR[2]
32 PALLET3_APP[1,1]
33 100% LIN A8 T1
34 100% LIN A8 T1

```

Program name

"Hand 1 close" signal OFF

"Hand 2 close" signal OFF

"Hand 1 open" signal ON

"Hand 2 open" signal ON

Move to P1

Wait "waiting for a work-piece" signal

Wait "Hand 1 open" signal

Wait "Hand 2 open" signal

Move to P2

"Hand 1 open" signal OFF

"Hand 2 open" signal OFF

"Hand 1 close" signal ON

"Hand 2 close" signal ON

Wait "Hand 1 close" signal

Wait "Hand 2 close" signal

Move to P3

Palletize start

**Set the grasp position "1"**

Approach ON

Move to P4

Move to P5

Move to P6

"Hand 1 close" signal OFF

"Hand 1 open" signal ON

Move to P7

Palletize end

Palletize start

**Set the grasp position "2"**

Approach ON

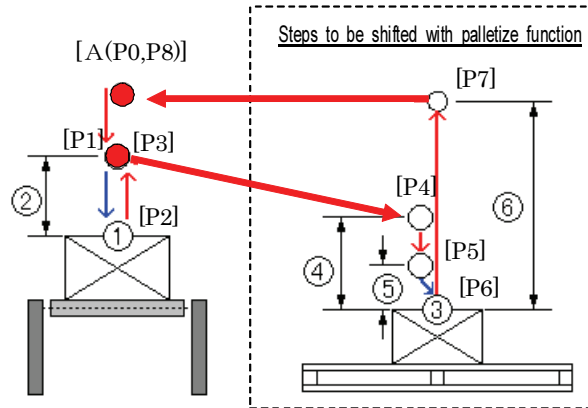
Move to P8

Move to P9

35	30% LIN A1P T1	Move to P10
36	RESET[O3]	"Hand 2 close" signal OFF
37	SET[O4]	"Hand 2 open" signal ON
38	100% LIN A8 T2	Move to P11
39	PALLET3_END[1,O30]	Palletize end
40	100% LIN A8 T2	Move to P12
41	GOTO *TOP	To the *TOP
42	END	

### 5.4.3 Palletize select height

An example of "Palletize select height" is shown as below.



1	REM	Program name
2	*TOP	
3	RESET [O1]	
4	SET[O2]	
5	100% LIN A8 T2	Move to P1
6	WAITI[I3]	
7	WAITI[I2]	
8	30% LIN A1P T2	Move to P2
9	RESET[O2]	
10	SET[O1]	
11	WAITI[I1]	
12	<b>PALLET3_SELZ[1,16]</b>	<b>Palletize select height (refer to step 16)</b>
13	<b>100% LIN A8 T1</b>	<b>Move to P3 (compare ①)</b>
14	PALLET3[1,0,O10,O20]	Palletize start
15	PALLET3_APR[1,1]	Approach ON
16	<b>100% LIN A8 T1</b>	<b>Move to P4 (compare ②)</b>
17	100% LIN A8 T1	Move to P5
18	30% LIN A1P T1	Move to P6
19	RESET[O1]	
20	SET[O2]	
21	<b>100% LIN A8 T2</b>	<b>Move to P7 (Compare ①)</b>
22	PALLET3_END[1,O30]	Palletize end
23	<b>PALLET3_SELZ[1,21]</b>	<b>Palletize select height (refer to step 21)</b>
24	<b>100% LIN A8 T2</b>	<b>Move to P8 (Compare ②)</b>
25	GOTO *TOP	To the loop top
26	END	

(Note 1)

The height of P3 (Z value of robot coordinate system) is higher value by comparing two values; those are the height of P3 before "palletize select height function" and P4.

(Note 2)

The height of P8 (Z value of robot coordinate system) is higher value by comparing two values; those are the height of P8 before "palletize select height function" and P7.

**POINT**

"Palletize select height function" must be recorded in the step that is outside of the palletizing area.

**POINT**

Referred step recorded in "Palletize select height function" must be the step that is included in the palletizing area designated by the palletizing number.

NOTE

## Chapter 6      Convenient functions

---

This chapter describes special functions or convenient functions that can be used for the motion check.

6.1	Shortcut.....	6-1
6.1.1	R377 Palletize counter reset.....	6-1
6.1.2	R378 Change palletize counter.....	6-1
6.1.3	R379 Execution palletize forcibly .....	6-1
6.2	Function keys (Software keys) .....	6-2
6.2.1	Select Pallet.....	6-2
6.2.2	Change Palletize Counter.....	6-2
6.2.3	Palletize direct modification .....	6-3
6.3	Special functions .....	6-4
6.3.1	FN377 Get palletize register .....	6-4
6.3.2	FN378 Set palletize register.....	6-5





## 6.1 Shortcut

### 6.1.1 R377 Palletize counter reset

The palletize counters for the palletize task which is designated via the parameter will be reset. (Both of the Layer counter and the Work-piece counter will be set to "0") It is also possible to reset the counters of the all palletize tasks.

Item	Contents	Setting range
Palletize No.	Input the number of the palletize task to reset. If "0" is set, the all palletize tasks will be reset.	From 1 - 255 (0:All palletize tasks)

### 6.1.2 R378 Change palletize counter

The value of a palletize counter can be set to any desired value.

Item	Description	Setting range
Palletize number	Set the number of the palletize task of which the counter is to be changed.	From 1 to 255
Layer counter	Set a new Layer number.	From 1 to 50
Work-piece counter	Set a new Work-piece number.	From 1 to 99

### 6.1.3 R379 Execution palletize forcibly

This can change the palletizing status to "ongoing" while robot is stopping. This is the same status after FN249 Palletize start is executed.

Also palletizing counter can be changed as wanted.

Item	Description	Setting range
Palletize number	Set the number of the palletize task of which the counter is to be changed.	From 1 to 255
Layer counter	Set a new Layer number.	From 1 to 50
Work-piece counter	Set a new Work-piece number.	From 1 to 99



When this R code is inputted and program playback is restarted, beware that immediately robot starts shift motion from the first move step.

## 6.2 Function keys (Software keys)

### 6.2.1 Select Pallet

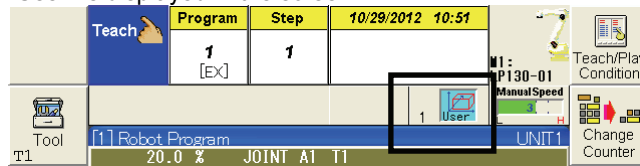
When operating the robot in manual mode, it is possible to change the operation coordinate system to the designated pallet coordinate system.

- 1 Press <Select Pallet> key.  
>>The following pallet list will be displayed.



Pallet List			
No.	Name	Kinds	Program No
1	PALLET01	UNIT1	1

- 2 Set the cursor to the desired pallet and press [Enter] key.  
>>The current coordinate system will be switched to the designated pallet coordinate system and "User" is displayed in the screen.



### 6.2.2 Change Palletize Counter

It is possible to set any desired value to the palletize counter.

- 1 Press <Change Counter> key.  
>>A following message will be displayed.



Change palletize counter

Please input palletize number[1 - 255]

- 2 Input a palletize pattern number and then press [Enter]  
>>A following message will be displayed.

Change palletize counter

Please input new layer number[1 - 5]

- 3 Input a new layer number and press [Enter].  
>>A following message will be displayed.

Change palletize counter

Please input new work number[1 - 4]

- 4 Input a new work-piece number and press [Enter].  
>>The inputted values are set to the palletize counter.  
The values can be confirmed using Palletize monitor.  
Concerning the palletize monitor, see the Chapter 7.

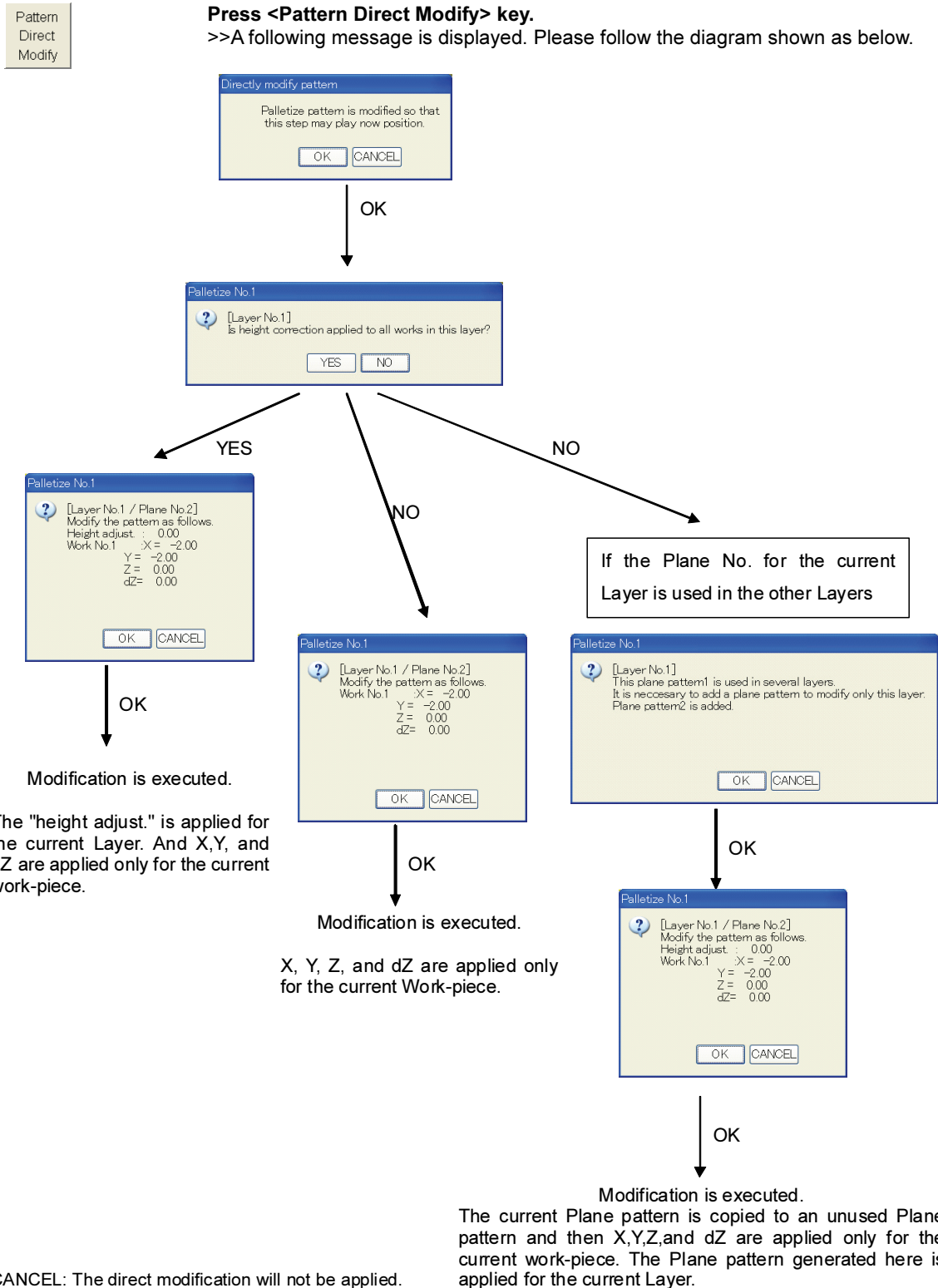
### 6.2.3 Palletize direct modification

It is possible to modify the palletize pattern directly by adjusting the robot position to the work-piece in manual operation.

- 1 Stop the robot while the palletizing is being executed and manually move the robot to a position where the work-piece is to be placed.

Press <Pattern Direct Modify> key.

>>A following message is displayed. Please follow the diagram shown as below.



## 6.3 Special functions

### 6.3.1 FN377 Get palletize register

"Palletize registers" are internal variables to manage the status of the palletize function. Normally it is not necessary to handle those values by yourself because the system software handles them. But by reading/ modifying those values, it becomes possible to build a complex motion.

**[Example]**

- Change the robot's motion path by referring to the current value of the palletize counter
- Skip the counter intentionally for a certain purpose.
- Modify the shift amount.

This application command is a command to copy the value of a palletize register to a desired variable of the controller. To write the modified value back to the register, please use " FN378 PALLET\_SETREG".

Mnemonic	Number	Command
PALLET3_GETREG	FN377	Get palletize register

Parameter	Data	Description, setting range
1st parameter	Variable No.	Target variable No. to store value Select from V!, V%, L! or L%
2nd parameter	Palletize No.	This specifies the palletizing number to be executed. (1 to 255)
3rd parameter	Register type (Start)	Set number of Palletize Registers(1 - 255) (1 to 16)
4th parameter	Register type (End)	Set number of Palletize Registers(1 - 255) (1 to 16) You can select and get consecutive register values from Start to End

Table 6.3.1 Register list

No.	Register name	Description	Type	Range	Permitted to be over-written
1	Palletize No.	Target palletize No.	Int.	1~255	
2	Pallet No.	Target pallet No.	Int.	1~100	
3	Running status	Stop or Running	Int.	0/1	
4	Type	Palletizing or De-palletizing	Int.	0/1	○
5	Layer counter	Layer No. in running	Int.	0~50	○
6	Work counter	Work No. in running	Int.	0~99	○
7	Total counter	Total work counter in running (Counting from the 1st work-piece of the 1st Layer)	Int.	0~4950	
8	Grasp position sel.	Work grasp position No. in use	Int.	1~4	○
9	Approach dir.	Approach direction in use	Int.	0~8	○
10	Layer count signal	LSB Signal No. of Layer count signal	Int.	0~1024	○
11	Work count signal	LSB Signal No. of work count signal	Int.	0~1024	○
12	Work complete signal	Work complete signal No.	Int.	0~1024	○
13	Shift value X	Current shift value of X axis based on the pallet coordinate	Real	—	○
14	Shift value Y	Current shift value of Y axis based on the pallet coordinate	Real	—	○
15	Shift value Z	Current shift value of Z axis based on the pallet coordinate	Real	—	○
16	Shift value Rz	Current shift value of Rz axis based on the pallet coordinate	Real	—	○

### 6.3.2 FN378 Set palletize register

"Palletize registers" are internal variables to manage the status of the palletize function. Normally it is not necessary to handle those values by yourself because the system software handles them. But by reading/ modifying those values, it becomes possible to build a complex motion.

**[Example]**

- Change the robot's motion path by referring to the current value of the palletize counter
- Skip the counter intentionally for a certain purpose.
- Modify the shift amount.

This application command is a command to copy a value of a desired variable of the controller to a specified palletize register. To copy a value in a register to the controller's variable, please use "FN377 PALLET3\_GETREG".

Some register is permitted to be over-written, but some is not. Please refer to the table 6.3-1 register list for detail.

If registers not permitted to be over-written, alarm is not generated but register is not changed.

Mnemonic	Number	Command
PALLET3_SETREG	FN378	Set palletize register

Parameter	Data	Description, setting range
1st parameter	Palletize No.	This specifies the palletizing number to be executed. (1 to 255)
2nd parameter	Register type (Start)	Set number of Palletize Registers(1 - 255) (1 to 16)
3rd parameter	Register type (End)	Set number of Palletize Registers(1 - 255) (1 to 16) You can select and write to consecutive registers from Start to End.
4th parameter	Variable No.	Target variable No. to store value Select from V!, V%, L! or L%



The value of the palletize registers affects the motion of the robot. Pay special attention not to change their values carelessly.



Only by changing of "layer counter" and "work counter", shift amount is not changed. When "FN249 Palletize start" is executed, new shift amount is calculated in accordance with the current counter.

NOTE

## Chapter 7 Motion checks and operation

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This chapter describes the useful functions that are available during the motion checks or automatic operations.

7.1	Monitoring the current statuses .....	7-1
7.1.1	How to display the palletize counter monitor.....	7-1
7.1.2	How to modify the palletize counter .....	7-2





## 7.1 Monitoring the current statuses

### 7.1.1 How to display the palletize counter monitor

In this palletize function, it is possible to execute several palletize pattern in parallel (Simultaneous palletizing / Multiple palletizing). Using "Palletize Monitor", it is possible to monitor which palletize pattern is handling which work-piece.

A variable that holds the number of the work-piece which is being handled is called as "Palletize counter (Work-piece)". And, a variable that holds the number of the Layer which is being handled is called as "Palletize counter (Work-piece)". When a new palletizing task is started, both of those 2 counter values are set to "1", and then they are incremented when executing "FN250 Palletize end". In short, at the start function (FN249), the value will show the number of the work-piece which will be loaded from now on and at the end function (FN250), the value will change to the value which shows the number of the next work-piece.

When the palletizing task is finished completely, both of the Layer counter and the Work-piece counter will become "1"

The value of those counters can be monitored in real-time by the following operations.

#### 1 Select Teach mode or Playback mode.

#### 2 Press <Palletize Monitor> key.

>>A monitor screen for palletize counter will be displayed.



[2] palletizing monitor					
No.	Pallet	Layer	Work	Name	
1	1	1 / 5	1 / 4	Palletize01	
2	1	0 / 3	0 / -	Palletize02	
3	1	0 / 4	0 / -	Palletize03	
4	1	0 / 2	0 / -	Palletize04	

Item	Content
No.	This is a number of the palletize which is currently being executed. The all palletize patterns which are registered are displayed.
Pallet	This number shows which pallet (coordinate system) the concerned palletize pattern is using.
Layer	The current Layer number and the total number of the layers are displayed here. When not being executed, the display will be like "0 / Total number"
Work (Work-piece)	The current work-piece number of the current layer and the total number of the work-pieces of the layer. When not being executed, the display will be like "0 / -"

### 7.1.2 How to modify the palletize counter

The contents of the palletize counter can be modified using an editor mode of palletize monitor.

- 1 Press <Palletize Monitor> key.**  
 >>A monitor screen for palletize counter will be displayed.



No.	Pallet	Layer	Work	Name
1	1	1 / 5	1 / 4	Palletize01
2	1	0 / 3	0 / -	Palletize02
3	1	0 / 4	0 / -	Palletize03
4	1	0 / 2	0 / -	Palletize04

- 2 Press [EDIT] key.**  
 >>The monitor screen will enter an editor mode.



No. Pallet	Layer	Work	Name
1 1	1 / 5	1	Palletize01
2 1	0 / 3	0	Palletize02
3 1	0 / 4	0	Palletize03
4 1	0 / 2	0	Palletize04

- 3 Select the Layer or Work-piece to be modified and then input the desired value.**  
To abort the palletize function, set "0" for the Layer or Work and press "Complete". To enter palletize execution status from the not-executed status, set a value except for "0" both to Layer and Work.

- 4** Press f12<Complete> key.  
>>The counter is changed.



1	1	1 / 5	4 / 4	Palletize01
2	1	0 / 3	0 / -	Palletize02
3	1	0 / 4	0 / -	Palletize03
4	1	0 / 2	0 / -	Palletize04

## Chapter 8      Troubleshooting

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In this chapter, troubleshooting related to the palletize function is described.

8.1 Trouble shooting .....	8-1
----------------------------	-----



## 8.1 Trouble shooting

No.	A2201 (Alarm)
Message	Palletize-end does not follow Palletize function.
Cause	This error is detected when "FN249 Palletize start" and "FN250 Palletize end" functions are not executed in a correct combination/order.
Countermeasure	Please check if these 2 functions are recorded in a correct order. If there is an incorrect step, correct the program. When this error is detected even if the recorded steps (Palletize start and end) look correct, because it is assumed that the execution status of the palletize start and palletize end are conflicting, execute "R0 Reset & step 0 return" to cancel the confliction.

No.	A2202 (Alarm)
Message	More than 32 Palletizing routines not allowed.
Cause	When palletizing of 32 or more is executed at the same time, this error is detected.
Countermeasure	Terminate the unnecessary palletize by using "R377 Palletize counter reset" or "R378 Change Palletize counter" shortcuts.

No.	A2203 (Alarm)
Message	Palletize data is abnormal.
Cause	[FN249 palletize start] function calculates the shift amount using palletize data. This error is detected when the calculation result was incorrect. The reason is assumed that the necessary data for the calculation is not set yet.
Countermeasure	Please refer to palletize data.

No.	A2204 (Alarm)
Message	Multiplex palletize over.
Cause	This error occurs when multiplex palletize over 8 is carried out.
Countermeasure	Modify the program so that the number of the multiplex palletize does not exceed 8. Or, finish an unnecessary palletize by using "R377 Palletize counter reset" or "R378 Change Palletize counter" shortcuts.


No.	A2173 (Alarm)
Message	Shift value limit exceeded.
Cause	Not only in case of palletize motion, when the robot tries to move with shift motion exceeding the "Shift limit" value, this error is detected.
Countermeasure	Check the "Shift limit" setting. Or, correct the palletize data so that the calculated shift amount does not make an impossible shift motion.

No.	A2861 (Alarm)
Message	The designated palletize No. is not registered.
Cause	The palletize pattern of designated number by function etc. is not defined.
Countermeasure	(1) Please use a registered palletize number. (2) Please register the palletize pattern of the number concerned.

No.	A2862
Message	Designated palletize number has never been executed yet.
Cause	Palletize status is registered in palletize register when executing it once, and maintained until it is reset. This operation cannot be done to a palletize number unregistered in the palletize register.
Countermeasure	(1) Please designate an already-executed palletize number. (2) Please execute the palletize of the designated number at least one time before doing this operation.

No.	A2863
Message	Designate a palletize number which is being executed.
Cause	This operation is available only for a palletize which is being executed.
Countermeasure	(1) Designate a palletize number which is being executed. (2) Please execute palletize of the designated number before doing this operation.



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