FANUC Robot series

R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/ R-30*i*B Mate Plus CONTROLLER

Machine Tool Easy Setup Function

OPERATOR'S MANUAL

B-83634EN/01

- **Original Instructions**

Before using the Robot, be sure to read the "FANUC Robot Safety Manual (B-80687EN)" and understand the content.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan.
Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government.
Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

SAFETY PRECAUTIONS

This chapter describes the precautions which must be followed to ensure the safe use of the robot.
Before using the robot, be sure to read this chapter thoroughly.

For detailed functions of the robot operation, read the relevant operator's manual to understand fully its specification.
For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral equipment installed in a work cell.
In addition, refer to the "FANUC Robot SAFETY HANDBOOK (**B-80687EN)**".

1 DEFINITION OF USER

The user can be defined as follows.

Operator:
- Turns ON/OFF power to the robot
- Starts the robot program from the operator's panel

Programmer:
- Operates the robot
- Teaches the robot inside the safety fence

Maintenance engineer:
- Operates the robot
- Teaches the robot inside the safety fence
- Performs maintenance (repair, adjustment, replacement)

- Operator is not allowed to work in the safety fence.
- Programmers and maintenance engineers are allowed to work in the safety fence. The work inside the safety fence includes lifting, setting, teaching, adjustment, maintenance, etc.
- To work inside the safety fence, the person must receive a professional training for the robot.

During the operation, programming, and maintenance of your robotic system, the programmer, operator, and maintenance engineer should take additional care of their safety by wearing the following safety items.

- Adequate clothes for the operation
- Safety shoes
- A helmet

2 DEFINITION OF SAFETY NOTATIONS

To ensure the safety of users and prevent damage to the machine, this manual indicates each precaution on safety with "**WARNING**" or "**CAUTION**" according to its severity. Supplementary information is indicated by "**NOTE**". Read the contents of each "**WARNING**", "**CAUTION**" and "**NOTE**" before using the robot.

Symbol	Definitions
⚠**WARNING**	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
⚠**CAUTION**	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

- Check this manual thoroughly, and keep it handy for the future reference.

3 SAFETY OF THE USER

User safety is the primary safety consideration. Because it is very dangerous to enter the operating space of the robot during automatic operation, adequate safety precautions must be observed.
The following lists the general safety precautions. Careful consideration must be made to ensure user safety.

(1) Have the robot system users attend the training courses held by FANUC.

FANUC provides various training courses. Contact our sales office for details.

(2) Even when the robot is stationary, it is possible that the robot is still in a ready to move state, and is waiting for a signal. In this state, the robot is regarded as still in motion. To ensure user safety, provide the system with an alarm to indicate visually or aurally that the robot is in motion.
(3) Install a safety fence with a gate so that no user can enter the work area without passing through the gate. Install an interlocking device, a safety plug, and so forth in the safety gate so that the robot is stopped as the safety gate is opened.

The controller is designed to receive this interlocking signal of the door switch. When the gate is opened and this signal received, the controller stops the robot (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type). For connection, see Fig. 3 (b).

(4) Provide the peripheral equipment with appropriate earth (Class A, Class B, Class C, and Class D).
(5) Try to install the peripheral equipment outside the robot operating space.
(6) Draw an outline on the floor, clearly indicating the range of the robot operating space, including the tools such as a hand.
(7) Install a mat switch or photoelectric switch on the floor with an interlock to a visual or aural alarm that stops the robot when a user enters the work area.
(8) If necessary, install a safety lock so that no one except the user in charge can turn on the power of the robot.

The circuit breaker installed in the controller is designed to disable anyone from turning it on when it is locked with a padlock.

(9) When adjusting each peripheral equipment independently, be sure to turn off the power of the robot.
(10) Operators should be ungloved while manipulating the operator panel or teach pendant. Operation with gloved fingers could cause an operation error.
(11) Programs, system variables, and other information can be saved on memory card or USB memories. Be sure to save the data periodically in case the data is lost in an accident. (refer to Controller OPERATOR'S MANUAL.)
(12) The robot should be transported and installed by accurately following the procedures recommended by FANUC. Wrong transportation or installation may cause the robot to fall, resulting in severe injury to workers.
(13) In the first operation of the robot after installation, the operation should be restricted to low speeds. Then, the speed should be gradually increased to check the operation of the robot.
(14) Before the robot is started, it should be checked that no one is inside the safety fence. At the same time, a check must be made to ensure that there is no risk of hazardous situations. If detected, such a situation should be eliminated before the operation.
(15) When the robot is used, the following precautions should be taken. Otherwise, the robot and peripheral equipment can be adversely affected, or workers can be severely injured.
- Avoid using the robot in a flammable environment.
- Avoid using the robot in an explosive environment.
- Avoid using the robot in an environment full of radiation.
- Avoid using the robot under water or at high humidity.
- Avoid using the robot to carry a person or animal.
- Avoid using the robot as a stepladder. (Never climb up on or hang from the robot.)
- Outdoor

(16) When connecting the peripheral equipment related to stop (safety fence etc.) and each signal (external emergency, fence etc.) of robot, be sure to confirm the stop movement and do not take the wrong connection.
(17) When preparing footstep, please consider security for installation and maintenance work in high place according to Fig. 3 (c). Please consider footstep and safety belt mounting position.

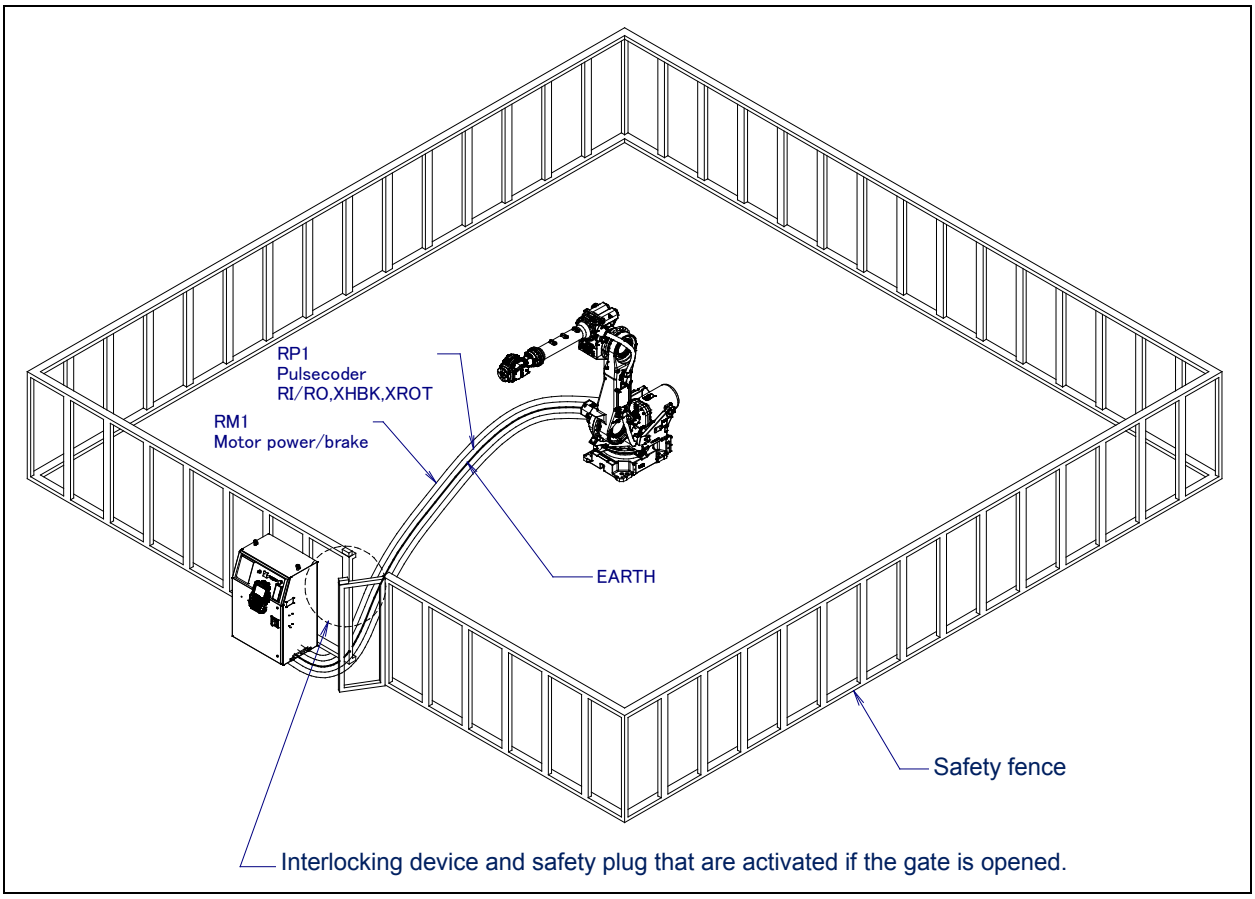

Fig. 3 (a) Safety fence and safety gate

⚠WARNING
When you close a fence, please confirm that there is not a person from all directions of the robot.

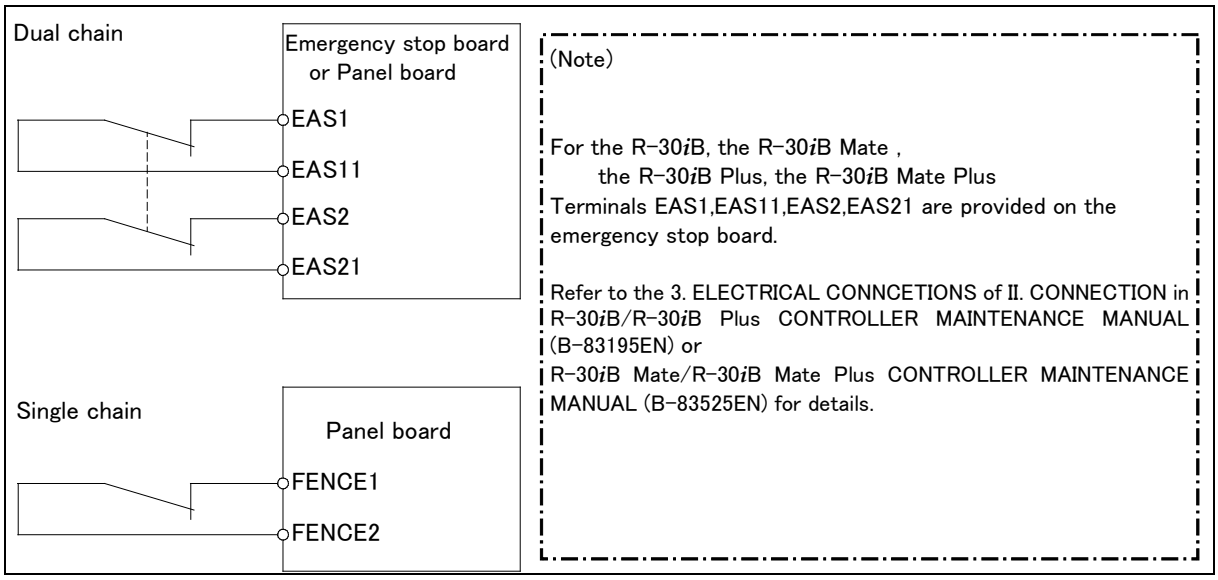

Fig. 3 (b) Connection diagram for the signal of safety fence

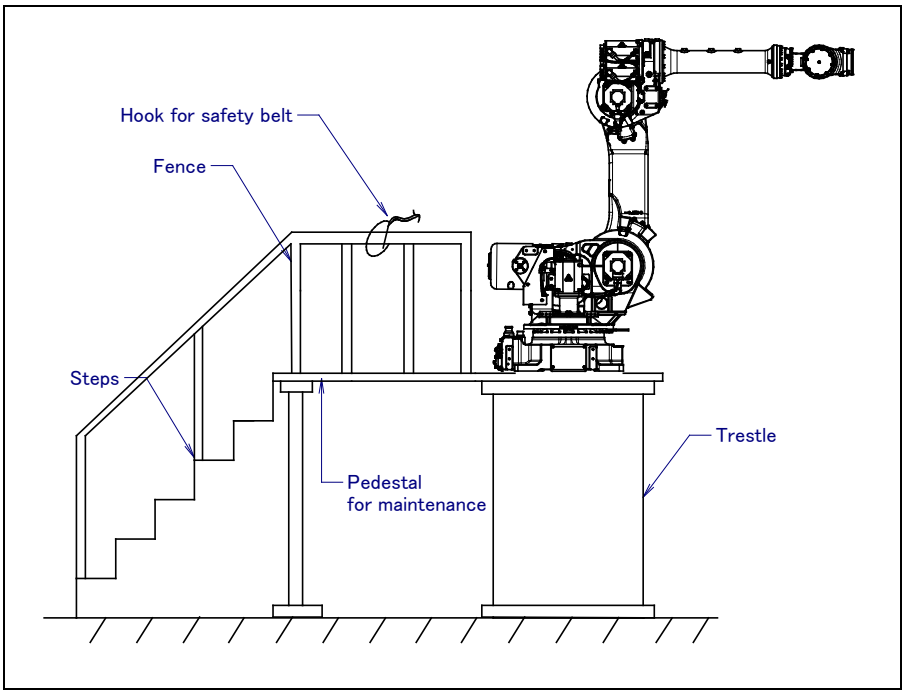

Fig. 3 (c) Pedestal for maintenance

3.1 SAFETY OF THE OPERATOR

An operator refers to a person who turns on and off the robot system and starts a robot program from, for example, the operator panel during daily operation.
Operators cannot work inside of the safety fence.

(1) If the robot does not need to be operated, turn off the robot controller power or press the EMERGENCY STOP button during working.
(2) Operate the robot system outside the operating space of the robot.
(3) Install a safety fence or safety door to avoid the accidental entry of a person other than an operator in charge or keep operator out from the hazardous place.
(4) Install one or more necessary quantity of EMERGENCY STOP button(s) within the operator's reach in appropriate location(s) based on the system layout.

The robot controller is designed to be connected to an external EMERGENCY STOP button. With this connection, the controller stops the robot operation (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type) when the external EMERGENCY STOP button is pressed. See the diagram below for connection.

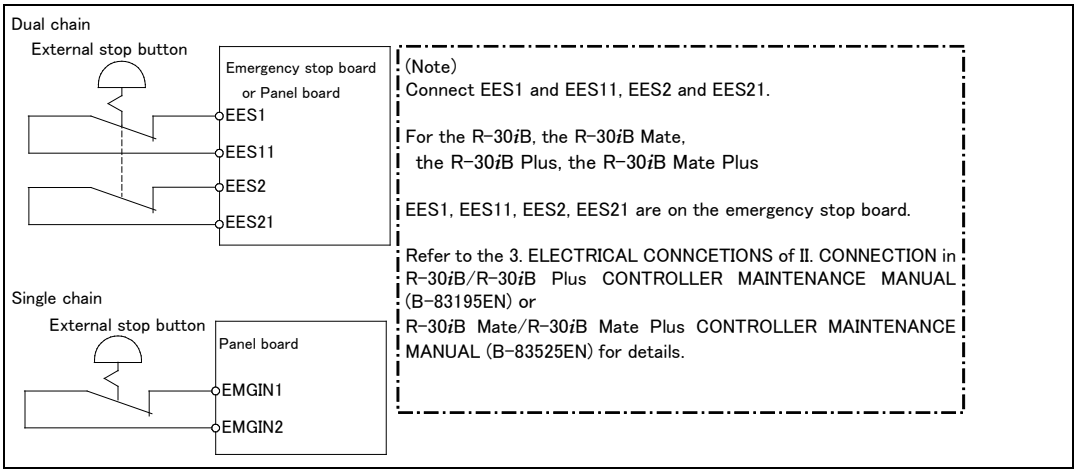

Fig. 3.1 Connection diagram for external emergency stop button

3.2 SAFETY OF THE PROGRAMMER

While teaching the robot, the operator may need to enter the robot operation area. The programmer must ensure the safety especially.

(1) Unless it is specifically necessary to enter the robot operating space, carry out all tasks outside the operating space.
(2) Before teaching the robot, check that the robot and its peripheral equipment are all in the normal operating condition.
(3) If it is inevitable to enter the robot operating space to teach the robot, check the locations, settings, and other conditions of the safety devices (such as the EMERGENCY STOP button, the DEADMAN switch on the teach pendant) before entering the area.
(4) The programmer must be extremely careful not to let anyone else enter the robot operating space.
(5) Programming should be done outside the area of the safety fence as far as possible. If programming needs to be done inside the safety fence, the programmer should take the following precautions:
   - Before entering the area of the safety fence, ensure that there is no risk of dangerous situations in the area.
   - Be prepared to press the emergency stop button whenever necessary.
   - Robot motions should be made at low speeds.
   - Before starting programming, check the whole robot system status to ensure that no remote instruction to the peripheral equipment or motion would be dangerous to the user.

Our operator panel is provided with an emergency stop button and a key switch (mode switch) for selecting the automatic operation (AUTO) and the teach modes (T1 and T2). Before entering the inside of the safety fence for the purpose of teaching, set the switch to a teach mode, remove the key from the mode switch to prevent other people from changing the operation mode carelessly, then open the safety gate. If the safety gate is opened with the automatic operation set, the robot stops (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type). After the switch is set to a teach mode, the safety gate is disabled. The programmer should understand that the safety gate is disabled and is responsible for keeping other people from entering the inside of the safety fence.

Our teach pendant is provided with a DEADMAN switch as well as an emergency stop button. These button and switch function as follows:

(1) Emergency stop button: Causes the stop of the robot (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type) when pressed.
(2) DEADMAN switch: Functions differently depending on the teach pendant enable/disable switch setting status.
   (a) Enable: Servo power is turned off when the operator releases the DEADMAN switch or when the operator presses the switch strongly.
   (b) Disable: The DEADMAN switch is disabled.
   (Note) The DEADMAN switch is provided to stop the robot when the operator releases the teach pendant or presses the pendant strongly in case of emergency. The R-30*i*B/R-30*i*B Mate/R-30*i*B Plus/R-30*i*B Mate Plus employs a 3-position DEADMAN switch, which allows the robot to operate when the 3-position DEADMAN switch is pressed to its intermediate point. When the operator releases the DEADMAN switch or presses the switch strongly, the robot stops immediately.

The operator's intention of starting teaching is determined by the controller through the dual operation of setting the teach pendant enable/disable switch to the enable position and pressing the DEADMAN switch. The operator should make sure that the robot could operate in such conditions and be responsible in carrying out tasks safely.

Based on the risk assessment by FANUC, number of operation of DEADMAN SW should not exceed about 10000 times per year.

The teach pendant, operator panel, and peripheral equipment interface send each robot start signal. However the validity of each signal changes as follows depending on the mode switch and the DEADMAN switch of the operator panel, the teach pendant enable switch and the remote condition on the software.

Mode	Teach pendant enable switch	Software remote condition	Teach pendant	Operator panel	Peripheral equipment
AUTO mode	On	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed
	Off	Local	Not allowed	Allowed to start	Not allowed
		Remote	Not allowed	Not allowed	Allowed to start
T1, T2 mode	On	Local	Allowed to start	Not allowed	Not allowed
		Remote	Allowed to start	Not allowed	Not allowed
	Off	Local	Not allowed	Not allowed	Not allowed
		Remote	Not allowed	Not allowed	Not allowed

T1,T2 mode: DEADMAN switch is effective.

(6) To start the system using the operator box or operator panel, make certain that nobody is the robot operating space area and that there are no abnormalities in the robot operating space.
(7) When a program is completed, be sure to carry out a test operation according to the following procedure.
   (a) Run the program for at least one operation cycle in the single step mode at low speed.
   (b) Run the program for at least one operation cycle in continuous operation at low speed.
   (c) Run the program for one operation cycle in continuous operation at the intermediate speed and check that no abnormalities occur due to a delay in timing.
   (d) Run the program for one operation cycle in continuous operation at the normal operating speed and check that the system operates automatically without trouble.
   (e) After checking the completeness of the program through the test operation above, execute it in the automatic operation.
(8) While operating the system in the automatic operation, the programmer should leave the safety fence.

3.3 SAFETY OF THE MAINTENANCE ENGINEER

For the safety of maintenance engineer personnel, pay utmost attention to the following.

(1) During operation, never enter the robot operating space.
(2) A hazardous situation may arise when the robot or the system, are kept with their power-on during maintenance operations. Therefore, for any maintenance operation, the robot and the system should be put into the power-off state. If necessary, a lock should be in place in order to prevent any other person from turning on the robot and/or the system. In case maintenance needs to be executed in the power-on state, the emergency stop button must be pressed as far as possible.
(3) If it becomes necessary to enter the robot operating space while the power is on, press the emergency stop button on the operator box or operator panel, or the teach pendant before entering the range. The maintenance worker must indicate that maintenance work is in progress and be careful not to allow other people to operate the robot carelessly.
(4) When entering the area enclosed by the safety fence, the worker must check the whole robot system in order to make sure no dangerous situations exist. In case the worker needs to enter the safety area whilst a dangerous situation exists, extreme care must be taken, and whole robot system status must be carefully monitored.
(5) Before the maintenance of the pneumatic system is started, the supply pressure should be shut off and the pressure in the piping should be reduced to zero.
(6) Before the start of maintenance work, check that the robot and its peripheral equipment are all in the normal operating condition.
(7) Do not operate the robot in the automatic operation while anybody is in the robot operating space.
(8) When you maintain the robot alongside a wall or instrument, or when multiple users are working nearby, make certain that their escape path is not obstructed.
(9) When a tool is mounted on the robot, or when any movable device other than the robot is installed, such as belt conveyor, pay careful attention to its motion.
(10) If necessary, have a user who is familiar with the robot system stand beside the operator panel and observe the work being performed. If any danger arises, the user should be ready to press the EMERGENCY STOP button at any time.
(11) When replacing a part, please contact your local FANUC representative. If a wrong procedure is followed, an accident may occur, causing damage to the robot and injury to the user.
(12) When replacing or reinstalling components, take care to prevent foreign material from entering the system.
(13) When handling each unit or printed circuit board in the controller during inspection, turn off the circuit breaker to protect against electric shock.
If there are two cabinets, turn off the both circuit breaker.
(14) A part should be replaced with a part recommended by FANUC. If other parts are used, malfunction or damage would occur. Especially, a fuse that is not recommended by FANUC should not be used. Such a fuse may cause a fire.
(15) When restarting the robot system after completing maintenance work, make sure in advance that there is no person in the operating space and that the robot and the peripheral equipment are not abnormal.
(16) When a motor or brake is removed, the robot arm should be supported with a crane or other equipment beforehand so that the arm would not fall during the removal.
(17) Whenever grease is spilled on the floor, it should be removed as quickly as possible to prevent dangerous falls.
(18) The following parts are heated. If a maintenance user needs to touch such a part in the heated state, the user should wear heat-resistant gloves or use other protective tools.
- Servo motor
- Inside the controller
- Reducer
- Gearbox

- Wrist unit

(19) Maintenance should be done under suitable light. Care must be taken that the light would not cause any danger.
(20) When a motor, reducer, or other heavy load is handled, a crane or other equipment should be used to protect maintenance workers from excessive load. Otherwise, the maintenance workers would be severely injured.
(21) The robot should not be stepped on or climbed up during maintenance. If it is attempted, the robot would be adversely affected. In addition, a misstep can cause injury to the worker.
(22) When performing maintenance work in high place, secure a footstep and wear safety belt.
(23) After the maintenance is completed, spilled oil or water and metal chips should be removed from the floor around the robot and within the safety fence.
(24) When a part is replaced, all bolts and other related components should put back into their original places. A careful check must be given to ensure that no components are missing or left not mounted.
(25) In case robot motion is required during maintenance, the following precautions should be taken :
- Foresee an escape route. And during the maintenance motion itself, monitor continuously the whole robot system so that your escape route will not become blocked by the robot, or by peripheral equipment.
- Always pay attention to potentially dangerous situations, and be prepared to press the emergency stop button whenever necessary.

(26) The robot should be periodically inspected. (Refer to the robot mechanical manual and controller maintenance manual.) A failure to do the periodical inspection can adversely affect the performance or service life of the robot and may cause an accident
(27) After a part is replaced, a test execution should be given for the robot according to a predetermined method. (See TESTING section of "Controller operator's manual".) During the test execution, the maintenance worker should work outside the safety fence.

4 SAFETY OF THE TOOLS AND PERIPHERAL EQUIPMENT

4.1 PRECAUTIONS IN PROGRAMMING

(1) Use a limit switch or other sensor to detect a dangerous condition and, if necessary, design the program to stop the robot when the sensor signal is received.
(2) Design the program to stop the robot when an abnormality occurs in any other robots or peripheral equipment, even though the robot itself is normal.
(3) For a system in which the robot and its peripheral equipment are in synchronous motion, particular care must be taken in programming so that they do not interfere with each other.
(4) Provide a suitable interface between the robot and its peripheral equipment so that the robot can detect the states of all devices in the system and can be stopped according to the states.

4.2 PRECAUTIONS FOR MECHANISM

(1) Keep the component cells of the robot system clean, operate the robot where insulated from the influence of oil, water, and dust.
(2) Don't use unconfirmed liquid for cutting fluid and cleaning fluid.
(3) Adopt limit switches or mechanical stoppers to limit the robot motion, and avoid the robot from collisions against peripheral equipment or tools.
(4) Observe the following precautions about the mechanical unit cables. Failure to follow precautions may cause problems.
- Use mechanical unit cable that have required user interface.

- Do not add user cable or hose to inside of the mechanical unit.
- Please do not obstruct the movement of the mechanical unit when cables are added to outside of mechanical unit.
- In the case of the model that a cable is exposed, please do not perform remodeling (Adding a protective cover and fix an outside cable more) obstructing the behavior of the outcrop of the cable.
- When installing user peripheral equipment on the robot mechanical unit, please pay attention that the device does not interfere with the robot itself.

(5) The frequent power-off stop for the robot during operation causes the trouble of the robot. Please avoid the system construction that power-off stop would be operated routinely. (Refer to bad case example.) Please perform power-off stop after reducing the speed of the robot and stopping it by hold stop or cycle stop when it is not urgent. (Please refer to "STOP TYPE OF ROBOT" in "SAFETY PRECAUTIONS" for detail of stop type.)
(Bad case example)

- Whenever poor product is generated, a line stops by emergency stop and power-off of the robot is incurred.
- When alteration is necessary, safety switch is operated by opening safety fence and power-off stop is incurred for the robot during operation.
- An operator pushes the emergency stop button frequently, and a line stops.
- An area sensor or a mat switch connected to safety signal operates routinely and power-off stop is incurred for the robot.
- Power-off stop is regularly incurred due to an inappropriate setting for Dual Check Safety (DCS).

(6) Power-off stop of Robot is executed when collision detection alarm (SRVO-050) etc. occurs. Please try to avoid unnecessary power-off stops. It may cause the trouble of the robot, too. So remove the causes of the alarm.

5 SAFETY OF THE ROBOT MECHANICAL UNIT

5.1 PRECAUTIONS IN OPERATION

(1) When operating the robot in the jog mode, set it at an appropriate speed so that the operator can manage the robot in any eventuality.
(2) Before pressing the jog key, be sure you know in advance what motion the robot will perform in the jog mode.

5.2 PRECAUTIONS IN PROGRAMMING

(1) When the operating spaces of robots overlap, make certain that the motions of the robots do not interfere with each other.
(2) Be sure to specify the predetermined work origin in a motion program for the robot and program the motion so that it starts from the origin and terminates at the origin. Make it possible for the operator to easily distinguish at a glance that the robot motion has terminated.

5.3 PRECAUTIONS FOR MECHANISMS

(1) Keep the robot operation area clean, and operate the robot in an environment free of grease, water, and dust.

5.4 PROCEDURE TO MOVE ARM WITHOUT DRIVE POWER IN EMERGENCY OR ABNORMAL SITUATIONS

For emergency or abnormal situations (e.g. persons trapped in or pinched by the robot), brake release unit can be used to move the robot axes without drive power.
Please refer to controller maintenance manual and mechanical unit operator's manual for using method of brake release unit and method of supporting robot.

6 SAFETY OF THE END EFFECTOR

6.1 PRECAUTIONS IN PROGRAMMING

(1) To control the pneumatic, hydraulic and electric actuators, carefully consider the necessary time delay after issuing each control command up to actual motion and ensure safe control.
(2) Provide the end effector with a limit switch, and control the robot system by monitoring the state of the end effector.

7 STOP TYPE OF ROBOT (R-30*i*B, R-30*i*B Mate)

There are following four types of Stopping Robot.

Power-Off Stop (Category 0 following IEC 60204-1)

Servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.
"**Power-Off stop**" performs following processing.

- An alarm is generated, and then the servo power turns off. Instantly the robot stops.
- Execution of the program is paused.

Frequent Power-Off stop of the robot during operation can cause mechanical problems of the robot.
Avoid system designs that require routine or frequent Power-Off stop conditions.

Controlled stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.
"**Controlled stop**" performs following processing.

- The alarm "**SRVO-199 Controlled stop**" occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

Smooth stop (Category 1 following IEC 60204-1)

The robot is decelerated until it stops, and servo power is turned off.
"**Smooth stop**" performs following processing.

- The alarm "**SRVO-289 Smooth Stop**" occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.
- In Smooth stop, the robot decelerates until it stops with the deceleration time shorter than Controlled stop.

Hold (Category 2 following IEC 60204-1)

The robot is decelerated until it stops, and servo power remains on.
"**Hold**" performs following processing.

- The robot operation is decelerated until it stops. Execution of the program is paused.

⚠ WARNING

1 The stopping distance and time of Controlled stop and Smooth stop are longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time is necessary when Controlled stop or Smooth Stop is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.
2 In multi arm system, the longest stopping distance and time of Controlled Stop or Smooth Stop among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.
3 In the system which has extended axis, the longer stopping distance and time of Controlled Stop or Smooth Stop among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator's manual for considering the stopping distance and time of the extended axis.
4 When Smooth stop occurs during deceleration by Controlled stop, the stop type of robot is changed to Power-Off Stop.
When Smooth stop occurs during deceleration by Hold, the stop type of robot is changed to Power-Off Stop.
5 In case of Controlled stop or Smooth Stop, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Power-Off stop, Controlled stop, or Smooth stop. The configuration of stop type for each situation is called stop pattern. The stop pattern is different according to the option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Deadman switch (*)
A	AUTO	P-Stop	P-Stop	C-Stop	C-Stop	-
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
C	AUTO	C-Stop	C-Stop	C-Stop	C-Stop	-
	T1	P-Stop	P-Stop	-	C-Stop	P-Stop
	T2	P-Stop	P-Stop	-	C-Stop	P-Stop
D	AUTO	S-Stop	S-Stop	C-Stop	C-Stop	-
	T1	S-Stop	S-Stop	-	C-Stop	S-Stop
	T2	S-Stop	S-Stop	-	C-Stop	S-Stop

P-Stop: Power-Off stop
C-Stop: Controlled stop
S-Stop: Smooth stop

-: Disable
(*) The stop pattern of NTED input is same as Deadman switch.

The following table indicates the Stop pattern according to the controller type or option configuration.

Option	R-30*i*B/ R-30*i*B Mate
Standard	A(**)
Controlled stop by E-Stop (A05B-2600-J570)	C(**)
Smooth E-Stop (A05B-2600-J651)	D(**)

(**)R-30*i*B Mate does not have SVOFF input.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer to "Software version" in operator's manual of controller for the detail of software version screen.

"Controlled stop by E-Stop" option

When "**Controlled stop by E-Stop**" (A05B-2600-J570) option is specified, the stop type of the following alarms become Controlled stop but only in AUTO mode. In T1 or T2 mode, the stop type is Power-Off stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Controlled stop is different from **Power-Off stop** as follows:

- In Controlled stop, the robot is stopped on the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Controlled stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and time of Controlled stop is longer than those of Power-Off stop, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Controlled stop are longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

"Smooth E-Stop Function" option

When "**Smooth E-Stop Function**" (A05B-2600-J651) option is specified, the stop type of the following alarms becomes Smooth stop in all operation modes (AUTO, T1 and T2 mode).

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-003 Deadman switch released	Both deadman switches on Teach pendant are released.

Alarm	Condition
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-037 IMSTP input (Group: %d)	IMSTP input (*IMSTP signal for a peripheral device interface) is OFF.
SRVO-232 NTED input	NTED input (NTED1-NTED11, NTED2-NTED21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.
SRVO-410 DCS SSO NTED input	In DCS Safe I/O connect function, SSO[5] is OFF.
SRVO-419 DCS PROFIsafe comm. error	PROFINET Safety communication error occurs.

Smooth stop is different from **Power-Off stop** as follows:

- In Smooth stop, the robot is stopped along the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Smooth stop, physical impact is less than Power-Off stop. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End Of Arm Tool) should be minimized.
- The stopping distance and time of Smooth stop is longer than those of Power-Off stop, depending on the robot model and axis.

Smooth stop is different from **Controlled stop** as follows:

- The stopping distance and time of Smooth stop is normally shorter than those of Controlled stop, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Smooth stop are longer than those of Power-Off stop. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

8 STOP TYPE OF ROBOT (R-30*i*B Plus, R-30*i*B Mate Plus)

There are following three types of Stop Category.

Stop Category 0 following IEC 60204-1 (Power-off Stop)

Servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.

"**Stop Category 0**" performs following processing.

- An alarm is generated, and then the servo power turns off. Instantly the robot stops.
- Execution of the program is paused.

Frequent Category 0 Stop of the robot during operation can cause mechanical problems of the robot.
Avoid system designs that require routine or frequent Category 0 Stop conditions.

Stop Category 1 following IEC 60204-1 (Controlled Stop, Smooth Stop)

The robot is decelerated until it stops, and servo power is turned off.

"**Stop Category 1**" performs following processing.

- The alarm "**SRVO-199 Controlled stop**" or "**SRVO-289 Smooth Stop**" occurs along with a decelerated stop. The program execution is paused.
- An alarm is generated, and then the servo power turns off.

In Smooth stop, the robot decelerates until it stops with the deceleration time shorter than Controlled stop. The stop type of Stop Category 1 is different according to the robot model or option configuration. Please refer to the operator's manual of a particular robot model.

Stop Category 2 following IEC 60204-1 (Hold)

The robot is decelerated until it stops, and servo power remains on.
"**Stop Category 2**" performs following processing.

- The robot operation is decelerated until it stops. Execution of the program is paused.

⚠ WARNING

1 The stopping distance and time of Stop Category 1 are longer than those of Stop Category 0. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time is necessary when Stop Category 1 is used. Please refer to the operator's manual of a particular robot model for the data of stopping distance and time.
2 In multi arm system, the longest stopping distance and time of Stop Category 1 among each robot are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the multi arm system.
3 In the system which has extended axis, the longer stopping distance and time of Stop Category 1 among robot and extended axis are adopted as those for the system. A risk assessment for the whole robot system which takes into consideration a possibility that the stopping distance and time increase, is necessary on the system which has extended axis. Please refer to the extended axis setup procedure of the controller operator's manual for considering the stopping distance and time of the extended axis.
4 When Stop Category 1 occurs during deceleration by Stop Category 2, the stop type of robot is changed to Stop Category 0.
5 In case of Stop Category 1, motor power shutdown is delayed for a maximum of 2 seconds. In this case, a risk assessment for the whole robot system is necessary, including the 2 seconds delay.

When the emergency stop button is pressed or the FENCE is open, the stop type of robot is Stop Category 0 or Stop Category 1. The configuration of stop type for each situation is called *stop pattern*. The stop pattern is different according to the option configuration.

There are the following 3 Stop patterns.

Stop pattern	Mode	Emergency stop button	External Emergency stop	FENCE open	SVOFF input	Deadman switch (*)
A	AUTO	Category 0	Category 0	Category 1	Category 1	-
	T1	Category 0	Category 0	-	Category 1	Category 0
	T2	Category 0	Category 0	-	Category 1	Category 0
C	AUTO	Category 1	Category 1	Category 1	Category 1	-
	T1	Category 0	Category 0	-	Category 1	Category 0
	T2	Category 0	Category 0	-	Category 1	Category 0
D	AUTO	Category 1	Category 1	Category 1	Category 1	-
	T1	Category 1	Category 1	-	Category 1	Category 1
	T2	Category 1	Category 1	-	Category 1	Category 1

Category 0: Stop Category 0
Category 1: Stop Category 1
-: Disable
(*) The stop pattern of NTED input is same as Deadman switch.
The following table indicates the Stop pattern according to the controller type or option configuration.
The case R651 is specified.

Option	R-30*i*B Plus/ R-30*i*B Mate Plus
Standard	C(**)
Old Stop Function (A05B-2670-J680)	A(**)
All Smooth Stop Function (A05B-2670-J651)	D(**)

The case R650 is specified.

Option	R-30*i*B Plus/ R-30*i*B Mate Plus
Standard	A(**)
Stop Category 1 by E-Stop (A05B-2670-J521)	C(**)
All Smooth Stop Function (A05B-2670-J651)	D(**)

(**)R-30*i*B Mate Plus does not have SVOFF input.

The stop pattern of the controller is displayed in "Stop pattern" line in software version screen. Please refer to "Software version" in operator's manual of controller for the detail of software version screen.

"Old Stop Function" option

When "**Old Stop Function**" (A05B-2670-J680) option is specified, the stop type of the following alarms becomes Stop Category 0 in AUTO mode.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Stop Category 0 is different from **Stop Category 1** as follows:

- In Stop Category 0, servo power is turned off, and the robot stops immediately. Servo power is turned off when the robot is moving, and the motion path of the deceleration is uncontrolled.
- The stopping distance and time of Stop Category 0 is shorter than those of Stop Category 1, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

"All Smooth Stop Function" option

When "**All Smooth Stop Function**" (A05B-2670-J651) option is specified, the stop type of the following alarms becomes Stop Category 1 in all operation modes (AUTO, T1 and T2 mode).

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-003 Deadman switch released	Both deadman switches on Teach pendant are released.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-037 IMSTP input (Group: %d)	IMSTP input (*IMSTP signal for a peripheral device interface) is ON.
SRVO-232 NTED input	NTED input (NTED1-NTED11, NTED2-NTED21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.
SRVO-410 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[5] is OFF.
SRVO-419 DCS PROFIsafe comm. error	PROFINET Safety communication error occurs.

Stop Category 1 is different from **Stop Category 0** as follows:

- In Stop Category 1, the robot is stopped along the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.
- In Stop Category 1, physical impact is less than Stop Category 0. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End of Arm Tool) should be minimized.
- The stopping distance and time of Stop Category 1 is longer than those of Stop Category 0, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Stop Category 1 are longer than those of Stop Category 0. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

"Stop Category 1 by E-Stop" option

When "**Stop Category 1 by E-Stop**" (A05B-2670-J521) option is specified, the stop type of the following alarms become Category 1 Stop but only in AUTO mode. In T1 or T2 mode, the stop type is Category 0 Stop which is the normal operation of the system.

Alarm	Condition
SRVO-001 Operator panel E-stop	Operator panel emergency stop is pressed.
SRVO-002 Teach pendant E-stop	Teach pendant emergency stop is pressed.
SRVO-007 External emergency stops	External emergency stop input (EES1-EES11, EES2-EES21) is open.
SRVO-408 DCS SSO Ext Emergency Stop	In DCS Safe I/O connect function, SSO[3] is OFF.
SRVO-409 DCS SSO Servo Disconnect	In DCS Safe I/O connect function, SSO[4] is OFF.

Stop Category 1 is different from **Stop Category 0** as follows:

- In Stop Category 1, the robot is stopped along the program path. This function is effective for a system where the robot can interfere with other devices if it deviates from the program path.

- In Stop Category 1, physical impact is less than Stop Category 0. This function is effective for systems where the physical impact to the mechanical unit or EOAT (End of Arm Tool) should be minimized.
- The stopping distance and time of Stop Category 1 is longer than those of Stop Category 0, depending on the robot model and axis.

When this option is loaded, this function cannot be disabled.

The stop type of DCS Position and Speed Check functions is not affected by the loading of this option.

> ⚠ **WARNING**
> The stopping distance and time of Stop Category 1 are longer than those of Stop Category 0. A risk assessment for the whole robot system which takes into consideration the increased stopping distance and stopping time, is necessary when this option is loaded.

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TABLE OF CONTENTS

1 GENERAL

Machine Tool Easy Setup runs on *i*Pendant and provides graphics-based programming. Wizards will guide you through simple step-by-step procedures to create complete, custom robot programs for the desired machine tending process. An optional touch screen interface is provided. In lieu of a touch screen, cursor keys and enter can select the buttons. Function keys are used for navigating the wizards. Machine Tool Easy Setup is only available on the *i*Pendant.

NOTE
The teach pendant of the robot must be *i*Pendant to use this function.

This function sets and creates the followings by the wizards.
- Number of machine tools connected to the robot
- Setting for the connection between the machine tool and the robot (I/O configuration, communication)
- Tool frames
- User frames
- Programs (Macro programs, PNS program)

You can complete the initial setup of the robot by simple step-by-step procedure in wizard. You can teach the programs easily by editing template TP programs that is loaded in response to setup by the wizard. In template TP program, the standard sequence of machine tending process has been already taught. Please edit the loaded program if you need, and then teach the position data in the loaded program.

You can customize the figures in the wizards and template TP programs in accordance with your system. For customization, you can save and load figure files and template TP programs provided by the system.

One of the following options is required to use this function.
- Machine Tool Easy Setup (A05B-2600-R835)
- Machine Tool Interface Package (A05B-2600-R808)
- ROBODRILL Interface Package (A05B-2600-R814)
- ROBODRILL Interface Package2 (A05B-2600-R836)

In case that one of Machine Tool Connection function, ROBODRILL Connection function or ROBODRILL Connection function 2 is loaded, some features are changed according to the loaded function.
- Machine Tool Connection function is included in Machine Tool Easy Interface Package (A05B-2600-R808).
- ROBODRILL Connection function is an optional function (A05B-2600-J571). ROBODRILL Connection function is included in ROBODRILL Interface Package (A05B-2600-R814).
- ROBODRILL Connection function 2 is an optional function (A05B-2600-J561). ROBODRILL Connection function 2 is included in ROBODRILL Interface Package2 (A05B-2600-R836).

2 USER INTERFACE

Machine Tool Easy Setup is started by pressing the MENU key on the *i*Pendant and selecting Machine Tool from UTILITIES, or by pressing the F1 key in the Menu Favorites dialog.

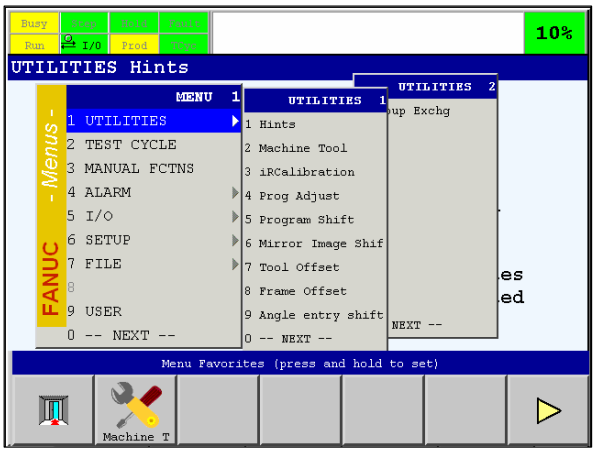

Fig. 2(a) Menu

The Process Navigator will open “Define the Cell” as shown in Fig. 2(b).

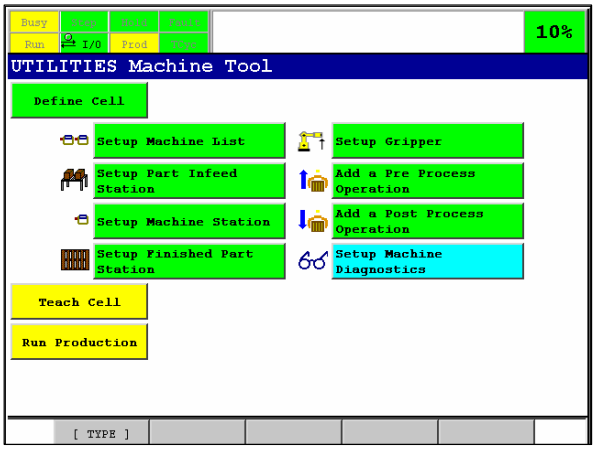

Fig. 2(b) Process Navigator (Define the Cell)

2.1 PROCESS NAVIGATEOR

There are following 3 categories in the Process Navigator.

1. Define the Cell
   Define the Cell is used to setup the robot and the machine tool cell. There are following wizards in this category.
   - Setup Machine List
   - Setup Gripper
   - Setup Part Infeed Station
   - Add a Pre Process Operation
   - Setup Machine Station
   - Add a Post Process Operation
   - Setup Finished Part Station

   And there is a following shortcut.

- Setup Machine Diagnostics (In case that the software option Visual Diagnostics is loaded)

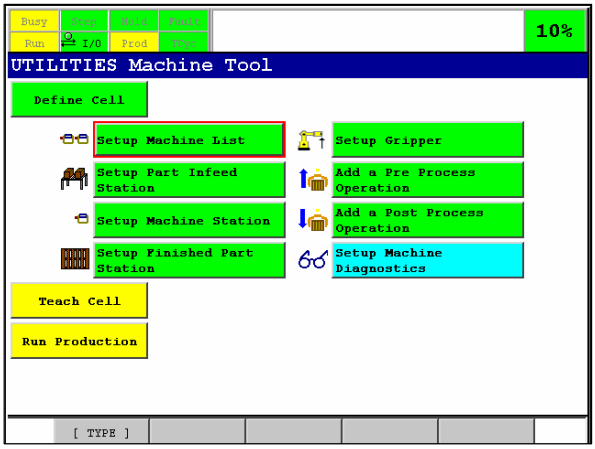

Fig. 2.1(a) Define the Cell

2. Teach Cell

Teach Cell is used to teach Home position and Maintenance Position, and PNS programs. There is a following wizard in this category.

- Program Number Selection

And there are following shortcuts.

- Teach Home Position
- Teach Maintenance Position
- Teach Reference Position
- Edit Main Program (In case that none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded)

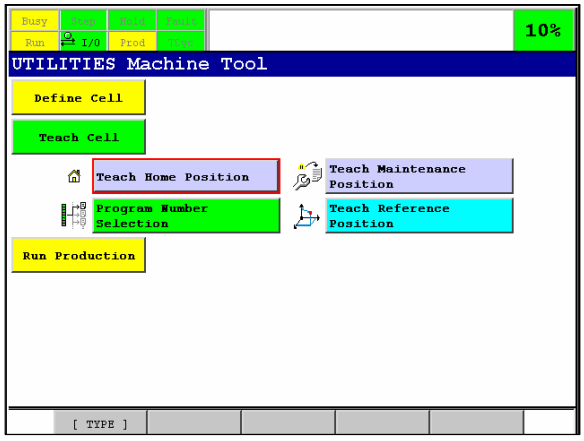

Fig. 2.1(b) Teach Cell

3. Run Production

Run Production is used to monitor production status. There are following shortcuts in this category.

- Production Status
- CNC status
- View Machine Diagnostics (In case that Visual Diagnostics is loaded)
- Manual CNC Operation (In case that one of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded)

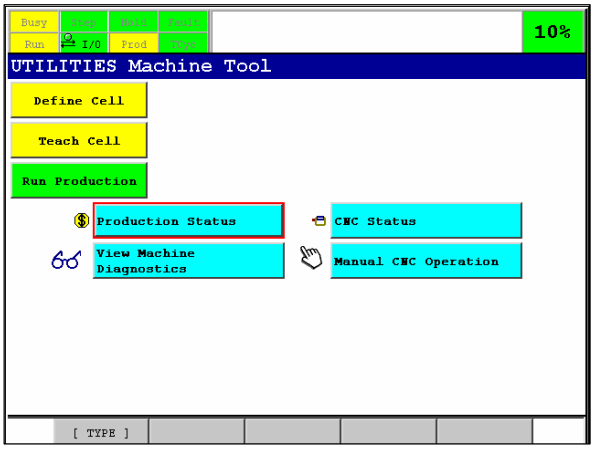

Fig. 2.1(c) Run Production

First set up the cell by the wizard in “Define the Cell”. Then, after all setups in “Define the Cell” are finished, teach the reference points and PNS program by “Teach Cell”. After that, while production is running, monitor production status by “Run Production”.

2.2 BUTTON IN THE SCREEN

The background color of a button can be used to distinguish the links in the Process Navigator.

Table 2.2 Color of button

Color	Description
Green	Wizard button
Yellow	Navigator button
Cyan	Shortcut to other menu
Lavender	Shortcut to TP editor with specified program

2.3 WIZARD

Wizard guides you to set up the cell through simple step-by-step procedure. Fig. 2.3 is an example of a wizard. In this screen, select the number of machine tools that are connected to the robot, and then go to next step by pressing F3 NEXT key.

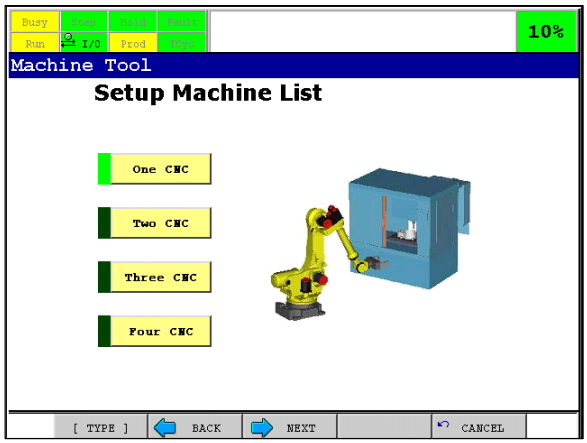

Fig. 2.3 Wizard

When a wizard is in progress, the function keys are defined as follows.

Table 2.3 Function keys in wizard

Function Key		Description
BACK	F2	BACK will go back one step.
NEXT	F3	NEXT will continue to the next step.
FINISH	F3	FINISH will finish the wizard and return to the Process Navigator.
CANCEL	F5 (F10)	CANCEL will cancel the wizard and return to the Process Navigator. Sometimes CANCEL is on F10 so you may need to press NEXT key on *i*Pendant to get the next page of function keys.
DIRECT ENTRY	F3	DIRECT ENTRY is used to directly enter the tool frame or user frame values.
SKIP	F5	SKIP is used to skip setup of tool frame or user frame and directly go to the program step.

When a wizard is in progress, the current step is saved when the Machine Tool menu is exited. It will resume the wizard when the Machine Tool menu is reentered. If this is not what you want, press CANCEL to return to the Process Navigator.

2.4 MACHINE TOOL SHORTCUT

When the MENU key is pressed, the Machine Tool menu can be selected by pressing F1 in the Menu Favorites dialog. While in the TP Editor, the function key labeled MTOOL will shortcut to the Machine Tool menu.

2.5 PASSWORD PROTECTION

If passwords are set up, SETUP level access is required to change any of the settings in the Machine Tool menu. All wizards still operate, but will not let you change any data. The shortcuts are still available. While in the TP Editor, PROGRAM level access is required.

3 OPERATING PROCEDURE

This chapter describes the operating procedures in each category in the Process Navigator.

3.1 DEFINE THE CELL

Define the Cell is used to set up the cell that is consists of the robot and the machine tool. First, set up the connection between the robot and the machine tool, I/O configuration and communication, then set up the gripper. After that, set up user frame and teach the programs for each station in the cell, “Part Infeed station”, “Machine station”, and “Finished part station”. If you need the operation by the robot between Part Infeed Station and Machine Station, please enable pre process operation. If you need the operation by the robot between Machine Station and Finished Part Station, please enable post process operation.

The functions in Define the Cell are as follows.

Table 3.1 Function in Define the Cell

Function	Description
Setup Machine List	Wizard to setup the number of machine tools and configure I/O. Up to 4 machine tools can be connected to the robot. When one of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, the wizard will contain additional steps, such as selecting the I/O device, loading the standard configuration, and setting data communications.
Setup Gripper	Wizard to setup single or dual gripper, create the tool frame(s) and edit the gripper open and close macros.
Setup Part Infeed Station	Wizard which selects the station from a predefined list, such as fixture, fixed grid, flexible location using *i*RVision, or drawers. The wizard will create the user frame(s) and edit the pick program.
Add a Pre Process Operation	Wizard to add a pre process operation and edit the pre process program.
Setup Machine Station	Wizard to create the user frame and edit the load/unload program for each machine tool in the cell.
Add a Post Process Operation	Wizard to add a post process operation and edit the post process program.
Setup Finished Part Station	Wizard which selects the station from a predefined list, such as fixture or fixed grid. The wizard will create the user frame(s) and edit the pick program.
Setup Machine Diagnostics	Shortcut to SETUP Visual Diagnostics if Visual Diagnostics option is loaded.

3.1.1 Setup Machine List

This section describes the operation in Setup Machine List wizard. According to the loaded software option, this wizard has four cases as follows.

1. None of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded.
2. Machine Tool Connection is loaded.
3. ROBODRILL Connection is loaded.
4. ROBODRILL Connection 2 is loaded.

Procedure 3-1 Operation in Setup Machine List wizard

Steps

In case that none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is not loaded

1. Press Setup Machine List to display the screen to set up the number of the machine tools.

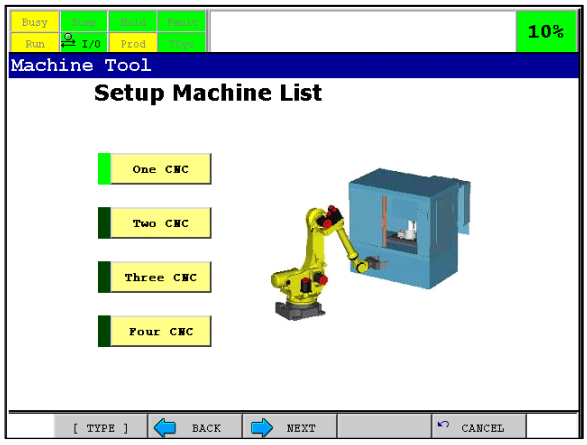

Fig. 3.1.1(a) Setup Machine List wizard

2. Select the number of the machine tools connected to the robot. Up to 4 machine tools can be connected. After selection is finished, press the NEXT key. The screen to set up I/O configuration is displayed.

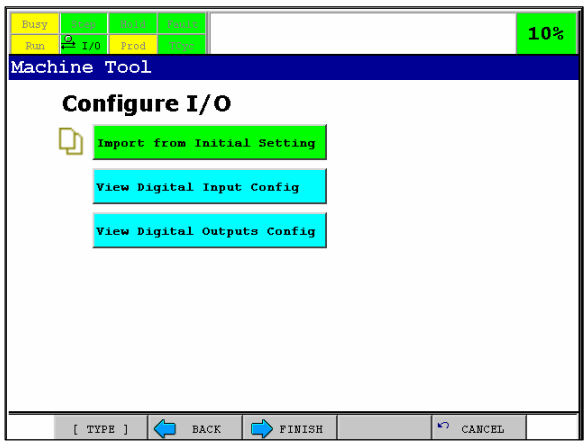

Fig. 3.1.1(b) Setup Machine List wizard

3. If you want to set up I/O configuration by Initial Setting Load function, press “Import from Initial Setting” button. Initial Setting Load screen is displayed as follows. If you want to check I/O configuration, press “View Digital Input Config.” or “View Digital Output Config.” button to display digital input or digital output configuration screen.

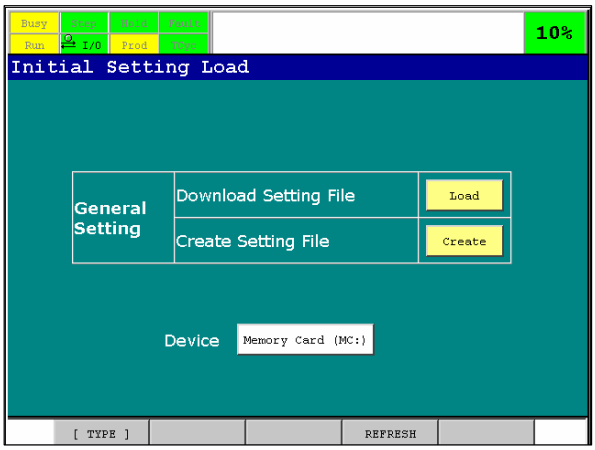

Fig. 3.1.1(c) Initial Setting Load screen

About Initial Setting Load function, please refer to FANUC Robot Series R-30*i*A/R-30*i*A Mate controller Initial Setup Function Operator's Manual (B-83054EN).

4. After I/O configuration setup is finished, return to the wizard by pressing the MENU key on the *i*Pendant and selecting Machine Tool from UTILITIES or by pressing the F1 key in the Menu Favorites dialog.

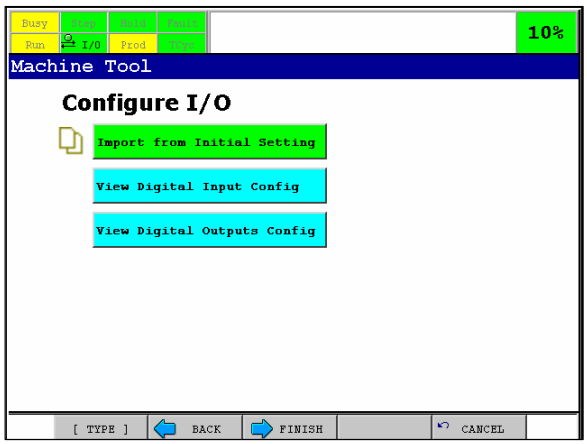

Fig. 3.1.1(d) Setup Machine List wizard

5. Press the FINISH key to finish the wizard and return to the Process Navigator.

In case that Machine Tool Connection is loaded

1. Press Setup Machine List to display the screen to set up the number of machine tools.

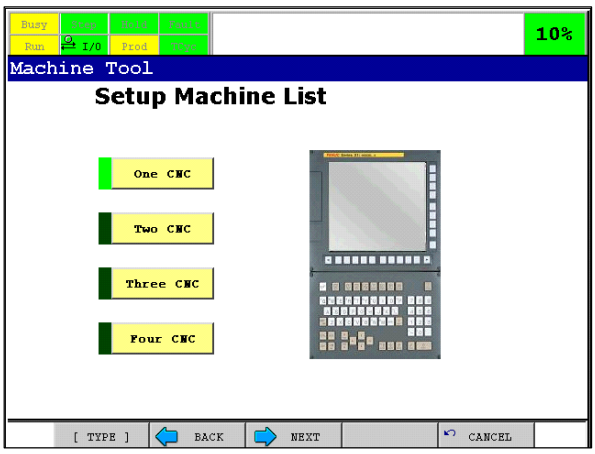

Fig. 3.1.1(e) Setup Machine List wizard

2. Select the number of the machine tools connected to the robot. Up to 4 machine tools can be connected. After selection is finished, press the NEXT key. The screen to enable/disable Machine Tool Connection function is displayed.

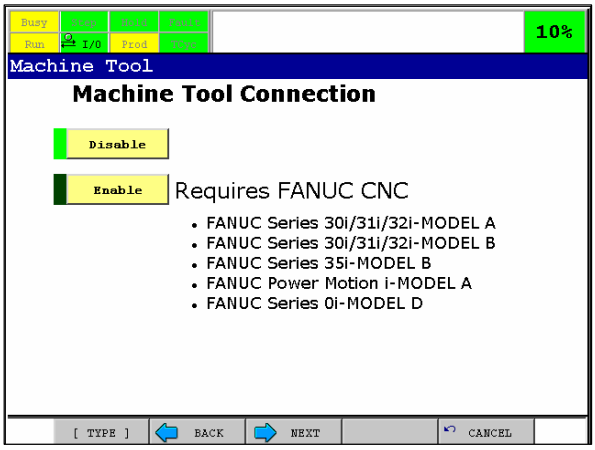

Fig. 3.1.1(f) Setup Machine List wizard

3. If you use Machine Tool Connection function, press the Enable button. In order to use Machine Tool Connection function, it is required that CNC type is one of the types listed in the screen. When you change setting in this screen, the alarm "VARS-064 Change requires cycle power" occurs because it is required to turn off/on the power of the controller to enable the changes in this screen. If this alarm occurs, please turn off/on the power after Setup Machine List wizard is finished.
4. After setting is finished, press the NEXT key. In case that Machine Tool Connection function is enabled, the screen to select I/O device is displayed as follows. If the Machine Tool Connection function is disabled, the screen to configure I/O described in Fig. 3.1.1(b) is displayed. Please refer to the procedure for the case that none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded.

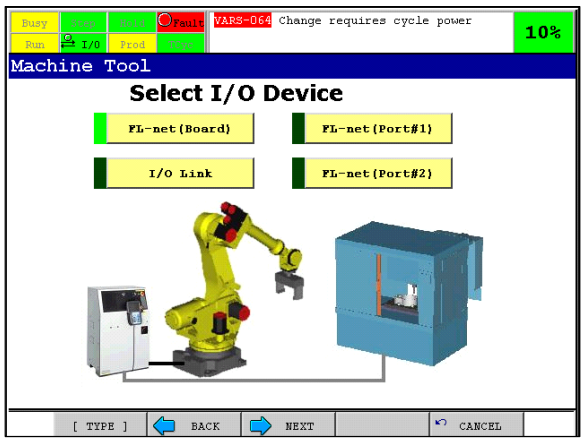

Fig. 3.1.1(g) Setup Machine List wizard

Depending on the software series and version, only two buttons, "FL-net" and "I/O Link", are dipalyed on this screen. In that case, "FL-net" is same as "FL-net (Board)".
In case that FL-net option (A05B-2600-J759) is not loaded, only "I/O Link" buttons can be selected.

5. Select I/O device that is used to connect the robot to the machine tool. When you change the selection in this screen, the alarm "VARS-064 Change requires cycle power" occurs because it is required to turn off/on the power of the controller to enable change in this screen. If this alarm occurs, please turn off/on the power after Setup Machine List wizard is finished. After the selection is finished, press the NEXT key. The screen to load I/O configuration is displayed.

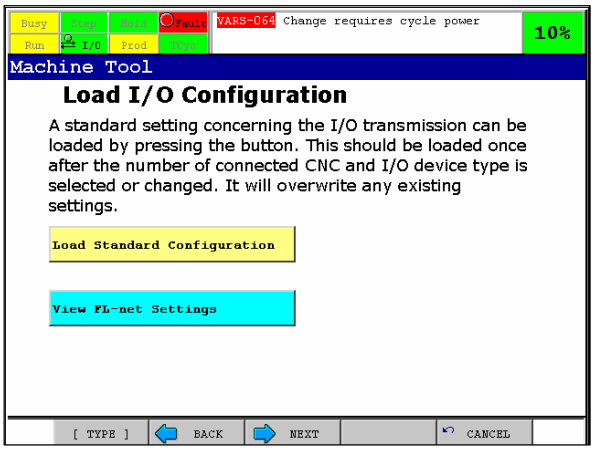

Fig. 3.1.1(h) Setup Machine List wizard

6. If the "Load Standard Configuration" button is pressed, a standard setting concerning the I/O transmission is loaded. Refer to "6 STANDARD SETTING VALUE" about the data loaded by this operation. When you load the standard setting, the alarm "VARS-064 Change requires cycle power" occurs because it is required to turn off/on the power of the controller to enable the loaded data. If this alarm occurs, please turn off/on the power after Setup Machine List wizard is finished. If you want to refer setting of FL-net, press "View FL-net settings" button to display FL-net setting screen. If I/O link is selected as the I/O device, "View I/O Link Device configuration" button appears instead of "View FL-net setting" button. After the operation in this screen is finished, press the NEXT key. The screen to set data communication is displayed.

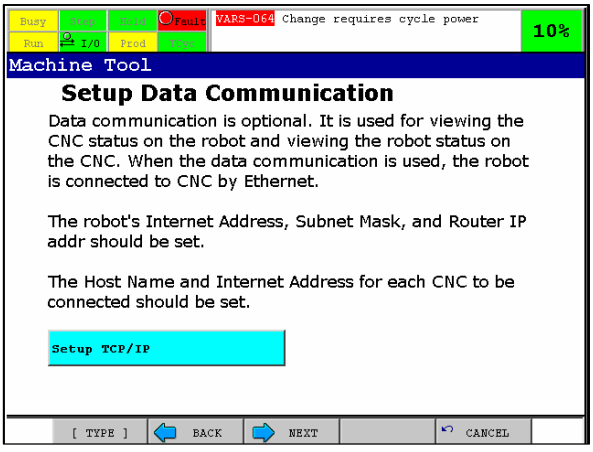

Fig. 3.1.1(i) Setup Machine List wizard

7. Press "Setup TCP/IP" button to display HOST communication setup screen, then set the IP address of the robot, Subnet Mask and Router IP address.
   In case that "FL-net(Port#1)" or "FL-net(Port#2)" is selected as the I/O device in step 5, when the "Load Standard Configuration" button is pressed in step 6, IP address and Subnet Mask of the FL-net port are set to the standard value, and Router IP address is initialized.
   After setup in HOST communication setup screen is finished, return to the wizard by pressing the MENU key on the *i*Pendant and selecting Machine Tool from UTILITIES or by pressing the F1 key in the Menu Favorites dialog, then press the NEXT key. The screen to set client tags is displayed.

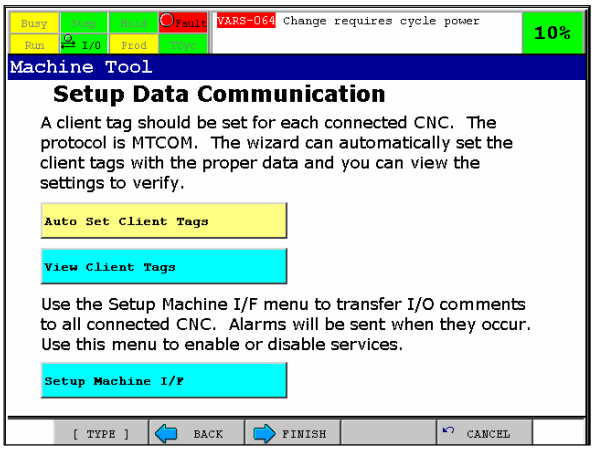

Fig. 3.1.1(j) Setup Machine List wizard

8. If "Auto Set Client Tags" button is pressed, the client tags that are needed for communication with CNC are set automatically according to the number of CNCs connected to the robot. If you want to check or change the setting of client tags, press "View Client Tags" button. "Setup Machine I/F" button is the shortcut to Machine I/F setup screen of Machine Tool Connection function.
9. After operation in this screen, press the FINISH key to return to the Process Navigator.
10. If the alarm "VARS-064 Change requires cycle power" has occurred during above procedures, please turn off and on the power of the controller.

In case that ROBODRILL Connection is loaded

1. Press Setup Machine List to display the screen to set up the number of ROBODRILLs.

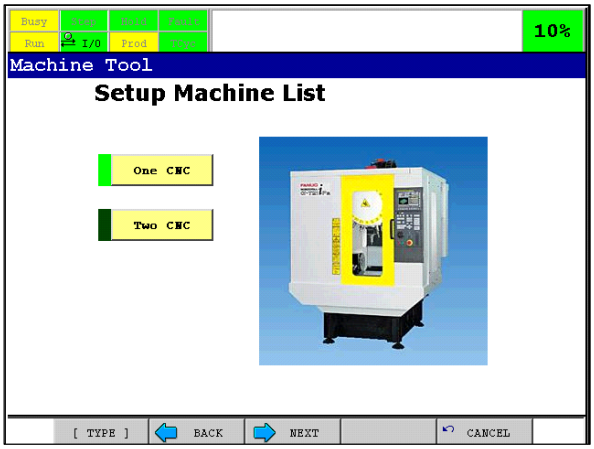

Fig. 3.1.1(k) Setup Machine List wizard

2. Select the number of ROBODRILLs connected to the robot. Up to 2 ROBODRILLs can be connected. After selection is finished, press the NEXT key. The screen to enable/disable ROBODRILL Connection function is displayed.

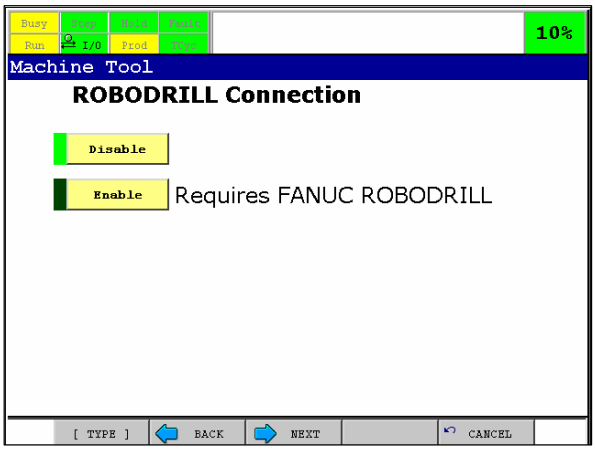

Fig. 3.1.1(l) Setup Machine List wizard

3. If you use ROBODRILL Connection function, press the Enable button. When you change setting in this screen, the alarm "VARS-064 Change requires cycle power" occurs because it is required to turn off/on the power of the controller to enable the change in this screen. If this alarm occurs, please turn off/on the power after Setup Machine List wizard is finished.
4. After setting is finished, press the NEXT key. In case that ROBODRILL Connection function is enabled, the screen to load I/O configuration is displayed as follows. In case that ROBODRILL Connection function is disabled, the screen to configure I/O described in Fig. 3.1.1(b) is displayed. Please refer to the procedure for the case that none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded.

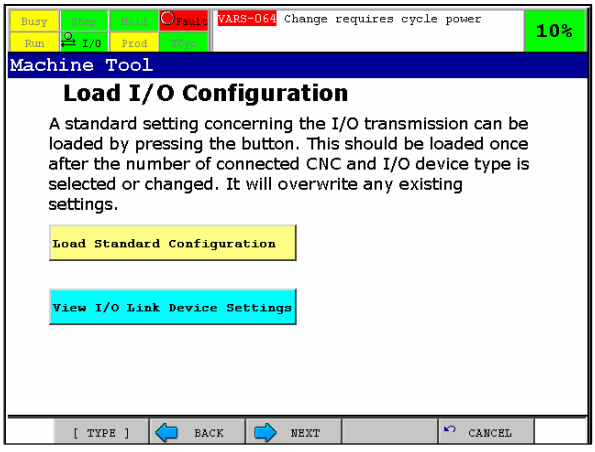

Fig. 3.1.1(m) Setup Machine List wizard

5. If "Load Standard Configuration" button is pressed, a standard setting concerning the I/O transmission is loaded. Refer to "6 STANDARD SETTING VALUE" about the data loaded by this operation. When you load the standard setting, the alarm "VARS-064 Change requires cycle power" occurs because it is required to turn off/on the power of the controller to enable the loaded data. If this alarm occurs, please turn off/on the power after Setup Machine List wizard is finished. If you want to refer I/O configuration, press "View I/O Link Device settings" button. After the operation in this screen is finished, press the NEXT key. The screen to set data communication is displayed.

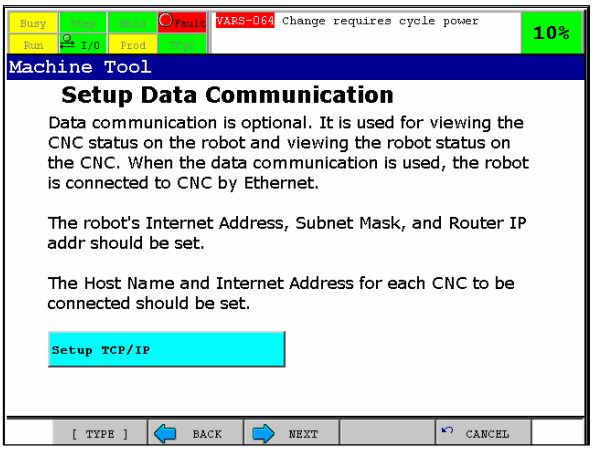

Fig. 3.1.1(n) Setup Machine List wizard

6. Press "Setup TCP/IP" button to display HOST communication setup screen, then set the IP address of the robot, Subnet Mask and Router IP address. After setup in HOST communication setup screen is finished, return to the wizard by pressing the MENU key on the *i*Pendant and selecting Machine Tool from UTILITIES or by pressing the F1 key in the Menu Favorites dialog, then press the NEXT key. The screen to set client tags is displayed.

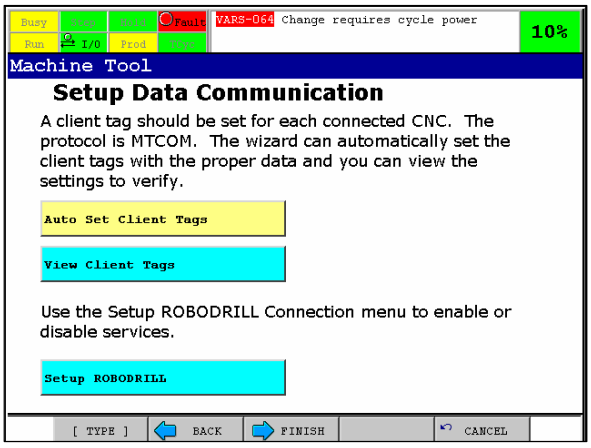

Fig. 3.1.1(o) Setup Machine List wizard

7. If "Auto Set Client Tags" button is pressed, the client tags that are needed for communication with CNC are set automatically according to the number of CNCs connected to the robot. If you want to check or change the setting of client tags, press "View Client Tags" button. "Setup ROBODRILL" button is the shortcut to Machine I/F setup screen of ROBODRILL Connection function.
8. After the operation in this screen, press the FINISH key to return to the Process Navigator.
9. If the alarm "VARS-064 Change requires cycle power" has occurred during above procedures, please turn off and on the power of the controller.

In case that ROBODRILL Connection 2 is loaded

1. Press Setup Machine List to display the screen to set up the number of ROBODRILLs.

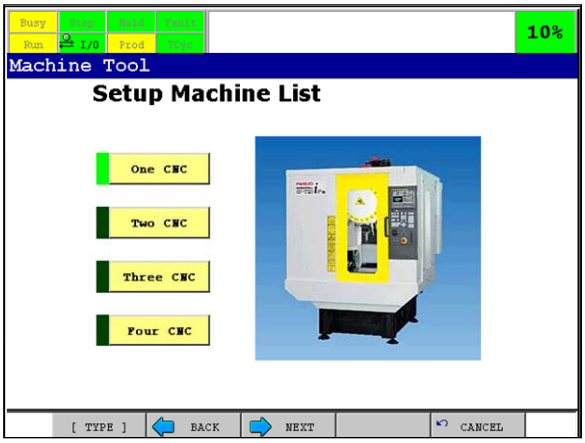

Fig. 3.1.1(p) Setup Machine List wizard

2. Select the number of ROBODRILLs connected to the robot. Up to 4 ROBODRILLs can be connected with ROBODRILL Connection 2. After selection is finished, press NEXT key. The screen to enable/disable ROBODRILL Connection function is displayed.

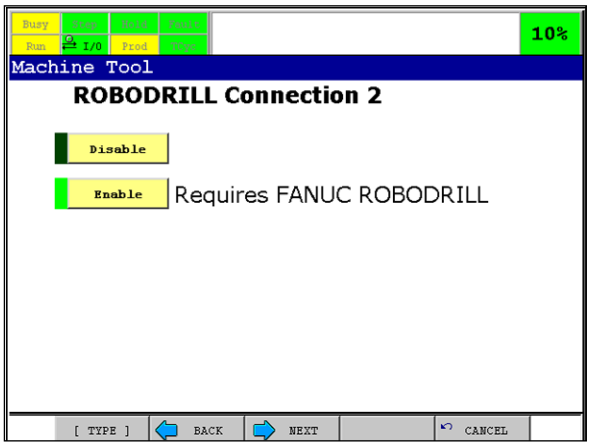

Fig. 3.1.1(q) Setup Machine List wizard

3. If you use ROBODRILL Connection function 2, press the Enable button When you change setting in this screen, the alarm “VARS-064 Change requires cycle power” occurs because it is required to turn off/on the power of the controller to enable the change in this screen. If this alarm occurs, please turn off/on the power after Setup Machine List wizard is finished.
4. After selection is finished, press NEXT key. In case that ROBODRILL Connection function 2 is enabled, the screen to select I/O device is displayed as follows. In case that ROBODRILL Connection function 2 is disabled, the screen to configure I/O described in Fig. 3.1.1(b) is displayed. Please refer to the procedure for the case that none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded.

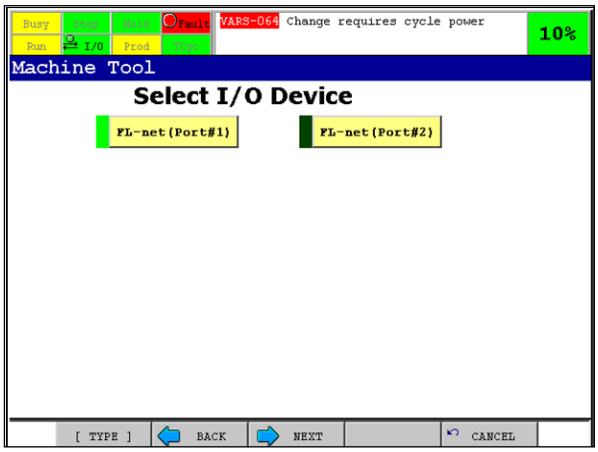

Fig. 3.1.1(r) Setup Machine List wizard

5. After selection is finished, press NEXT key. The screen to load I/O configration is displayed as follows.

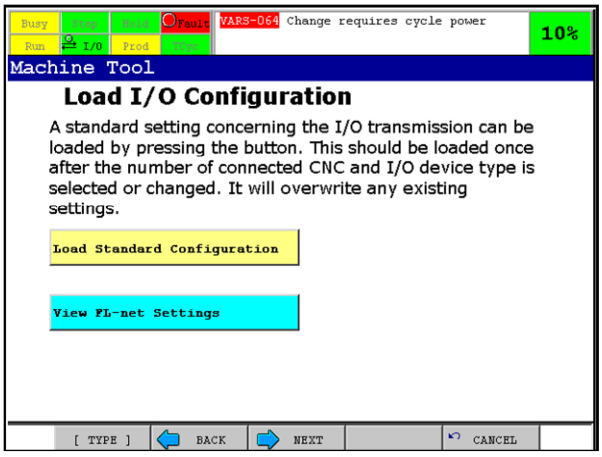

Fig. 3.1.1(s) Setup Machine List wizard

If "Load Standard Configuration" button is pressed, a standard setting concerning the I/O transmission is loaded. Refer to "6 STANDARD SETTING VALUE" about the data loaded by this operation. When you load the standard setting, the alarm "VARS-064 Change requires cycle power" occurs because it is required to turn off/on the power of the controller to enable the loaded data. If this alarm occurs, please turn off/on the power after Setup Machine List wizard is finished. If you want to refer FL-net configuration, press "View FL-net settings" button.

6. After selection is finished, press NEXT key. The BG Logic configuration screen is displayed.

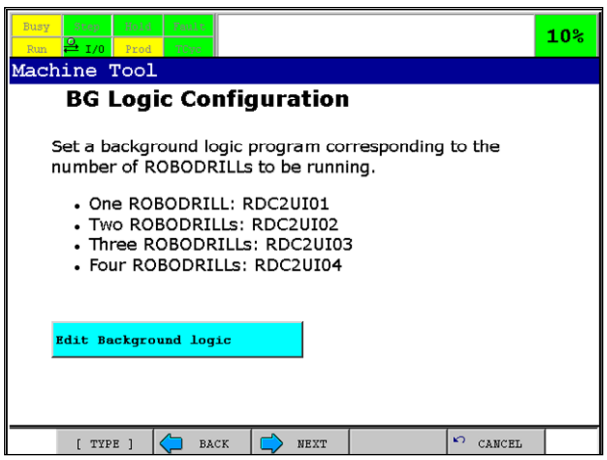

Fig. 3.1.1(t) Setup Machine List wizard

7. One of four preloaded background logic programs is used in ROBODRILL Connection function 2. Press then "Edit Background logic" button and select the background logic program corresponding to the number of ROBODRILLs. Background logic program can not run until power cycle in case standard setting is loaded. Just select the background logic program at this time.
   After setup is finished, return to the wizard by pressing the MENU key on the *i*Pendant and selecting Machine Tool from UTILITIES or by pressing the F1 key in the Menu Favorites dialog, then press the NEXT key. The screen to set client tags is displayed.

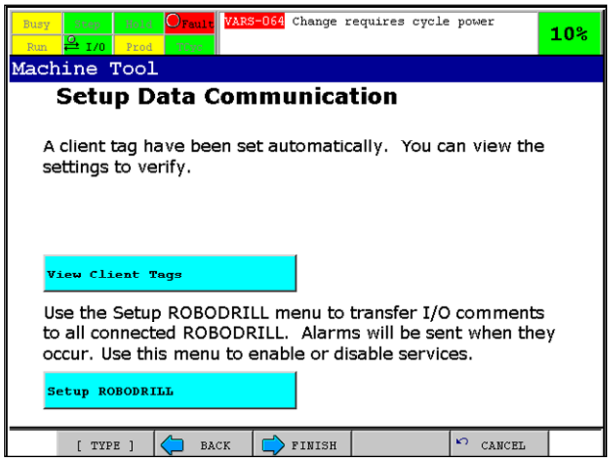

Fig. 3.1.1(u) Setup Machine List wizard

8. The client tags are automatically configured with standard setting loading in ROBODRILL Connection funcion 2. If you want to check or change the setting of client tags, press “View Client Tags” button. “Setup ROBODRILL” button is the shortcut to Machine I/F setup screen of ROBODRILL Connection function.
9. After the operation in this screen, press the NEXT key to return to the Process Navigator.
10. If the alarm “VARS-064 Change requires cycle power” has occurred during above procedures, please turn off and on the power of the controller.

3.1.2 Setup Gripper

In Setup Gripper wizard, select the gripper type from single gripper and dual gripper first, then setup tool frame and edit macro program to operate gripper.

Procedure 3-2 Operation in Setup Gripper wizard

Steps

1. Press Setup Gripper to display the screen to select the gripper type.

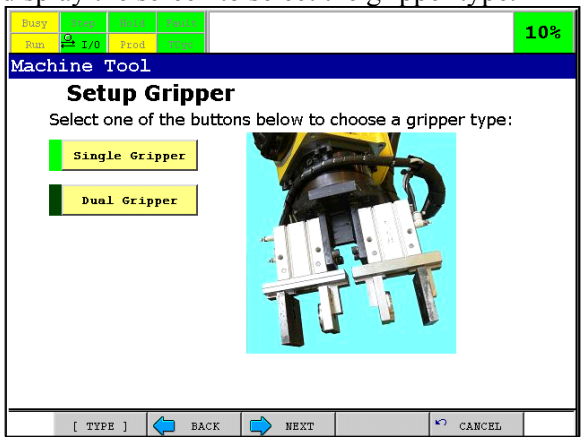

Fig. 3.1.2(a) Set Gripper wizard

2. Select the gripper type form single gripper and dual gripper, then press the NEXT key. After this step, the wizard for single gripper and the wizard for dual gripper are different.

Single Gripper

In case that you selected dual gripper, go to step 20.

3. The screen to set the tool frame is displayed.

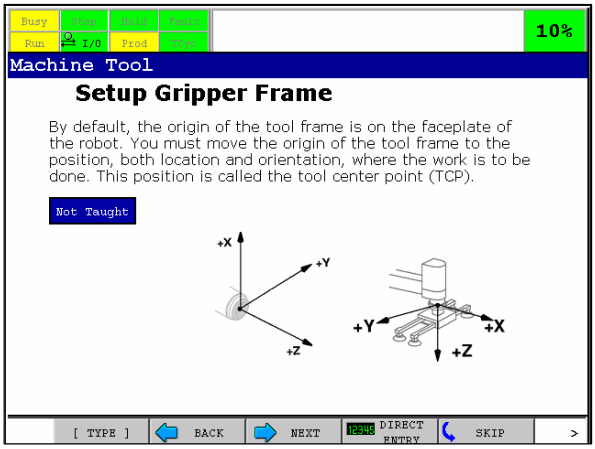

Fig. 3.1.2(b) Setup Gripper wizard

4. In order to start the tool frame setup, press the NEXT key to go to step 5. If you want to edit macro program to operate gripper without the tool frame setup, press the SKIP key to go to step 17. If you want to directly enter the tool frame value, press the DIRECT ENTRY key and input the tool frame value in the following screen, then press the NEXT key to go to step 17.

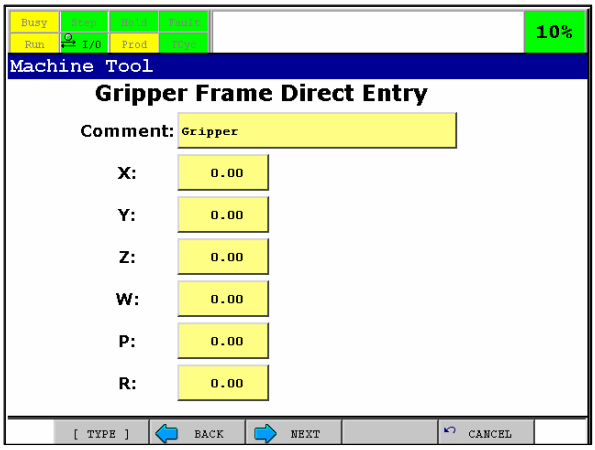

Fig. 3.1.2(c) Setup Gripper wizard

5. The screen to teach the first approach point is displayed.

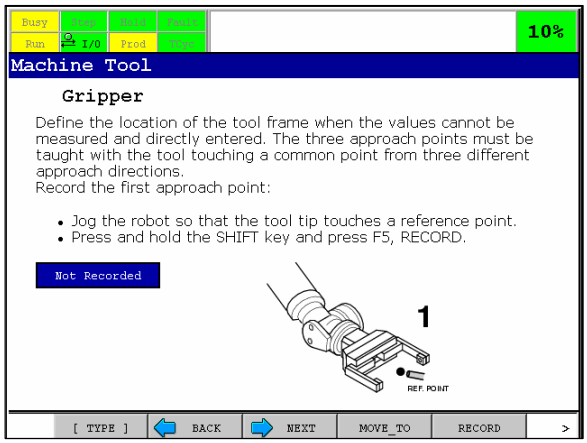

Fig. 3.1.2(d) Setup Gripper wizard

6. Record the first approach point according to the instruction in the screen. If the approach point is taught correctly, the message " Point recorded" is displayed in the status window, and the caption in the blue lamp is changed to "Recorded" from "Not Recorded". After the approach point is taught, press the NEXT key. The screen to teach the second approach point is displayed.

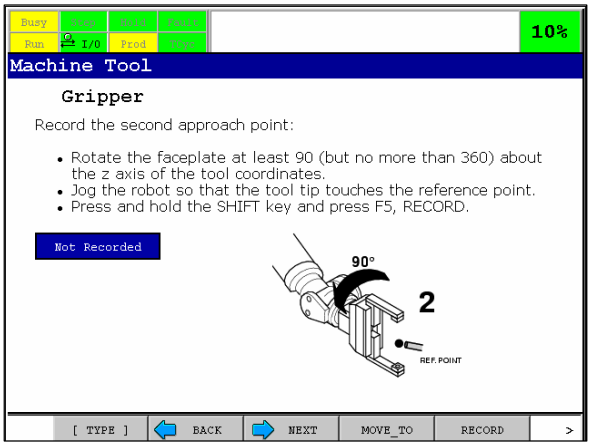

Fig. 3.1.2(e) Setup Gripper wizard

7. Record the second approach point according to the instruction in the screen. After the approach point is taught, press the NEXT key. The screen to teach the third approach point is displayed.

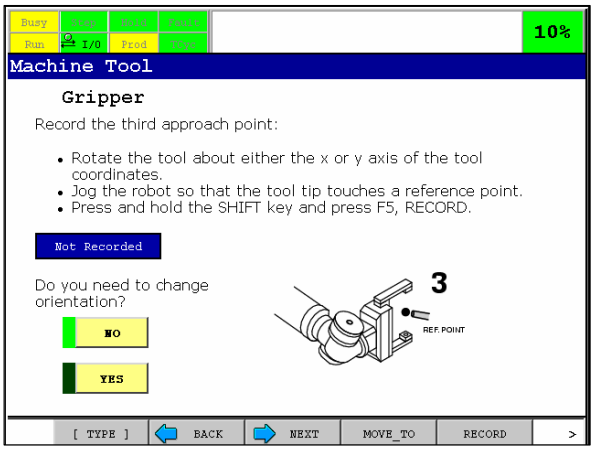

Fig. 3.1.2(f) Setup Gripper wizard

8. Record the third approach point according to the instruction in the screen. When the third point is taught correctly, the origin of the tool frame (Tool Center Point) is set, and the message “New position calculated” is displayed in the status window.
9. If you want to change orientation of the tool frame, select YES to the question “Do you need to change orientation?” and press the NEXT key. Wizard goes to step 10. If you want not to change orientation, select NO and press the NEXT key. Wizard goes to step 14.
10. The screen to teach the orient origin point of the tool frame is displayed.

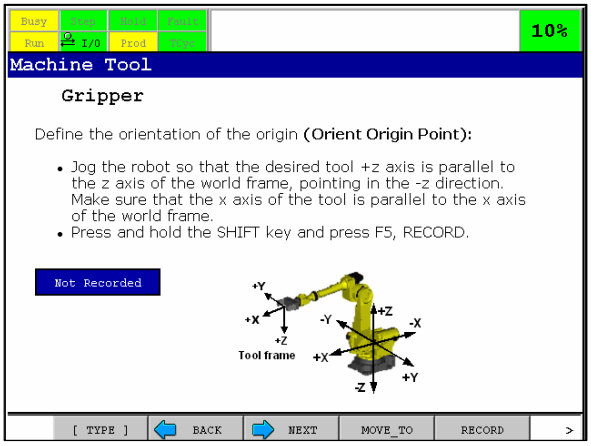

Fig. 3.1.2(g) Setup Gripper wizard

11. Record the orient origin point according to the instruction in the screen. After the orient origin point is taught, press the NEXT key. The screen to teach the X direction point of the tool frame is displayed.

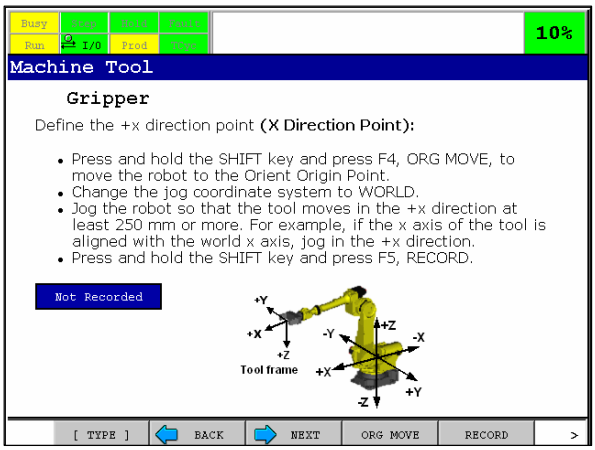

Fig. 3.1.2(h) Setup Gripper wizard

12. Record the X direction point of the tool frame according to the instruction in the screen. After the X direction point is taught, press the NEXT key. The screen to record Z direction point of the tool frame is displayed.

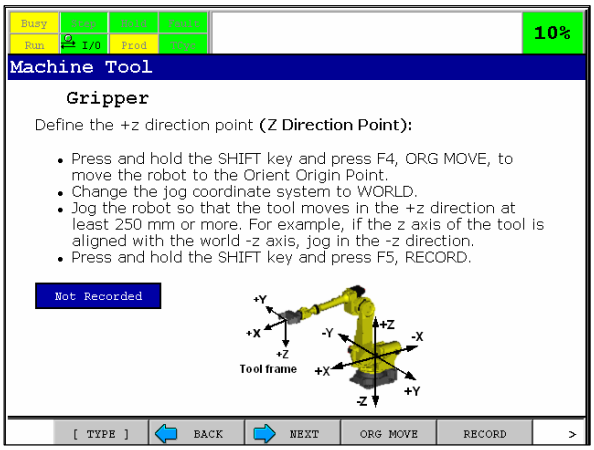

Fig. 3.1.2(i) Setup Gripper wizard

13. Record the Z direction point of the tool frame. After the Z direction point is taught, press the NEXT key.
14. The screen to confirm the tool frame set by the wizard is displayed.

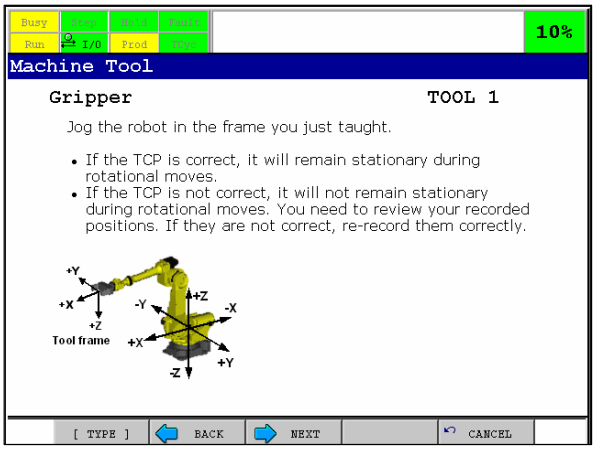

Fig. 3.1.2(j) Setup Gripper wizard

15. Confirm the tool frame according to the instruction in the screen. After confirmation is finished, press the NEXT key. The screen to display the tool frame value is displayed.

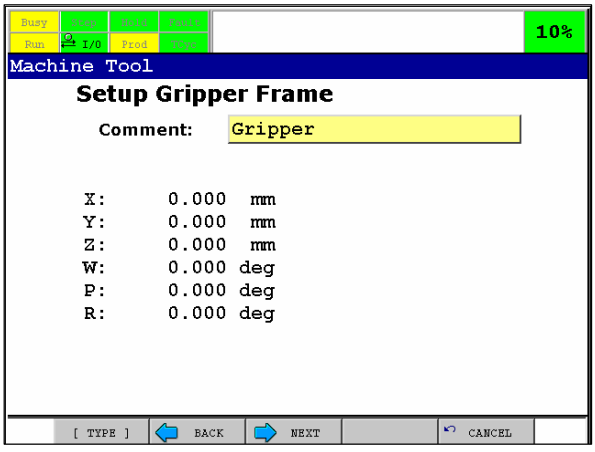

Fig. 3.1.2(k) Setup Gripper wizard

16. In this screen, you can change the comment of the tool frame. After confirmation of the tool frame data and change of the comment is finished, press the NEXT key.
17. The screen to teach the macro programs for gripper is displayed.

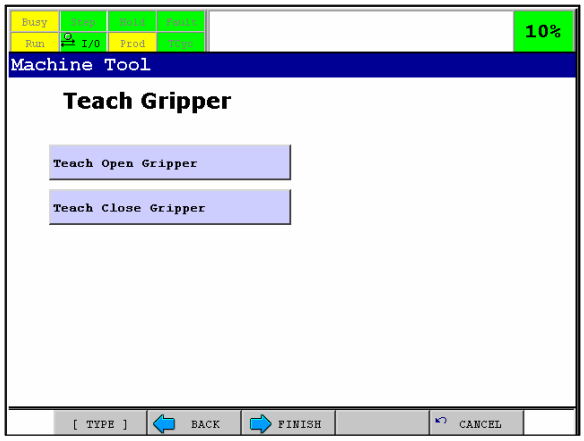

Fig. 3.1.2(l) Setup Gripper wizard

18. Teach the macro program to operate gripper. When "Teach Open Gripper" button or "Teach Close Gripper" button is pressed, the program edit screen is displayed and the template TP program to open or close gripper is selected. Please change the loaded program if required. After the program edit is finished, return to the wizard by pressing the MENU key on the *i*Pendant and selecting Machine Tool from UTILITIES or by pressing the F1 key in the Menu Favorites dialog.
19. Press the FINISH key to return to the Process Navigator.

Dual Gripper

20. In case that the gripper type is Dual Gripper, the following screen is displayed.

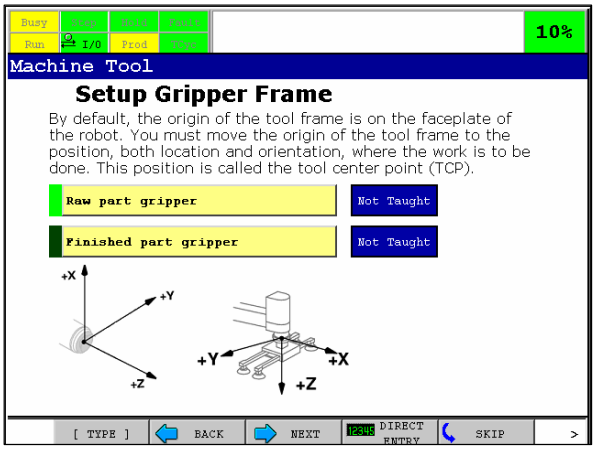

Fig. 3.1.2(m) Setup Gripper wizard

21. Setup of the tool frames and creation of macro programs for both the raw part gripper and the finished part gripper are done in this wizard. Wizard starts from the tool frame setup of the raw part gripper. Confirm that the raw part gripper is selected, and press the NEXT key and go to step 22. If you want to edit macro program to operate gripper without the tool frame setup, press the SKIP key and go to step 24. If you want to directly enter the tool frame value, press the DIRECT ENTRY key and input the tool frame value in the following screen, then press the NEXT key to go to step 24.

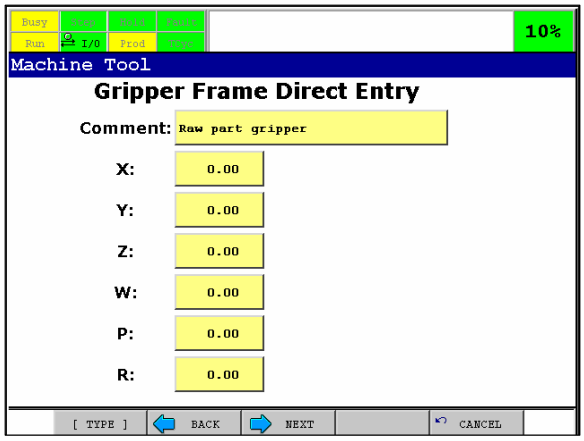

Fig. 3.1.2(n) Setup Gripper wizard

22. The screen to set up the tool frame for the raw part gripper is displayed.

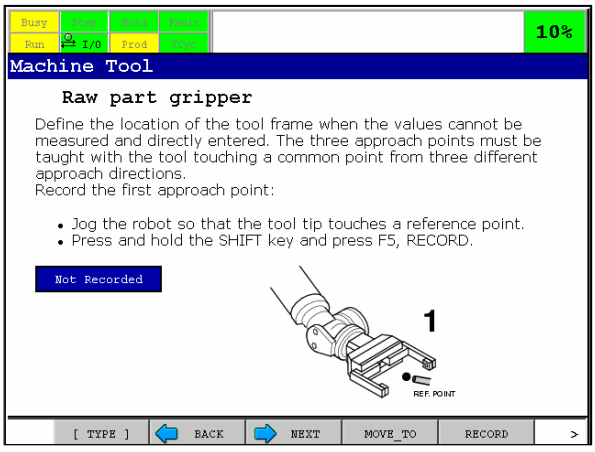

Fig. 3.1.2(o) Setup Gripper wizard

23. Set up the tool frame of the raw part gripper as with the procedure 5 to 16, then press the NEXT key.
24. The screen to edit the macro programs for the raw part gripper.

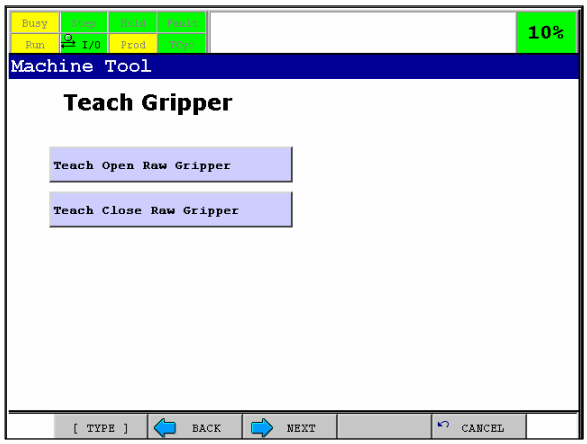

Fig. 3.1.2(p) Setup Gripper wizard

25. Teach the macro programs to operate the raw part gripper. When “Teach Open Raw Gripper” button or “Teach Close Raw Gripper” button is pressed, the program edit screen is displayed and the template TP program to open or close the raw part gripper is selected. Please change the loaded program if required. After the program edit is finished, return to the wizard by pressing the MENU

key on the *i*Pendant and selecting Machine Tool from UTILITIES or by pressing the F1 key in the Menu Favorites dialog.

26. Press the NEXT key. The first screen of the tool frame setup is displayed to set up the tool frame of the finished part gripper.

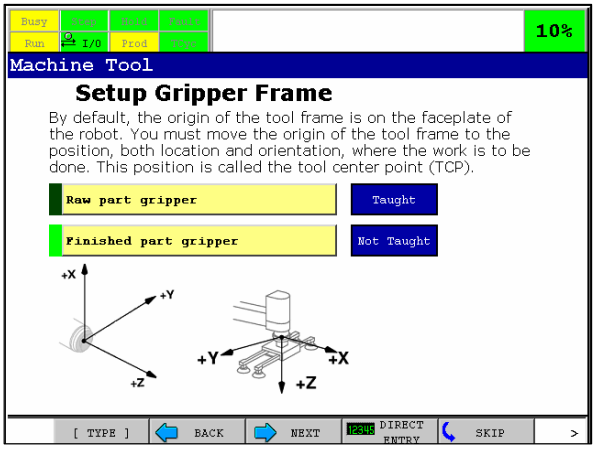

Fig. 3.1.2(q) Setup Gripper wizard

27. Set up the finished part gripper as with the raw part gripper. After setup of the finished part gripper is finished, press the FINISH key to return to the Process Navigator.

3.1.3 Setup Part Infeed Station

In Setup Part Infeed Station wizard, select the type of part infeed station where the robot picks up the raw part to load the machine tool, then setup the user frame of the part infeed station and edit macro program to pick up the raw part. The part infeed station types are described in Table 3.1.3.

Table 3.1.3 Type of Part Infeed Station

Type	Description
Fixed location/fixture	Robot picks the raw parts on the fixed location or fixture.
Flexible location using *i*RVision-2D	Robot picks the raw parts from flexible location using *i*RVision 2D with overhead camera.
Fixed grid (tray, single drawer, etc)	Robot picks the raw parts from a fixed 2D grid (e.g. tray, conveyor, single drawer etc.).
Flexible grid with *i*RVision-2D	Robot picks the raw parts from a flexible grid using *i*RVision 2D with fixed overhead camera (e.g. tray, table, conveyor, drawer etc.).
Multiple drawers	Robot picks the raw parts from a fixed 2D grid with multiple drawers.

Note

"Flexible location using *i*RVision-2D" and "Flexible grid *i*RVision-2D" in Part Infeed Station type can be selected only when *i*RVision 2D option (A05B-2600-J901) is loaded.

Procedure 3-3 Operation in Setup Part Infeed Station wizard

Steps

1. Press Setup Part Infeed Station to display the screen to select the part infeed station type.

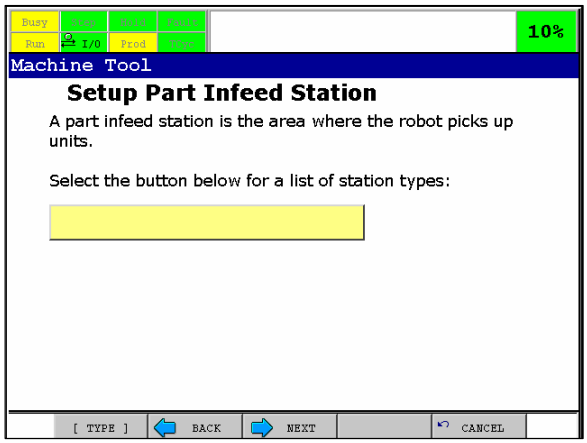

Fig. 3.1.3(a) Setup Part Infeed Station wizard

2. Press the yellow box to display menu to select the part infeed station type. Refer to Table 3.1.3 and select the part infeed station type. After the selection is finished, press the NEXT key. The screen to set up user frame is displayed.

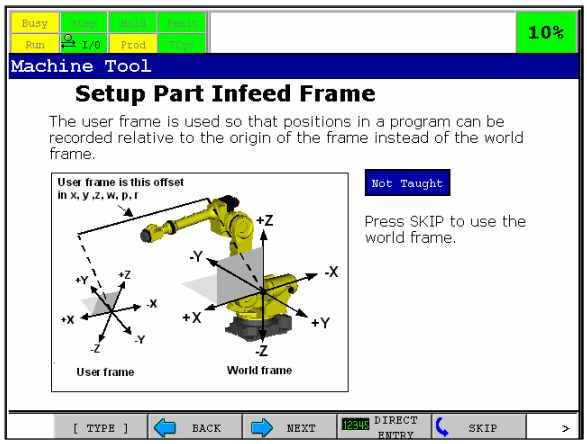

Fig. 3.1.3(b) Setup Part Infeed Station wizard

In case that “Multiple drawers” is selected as the part infeed station type, the following screen is displayed.

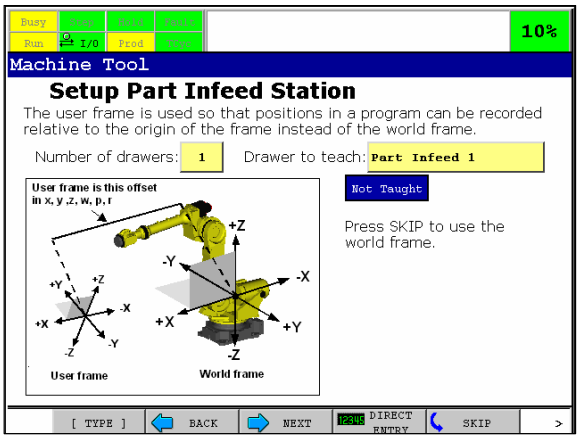

Fig. 3.1.3(c) Setup Part Infeed Station wizard

In case that you select “Multiple drawers” as the part infeed station type, set “Number of drawers” and set up as many user frames as drawers.

3. In order to start the user frame setup, press the NEXT key and go to step 4. If you use the world frame as the user frame, press the SKIP key to go to step 14. If you want to directly enter the

user frame value, press the DIRECT ENTRY key and input the user frame value in the following screen, then press the NEXT key to go to step 14.

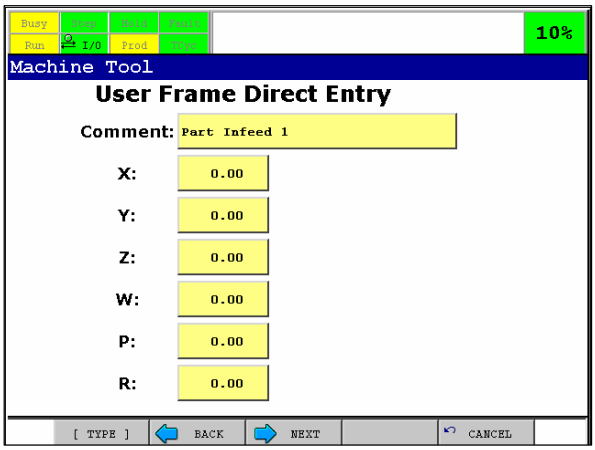

Fig. 3.1.3(d) Setup Part Infeed Station wizard

4. The screen to teach the origin of the user frame is displayed.

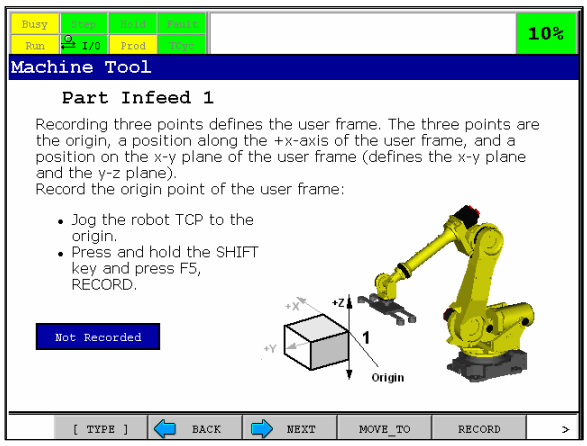

Fig. 3.1.3(e) Setup Part Infeed Station wizard

5. Record the origin of the user frame according to the instruction in the screen. If the position is taught correctly, the message " Point recorded" is displayed in the status window, and the caption in the blue lamp in the screen is changed to "Recorded" from "Not Recorded". After the origin of the user frame is taught, press the NEXT key. The screen to teach the X direction point of the user frame is displayed.

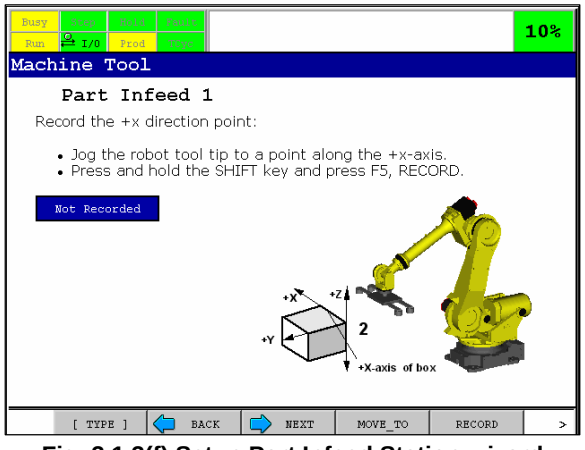

Fig. 3.1.3(f) Setup Part Infeed Station wizard

6. Record the X direction point of the user frame according to the instruction in the screen. After the X direction point is taught, press the NEXT key. The screen to teach the X-Y plane of the tool frame is displayed.

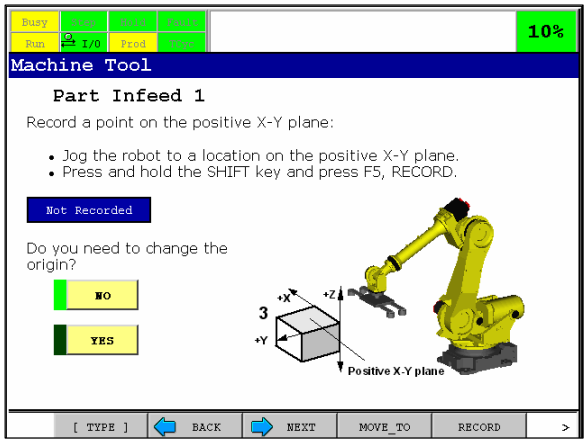

Fig. 3.1.3(g) Setup Part Infeed Station wizard

7. Record the reference point on X-Y plane of the user frame according to the instruction in the screen. When the reference point on X-Y plane is taught correctly, the user frame is set, and the message "New position calculated" is displayed in the status window.
8. If you want to change the origin of the user frame, select YES to the question "Do you need to change origin?" and press the NEXT key. Wizard goes to step 9. If you want not to change origin, select NO and press the NEXT key. Wizard goes to step 11.
9. The screen to teach the origin point of the user frame is displayed.

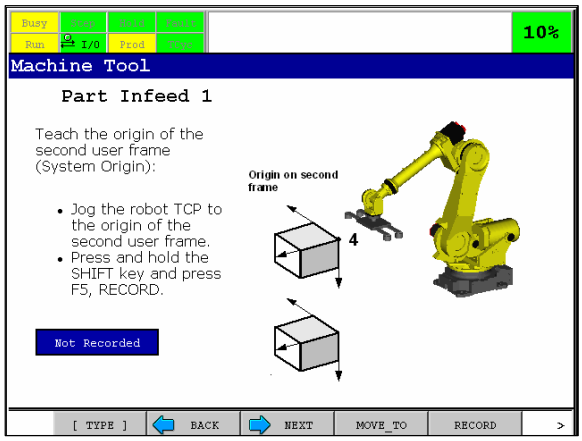

Fig. 3.1.3(h) Setup Part Infeed Station wizard

10. Record the origin of the user frame according to the instruction in the screen. After the origin is taught, press the NEXT key.
11. The screen to confirm the user frame set by the wizard is displayed.

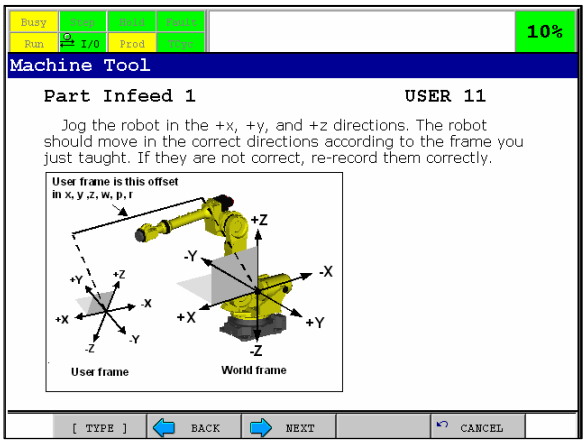

Fig. 3.1.3(i) Setup Part Infeed Station wizard

12. Confirm the user frame set by the wizard according to the instruction in the screen. After confirmation is finished, press the NEXT key. The screen to display the user frame value is displayed.

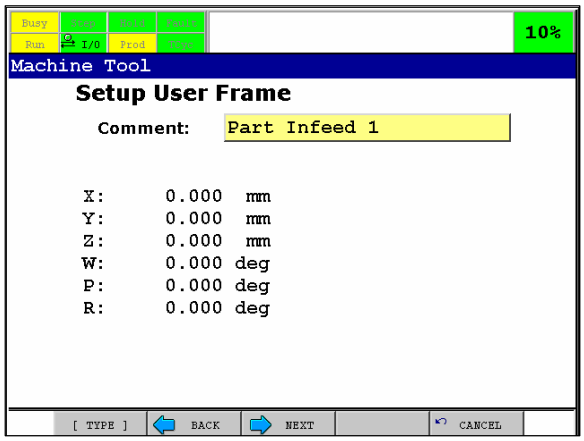

Fig. 3.1.3(j) Setup Part Infeed Station wizard

13. In this screen, you can change the comment of the user frame. After confirmation of the user frame data and change of the comment is finished, press the NEXT key.
14. The screen to teach the macro program to pick the raw part is displayed.

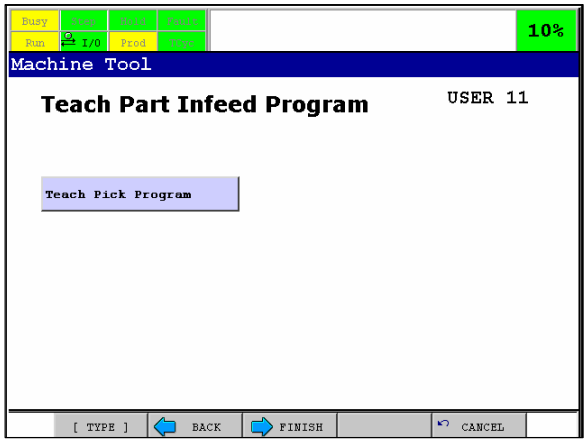

Fig. 3.1.3(k) Setup Part Infeed Station wizard

15. Teach the macro program to pick the raw part. When “Teach Pick Program” button is pressed, the program edit screen is displayed and the template TP program to pick the raw part is selected. Please

teach the position data and change the loaded program if required. After the program edit is finished, return to the wizard by pressing F2 MTOOL in the program edit screen.

16. If the type of the part infeed station is not “Multiple drawers”, press the FINISH key to return to the Process Navigator. If the type is “Multiple drawers”, when the NEXT key is pressed, the first screen of the user frame setup is displayed to set up the user frame for the next drawer. After setup of the user frame for all drawers is finished, press the FINISH key to return to the Process Navigator.

3.1.4 Add a Pre Process Operation

Pre process operation would occur after the robot has picked up the raw part but before placing it into the machine tool. Pre process operation is used to re-grip parts or change orientation of the robot. If you want to use pre process operation, enable pre process operation, then teach the program of pre process operation.

Procedure 3-4 Operation in Add a Pre Process Operation wizard

Steps

1. Press Add a Pre Process Operation to display the screen to enable/disable pre process operation.

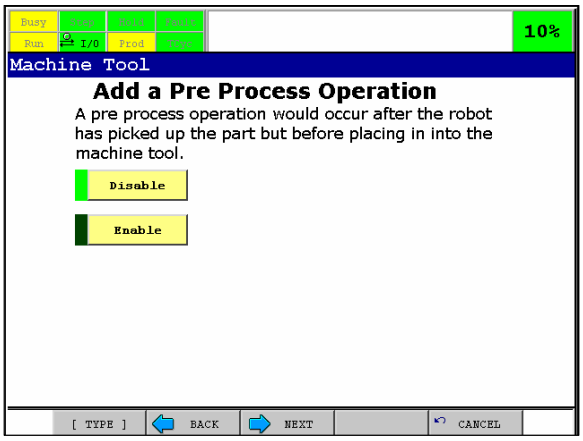

Fig. 3.1.4(a) Add a Pre Process Operation wizard

2. If you want to enable the pre process operation, select Enable and press the NEXT key. The screen to edit the program of the pre process operation is displayed. If you select Disable and press the NEXT key, the Process Navigator screen is displayed.

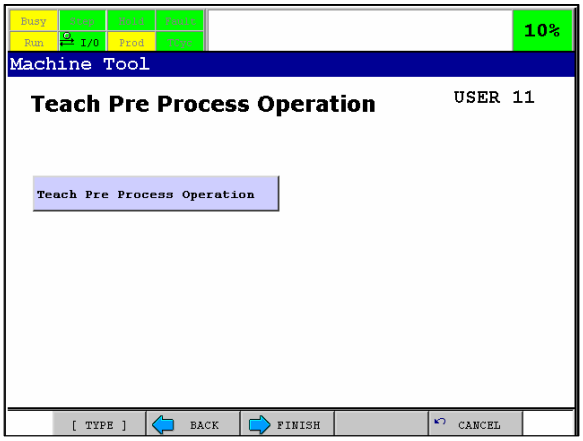

Fig. 3.1.4(b) Add a Pre Process Operation wizard

3. Teach the macro program to execute pre process operation. When “Teach Pre Process Operation” button is pressed, the program edit screen is displayed and the template TP program for pre process operation is selected. Please teach the position data and change the loaded program if required. After the program edit is finished, press F2 MTOOL in the program edit screen to return to the wizard. Then, press the FINISH key to return to the Process Navigator.

3.1.5 Setup Machine Station

In Setup Machine Station wizard, set up the user frame and edit macro program to load/unload the parts to the machine tool. In case that multiple machine tools are connected to the robot, set up as many user frames and macro programs as the machine tools connected to the robot.

Procedure 3-5 Operation in Setup Machine Station

Steps

1. Press Setup Machine Station to display the screen to set the user frame.

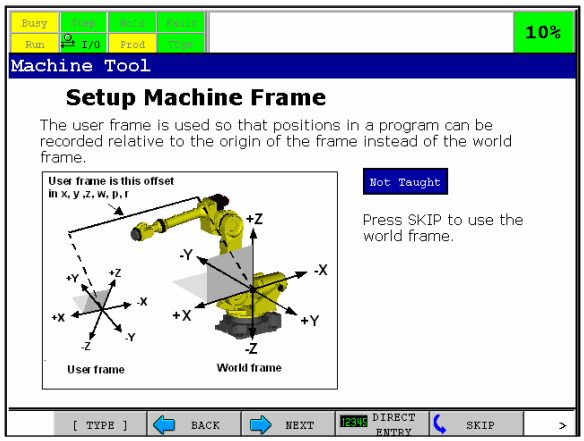

Fig. 3.1.5(a) Setup Machine Station wizard

In case that multiple machine tools are connected to the robot, the following screen is displayed. Set up as many user frames and macro programs as the machine tools connected to the robot.

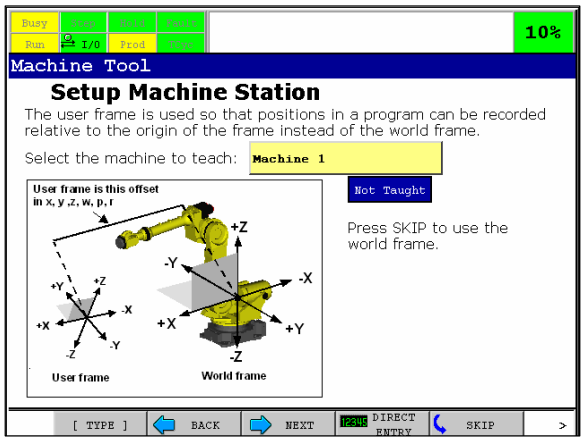

Fig. 3.1.5(b) Setup Machine Station wizard

2. In order to start the user frame setup, press the NEXT key to go to step 3. If you use the world frame as the user frame, press the SKIP key and go to step 13. If you want to directly enter the user frame value, press the DIRECT ENTRY key and input the user frame value in the following screen, then press the NEXT key to go to step 13.

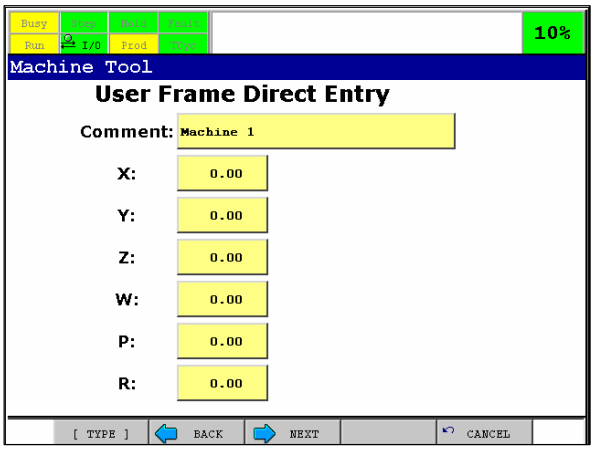

Fig. 3.1.5(c) Setup Machine Station wizard

3. The screen to teach the origin of the user frame is displayed.

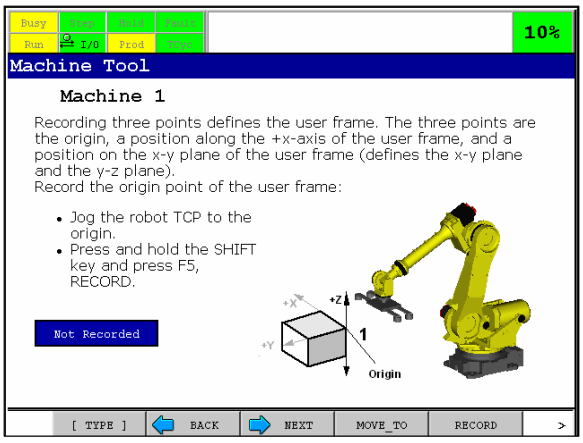

Fig. 3.1.5(d) Setup Machine Station wizard

4. Record the origin of the user frame according to the instruction in the screen. If the position is taught correctly, the message " Point recorded" is displayed in the status window, and the caption in the blue lamp is changed to "Recorded" from "Not Recorded". After the origin of the user frame is taught, press the NEXT key. The screen to teach the X direction point of the user frame is displayed.

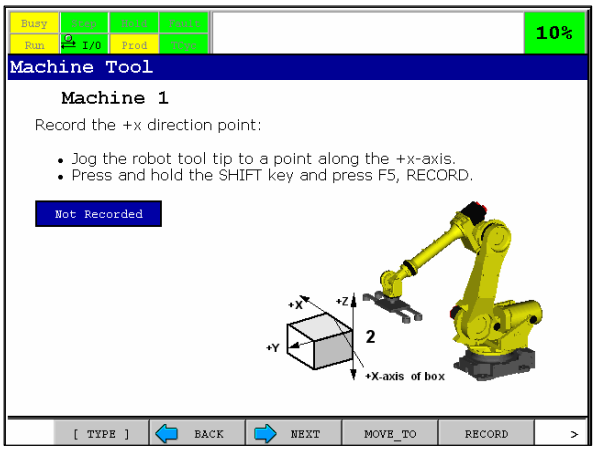

Fig. 3.1.5(e) Setup Machine Station wizard

5. Record the X direction point of the user frame according to the instruction in the screen. After the X direction point is taught, press the NEXT key. The screen to teach the X-Y plane of the tool frame is displayed.

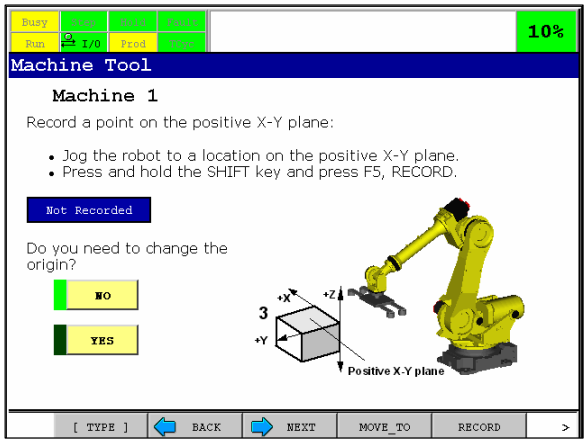

Fig. 3.1.5(f) Setup Machine Station wizard

6. Record the reference point on X-Y plane of the user frame according to the instruction in the screen. When the reference point on X-Y plane is taught correctly, the user frame is set, and the message "New position calculated" is displayed in the status window.
7. If you want to change the origin of the user frame, select YES to the question "Do you need to change origin?" and press the NEXT key. Wizard goes to step 8. If you want not to change origin, select NO and press the NEXT key. Wizard goes to step 10.
8. The screen to teach the origin point of the user frame is displayed.

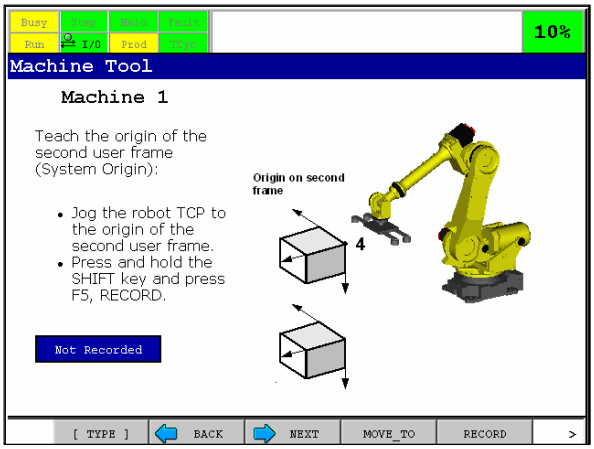

Fig. 3.1.5(g) Setup Machine Station wizard

9. Record the origin of the user frame according to the instruction in the screen. After the origin is taught, press the NEXT key.
10. The screen to confirm the user frame set by the wizard is displayed.

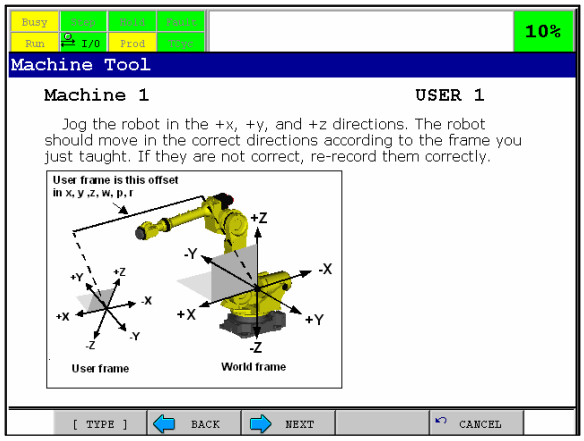

Fig. 3.1.5(h) Setup Machine Station wizard

11. Confirm the user frame set by the wizard according to the instruction in the screen. After confirmation is finished, press the NEXT key. The screen to display the user frame value is displayed.

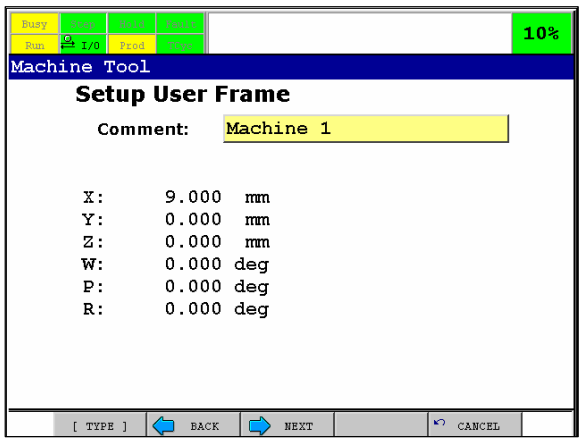

Fig. 3.1.5(i) Setup Machine Station wizard

12. In this screen, you can change the comment of the user frame. After confirmation of the user frame data and change of the comment is finished, press the NEXT key.
13. The screen to teach the macro program to load/unload the parts to the machine tool is displayed.

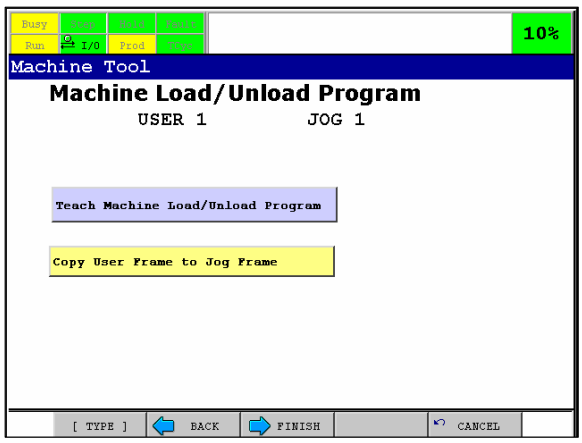

Fig. 3.1.5(j) Setup Machine Station wizard

14. Teach the macro program to load/unload the parts to the machine tool. When “Teach Machine Load/Unload Program” button is pressed, the program edit screen is displayed and the template TP program to load/unload the parts to the machine tool is selected. Please teach the position data and

change the loaded program if required. After the program edit is finished, return to the wizard by pressing F2 MTOOL key in the program edit screen.

15. When "Copy User Frame to Jog Frame" button is pressed, the user frame set by the wizard is copied to the jog frame. In case that only one machine tool is connected to the robot, the user frame is copied to the jog frame whose frame number is 1. In case that the multiple machine tools are connected to the robot, the user frames are copied as follows.

Table 3.1.5 Jog Frame Number that User Frame is copied to

User Frame (Copy Source)	Jog Frame (Copy Destination)
User Frame for machine tool 1	Jog Frame 1
User Frame for machine tool 2	Jog Frame 2
User Frame for machine tool 3	Jog Frame 3
User Frame for machine tool 4	Jog Frame 4

16. If only one machine tool is connected to the robot, press the FINISH key to return to the Process Navigator. If the multiple machine tools are connected to the robot, when the NEXT key is pressed, the first screen of the user frame setup is displayed to set up the user frame for the next machine tool. After setup of the user frame for all machine tools, press the FINISH key to return to the Process Navigator.

3.1.6 Add a Post Process Operation

Post process operation would occur after the robot has retrieved the part from the machine tool but before placing it into the finished part station. If you want to use post process operation, enable post process operation, then teach the program of post process operation.

Procedure 3-6 Operation in Add a Post Process Operation wizard

Steps

1. Press Add a Post Process Operation to display the screen to enable/disable post process operation.

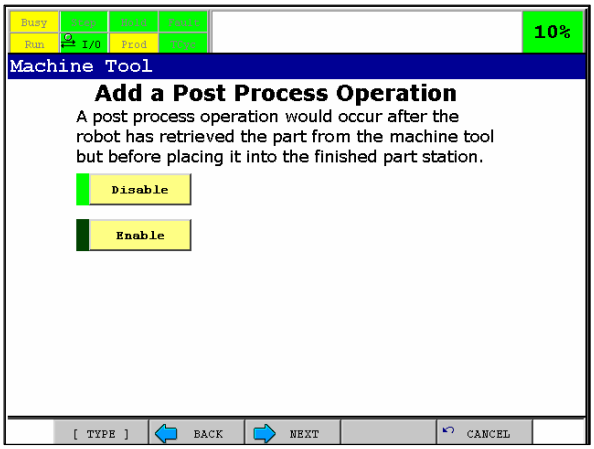

Fig. 3.1.6(a) Add a Post Process Operation wizard

2. If you want to enable the post process operation, select Enable and press the NEXT key. The screen to edit the program of the post process operation is displayed. If you select Disable and press the NEXT key, the Process Navigator screen is displayed.

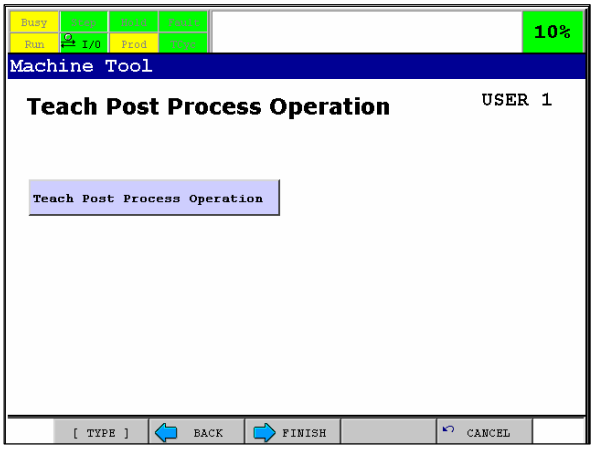

Fig. 3.1.6(b) Add a Post Process Operation wizard

3. Teach the macro program to execute post process operation. When "Teach Post Process Operation" button is pressed, the program edit screen is displayed and the template TP program for post process operation is selected. The template TP program for post process operation is an empty program. Please teach the post process operation in the loaded program. After the program edit is finished, press F2 MTOOL in the program edit screen to return to the wizard. Then, press the FINISH key to return to the Process Navigator.

3.1.7 Setup Finished Part Station

In Setup Finished Part Station wizard, select the type of the finished part station where the robot places the finished part that is picked up from the machine tool, then setup user frame of the finished part station and edit macro program to place the finished part. The finished part station types are described in Table 3.1.7.

Table 3.1.7 Type of Finished Part Station

Type	Description
Fixed location/fixture	Robot places the finished parts on the fixed location or fixture.
Fixed grid (tray, single drawer, etc)	Robot places the finished parts on a fixed 2D grid (e.g. tray, conveyor, single drawer etc.).

Procedure 3-7 Operation in Setup Finished Part Station wizard

Steps

1. Press Setup Finished Part Station to display the screen to select the finished part station type.

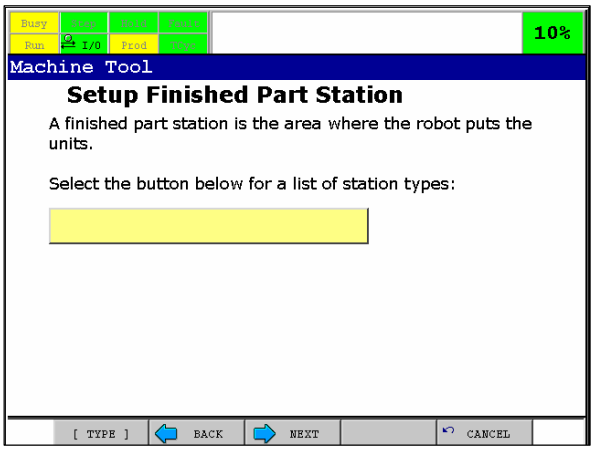

Fig. 3.1.7(a) Setup Finished Part Station wizard

2. Press the yellow box to display menu to select the finished part station type. Refer to Table 3.1.7 and select the finished part station type. After the selection is finished, press the NEXT key. The screen to set up the user frame is displayed.

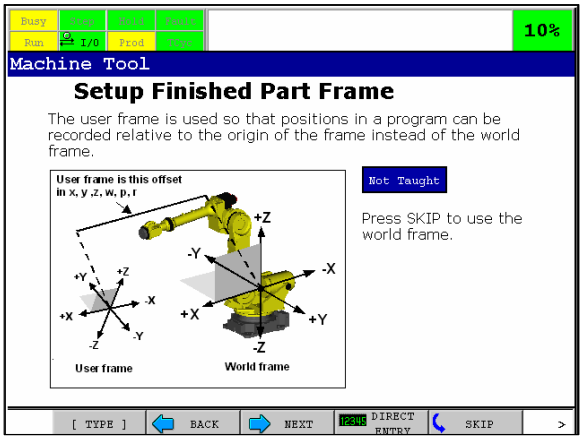

Fig. 3.1.7(b) Setup Finished Part Station wizard

3. In order to start the user frame setup, press the NEXT key to go to step 4. If you use the world frame as the user frame, press the SKIP key to go to step 14. If you want to directly enter the user frame value, press the DIRECT ENTRY key and input the user frame value in the following screen, then press the NEXT key to go to step 14.

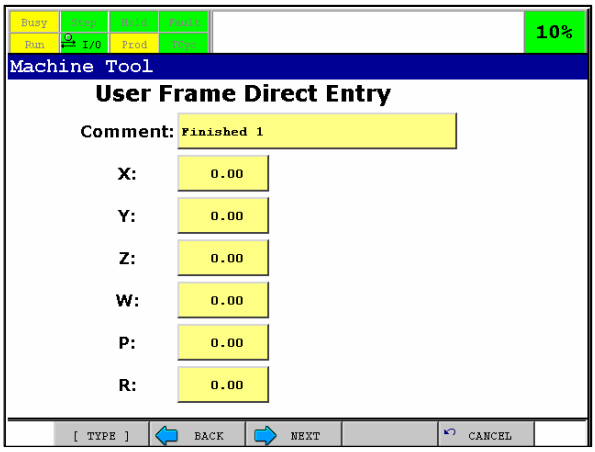

Fig. 3.1.7(c) Setup Finished Part Station wizard

4. The screen to teach the origin of the user frame is displayed.

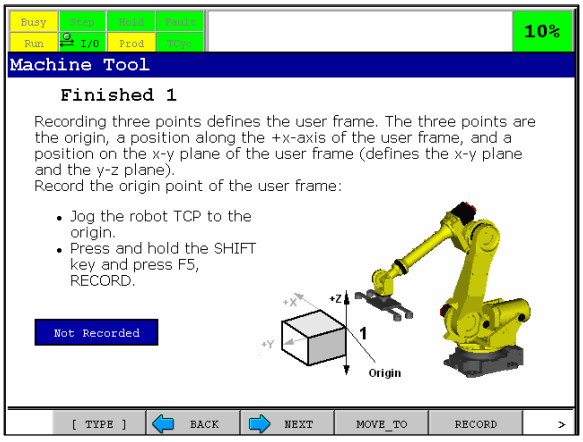

Fig. 3.1.7(d) Setup Finished Part Station wizard

5. Record the origin of the user frame according to the instruction in the screen. If the position is taught correctly, the message " Point recorded" is displayed in the status window, and the caption in the blue lamp is changed to "Recorded" from "Not Recorded". After the origin of the user frame is taught, press the NEXT key. The screen to teach the X direction point of the user frame is displayed.

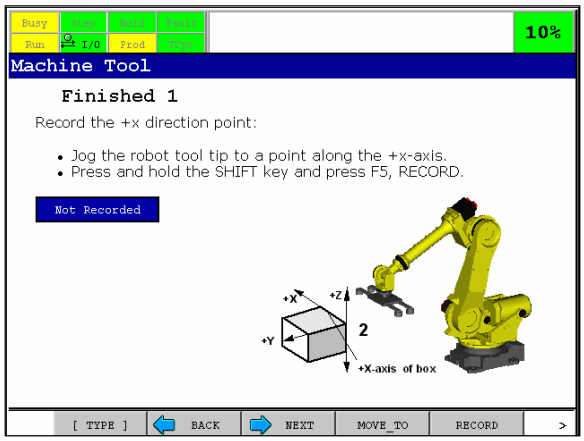

Fig. 3.1.7(e) Setup Finished Part Station wizard

6. Record the X direction point of the user frame according to the instruction in the screen. After the X direction point is taught, press the NEXT key. The screen to teach the X-Y plane of the tool frame is displayed.

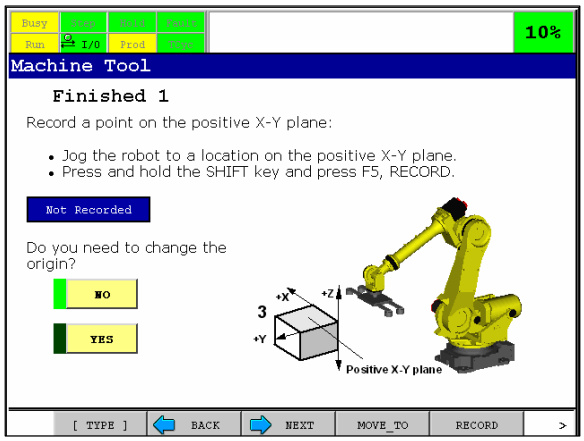

Fig. 3.1.7(f) Setup Finished Part Station wizard

7. Record the reference point on X-Y plane of the user frame according to the instruction in the screen. When the reference point on X-Y plane is taught correctly, the user frame is set, and the message "New position calculated" is displayed in the status window.
8. If you want to change the origin of the user frame, select YES to the question "Do you need to change origin?" and press the NEXT key. Wizard goes to step 9. If you want not to change origin, select NO and press the NEXT. Wizard goes to step 11.
9. The screen to teach the origin point of the user frame is displayed.

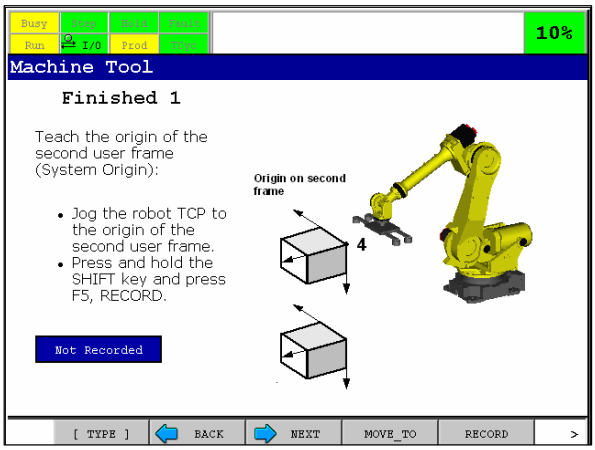

Fig. 3.1.7(g) Setup Finished Part Station wizard

10. Record the origin of the user frame according to the instruction in the screen. After the origin is taught, press the NEXT key.
11. The screen to confirm the user frame set by the wizard is displayed.

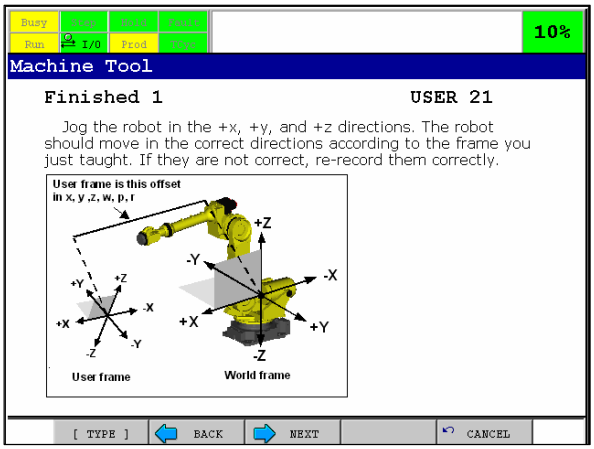

Fig. 3.1.7(h) Setup Finished Part Station wizard

12. Confirm the user frame set by the wizard according to the instruction in the screen. After confirmation is finished, press the NEXT key. The screen to display the user frame value is displayed.

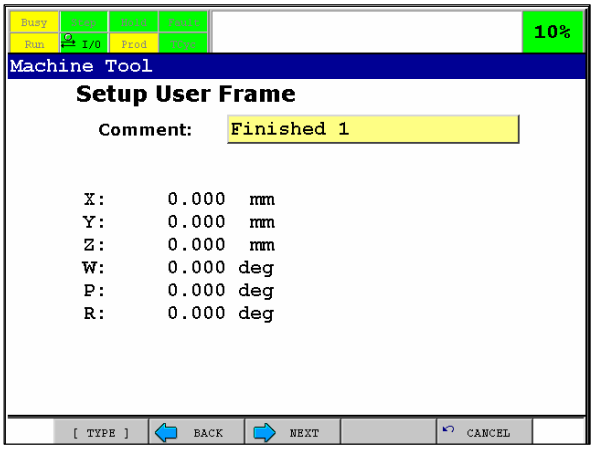

Fig. 3.1.7(i) Setup Finished Part Station wizard

13. In this screen, you can change the comment of the user frame. After confirmation of the user frame data and change of the comment is finished, press the NEXT key.
14. The screen to teach the macro program to place the finished part is displayed.

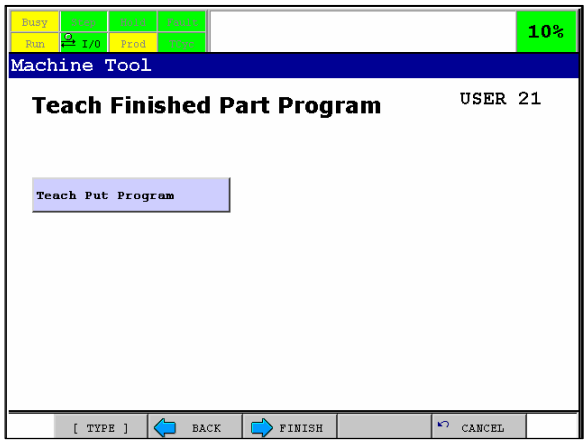

Fig. 3.1.7(j) Setup Finished Part Station wizard

15. Teach the macro program to place the finished part. When "Teach Put Program" button is pressed, the program edit screen is displayed and the template TP program to place the finished part is selected. Please teach the position data and change the loaded program if required. After the program edit is finished, return to the wizard by pressing F2 MTOOL in the program edit screen.
16. Press the FINISH key to return to the Process Navigator.

3.1.8 Setup Machine Diagnostics

This is a shortcut button to setup screen of Visual Diagnostics. Setup Visual Diagnostics function to diagnose the machine tool.

> **Note**
> "Setup Machine Diagnostics" button is shown only when Visual Diagnostics option (A05B-2600-R702) is loaded.

3.2 TEACH CELL

Teach Cell is used to teach home position, maintenance position and PNS program. The functions in Teach Cell are as follows.

Table 3.2 Function in Teach Cell

Function	Description
Teach Home Position	Shortcut to TP Editor with the home position macro.
Teach Maintenance Position	Shortcut to TP Editor with the maintenance program.
Program Number Selection	Wizard to create and edit PNS programs which can be started by CNC.
Teach Reference Position	Shortcut to Reference Position menu. When using Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2, the robot program can be started by CNC only when the robot is at reference position 1.
Edit Main Program	Shortcut to TP Editor with the main program when none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded.

3.2.1 Teach Home Position

In Teach home position, teach home position and edit the macro program to move the robot to home position.

Procedure 3-8 Operation to teach Home Position

Steps

1. Press Teach Home Position to display the TP Editor with the home position macro program.
2. Teach home position and the macro program to move the robot to home position. After home position is taught, define the taught position as the reference position in SETUP Reference Position menu.
3. After teaching of home position is finished, press F2 MTOOL to return to the Process Navigator.

3.2.2 Teach Maintenance Position

In Teach Maintenance Position, teach the maintenance position that is the position to maintain the robot and edit the macro program to move the robot to the maintenance position.

Procedure 3-9 Operation to teach Maintenance Position

Steps

1. Press Teach Maintenance Position to display the TP Editor with the maintenance position macro program.
2. Teach maintenance position and the macro program to move the robot to the maintenance position.
3. After teaching of the maintenance position is finished, press F2 MTOOL to return to the Process Navigator.

3.2.3 Program Number Selection

In Program Number Selection, teach PNS program that is started by CNC. The procedure for the case that Machine Tool Connection is loaded is different from the procedure for the case that ROBODRILL Connection or ROBODRILL Connection 2 is loaded. When none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, the procedure is equal to the procedure for the case that Machine Tool Connection is loaded.

Procedure 3-10 Operation in Program Number Selection wizard

Steps

In case that Machine Tool Connection is loaded

In case that Machine Tool Connection is loaded, the loaded template TP program varies depending on the start method of the program. In Program Number Selection wizard, select the start method, and edit the loaded program.

Table 3.2.3 Program Start method

Program Start method	Description
Normal Start	The robot program is started when machining by the machine tool is finished.
Overlap Start	The robot program is started before machining by the machine tool is finished. The robot moves in front of the machine tool and waits for the end of machining.

1. Press Program Number Selection in Teach Cell to display the screen to teach PNS program.

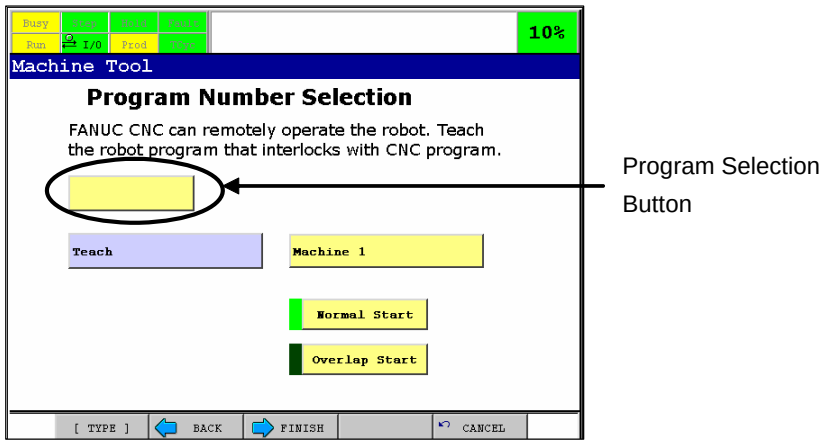

Fig. 3.2.3(a) Program Number Selection wizard

2. Press Program Selection Button in the upper left of the screen, and select <New Program> in the displayed menu. The following pop-up is displayed.

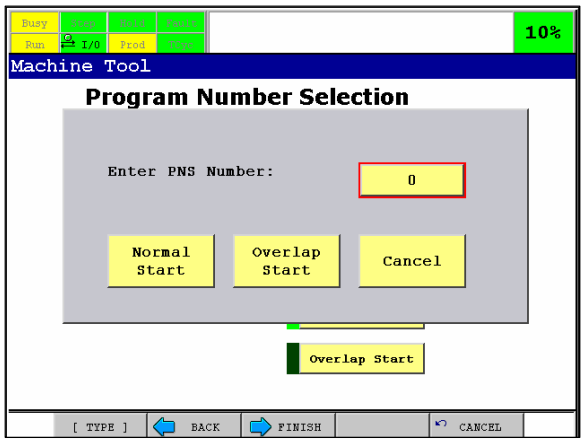

Fig. 3.2.3(b) Program Number Selection wizard

In case that the multiple machine tools are connected to the robot, the following pop-up is displayed.

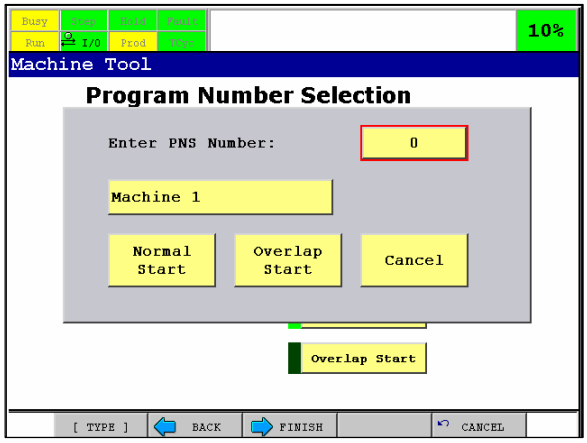

Fig. 3.2.3(c) Program Number Selection wizard

3. Enter PNS number. And, if the multiple machine tools are connected to the robot, select the machine tool number. Then, select the program start method from Normal Start and Overlap Start. The template TP program corresponding to the selected start method is loaded, and the name of the loaded program is PNS****.TP (**** is the PNS number entered on pop-up). When Cancel button is pressed, pop-up disappears without loading the program.

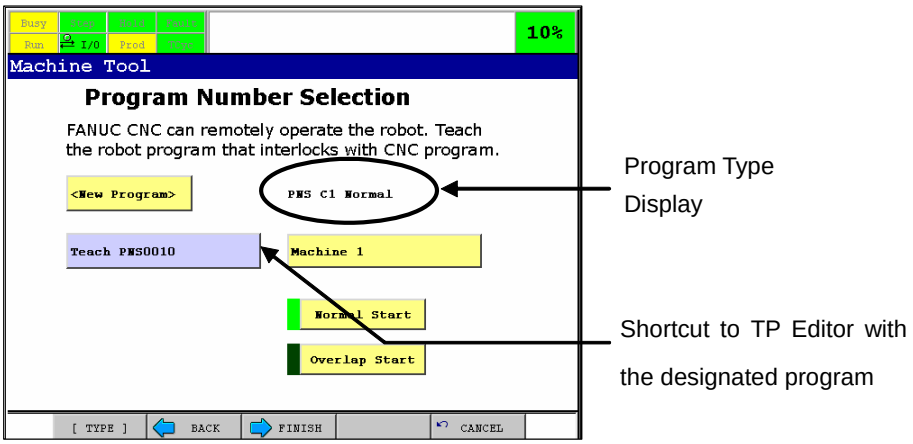

Fig. 3.2.3(d) Program Number Selection wizard

4. When the template TP program is loaded properly, the type of the loaded program is displayed in the right of program selection button as follows. And the name of the loaded program is displayed on the shortcut button to TP editor.

PNS	C1	Normal
(1)	(2)	(3)

(1) This means that this program is PNS program.
(2) CNC number
(3) Start method

5. Press the shortcut to TP editor, and teach the program. After the program edit, press F2 MTOOL to return to Program Number Selection wizard.
6. Press the FINISH key to return to the Process Navigator.

In case that ROBODRILL Connection or ROBODRILL Connection 2 is loaded

1. Press Program Number Selection in Teach Cell to display the screen to teach PNS program.

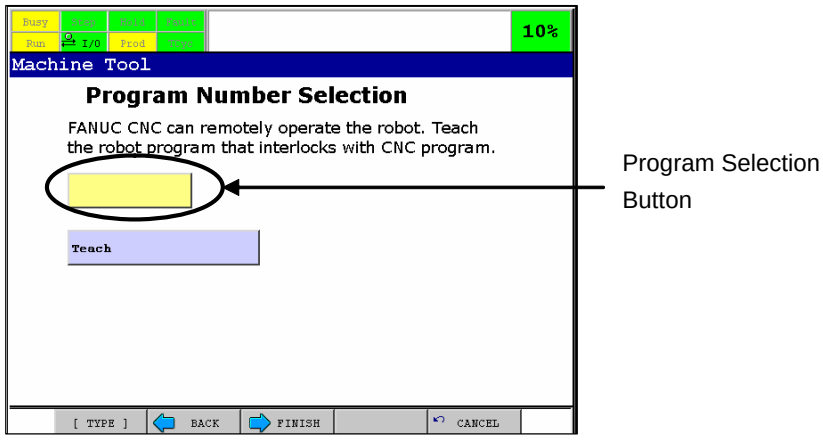

Fig. 3.2.3(e) Program Number Selection wizard

2. Press Program Selection Button in the upper left of the screen, and select <New Program> in the displayed menu. The following pop-up is displayed.

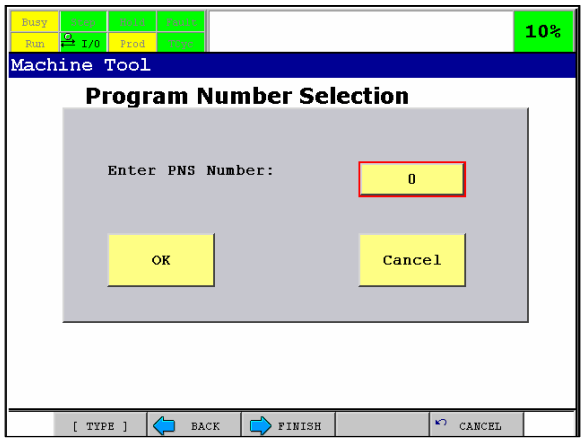

Fig. 3.2.3(f) Program Number Selection wizard

3. Enter PNS number and press “OK” button. The template TP program corresponding to the number of the connected machine tools is loaded, and the name of the loaded program is PNS****.TP (**** is the PNS number entered on pop-up). When Cancel button is pressed, pop-up disappears without loading the program.

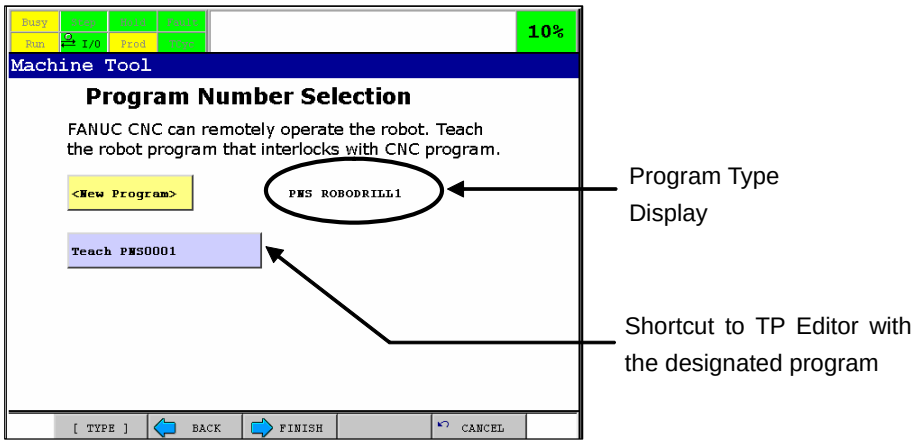

Fig. 3.2.3(g) Program Number Selection wizard

4. When the template TP program is loaded properly, the type of the loaded program is displayed in the right of program selection button as follows. And the name of the loaded program is displayed on the shortcut button to TP editor.

PNS	ROBODRILL1
(1)	(2)

(1) This means that this program is PNS program.
(2) In ROBODRILL Connection, in case that only one ROBODRILL is connected to the robot, “ROBODRILL1” is displayed. In case that two ROBODRILLs are connected to the robot, “ROBODRILL1,2” is displayed.
In ROBODRILL Connection function 2, "DRILL1" is displayed for one ROBODRILL system and "DRILL1,2" for two, "DRILL1,2,3" for three, "DRILL1,2,3,4" for four.

5. Press the shortcut to TP editor, and teach the program. After the program edit, press F2 MTOOL to return to Program Number Selection wizard.
6. Press the FINISH key to return to the Process Navigator.

3.2.4 Teach Reference Position

In Teach Reference Position, set the position taught in Teach Home Position as home position. Especially, when Machine Tool Connection function, ROBODRILL Connection function or ROBODRILL Connection function 2 is used, PNS program can be started only when the robot is at reference position 1.

Procedure 3-11 Operation to teach reference position

Steps

1. Press Teach Reference Position in Teach Cell to display the SETUP reference position screen.
2. Set the position taught in Teach Home Position to the reference position.
3. If setting is finished, press the MENU key on the *i*Pendant and select Machine Tool from UTILITIES or press the F1 key in the Menu Favorites dialog to return to the Process Navigator.

3.2.5 Edit Main Program

In Edit Main Program, teach main program when none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded and PNS program is not used.

> **Note**
> "Edit Main Program" button is shown only when none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded.

Procedure 3-12 Operation to edit main program

Steps

1. Press Edit Main Program in Teach Cell to display TP Editor with the main program.
2. Edit main program. After the program edit, press F2 MTOOL to return to the Process Navigator.

3.3 RUN PRODUCTION

Run Production is used to monitor production after setup in Define the Cell and teaching in Teach Cell. The functions in Run Production are as follows.

Table 3.3 Function in Run Production

Function	Description
Production Status	Shortcut to a Production Status screen. This screen can be changed using the BROWSER Panel Wizard menu. Start the Panel Wizard and select Panel 1.
CNC Status	Shortcut to CNC Status screen if Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded. If none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, this will link to the Browser Favorites menu. If CNC has a web server, a link can be made to display its information.
View Machine Diagnostics	Shortcut to STATUS Visual Diagnostics if Visual Diagnostics option is loaded.
Manual CNC Operation	Shortcut to Machine Operation screen. This is shown only if Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded. This screen enables you to operate jog feed of the connected machine tool.

3.3.1 Production Status

In Production Status, the Production Status screen that monitors the counter and the running status is displayed.

Procedure 3-13 Operation to monitor production status

Steps

1. Press Production Status in Run Production to display the Production Status screen.

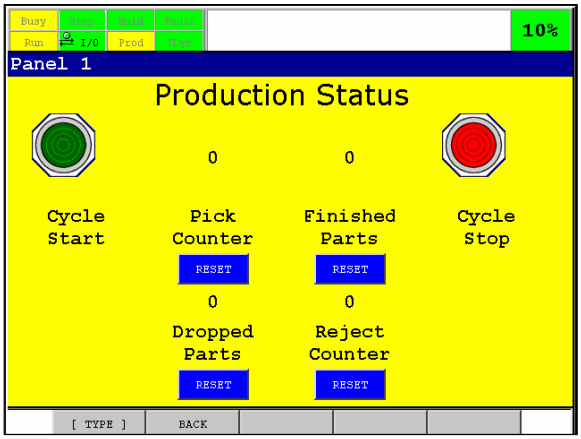

Fig. 3.3.1 Production Status screen

2. Some counters set in the following registers are displayed. Each counter can be cleared by reset button. Cycle Start and Cycle Stop lamps indicate the running status.

Table 3.3.1 Register for the counter

Counter	Register
Pick Counter	R[2]
Dropped Counter	R[3]
Reject Counter	R[4]
Finished Parts	R[5]

3. In order to return to the Process Navigator, press F2 BACK key.

3.3.2 CNC Status

In CNC Status, there are several screens to monitor following CNC status by communication with CNC.

- CNC Actual Position
- CNC Alarm
- CNC Message
- CNC Running Program
- I/O data connected with CNC

In case that none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, the Browser Favorites menu is displayed. If the CNC connected with the robot has a web server, it is possible to display its information.

Procedure 3-14 Operation to monitor CNC status

Steps

1. Press CNC Status in Run Production to display the CNC Status screen.

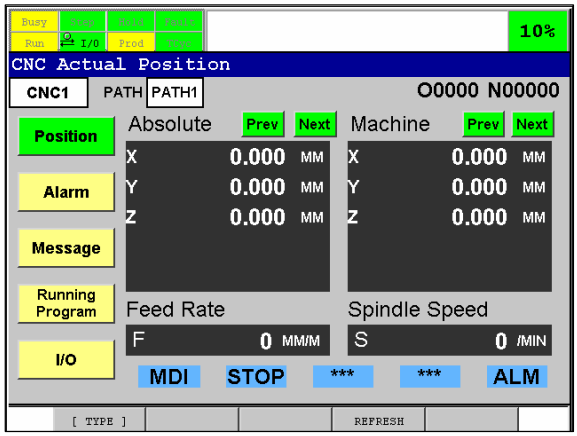

Fig. 3.3.2(a) CNC Status screen

In case that none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, the Browser Favorites screen is displayed.

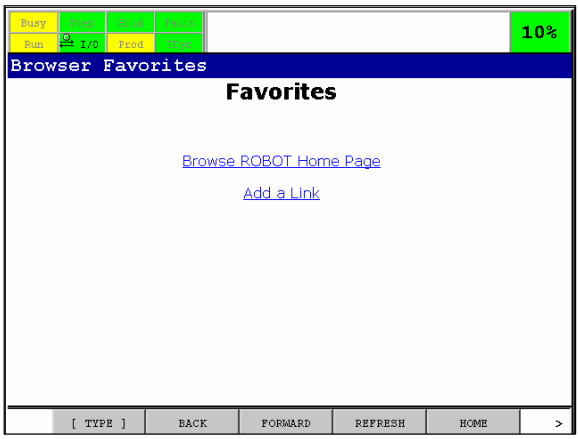

Fig. 3.3.2(b) Browser Favorites screen

2. In order to return to the Process Navigator, press the MENU key on the *i*Pendant and select Machine Tool from UTILITIES or press the F1 key in the Menu Favorites dialog.

3.3.3 View Machine Diagnostics

In View Machine Diagnostics, STATUS Visual Diagnostics screen is displayed to diagnose the machine tool status. In order to use Visual Diagnostics function, it is required to set up Visual Diagnostics function by Setup Machine Diagnostics in Define the Cell in advance.

> **Note**
> "View Machine Diagnostics" button is shown only when Visual Diagnostics option (A05B-2600-R702) is loaded.

Procedure 3-15 Operation to view machine diagnostics

Steps

1. Press View Visual Diagnostics in Run Production to display the STATUS Visual Diagnostics screen.

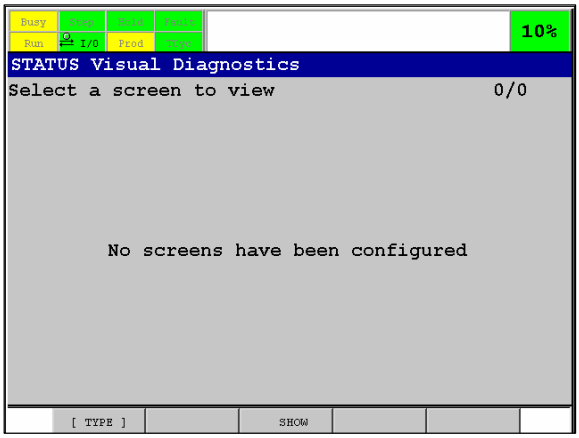

Fig. 3.3.3 Visual Diagnostics screen

2. In order to return to the Process Navigator, press the MENU key on the *i*Pendant and select Machine Tool from UTILITIES or press the F1 key in the Menu Favorites dialog.

3.3.4 Manual CNC Operation

In Manual CNC Operation, the Machine Tool Operation screen of Machine Tool Connection function, ROBODRILL Connection function or ROBODRILL Connection function 2 is displayed. In the Machine Tool Operation screen, it is possible to operate jog feed of Machine Tool from *i*Pendant.

Note
"Manual CNC Operation" button is shown only when Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded.

Procedure 3-16 Operation of CNC

Step

1. Press Manual CNC Operation in Run Production to display the Machine Tool Operation screen.

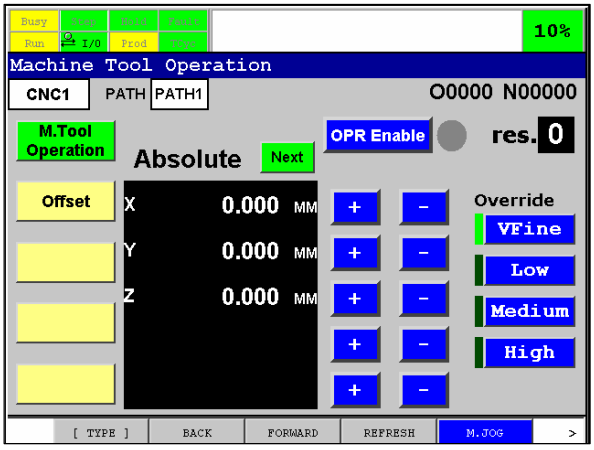

Fig. 3.3.4 Machine Tool Operation screen

2. In order to return to the Process Navigator, press the MENU key on the *i*Pendant and select Machine Tool from UTILITIES or press the F1 key in the Menu Favorites dialog.

4 TEMPLATE TP PROGRAM

This chapter describes the loaded TP program by the wizard.

4.1 PROGRAM SEQUENCE

The program sequence taught by the Process Navigator is as follows.

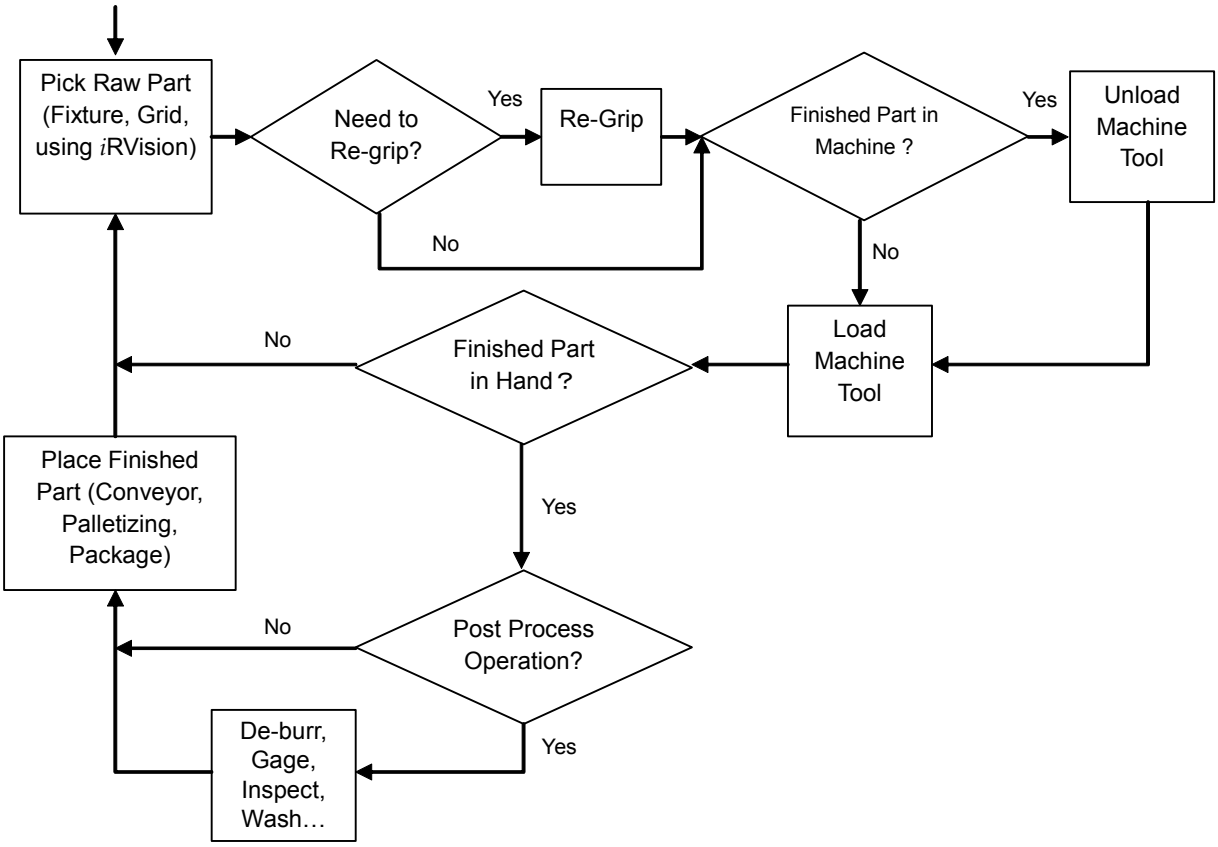

Fig. 4.1 CNC Tending Flowchart

4.2 TEMPLATE TP PROGRAM LIST

The template TP programs loaded by the wizard are as follows.

Table 4.2 Template TP Program

Program	Gripper Type	Description
GRIPOPEN.TP	Single	This macro opens the gripper.
GRIPCLOS.TP	Single	This macro closes the gripper.
RAWOPEN.TP	Dual	This macro opens the raw part gripper.
RAWCLOSE.TP	Dual	This macro closes the raw part gripper.
FINOPEN.TP	Dual	This macro opens the finished part gripper.
FINCLOS.TP	Dual	This macro closes the finished part gripper.

Program	Gripper Type	Description
MTSHOME.TP		When one of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, this macro sends the robot to home position.
MT_HOME.TP		When none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, this macro sends the robot to home position.
MT_MAINT.TP		This macro sends the robot to the maintenance position.
MT_MAIN.TP		When none of Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is loaded, this program initializes the machine tending process. If CNC will not signal a PNS program to run, then this program can be changed to handle the tending process. Please refer to the Program Number Selection templates for an example.
MT_PIK01.TP		This program picks the raw part from a fixed location/fixture.
MT_PIK02.TP		This program picks the raw part from a flexible location using *i*RVision 2D with fixed overhead camera.
MT_PIK03.TP		This program picks the raw part from a fixed 2D grid (e.g. tray, conveyor, single drawer etc.).
MT_PIK04.TP		This program picks the raw part from a flexible grid using 2D with fixed overhead camera (e.g. parts from a tray, table, conveyor, drawer etc.).
MT_PIK05.TP		This program picks the raw part from a fixed 2D grid with multiple drawers.
MT_PRP01.TP		This program pre processes the raw part. It contains commands for reorient and regrip. It can be modified to handle any pre processing necessary.
MT_LUL11.TP	Single	This program loads/unloads machine 1.
MT_LUL12.TP	Single	This program loads/unloads machine 2.
MT_LUL13.TP	Single	This program loads/unloads machine 3.
MT_LUL14.TP	Single	This program loads/unloads machine 4.
MT_LUL21.TP	Dual	This program loads/unloads machine 1.
MT_LUL22.TP	Dual	This program loads/unloads machine 2.
MT_LUL23.TP	Dual	This program loads/unloads machine 3.
MT_LUL24.TP	Dual	This program loads/unloads machine 4.
MT_POP01.TP		This program post processes the finished part. This is an empty program. It can be modified to handle any post processing necessary.
MT_NOPR.TP		This program is used when pre or post processing is not required.
MT_PUT11.TP	Single	This program places the finished part to a single fixture.
MT_PUT12.TP	Single	This program places the finished part to a grid (e.g. table, tray, conveyor or drawer).
MT_PUT21.TP	Dual	This program places the finished part to a single fixture.
MT_PUT22.TP	Dual	This program places the finished part to a grid (e.g. table, tray, conveyor or drawer).
MT_PNS11n.TP MT_PNS12n.TP MT_PNS13n.TP MT_PNS14n.TP	Single	Program Number Selection template for normal CNC start with CNC 1-4. This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.

Program	Gripper Type	Description
MT_PNS11o.TP MT_PNS12o.TP MT_PNS13o.TP MT_PNS14o.TP	Single	Program Number Selection template for overlap CNC start with CNC 1-4. This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.
MT_PNS21n.TP MT_PNS22n.TP MT_PNS23n.TP MT_PNS24n.TP	Dual	Program Number Selection template for normal CNC start with CNC 1-4. This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.
MT_PNS21o.TP MT_PNS22o.TP MT_PNS23o.TP MT_PNS24o.TP	Dual	Program Number Selection template for overlap CNC start with CNC 1-4. This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.
RD_LUL11.TP	Single	This program loads/unloads ROBODRILL 1 (for ROBODRILL Connection) .
RD_LUL12.TP	Single	This program loads/unloads ROBODRILL 2 (for ROBODRILL Connection) .
RD_LUL21.TP	Dual	This program loads/unloads ROBODRILL 1 (for ROBODRILL Connection) .
RD_LUL22.TP	Dual	This program loads/unloads ROBODRILL 2 (for ROBODRILL Connection) .
RD_PNS11.TP RD_PNS12.TP	Single	Program Number Selection template with ROBODRILL 1-2 (for ROBODRILL Connection). This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.
RD_PNS21.TP RD_PNS22.TP	Dual	Program Number Selection template with ROBODRILL 1-2 (for ROBODRILL Connection). This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.
R2_LUL11.TP	Single	This program loads/unloads ROBODRILL 1 (for ROBODRILL Connection 2).
R2_LUL12.TP	Single	This program loads/unloads ROBODRILL 2 (for ROBODRILL Connection 2).
RL_LUL13.TP	Single	This program loads/unloads ROBODRILL 3 (for ROBODRILL Connection 2).
RL_LUL14.TP	Single	This program loads/unloads ROBODRILL 4 (for ROBODRILL Connection 2).
R2_LUL21.TP	Dual	This program loads/unloads ROBODRILL 1 (for ROBODRILL Connection 2).
R2_LUL22.TP	Dual	This program loads/unloads ROBODRILL 2 (for ROBODRILL Connection 2).
R2_LUL23.TP	Dual	This program loads/unloads ROBODRILL 3 (for ROBODRILL Connection 2).
R2_LUL24.TP	Dual	This program loads/unloads ROBODRILL 4 (for ROBODRILL Connection 2).
R2_PNS11.TP R2_PNS12.TP R2_PNS13.TP R2_PNS14.TP	Single	Program Number Selection template with ROBODRILL 1-4 (for ROBODRILL Connection 2). This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.
R2_PNS21.TP R2_PNS22.TP R2_PNS23.TP R2_PNS24.TP	Dual	Program Number Selection template with ROBODRILL 1-4 (for ROBODRILL Connection 2). This template will be ascii uploaded to PNS****.TP based on the number you select in the Program Number Selection wizard.

4.3 DETAIL OF PROGRAM

4.3.1 Raw Part Pick Programs

One of the following programs is loaded according to the selection of Part Infeed Station type.

Fixed Location/Fixture: MT_PIK01.TP

- This is the program to pick the raw part on the fixed location or fixture.
- The robot moves to the pick position via the approach position. After the robot grips the part, the robot moves to the retract position.
- Teach the pick position to the position register [11], and set the offset to the approach position to the position register [10], and set the offset to the retract position to the position register [12].

Flexible location using *i*RVision 2D: MT_PIK02.TP

- This is the program to pick the raw part from flexible position by detection using *i*RVision 2D.
- After the detection of the part, the robot moves to the pick position via the approach position. Then the robot grips the part and moves to the retract position. The approach position, the pick position, and the retract position are all compensated by the vision offset.
- Teach the pick position to the position register [11], and set the offset to the approach position to the position register [10], and set the offset to the retract position to the position register [12].

Fixed Grid: MT_PIK03.TP

- This is the program to picks the raw part from a fixed 2D grid as follows.

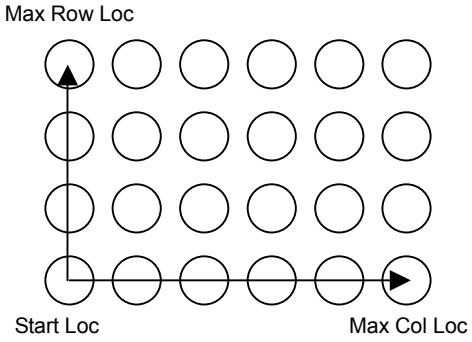

Fig. 4.3.1 Grid Example

- The position data that is required to teach is only Start Location. Other positions are calculated by the counter and the offset in the row and column direction.
- The robot moves to the pick position via the approach position. After the robot grips the part, the robot moves to the retract position.
- Teach Start Location to the position register [5], and set the offset to the approach position to the position register [10], and set the offset to the retract position to the position register [12].
- Set maximum row number to the register [18], and maximum column number to the register [19].
- Set the offset in the row direction to the register [16], and the offset in the column direction to the register [17].

Flexible grid with *i*RVision-2D: MT_PIK04.TP

- This is the program to pick the raw part from a flexible grid by detection using *i*RVision 2D.
- After the detection of the part, the robot moves to the pick position via the approach position. Then the robot grips the part and moves to the retract position. The approach position, the pick position, and the retract position are all compensated by the vision offset.
- Teach the nominal pick position to the position register [11], and set the offset to the approach position to the position register [10], and set the offset to the retract position to the position register [12].

Multiple drawers: MT_PIK05.TP

- This is the program to pick the raw part from a 2D grid in multiple drawers.
- Up to a maximum 10 drawers are supported.

- Robot is programmed to open the drawer, pick up the parts one by one and then close the drawer before proceeding to the next drawer.
- The drawers are set up to be serviced from top to bottom.
- The robot motion in each drawer is the same as the robot motion of MT_PIK03.TP.
- Teach Start Location to the position register [5], and set the offset to the approach position to the position register [10], and set the offset to the retract position to the position register [12].
- Set maximum row number to the register [14], and maximum column number to the register [15].
- Set the offset in the row direction to the register [16], and the offset in the column direction to the register [17].
- Teach the position to open and close the drawer to the position data in the program. Refer to comment of the position data to teach position.

4.3.2 Load/Unload Programs

The following programs are loaded according to the selected gripper type and the number of machine tools that are connected to the robot.

Single gripper: MT_LUL11.TP, MT_LUL12.TP, MT_LUL13.TP, MT_LUL14.TP

- These are the programs to place the raw part to the machine tool and pick up the finished part from the machine tool by single gripper.
- These programs have two arguments.
  - In case that first argument is 1 and the second argument is 0, the robot loads the raw part.
  - In case that first argument is 0 and the second argument is 1, the robot unloads the finished part.
  - In other cases, user alarm [1] “Incorrect Service” occurs.
- MT_LUL11.TP is the program for machine tool 1. MT_LUL12.TP is the program for machine tool 2, MT_LUL13.TP is for machine tool 3, and MT_LUL14 is for machine tool 4. According to the number of machine tools that are connected to the robot, some of these programs are loaded.
- In MT_LUL11.TP, teach the position to place the raw part to the position register [34], and set the offset to the approach point to the position register [35], and set the offset to the retract point to the position register [36]. And teach the position to pick up the finished part to the position register [37], and set the offset to the approach point to the position register [38], and set the offset to the retract point to the position register [39]. Furthermore, teach the inside position of the machine tool that is passed before the approach point to the position register [30]. This position is used as the position that is passed before the robot goes out of the machine tool from the retract point.
- In case that multiple machine tools are connected to the robot, the position registers that are required to teach are as follows.

Table 4.3.2(a) Position Register to teach (Single Gripper)

Position	Position Register Number			
	MT_LUL11.TP	MT_LUL12.TP	MT_LUL13.TP	MT_LUL14.TP
Position to place the raw part	PR[34]	PR[44]	PR[54]	PR[64]
Approach point for place position (Offset from the place position)	PR[35]	PR[45]	PR[55]	PR[65]
Retract point for place position (Offset from the place position)	PR[36]	PR[46]	PR[56]	PR[66]
Position to pick up the finished part	PR[37]	PR[47]	PR[57]	PR[67]
Approach point for pick up position (Offset from the pick up position)	PR[38]	PR[48]	PR[58]	PR[68]
Retract point for pick up position (Offset from the pick up position)	PR[39]	PR[49]	PR[59]	PR[69]
Passing point in the machine tool	PR[30]	PR[40]	PR[50]	PR[60]

Dual Gripper: MT_LUL21.TP, MT_LUL22.TP, MT_LUL23.TP, MT_LUL24.TP

- These are the programs to place the raw part to the machine tool and pick up the finished part from the machine tool by dual gripper.
- These programs have two arguments.
  - In case that first argument is 1 and the second argument is 0, the robot loads the raw part.
  - In case that first argument is 0 and the second argument is 1, the robot unloads the finished part.
  - In case that first argument is 1 and the second argument is 1, the robot unloads the finished part and loads the raw part.
  - In other cases, user alarm [1] "Incorrect Service" is posted.
- MT_LUL21.TP is the program for machine tool 1. MT_LUL22.TP is the program for machine tool 2, MT_LUL23.TP is for machine tool 3, and MT_LUL24 is for machine tool 4. According to the number of machine tools that are connected to the robot, some of these programs are loaded.
- In MT_LUL21.TP, teach the position to place the raw part to the position register [34], and set the offset to the approach point to the position register [35], and set the offset to the retract point to the position register [36]. And teach the position to pick up the finished part to the position register [37], and set the offset to the approach point to the position register [38], and set the offset to the retract point to the position register [39]. Furthermore, teach the inside position of the machine tool that is passed before the approach point at loading the part to the position register [30], and teach the inside position of the machine tool that is passed before the approach point at unloading the part to the position register [31]. These positions are used as the position that is passed before the robot goes out of the machine tool from the retract point.
- In case that multiple machine tools are connected to the robot, the position registers that are required to teach are as follows.

Table 4.3.2(b) Position Register to teach (Dual gripper)

Position	Position Register Number			
	MT_LUL21.TP	MT_LUL22.TP	MT_LUL23.TP	MT_LUL24.TP
Position to place the raw part	PR[34]	PR[44]	PR[54]	PR[64]
Approach point for place position (Offset from the place position)	PR[35]	PR[45]	PR[55]	PR[65]
Retract point for place position (Offset from the place position)	PR[36]	PR[46]	PR[56]	PR[66]
Position to pick up the finished part	PR[37]	PR[47]	PR[57]	PR[67]
Approach point for pick up position (Offset from the pick up position)	PR[38]	PR[48]	PR[58]	PR[68]
Retract point for pick up position (Offset from the pick up position)	PR[39]	PR[49]	PR[59]	PR[69]
Passing point in the machine tool (When part is loaded)	PR[30]	PR[40]	PR[50]	PR[60]
Passing point in the machine tool (When part is unloaded)	PR[31]	PR[41]	PR[51]	PR[61]

4.3.3 Finished Part Place Program

One of the following programs is loaded according to the selection of Finished Part Station type.

Fixed Location/Fixture: MT_PUT11.TP, MT_PU21.TP

- This is the program to place the finished part on the fixed location or fixture.
- The robot moves to the place position via the approach position. After the robot releases the part, the robot moves to the retract position.
- Teach the place position to the position register [16], and set the offset to the approach position to the position register [15], and set the offset to the retract position to the position register [17].

- MT_PUT11.TP is the program for single gripper, and MT_PUT21.TP is the program for dual gripper.

Fixed Grid: MT_PUT12.TP, MT_PUT22.TP

- This is the program to place the finished part to a fixed 2D grid as follows.

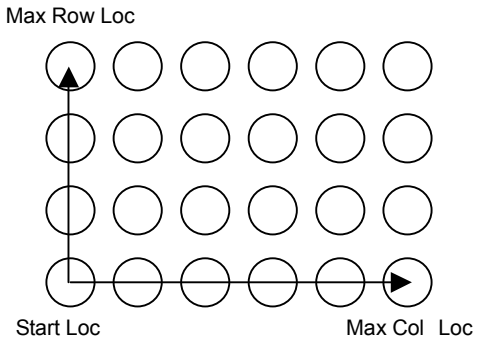

Fig. 4.3.3 Grid Example

- The position data that is required to teach is only Start Location. Other positions are calculated by the counter and the offset in the row and column direction.
- The robot moves to the place position via the approach position. After the robot releases the part, the robot moves to the retract position.
- Teach Start Location to the position register [6], and set the offset to the approach position to the position register [15], and set the offset to the retract position to the position register [17].
- Set maximum row number to the register [24], and maximum column number to the register [25].
- Set the offset in the row direction to the register [22], and the offset in the column direction to the register [23].
- MT_PUT12.TP is the program for single gripper, and MT_PUT22.TP is the program for dual gripper.

4.3.4 PNS Program

The following programs are loaded according to the selected gripper type and setting in Program Number Selection wizard.

Single Gripper, Normal Start: MT_PNS11n.TP - MT_PNS14n.TP

- This is the PNS program for single gripper that is started by Normal Start.
- GI[1] defines the service type for CNC.
  - GI[1]=1; The robot picks up a work piece from the Infeed Station and loads a work piece to machine tool. In this case, the robot executes only the load of a work piece because a processed work piece is not in the machine tool.
  - GI[1]=3; The robot unloads a processed work piece from the machine tool and places the work piece at the Finished Part Station.
  - Otherwise user alarm [1] “Incorrect Service“ is posted.
- Teach the outside position of the machine tool that the robot checks the condition to enter the machine tool to the position register [32]. This position is used as the position that is passed before the robot goes out of the machine tool from the retract point.

Single Gripper, Overlap Start: MT_PNS11o.TP - MT_PNS14o.TP

- This is the PNS program for single gripper that is started by Overlap Start.
- Same as MT_PNS1*n except provides an Overlap Start.
- In case that only unloading a work piece is executed, the robot moves to the position in front of the machine tool and waits until Service Call signal is turned on. When Service Call signal is turned on,

the robot moves into the machine tool and designated process is executed. After the process executed into the machine tool is ended, when the robot moves to the position out of the machine tool, the robot turns off Service Completed signal to release waiting in CNC program. Service Completed signal is turned off when Service Call Signal is turned off.

Dual gripper, Normal Start: MT_PNS21n.TP - MT_PNS24n.TP

- This is the PNS program for dual gripper that is started by Normal Start.
- GI [1] defines the service type for CNC.
  - GI[1]=1; The robot picks up a work piece from the Infeed Station and loads a work piece to machine tool. In this case, the robot executes only the load of a work piece because a processed work piece is not in the machine tool.
  - GI[2]=1; The robot moves into the machine tool with holding an unprocessed work piece, then unloads a processed work piece at first, and loads an unprocessed work piece.
  - GI[1]=3; The robot unloads a processed work piece from the machine tool at cycle ends.
  - Otherwise user alarm [1] "Incorrect Service" is posted.
- Teach the outside position of the machine tool that the robot checks the condition to enter the machine tool at loading the part to the position register [32] and teach the outside position of the machine tool that the robot checks the condition to enter the machine tool at unloading the part to the position register [33]. These positions are used as the position that is passed before the robot goes out of the machine tool from the retract point.

Dual Gripper, Overlap Start: MT_PNS21o.TP - MT_PNS24o.TP

- This is the PNS program for dual gripper that is started by Overlap Start.
- Same as MT_PNS2*n except provides an Overlap Start.
- In case that both loading and unloading a work piece are executed in the same cycle and only unloading a work piece is executed at ending cycle, the robot moves to the position in front of the machine tool and waits until Service Call signal is turned on. When Service Call signal is turned on, the robot moves into the machine tool and designated process is executed. After the process executed into the machine tool is ended, when the robot moves to the position out of the machine tool, the robot turns off Service Completed signal to release waiting in CNC program. Service Completed signal is turned off when Service Call Signal is turned off.

4.3.5 Load/Unload Programs for ROBODRILL Connection

In case that ROBODRILL Connection or ROBODRIL Connection 2 is loaded, the following programs are loaded according to the selected gripper type and the number of ROBODRILLs that are connected to the robot. These programs are different between ROBODRILL Connection and ROBODRILL Connection 2.

Single gripper: RD_LUL11.TP, RD_LUL12.TP (ROBODRILL Connection)

- These are the programs to place the raw part to ROBODRILL and pick up the finished part from the ROBODRILL by single gripper.
- These programs have two arguments.
  - In case that first argument is 1 and the second argument is 0, the robot loads the raw part.
  - In case that first argument is 0 and the second argument is 1, the robot unloads the finished part.
  - In other cases, user alarm [1] "Incorrect Service" occurs.
- RT_LUL11.TP is the program for ROBODRILL 1. RD_LUL12.TP is the program for ROBODRILL 2. According to the number of ROBODRILLs that are connected to the robot, some of these programs are loaded.
- In RD_LUL11.TP, teach the position to place the raw part to the position register [34], and set the offset to the approach point to the position register [35], and set the offset to the retract point to the position register [36]. And teach the position to pick up the finished part to the position register [37], and set the offset to the approach point to the position register [38], and set the offset to the retract

point to the position register [39]. Furthermore, teach the inside position of ROBODRILL that is passed before the approach point to the position register [30]. This position is used as the position that is passed before the robot goes out of ROBODRILL from the retract point.

- In case that two ROBODRILLs are connected to the robot, the position registers that are required to teach are as follows.

Table 4.3.5(a) Position Register to teach (ROBODRILL Connection Single Gripper)

Position	Position Register Number	
	RD_LUL11.TP	RD_LUL12.TP
Position to place the raw part	PR[34]	PR[44]
Approach point for place position (Offset from the place position)	PR[35]	PR[45]
Retract point for place position (Offset from the place position)	PR[36]	PR[46]
Position to pick up the finished part	PR[37]	PR[47]
Approach point for pick up position (Offset from the pick up position)	PR[38]	PR[48]
Retract point for pick up position (Offset from the pick up position)	PR[39]	PR[49]
Passing point in ROBODRILL	PR[30]	PR[40]

Dual Gripper: RD_LUL21.TP, RD_LUL22.TP (ROBODRILL Connection)

- These are the programs to place the raw part to ROBODRILL and pick up the finished part from ROBODRILL by dual gripper.
- These programs have two arguments.
  - In case that first argument is 1 and the second argument is 0, the robot loads the raw part.
  - In case that first argument is 0 and the second argument is 1, the robot unloads the finished part.
  - In case that first argument is 1 and the second argument is 1, the robot unloads the finished part and loads the raw part.
  - In other cases, user alarm [1] “Incorrect Service” is posted.
- RD_LUL21.TP is the program for ROBODRILL 1. RD_LUL22.TP is the program for ROBODRILL 2. According to the number of ROBODRILLs that are connected to the robot, some of these programs are loaded.
- In RD_LUL21.TP, teach the position to place the raw part to the position register [34], and set the offset to the approach point to the position register [35], and set the offset to the retract point to the position register [36]. And teach the position to pick up the finished part to the position register [37], and set the offset to the approach point to the position register [38], and set the offset to the retract point to the position register [39]. Furthermore, teach the inside position of ROBODRILL that is passed before the approach point at loading the part to the position register [30], and teach the inside position of ROBODRILL that is passed before the approach point at unloading the part to the position register [31]. These positions are used as the position that is passed before the robot goes out of ROBODRILL from the retract point.
- In case that two ROBODRILLs are connected to the robot, the position registers that are required to teach are as follows.

Table 4.3.5(b) Position Register to teach (ROBODRILL Connection Dual gripper)

Position	Position Register Number	
	RD_LUL21.TP	RD_LUL22.TP
Position to place the raw part	PR[34]	PR[44]
Approach point for place position (Offset from the place position)	PR[35]	PR[45]
Retract point for place position (Offset from the place position)	PR[36]	PR[46]
Position to pick up the finished part	PR[37]	PR[47]
Approach point for pick up position (Offset from the pick up position)	PR[38]	PR[48]
Retract point for pick up position (Offset from the pick up position)	PR[39]	PR[49]
Passing point in ROBODRILL (When part is loaded)	PR[30]	PR[40]
Passing point in ROBODRILL (When part is unloaded)	PR[31]	PR[41]

Single Gripper: R2_LUL11.TP ~ R2_LUL14.TP (ROBODRILL Connection 2)

- R2_LUL11.TP is the program for ROBODRILL 1, R2_LUL12.TP for ROBODRILL 2, R2_LUL13.TP for ROBODRILL 3, R2_LUL14.TP for ROBODRILL 4.
- The same registers and position registers as RD_LUL11.TP or RD_LUL12.TP of ROBODRILL Connection are used. For four ROBODRILLs system, following position registers are used.
- The other behaviour is identical to RL_LUL11.TP, RD_LUL12.TP of ROBODRILL Connection.

Table 4.3.5(c) Position Register to teach (ROBODRILL Connection 2 Single Gripper)

Position	Position Register Number			
	R2_LUL21.TP	R2_LUL22.TP	R2_LUL23.TP	R2_LUL24.TP
Position to place the raw part	PR[34]	PR[44]	PR[54]	PR[64]
Approach point for place position (Offset from the place position)	PR[35]	PR[45]	PR[55]	PR[65]
Retract point for place position (Offset from the place position)	PR[36]	PR[46]	PR[56]	PR[66]
Position to pick up the finished part	PR[37]	PR[47]	PR[57]	PR[67]
Approach point for pick up position (Offset from the pick up position)	PR[38]	PR[48]	PR[58]	PR[68]
Retract point for pick up position (Offset from the pick up position)	PR[39]	PR[49]	PR[59]	PR[69]
Passing point in ROBODRILL	PR[30]	PR[40]	PR[50]	PR[60]

Dual Gripper: R2_LUL21.TP ~ R2_LUL24.TP (ROBODRILL Connection 2)

- R2_LUL21.TP is the program for ROBODRILL 1, R2_LUL22.TP for ROBODRILL 2, R2_LUL23.TP for ROBODRILL 3, R2_LUL24.TP for ROBODRILL 4.
- The same registers and position registers as RD_LUL21.TP or RD_LUL22.TP of ROBODRILL Connection are used. For four ROBODRILLs system, following position registers are used.
- The other behaviour is identical to RD_LUL21.TP, RD_LUL22.TP of ROBODRILL Connection.

Table 4.3.5(d) Position Register to teach (ROBODRILL Connection 2 Dual Gripper)

Position	Position Register Number			
	R2_LUL21.TP	R2_LUL22.TP	R2_LUL23.TP	R2_LUL24.TP
Position to place the raw part	PR[34]	PR[44]	PR[54]	PR[64]
Approach point for place position (Offset from the place position)	PR[35]	PR[45]	PR[55]	PR[65]
Retract point for place position (Offset from the place position)	PR[36]	PR[46]	PR[56]	PR[66]
Position to pick up the finished part	PR[37]	PR[47]	PR[57]	PR[67]
Approach point for pick up position (Offset from the pick up position)	PR[38]	PR[48]	PR[58]	PR[68]
Retract point for pick up position (Offset from the pick up position)	PR[39]	PR[49]	PR[59]	PR[69]
Passing point in ROBODRILL (When part is loaded)	PR[30]	PR[40]	PR[50]	PR[60]
Passing point in ROBODRILL (When part is unloaded)	PR[31]	PR[41]	PR[51]	PR[61]

4.3.6 PNS Program for ROBODRILL Connection

In case that ROBODRILL Connection or ROBODRILL Connection 2 is loaded, the following programs are loaded according to the selected gripper type. These programs are different between ROBODRILL Connection and ROBODRILL Connection 2.

Single Gripper: RD_PNS11.TP, RD_PNS12.TP (ROBODRILL Connection)

- This is the PNS program for single gripper.
- The signal input from ROBODRILL at the same time as the start signal decides the robot operation.
  - In case that DI[1] is ON, the robot moves into ROBODRILL and unloads a processed work piece at first, and loads an unprocessed work piece.
  - In case that DI[1] is OFF and DI[2] is ON, the robot picks up a work piece from the Infeed Station and loads a work piece to ROBODRILL. In this case, the robot executes only the load of a work piece because a processed work piece is not in ROBODRILL.
  - In case that DI[1] and DI[2] are OFF and DI[3] is ON, the robot unloads a processed work piece from ROBODRILL and places the work piece at the Finished Part Station.
- Teach the outside position of ROBODRILL that the robot checks the condition to enter ROBODRILL to the position register [32]. This position is used as the position that is passed before the robot goes out of ROBODRILL from the retract point.
- In case that the robot unloads a processed work piece and loads an unprocessed work piece at one cycle by single gripper, the robot must place the work piece in the gripper somewhere temporarily. Teach the position to place an unprocessed work piece before unloading and the position to place a processed work piece before loading to the position data in the program. And, teach the approach points and the retract points for those positions, too.

Dual gripper: RD_PNS21.TP, RD_PNS22.TP (ROBODRILL Connection)

- This is the PNS program for dual gripper.
- The signal input from ROBODRILL at the same time as the start signal decides the robot operation.
  - In case that DI[1] is ON, the robot moves into ROBODRILL and unloads a processed work piece at first, and loads an unprocessed work piece.
  - In case that DI[1] is OFF and DI[2] is ON, the robot picks up a work piece from the Infeed Station and loads a work piece to ROBODRILL. In this case, the robot executes only the load of a work piece because a processed work piece is not in ROBODRILL.
  - In case that DI[1] and DI[2] are OFF and DI[3] is ON, the robot unloads a processed work piece from ROBODRILL and places the work piece at the Finished Part Station.

- Teach the outside position of ROBODRILL that the robot checks the condition to enter ROBODRILL at loading the part to the position register [32] and teach the outside position of ROBODRILL that the robot checks the condition to enter ROBODRILL at unloading the part to the position register [33]. These positions are used as the position that is passed before the robot goes out of ROBODRILL from the retract point.

Single Gripper: R2_LUL11.TP ~ R2_LUL14.TP (ROBODRILL Connection 2)

- This is the PNS program of ROBODRILL Connection 2 for single gripper.
- The behavior of this program is identical to that of ROBODRILL Connection except this handles signals from four ROBODRILLs

Dual Gripper: R2_LUL21.TP ~ R2_LUL24.TP (ROBODRILL Connection 2)

- This is the PNS program of ROBODRILL Connection 2 for dual gripper.
- This behavior of this program is identical to that of ROBODRILL Connection except this handles signals from four ROBODRILLs.

4.4 DATA IN TEMPLATE PROGRAM

4.4.1 Tool Frame

Following tool frames are used in the template TP programs. The wizard will teach the following tool frames.

Table 4.4.1 Tool Frame

Tool Frame Number	Tool Frame Comment	Description
1	Gripper	Tool frame for single gripper
1	Raw part gripper	Tool frame for the raw part in dual gripper
2	Finished part gripper	Tool frame for the finished part in dual gripper

4.4.2 User Frame

Following user frames are used in the template TP programs. The wizard will teach the following user frames.

Table 4.4.2 User Frame

User Frame Number	User Frame Comment	Description
1	Machine 1	User frame for Machine Station 1
2	Machine 2	User frame for Machine Station 2
3	Machine 3	User frame for Machine Station 3
4	Machine 4	User frame for Machine Station 4
9		Vision Calibration Frame
11-20	Part Infeed 1 - Part Infeed 10	User frames for part infeed station
21-30	Finished 1 - Finished 10	User frames for finished part station

4.4.3 Macro

Following macros are used in the template TP programs. The wizard sets macros for use in the TP programs.

Table 4.4.3 Macro

Macro	Description
Open Gripper	This is the macro to open single gripper or the raw part gripper of dual gripper. Used by pick, load/unload, and place programs. Can be executed in Tool 1 menu.
Close Gripper	This is the macro to close single gripper or the raw part gripper of dual gripper. Used by pick, load/unload, and place programs. Can be executed in Tool 1 menu.
Open Fin Gripper	This is the macro to open the finished part gripper of dual gripper. Used by place programs. Can be executed in Tool 2 menu.
Close Fin Gripper	This is the macro to close the finished part gripper of dual gripper. Used by place programs. Can be executed in Tool 2 menu.
Move to Home	This is the macro to move the robot to Home position. Can be executed in Tool 1 menu.
Pick Program	This is the macro to pick up the raw part. Used by PNS program to call pick program selected by the wizard.
Pre Proc Prog	This is the macro for pre process motion. Used by PNS program to call pre process program selected by the wizard.
Load/Unload CNC1	This is the macro to load/unload the part to the machine tool 1. Used by PNS program to call load/unload CNC1 program selected by the wizard.
Load/Unload CNC2	This is the macro to load/unload the part to the machine tool 2. Used by PNS program to call load/unload CNC2 program selected by the wizard.
Load/Unload CNC3	This is the macro to load/unload the part to the machine tool 3. Used by PNS program to call load/unload CNC3 program selected by the wizard.
Load/Unload CNC4	This is the macro to load/unload the part to the machine tool 4. Used by PNS program to call load/unload CNC4 program selected by the wizard.
Post Proc Prog	This is the macro for post process motion. Used by PNS program to call post process program selected by the wizard.
Place Program	This is the macro to place the finished part. Used by PNS program to call place program selected by the wizard.

4.4.4 Register

Following registers are used in the template TP programs.

- The comments of the register [1] - [25] are set by the wizard.
- The comments of the register [100] - [108] are set at initial power on.
- The values of the register [100] - [108] are set by the wizard.

Table 4.4.4 Register

Register Number	Register Comment	Description
1		Not used.
2	Pick Counter	Incremented by pick program after picking up the part from the Part Infeed Station.
3	Dropped parts	Incremented by load/unload programs after unload operation if Robot Input for part presence gripper is OFF.
4	Reject Counter	Not used.

Register Number	Register Comment	Description
5	Finished Parts	Incremented by place program after placing the part on the Finished Part Station.
6	Drawer Number	Used internally by pick programs that use drawers.
7		Not used.
8		Not used.
9	Re_pick	Used by pre process program to reorient and repick the raw part. Please set this value to 1 if required.
10	Vis pick order	Incremented by pick program if *i*RVision is used.
11	Load	Used internally by load/unload programs.
12	Unload	Used internally by load/unload programs.
13	Index reg	Used internally by pick and place programs that use a grid.
14	Cur pick row	Used internally by pick programs that use a grid.
15	Cur pick col	Used internally by pick programs that use a grid.
16	Pick row offset	Used by pick programs that use a grid. Please set this value to the offset in the row direction.
17	Pick col offset	Used by pick programs that use a grid. Please set this value to the offset in the column direction.
18	Pick max row	Used by pick programs that use a grid. Please set this value to the maximum number of rows.
19	Pick max col	Used by pick programs that use a grid. Please set this value to the maximum number of columns.
20	Cur place row	Used internally by place programs that use a grid.
21	Cur place col	Used internally by place programs that use a grid.
22	Place row offset	Used by place programs that use a grid. Please set this value to the offset in the row direction.
23	Place col offset	Used by place programs that use a grid. Please set this value to the offset in the column direction.
24	Place max row	Used by place programs that use a grid. Please set this value to the maximum number of rows.
25	Place max col	Used by place programs that use a grid. Please set this value to the maximum number of columns.
100	Num Grippers	The gripper type selected by the wizard is set. 1- Single Gripper 2- Dual Gripper
101	Infeed Type	The Part Infeed Station type selected by the wizard is set. 1- Fixed location/fixture 2- Flexible location using *i*RVision 2D 3- Fixed grid (tray, single drawer, etc.) 4- Flexible grid using *i*RVision 2D 5- Fixed grid with multiple drawers
102	Pre Process	The selection of the addition of Pre Process set by the wizard is set. 0- Pre Process disabled 1- Pre Process enabled
103	Post Process	The selection of the addition of Post Process set by the wizard is set. 0- Post Process disabled 1- Post Process enabled
104	Machine No	The current machine selected by the wizard is set.
105	Num Machines	1 - 4 based on the number of machines is set.

Register Number	Register Comment	Description
106	Finish Type	The Finished Part Station type selected by the wizard is set. 1- Fixed location/fixture 2- Fixed grid (tray, single drawer, etc.)
107	Num Infeed	1 - 10 based on the number of Part Infeed drawers is set.
108	Num Finish	Not used.

4.4.5 Position Register

Following position registers are used in the template TP programs.

- The comments of the position register are set by the wizard.
- The position data are not set by the wizard. Teach the position data according to the description in Table 4.4.5.

Table 4.4.5 Position Register

Pos. Register Number	Pos. Register Comment	Description
5	Pick ref loc	First pick position for Part Infeed Station.
6	Place ref loc	First place position for Finished Part Station.
10	Pick ap offset	Approach offset for pick position for Part Infeed Station.
11	Pick pos	Pick Position for Part Infeed Station.
12	Pick rt offset	Retract offset for pick position for Part Infeed Station.
13	Re_pick pos	Re_pick position for pre process program.
14	Re_orient	Re_orient position for pre process program.
15	Place ap offset	Approach offset for place position for Finished Part Station.
16	Place pos	Place Position for Finished Part Station.
17	Place rt offset	Retract offset for place position for Finished Part Station.
Machine tool 1		
30	Inside C1 T1	Position inside Machine Tool 1 for loading the raw part. Also used for unloading the finished part if single gripper.
31	Inside C1 T2	Position inside Machine Tool 1 for unloading the finished part if dual gripper.
32	Outside C1 T1	Position just outside Machine Tool 1 for loading the raw part. Also used for unloading the finished part if single gripper.
33	Outside C1 T2	Position just outside Machine Tool 1 for unloading the finished part if dual gripper.
34	C1 place pos	Place position inside Machine Tool 1 for loading the raw part.
35	C1 Place ap ofst	Approach offset for place position inside Machine Tool 1 for loading the raw part.
36	C1 place rt ofst	Retract offset for place position inside Machine Tool 1 after loading the raw part.
37	C1 pick pos	Pick position inside Machine Tool 1 for unloading the finished part.
38	C1 pick ap ofst	Approach offset for pick position inside Machine Tool 1 for unloading the finished part.
39	C1 pick rt ofst	Retract offset for pick position inside Machine Tool 1 after unloading the finished part.

Pos. Register Number	Pos. Register Comment	Description
Machine Tool 2		
40	Inside C2 T1	Position inside Machine Tool 2 for loading the raw part. Also used for unloading the finished part if single gripper.
41	Inside C2 T2	Position inside Machine Tool 2 for unloading the finished part if dual gripper.
42	Outside C2 T1	Position just outside Machine Tool 2 for loading the raw part. Also used for unloading the finished part if single gripper.
43	Outside C2 T2	Position just outside Machine Tool 2 for unloading the finished part if dual gripper.
44	C2 place pos	Place position inside Machine Tool 2 for loading the raw part.
45	C2 Place ap ofst	Approach offset for place position inside Machine Tool 2 for loading the raw part.
46	C2 place rt ofst	Retract offset for place position inside Machine Tool 2 after loading the raw part.
47	C2 pick pos	Pick position inside Machine Tool 2 for unloading the finished part.
48	C2 pick ap ofst	Approach offset for pick position inside Machine Tool 2 for unloading the finished part.
49	C2 pick rt ofst	Retract offset for pick position inside Machine Tool 2 after unloading the finished part.
Machine Tool 3		
50	Inside C3 T1	Position inside Machine Tool 3 for loading the raw part. Also used for unloading the finished part if single gripper.
51	Inside C3 T2	Position inside Machine Tool 3 for unloading the finished part if dual gripper.
52	Outside C3 T1	Position just outside Machine Tool 3 for loading the raw part. Also used for unloading the finished part if single gripper.
53	Outside C3 T2	Position just outside Machine Tool 3 for unloading the finished part if dual gripper.
54	C3 place pos	Place position inside Machine Tool 3 for loading the raw part.
55	C3 Place ap ofst	Approach offset for place position inside Machine Tool 3 for loading the raw part.
56	C3 place rt ofst	Retract offset for place position inside Machine Tool 3 after loading the raw part.
57	C3 pick pos	Pick position inside Machine Tool 3 for unloading the finished part.
58	C3 pick ap ofst	Approach offset for pick position inside Machine Tool 3 for unloading the finished part.
59	C3 pick rt ofst	Retract offset for pick position inside Machine Tool 3 after unloading the finished part.
Machine Tool 4		
60	Inside C4 T1	Position inside Machine Tool 4 for loading the raw part. Also used for unloading the finished part if single gripper.
61	Inside C4 T2	Position inside Machine Tool 4 for unloading the finished part if dual gripper.
62	Outside C4 T1	Position just outside Machine Tool 4 for loading the raw part. Also used for unloading the finished part if single gripper.
63	Outside C4 T2	Position just outside Machine Tool 4 for unloading the finished part if dual gripper.
64	C4 place pos	Place position inside Machine Tool 4 for loading the raw part.
65	C4 Place ap ofst	Approach offset for place position inside Machine Tool 4 for loading the raw part.

Pos. Register Number	Pos. Register Comment	Description
66	C4 place rt ofst	Retract offset for place position inside Machine Tool 4 after loading the raw part.
67	C4 pick pos	Pick position inside Machine Tool 4 for unloading the finished part.
68	C4 pick ap ofst	Approach offset for pick position inside Machine Tool 4 for unloading the finished part.
69	C4 pick rt ofst	Retract offset for pick position inside Machine Tool 4 after unloading the finished part.

4.4.6 Robot I/O

Following Robot I/Os are used in the template TP programs. Wire Robot I/O according to the following table, or change the Robot I/O number in the macro program according to wiring of Robot I/O.

Table 4.4.6(a) Robot I/O (input)

Robot I/O Number	Robot I/O Comment	Description
RI[1]	Gripper Closed	In the case of single gripper, signal that gripper is closed. In the case of dual gripper, signal that raw part gripper is closed.
RI[2]	Gripper Opened	In the case of single gripper, signal that gripper is opened. In the case of dual gripper, signal that raw part gripper is opened.
RI[3]	Finish Closed	In the case of dual gripper, signal that finished part gripper is closed.
RI[4]	Finish Opened	In the case of dual gripper, signal that finished part gripper is opened.
RI[5]	Part presence gripper 1	In the case of single gripper, signal that part is present in gripper. In the case of dual gripper, signal that part is present in raw part gripper.
RI[6]	Part presence gripper 2	In the case of dual gripper, signal that part is present in finished part gripper.

Table 4.4.6(b) Robot I/O (Output)

Robot I/O Number	Robot I/O Comment	Description
RO[1]	Gripper Open	In the case of single gripper, signal to open gripper. In the case of dual gripper, signal to open raw part gripper.
RO[2]	Gripper Close	In the case of single gripper, signal to close gripper. In the case of dual gripper, signal to close raw part gripper.
RO[3]	Finish Grip Open	In the case of dual gripper, signal to open finished part gripper.
RO[4]	Finish Grip Close	In the case of dual gripper, signal to close finished part gripper.

4.4.7 User Alarm

Following user alarms are used in the template TP programs.

Table 4.4.7 User Alarm

User Alarm Number	Alarm Message	Severity	Description
1	Incorrect Service	PAUSE	When PNS program is called, the designated service type is not correct.
2	Wait timed out	PAUSE	Not currently used.
3	Part not in gripper	PAUSE	After the gripper grips the part, part presence signal is not turned on.
4	Part not at pickup position	PAUSE	Not currently used.
5	Part not at place position	PAUSE	Not currently used.
6	Drawers not locked in position	PAUSE	When the drawer is closed, the signal to check that the drawer is locked in position is not turned on.
7	Invalid drawer	PAUSE	The number of the drawers is not correct.
8	Gripper malfunction	PAUSE	When the gripper is opened, the check signal does not indicate gripper opened. Or, when the gripper is closed, the check signal does not indicate gripper closed.
9	No parts to pick	PAUSE	When Part Infeed Station type is Flexible grid with *i*RVision-2D, there is not part to pick up.
10	Part not found by vision	PAUSE	When Part Infeed Station type is Flexible grid with *i*RVision-2D, the detection by *i*RVision fails.

5 CUSTOMIZATION

Machine Tool Easy Setup function can be customized as follows.

- Modify TP programs which are used as template.
- Modify the images shown in the wizards.

5.1 BACKUP TEMPLATE TP PROGRAMS AND IMAGES

The template TP programs are stored as LS file on a protected device. The image files are stored as GIF, JPG and PNG files on a protected device. Before importing files, please a back up of the system provided files using the following procedure.

Procedure 5-1 Operation to backup template TP programs and images

Steps

1. Insert an empty memory card or USB stick to the robot controller.
2. Make this the default device using the File menu.
3. Press the MENU key on *i*Pendant.
4. Select SETUP.
5. Press F1 [TYPE].
6. Select *i*Pendant Setup. You will see the following screen.

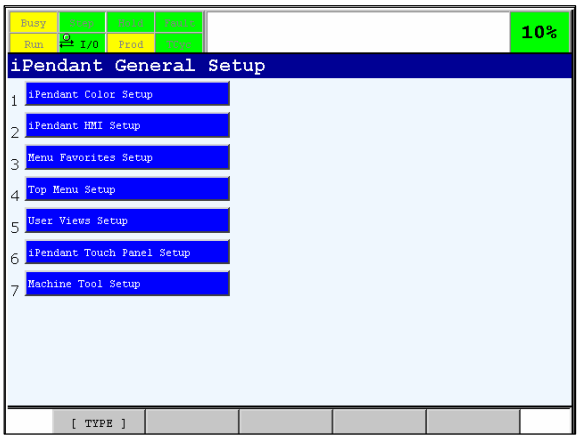

Fig. 5.1(a) *i*Pendant General Setup screen

7. Press Machine Tool Setup button. You will see the following screen.

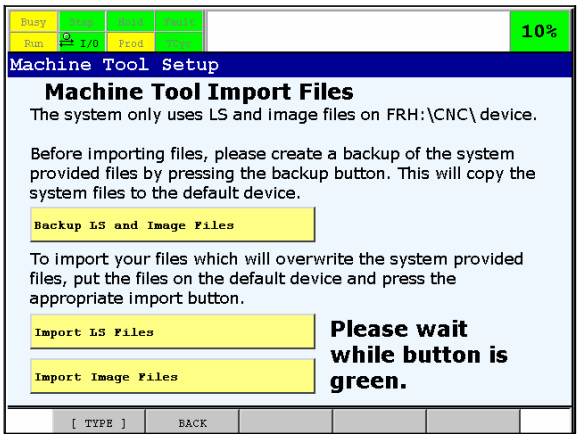

Fig. 5.1(b) File Import screen

8. To backup the files, select the button labeled “Backup LS and Image Files”.
9. Wait for confirmation pop-up.

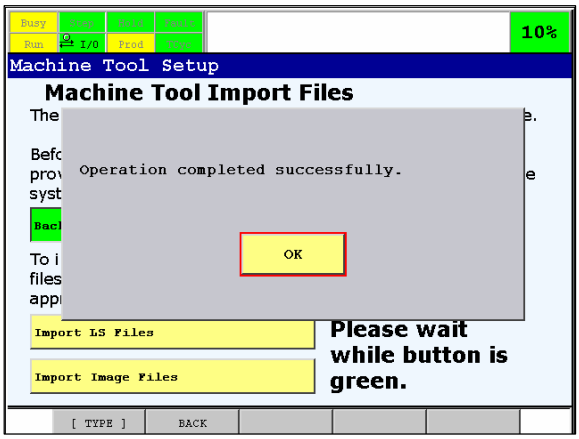

Fig.5.1(c) Confirmation pop-up

10. Store the memory card or USB stick in a safety space.

5.2 MODIFY THE TEMPLATE TP PROGRAMS

One of the easiest ways to customize Machine Tool Easy Setup is to modify the TP programs which are used as templates. The first time Machine Tool Easy Setup is entered, the default programs will be loaded from FRH:¥CNC¥ device using ASCII Program Loader (.LS files). The benefit of using ASCII Program Loader is that Register comments found in .LS files are also updated. As selections occur in the wizard, the appropriate programs are loaded from FRH:¥CNC¥ device. Therefore, by importing your files on FRH:¥CNC¥ device, your template programs will be loaded. Once a template is loaded, it is expected that the customer will modify the program.

The LS programs will not overwrite any existing TP programs which are loaded. They are used for templates when the TP program is not already loaded. You may need to delete a program in order to see your new template.

Please refer to “4.2 TEMPLATE TP PROGRAM LIST” which shows the list of TP programs used by the wizard.

To import your LS files which will overwrite the system provided files, refer to the following procedure.

Procedure 5-2 Operation to import the template TP programs

Conditions

You have backed up the system provided files, using Procedure 5-1.

Steps

1. Insert memory card or USB stick which contains only your changed LS files.
2. Set this as the default device using the FILE menu.
3. Select the Machine Tool Setup menu by the same procedure as Procedure 5-1.
4. To import the LS files, select the button labeled “Import LS Files”.
5. Wait for confirmation pop-up.

5.3 MODIFY IMAGES

Another easy way to customize Machine Tool Easy Setup is to modify the images which are used in the wizard. To import your image files which overwrite the system provided files, use the following procedure.

Procedure 5-3 Operation to import the image files

Conditions

You have backed up the system provided files, using Procedure 5-1.

Steps

1. Insert memory card or USB stick which contains only your changed image files.
2. Set this as the default device using the FILE menu.
3. Select the Machine Tool Setup menu by the same procedure as Procedure 5-1.
4. To import the image files, select the button labeled “Import Image Files”.
5. Wait for confirmation pop-up.
6. The *i*Pendant caches the images, so you may need to recycle power to see your images.

The following tables show the list of images used in the wizard.

Table 5.3(a) Images in Process Navigator

Screen	Image File	Web Page
Define the Cell	tbmach.gif tbgrip.gif tbinfeed.gif tbprepr.gif tbpostpr.gif tbpallet.gif tpvisual.gif	mtnav1.stm
Teach Cell	tbhome.gif tbmaint.gif tbpns.gif tbrefpos.gif tbmain.gif	mtnav2.stm
Run Production	tbprod.gif tpmach.gif tbvisual.gif tbmanual.gif	mtnav3.stm

Table 5.3(b) Images in Setup Machine List

Screen		Image File	Web Page
Setup Machine List	When Machine Tool Connection is loaded.	mtcncfr.jpg	mtcell.stm
	When ROBODRILL Connection or ROBODRILL Connection 2 is loaded.	mtcncrd.jpg	
	Others	mtcnc.jpg	
Configure I/O		tbfiles.gif	mtiocf.stm
Machine Tool Connection/ ROBODRILL Connection/ ROBODRILL Connection 2			mtfanu.stm
Select I/O Device		mtiolink.jpg	mtio.stm
Load I/O Configuration			mtiold.stm
Background Logic			mtbg.stm
Setup Data Communication			mthcom.stm
Setup Data Communication Client Tags			mthtag.stm

Table 5.3(c) Images in Setup Gripper

Screen	Image File	Web Page
Setup Gripper: Select Single or Dual	mtgrip.jpg	mtgrip.stm
Setup Tool Frame: Show Base Frame	mtutbase.png mtuttol.png	mtutba.stm
Setup Gripper Frame: Show Base Frame and Select Gripper Number	mtutbase.png mtuttol.png	mtutno.stm
Setup Tool Frame: Record First Approach Point	mtutapr1.png	mtuta1.stm
Setup Tool Frame: Record Second Approach Point	mtutapr2.png	mtuta2.stm
Setup Tool Frame: Record Third Approach Point	mtutapr3.png	mtuta3.stm
Setup Tool Frame: Record Orient Original Point	mtutorg1.png	mtuto1.stm
Setup Tool Frame: Record X Direction Point	mtutorg1.png	mtuto2.stm
Setup Tool Frame: Record Z Direction Point	mtutorg1.png	mtuto3.stm
Setup Tool Frame: Jog the robot in the frame	mtutorg1.png	mtutoj.stm
Setup Tool Frame: Enter Comment and Show Frame		mtutds.stm
Setup Tool Frame: Enter Comment and Direct Entry of Frame		mtutde.stm
Teach Gripper Macros		mtuted.stm

Table 5.3(d) Images in Setup Part Infeed Station

Screen	Image File	Web Page
Setup Part Infeed Station: Select the type of station		mtinty.stm
Setup Part Infeed Station: Show Base Frame	mtufbase.png	mtinba.stm
Setup Part Infeed Station: Show Base Frame and Select Drawer Number	mtufbase.png	mtinno.stm
Teach Part Infeed Program		mtined.stm

Table 5.3(e) Images in Add a Pre Process Operation

Screen	Image File	Web Page
Add a Pre Process Operation		mtpre.stm
Teach Pre Process Program		mtpred.stm

Table 5.3(f) Images in Setup Machine Station

Screen	Image File	Web Page
Setup Machine Station: Show Base Frame	mtufbase.png	mtmsba.stm
Setup Machine Station: Show Base Frame and Select Machine Number	mtufbase.png	mtmsno.stm
Teach Machine Load/Unload Program		mtmsed.stm

Table 5.3(g) Images in Add a Post Process Operation

Screen	Image File	Web Page
Add a Post Process Operation		mtpost.stm
Teach Post Process Program		mtpoed.stm

Table 5.3(h) Images in Setup Finished Part Station

Screen	Image File	Web Page
Setup Finished Part Station: Select the type of station		mtfity.stm
Setup Finished Part Station: Show Base Frame	mtufbase.png	mtfiba.stm
Setup Finished Part Station: Show Base Frame and Select Drawer Number	mtufbase.png	mtfino.stm
Teach Finished Part Program		mtfied.stm

Table 5.3(i) Images in Setup User Frame

Screen	Image File	Web Page
Setup User Frame: Record Origin Point	mtuforg.png	mtufp1.stm
Setup User Frame: Record X Direction Point	mtufx.png	mtufp2.stm
Setup User Frame: Record Point on X-Y Plane	mtufxy.png	mtufp3.stm
Setup User Frame: Record System Origin Point	mtuforg2.png	mtufp4.stm
Setup User Frame: Jog the robot in the frame	mtufbase.png	mtufpj.stm
Setup User Frame: Enter Comment and Show Frame		mtufds.stm
Setup User Frame: Enter Comment and Direct Entry Frame		mtufde.stm

6 STANDARD SETTING VALUE

In case that Machine Tool Connection, ROBODRILL Connection or ROBODRILL Connection 2 is enabled, when the button labeled “Load Standard Configuration” in Load I/O configuration screen in Setup Machine List wizard is pressed, the following setting is done as the standard setting.

6.1 MACHINE TOOL CONNECTION

In case that Machine Tool Connection is loaded and Machine Tool Connection function is enabled, when the button labeled “Load Standard Configuration” is pressed in Load I/O configuration screen, the following setting is done.

Table 6.1(a) System Variables

System Variable	Value	Remark
$IOLNK[1].$RACK	0	These system variables are set when I/O device is I/O link.
$IOLNK[1].$SLOT	1	
$IOLNK[1].$INPUT_N	256	
$IOLNK[1].$OUTPUT_N	256	
$IOLNK[2].$RACK	0	These system variables are set when I/O device is I/O link and the number of machine tools connected to the robot is 2 or more than 2.
$IOLNK[2].$SLOT	2	
$IOLNK[2].$INPUT_N	256	
$IOLNK[2].$OUTPUT_N	256	
$IOLNK[3].$RACK	0	These system variables are set when I/O device is I/O link and the number of machine tools connected to the robot is 3 or more than 3.
$IOLNK[3].$SLOT	3	
$IOLNK[3].$INPUT_N	256	
$IOLNK[3].$OUTPUT_N	256	
$IOLNK[4].$RACK	0	These system variables are set when I/O device is I/O link and the number of machine tools connected to the robot is 4.
$IOLNK[4].$SLOT	4	
$IOLNK[4].$INPUT_N	256	
$IOLNK[4].$OUTPUT_N	256	
$MACROMAXDRI	15	
$MAX_DIG_PRT	1080	
$MTSI.$DI_INDEX[1]	1032	
$MTSI.$DI_INDEX[2]	1051	
$MTSI.$DI_INDEX[3]	1052	
$MTSI.$DI_INDEX[4]	1053	
$MTSI.$DI_INDEX[5]	1054	
$MTSI.$DI_INDEX[6]	1055	
$MTSI.$DI_INDEX[7]	1056	
$MTSI.$DI_INDEX[8]	0	
$MTSI.$DI_INDEX[9]	1033	
$MTSI.$DI_INDEX[10]	1034	
$MTSI.$DI_INDEX[11]	1035	
$MTSI.$DI_INDEX[12]	1036	
$MTSI.$DI_INDEX[13]	1037	
$MTSI.$DI_INDEX[14]	1038	

System Variable	Value	Remark
$MTSI.$DI_INDEX[15]	1039	
$MTSI.$DI_INDEX[16]	1040	
$MTSI.$DI_INDEX[17]	1041	
$MTSI.$DI_INDEX[18]	1042	
$MTSI.$DI_INDEX[19]	1043	
$MTSI.$DI_INDEX[20]	1044	
$MTSI.$DI_INDEX[21]	1045	
$MTSI.$DI_INDEX[22]	1046	
$MTSI.$DI_INDEX[23]	1047	
$MTSI.$DI_INDEX[24]	1048	
$MTSI.$DI_INDEX[25]	1049	
$MTSI.$DI_INDEX[26]	1050	
$REMOTE_CFG.$REMOTE_TYPE	1	
$SHELL_CFG.$CONT_ONLY	TRUE	
$SHELL_CFG.$USE_ABORT	TRUE	
$SHELL_CFG.$PNS_ENABLE	TRUE	
THRESTABLE[4].$THR_ENB	TRUE	
THRESTABLE[4].$DI_NO	4	
THRESTABLE[4].$DO_NO	1026	

Table 6.1(b) Macros

Macro Number	Macro Name	Program	Assign	
120	HANDOP_M	HANDOP_M	DI	1027
121	HANDOP01	HANDOP01	MF	31
122	HANDOP02	HANDOP02	MF	32
123	HANDOP03	HANDOP03	MF	33
124	HANDOP04	HANDOP04	MF	34
125	HANDOP05	HANDOP05	MF	35
126	HANDOP06	HANDOP06	MF	36
127	HANDOP07	HANDOP07	MF	37
128	HANDOP08	HANDOP08	MF	38
129	HANDOP09	HANDOP09	MF	39
130	HANDOP10	HANDOP10	MF	40
136	OVRUP	OVRUP	DI	1028
137	OVRDOWN	OVRDOWN	DI	1029
138	HOME	MTSHOME	DI	1030
139	REM_ENT	REM_ENT	DI	1025
140	REM_EXT	REM_EXT	DI	1026

Table 6.1(c) PMC External I/O Configuration (When I/O device is I/O link)

I/O Type	Rack	Slot	Size	Address	
DI	0	1	32	1:X00000	
DI	0	2	32	1:X00032	*
DI	0	3	32	1:X00064	*
DI	0	4	32	1:X00096	*
DO	0	1	32	1:Y00000	
DO	0	2	32	1:Y00000	*
DO	0	3	32	1:Y00000	*
DO	0	4	32	1:Y00000	*

The lines that marked * are set depending on the number of machine tools connected to the robot.

Table 6.1(d) PMC External I/O Configuration (When I/O device is FL-net)

I/O Type	Rack	Slot	Size	Address	
DI	68	2	32	1:X00000	
DI	68	3	32	1:X00032	*
DI	68	4	32	1:X00064	*
DI	68	5	32	1:X00096	*
DO	68	1	32	1:Y00000	
DO	68	1	32	1:Y00000	*
DO	68	1	32	1:Y00000	*
DO	68	1	32	1:Y00000	*

The lines that marked * are set depending on the number of machine tools connected to the robot.

Table 6.1(e) PMC Internal I/O Configuration

I/O Type	Start Number	End Number	Size	Address	
UI	1	32	4	1:G01000	
UO	1	32	4	1:F01000	
GI	1	-	2	1:G00260	
GI	2	-	2	1:G00262	*
GI	3	-	2	1:G00264	*
GI	4	-	2	1:G00266	*
GI	5	-	2	1:G00268	
GO	1	-	2	1:F00260	
GO	10001	11500	3000	1:D00000	

The lines that marked * are set depending on the number of machine tools connected to the robot.

Table 6.1(f) I/O Configuration (When I/O device is I/O link)

I/O Type	Start Number	End Number	Rack	Slot	Start Point	Number of points	
DI	1	256	0	1	1	256	
DI	257	512	0	2	1	256	*
DI	513	768	0	3	1	256	*
DI	769	1024	0	4	1	256	*
DO	1	256	0	1	1	256	
DO	257	512	0	2	1	256	*
DO	513	768	0	3	1	256	*
DO	769	1024	0	4	1	256	*

The lines that marked * are set depending on the number of machine tools connected to the robot.

Table 6.1(g) I/O Configuration (When I/O device is FL-net)

I/O Type	Start Number	End Number	Rack	Slot	Start Point	Number of points	
DI	1	256	68	2	1	256	
DI	257	512	68	3	1	256	*
DI	513	768	68	4	1	256	*
DI	769	1024	68	5	1	256	*
DO	1	256	68	1	1	256	
DO	257	512	68	1	257	256	*
DO	513	768	68	1	513	256	*
DO	769	1024	68	1	769	256	*

The lines that marked * are set depending on the number of machine tools connected to the robot.

Table 6.1(h) FL-net Setting (When I/O device is FL-net)

Node	Item	Value	
Own Node	Area 1 Word Offset	0	
	Area 1 Word Size	64	
	DO Byte Size 1	128	
Node 2	Area 1 Word Offset	128	
	Area 1 Word Size	16	
	DI Byte Size 1	32	
Node 3	Area 1 Word Offset	160	*
	Area 1 Word Size	16	*
	DI Byte Size 1	32	*
Node 4	Area 1 Word Offset	192	*
	Area 1 Word Size	16	*
	DI Byte Size 1	32	*
Node 5	Area 1 Word Offset	224	*
	Area 1 Word Size	16	*
	DI Byte Size 1	32	*

The lines that marked * are set depending on the number of machine tools connected to the robot.

Table 6.1(i) TCP/IP Parameter (When I/O device is FL-net(Port #1) or FL-net(Port #2))

Parameter	Setting Value
IP Address	192.168.250.1
Subnet mask	255.255.255.0

Table 6.1(j) I/O Comments

DI			DO		
Number	**Comment**		**Number**	**Comment**	
1	*IMSTP		1	Command enabled	
2	*Hold		2	System ready	
3	*SFSPD		3	Program running	
4	Cycle stop		4	Program paused	
5	Fault reset		5	Motion held	
6	Start		6	Fault	
7	Home		7	At perch	
8	Enable		8	TP enabled	
9	PNS1		9	Battery alarm	
10	PNS2		10	Busy	
11	PNS3		11	SNO1	
12	PNS4		12	SNO2	
13	PNS5		13	SNO3	
14	PNS6		14	SNO4	
15	PNS7		15	SNO5	
16	PNS8		16	SNO6	
17	PNS strobe		17	SNO7	
18	Prod start		18	SNO8	
25	Service Type 1		19	SNACK	
26	Service Type 2		20	Reserved	
27	Service Type 3		25	RI[1]	
28	Service Type 4		26	RI[2]	
29	Hand Operation Type 1		27	RI[3]	
30	Hand Operation Type 2		28	RI[4]	
31	Hand Operation Type 3		29	RI[5]	
32	Hand Operation Type 4		30	RI[6]	
33	CNC Power On		31	RI[7]	
34	Interlock Mode		32	RI[8]	
35	Program Call		33	RO[1]	
36	Remote Operation Request		34	RO[2]	
37	Remote Operation Run		35	RO[3]	
38	Override Up		36	RO[4]	
39	Override Down		37	RO[5]	
40	Joint Jog Selection		38	RO[6]	
41	Joint Jog (J1 +)		39	RO[7]	
42	Joint Jog (J1 -)		40	RO[8]	
43	Joint Jog (J2 +)		41	Override output 1	
44	Joint Jog (J2 -)		42	Override output 2	
45	Joint Jog (J3 +)		43	Override output 3	
46	Joint Jog (J3 -)		44	Override output 4	
47	Joint Jog (J4 +)		45	Override output 5	
48	Joint Jog (J4 -)		46	Override output 6	
49	Joint Jog (J5 +)		47	Override output 7	
50	Joint Jog (J5 -)		48	Override output 8	

DI			DO		
Number	**Comment**		**Number**	**Comment**	
51	Joint Jog (J6 +)		49	CNC ID Number 1	
52	Joint Jog (J6 -)		50	CNC ID Number 2	
53	Coordinate jog (X+)		51	CNC ID Number 3	
54	Coordinate jog (X-)		52	CNC ID Number 4	
55	Coordinate jog (Y+)		53	Access Control 1	
56	Coordinate jog (Y-)		54	Access Control 2	
57	Coordinate jog (Z+)		55	Access Control 3	
58	Coordinate jog (Z-)		56	Access Control 4	
59	Home Position Return		57	Program Reply 1	
81	Rep. Peripheral Dev. 1		58	Program Reply 2	
82	Rep. Peripheral Dev. 2		59	Program Reply 3	
83	Rep. Peripheral Dev. 3		60	Program Reply 4	
84	Rep. Peripheral Dev. 4		61	Robot Power On	
85	Rep. Peripheral Dev. 5		62	Maintenance State	
86	Rep. Peripheral Dev. 6		63	Service State	
87	Rep. Peripheral Dev. 7		64	Machine Interlock Mode	
88	Rep. Peripheral Dev. 8		65	Remote Operation Mode	
89	Rep. Peripheral Dev. 9		66	Safety Fence Open	
90	Rep. Peripheral Dev. 10		67	Safety Fence Close	
91	Rep. Peripheral Dev. 11		68	In E.Stop state	
92	Rep. Peripheral Dev. 12		69	Not Ready	
93	Rep. Peripheral Dev. 13		70	Ready	
94	Rep. Peripheral Dev. 14		71	Completed	
95	Rep. Peripheral Dev. 15		72	Jog Feed Operation State	
96	Rep. Peripheral Dev. 16		73	Hand Operation State	
97	Production System Rep. 1		74	Home Return Op. State	
98	Production System Rep. 2		75	Remote Operation Req. ACK	
99	Production System Rep. 3		76	Remote Operation Req. NAK	
100	Production System Rep. 4		81	Com. Peripheral Dev. 1	
101	Input of System Op. 1		82	Com. Peripheral Dev. 2	
102	Input of System Op. 2		83	Com. Peripheral Dev. 3	
103	Input of System Op. 3		84	Com. Peripheral Dev. 4	
104	Input of System Op. 4		85	Com. Peripheral Dev. 5	
105	Robot Entry Approval		86	Com. Peripheral Dev. 6	
106	Service Call		87	Com. Peripheral Dev. 7	
107	Machine Alarm		88	Com. Peripheral Dev. 8	
108	Door Open		89	Com. Peripheral Dev. 9	
109	Door Close		90	Com. Peripheral Dev. 10	
110	Part Change Position		91	Com. Peripheral Dev. 11	
111	Cycle Stop		92	Com. Peripheral Dev. 12	
121	Operation Enabled		93	Com. Peripheral Dev. 13	
122	Operation Rejected		94	Com. Peripheral Dev. 14	
123	Operation Reject Code 0		95	Com. Peripheral Dev. 15	
124	Operation Reject Code 1		96	Com. Peripheral Dev. 16	
125	Operation Reject Code 2		97	Production System Op. 1	

DI			DO		
Number	**Comment**		**Number**	**Comment**	
126	Operation Reject Code 3		98	Production System Op. 2	
257~512	(CNC2 Area)	*	99	Production System Op. 3	
513~768	(CNC3 Area)	*	100	Production System Op. 4	
769~1024	(CNC4 Area)	*	101	Output System Resp. 1	
1025	(used)		102	Output System Resp. 2	
1026	(used)		103	Output System Resp. 3	
1027	(used)		104	Output System Resp. 4	
1028	(used)		105	*Robot Entry	
1029	(used)		106	Service Completed	
1030	(used)		121	Machine Operation Req.	
1031	(reserved)		122	Machine Operation Path 1	
1032	DIJogFeed Enable		123	Machine Operation Path 2	
1033	DIJogFeed 1+		124	Machine Operation Path 3	
1034	DIJogFeed 1-		125	Machine Operation Path 4	
1035	DIJogFeed 2+		126	Machine Operation Path 5	
1036	DIJogFeed 2-		127	Machine Operation H.Beat	
1037	DIJogFeed 3+		128	Reserve	
1038	DIJogFeed 3-		129	Machine Jog Override 0	
1039	DIJogFeed 4+		130	Machine Jog Override 1	
1040	DIJogFeed 4-		131	Machine Jog Override 2	
1041	DIJogFeed 5+		132	Machine Jog Override 3	
1042	DIJogFeed 5-		133	Machine Jog Override 4	
1043	DIJogFeed 6+		134	Machine Jog Override 5	
1044	DIJogFeed 6-		135	Machine Jog Override 6	
1045	DIJogFeed 7+		136	Machine Jog Override 7	
1046	DIJogFeed 7-		137	Machine Jog Override 8	
1047	DIJogFeed 8+		138	Machine Jog Override 9	
1048	DIJogFeed 8-		139	Machine Jog Override 10	
1049	DIJogFeed 9+		140	Machine Jog Override 11	
1050	DIJogFeed 9-		141	Machine Jog Override 12	
1051	DIJogFeed joint		142	Machine Jog Override 13	
1052	DIJogFeed jframe		143	Machine Jog Override 14	
1053	DIJogFeed JF1		144	Machine Jog Override 15	
1054	DIJogFeed JF2		145	Machine Jog (1st +)	
1055	DIJogFeed JF3		146	Machine Jog (1st -)	
1056	DIJogFeed JF4		147	Machine Jog (2nd +)	
1057	(reserved)		148	Machine Jog (2nd -)	
1058	(reserved)		149	Machine Jog (3rd +)	
1059	(reserved)		150	Machine Jog (3rd -)	
1060	(reserved)		151	Machine Jog (4th +)	
1061	(reserved)		152	Machine Jog (4th -)	
1062	(reserved)		153	Machine Jog (5th +)	
1063	(reserved)	*	154	Machine Jog (5th -)	
1064	(reserved)	*	155	Machine Jog (6th +)	
1065	(reserved)	*	156	Machine Jog (6th -)	

DI			DO		
Number	Comment		Number	Comment	
1066	(reserved)	*	157	Machine Jog (7th +)	
1067	(reserved)	*	158	Machine Jog (7th -)	
1068	(reserved)	*	159	Machine Jog (8th +)	
1069	(reserved)	*	160	Machine Jog (8th -)	
1070	(reserved)	*	257~512	(CNC2 Area)	*
1071	(reserved)	*	513~768	(CNC3 Area)	*
1072	(reserved)	*	769~1024	(CNC4 Area)	*
1073	(reserved)	*	1025	ESTOP	
1074	(reserved)	*	1026	FENCE	
1075	(reserved)	*	1027	(reserved)	
1076	(reserved)	*	1028	PG_RUN_C	
1077	(reserved)	*	1029	PG_END_C	
1078	(reserved)	*	1030	PG_ABORT_C	
1079	(reserved)	*	1031	(used)	
1080	(reserved)	*	1032	(reserved) or (used)	*

The items that marked * are set depending on the number of machine tools connected to the robot.
In CNCn Area (n=2 - 4), the same comments as the comments for CNC1 are set for CNCn.

Table 6.1(k) Group I/O Comment

GI			GO		
Number	Comment		Number	Comment	
1	Service Type 1		1	override output	
2	Service Type 2	*			
3	Service Type 3	*			
4	Service Type 4	*			
5	Hand Operation Type				

The items that marked * are set depending on the number of machine tools connected to the robot.

6.2 ROBODRILL CONNECTION

In case that ROBODRILL Connection is loaded and ROBODRILL Connection function is enabled, when the button labeled “Load Standard Configuration” is pressed in Load I/O configuration screen, the following setting is done.

Table 6.2(a) System Variables

System Variable	Value	Remarks
$BLAL_OUT.$BATALM_OR	TRUE	
$IOLNK[1].$RACK	0	
$IOLNK[1].$SLOT	1	
$IOLNK[1].$INPUT_N	256	
$IOLNK[1].$OUTPUT_N	256	
$IOLNK[2].$RACK	0	These system variables are set when the number of ROBODRILLs connected to the robot is 2.
$IOLNK[2].$SLOT	2	
$IOLNK[2].$INPUT_N	256	
$IOLNK[2].$OUTPUT_N	256	

System Variable	Value	Remarks
$MACROMAXDRI	15	
$MAX_DIG_PRT	1080	
$MTSERV_CFG.$CNC_POW_IO[1]	55	
$MTSERV_CFG.$CNC_POW_IO[2]	183	This system variable is set when the number of ROBODRILLs connected to the robot is 2.
$MTSERV_CFG.$NEEDSSETKR	1	
$MTSERV_CNC[1].$RECON_ENB	TRUE	
$MTSERV_CNC[2].$RECON_ENB	TRUE	This system variable is set when the number of ROBODRILLs connected to the robot is 2.
$MTSI.$DI_INDEX[1]	1032	
$MTSI.$DI_INDEX[2]	1051	
$MTSI.$DI_INDEX[3]	1052	
$MTSI.$DI_INDEX[4]	1053	
$MTSI.$DI_INDEX[5]	1054	
$MTSI.$DI_INDEX[6]	1055	
$MTSI.$DI_INDEX[7]	1056	
$MTSI.$DI_INDEX[8]	0	
$MTSI.$DI_INDEX[9]	1033	
$MTSI.$DI_INDEX[10]	1034	
$MTSI.$DI_INDEX[11]	1035	
$MTSI.$DI_INDEX[12]	1036	
$MTSI.$DI_INDEX[13]	1037	
$MTSI.$DI_INDEX[14]	1038	
$MTSI.$DI_INDEX[15]	1039	
$MTSI.$DI_INDEX[16]	1040	
$MTSI.$DI_INDEX[17]	1041	
$MTSI.$DI_INDEX[18]	1042	
$MTSI.$DI_INDEX[19]	1043	
$MTSI.$DI_INDEX[20]	1044	
$MTSI.$DI_INDEX[21]	1045	
$MTSI.$DI_INDEX[22]	1046	
$MTSI.$DI_INDEX[23]	1047	
$MTSI.$DI_INDEX[24]	1048	
$MTSI.$DI_INDEX[25]	1049	
$MTSI.$DI_INDEX[26]	1050	
$OPWORK.$UOP_DISABLE	0	
$PARAM_GROUP[1].$PPABN_ENBL	FALSE	
$REFPOS1[1].$COMMENT	REF POSITION	
$REFPOS1[1].$ENABLED	FALSE	
$REFPOS1[1].$DOUT_TYPE	2	
$REFPOS1[1].$DOUT_INDX	0	
$REFPOS1[2].$COMMENT	DRILL1 INTFZONE	
$REFPOS1[2].$ENABLED	FALSE	
$REFPOS1[2].$DOUT_TYPE	2	
$REFPOS1[2].$DOUT_INDX	6	

System Variable	Value	Remarks
$REFPOS1[3].$COMMENT	DRILL2 INTFZONE	These system variables are set when the number of ROBODRILLs connected to the robot is 2.
$REFPOS1[3].$ENABLED	FALSE	
$REFPOS1[3].$DOUT_TYPE	2	
$REFPOS1[3].$DOUT_INDX	134	
$REMOTE_CFG.$REMOTE_TYPE	1	
$SEMIPOWERFL	FALSE	
$SHELL_CFG.$CONT_ONLY	FALSE	
$SHELL_CFG.$USE_ABORT	TRUE	
$SHELL_CFG.$PNS_ENABLE	TRUE	
$SHELL_CFG.$PRODSTARTYP	1	
$SHELL_CFG.$CSTOPI_ALL	TRUE	

Table 6.2(b) Macros

Macro Number	Macro Name	Program	Assign	
121	HANDOP01	M_HAND11	MF	31
122	HANDOP02	M_HAND12	MF	32
123	HANDOP03	M_HAND13	MF	33
124	HANDOP04	M_HAND14	MF	34
125	HANDOP05	M_HAND15	MF	35
126	HANDOP06	M_HAND16	MF	36
127	HANDOP07	M_HAND17	MF	37
128	HANDOP08	M_HAND18	MF	38
129	HANDOP09	M_HAND21	MF	39
130	HANDOP10	M_HAND22	MF	40
131	HANDOP11	M_HAND23	MF	41
132	HANDOP12	M_HAND24	MF	42
133	HANDOP13	M_HAND25	MF	43
134	HANDOP14	M_HAND26	MF	44
135	HANDOP15	M_HAND27	MF	45
136	HANDOP16	M_HAND28	MF	46
137	MANL_OP	MANL_OP	DI	43
138	MANL_OP2	MANL_OP2	DI	171
139	REM_ENT	REM_ENT	DI	471
140	REM_EXT	REM_EXT	DI	472

Table 6.2(c) I/O Configuration (When the number of ROBODRILLs is 1)

I/O Type	Range (Start)	Range (End)	Rack	Slot	Start Point
UO	1	20	0	1	105
UI	1	18	0	1	105
DI	1	104	0	1	1
DI	209	214	0	1	123
DI	343	469	0	1	129
DI	471	472	33	2	2137
DI	497	497	0	1	256
DI	1025	1056	33	2	2137

I/O Type	Range (Start)	Range (End)	Rack	Slot	Start Point
DO	1	104	0	1	1
DO	105	105	0	1	256
DO	201	204	0	1	125
DO	333	459	0	1	129
DO	1025	1032	33	2	2089

Table 6.2(d) I/O Configuration (When the number of ROBODRILLs is 2)

I/O Type	Range (Start)	Range (End)	Rack	Slot	Start Point
UO	1	20	0	1	105
UI	1	18	0	1	105
DI	1	104	0	1	1
DI	105	128	0	2	105
DI	129	232	0	2	1
DI	337	469	0	1	123
DI	471	472	33	2	2137
DI	473	496	0	2	105
DI	497	497	0	1	256
DI	505	632	0	2	129
DI	1025	1056	33	2	2137
DO	1	104	0	1	1
DO	105	105	0	1	256
DO	129	232	0	2	1
DO	329	459	0	1	125
DO	465	488	0	2	105
DO	505	632	0	2	129
DO	1025	1032	33	2	2089

Table 6.2(e) PMC Internal I/O Configuration

I/O Type	Start Number	End Number	Size	Address	
DI	1	1024	128	1:X00000	
*UI	1	40	5	1:X01000	
WI	1	40	5	1:X01005	
WSI	1	40	5	1:X01010	
RI	1	40	5	1:X01020	
SI	0	15	2	1:X01025	
*UI	41	80	5	1:X01030	
DO	1	1024	128	1:Y00000	
*UO	1	40	5	1:Y01000	
WO	1	40	5	1:Y01005	
WSO	1	40	5	1:Y01010	
RO	1	40	5	1:Y01020	
SO	0	15	2	1:Y01025	
*UO	41	80	5	1:Y01030	
GI	1	64	128	1:F00000	
AI	1	64	128	1:F00128	

I/O Type	Start Number	End Number	Size	Address	
UO	1	64	8	1:F01000	
INFO	1	32	4	1:F01008	
GO	1	64	128	1:G00000	
AO	1	64	128	1:G00128	
UI	1	64	8	1:G01000	
UALM	1	32	4	1:G01008	
DO	10001	10136	17	1:K00000	
DO	10137	10160	3	1:K00900	
DO	11001	23000	1500	1:R00000	
GO	10001	11500	3000	1:D00000	

Table 6.2(f) I/O Comments

DI			DO		
Number	**Comment**		**Number**	**Comment**	
1	SERVICE REQUEST		1	SERVICE OK (RBT)	
2	WORK INSTALL.REQ.		2	IN SERV. TO FRD1	
3	WORK REMOV. REQ.		3	CYCLE STOP OK	
4	NOTICE OF M30/M02		4	SYSTEM STOP OK	
5	CYCLE STOP REQ.		5	GATE CLOSE LOCK	
6	SYSTEM STOP REQ.		6	REF.POINT RTN OK	
7	ALARM (FRD)		7		
8	GATE OPEN		8		
9	WORK L/UL POS		9		
10			10		
11			11		
12			12		
13			13		
14			14		
15			15		
16			16		
17			17		
18			18		
19			19		
20			20		
21			21		
22			22		
23			23		
24			24		
25	JOG X+ (ROBOT)		25		
26	JOG X- (ROBOT)		26		
27	JOG Y+ (ROBOT)		27		
28	JOG Y- (ROBOT)		28		
29	JOG Z+ (ROBOT)		29		
30	JOG Z- (ROBOT)		30		
31	JOG J1+ (ROBOT)		31		

DI			DO		
Number	**Comment**		**Number**	**Comment**	
32	JOG J1- (ROBOT)		32		
33	JOG J2+ (ROBOT)		33		
34	JOG J2- (ROBOT)		34		
35	JOG J3+ (ROBOT)		35		
36	JOG J3- (ROBOT)		36		
37	JOG J4+ (ROBOT)		37		
38	JOG J4- (ROBOT)		38		
39	JOG J5+ (ROBOT)		39		
40	JOG J5- (ROBOT)		40		
41	JOG J6+ (ROBOT)		41	RI1 STATE	
42	JOG J6- (ROBOT)		42	RI2 STATE	
43	HAND ACT. REQUEST		43	RI3 STATE	
44	HAND ON/OFF SEL.		44	RI4 STATE	
45	MACRO 1 SELECT.		45	RI5 STATE	
46	MACRO 2 SELECT.		46	RI6 STATE	
47	RO1 SELECT.		47	RI7 STATE	
48	RO2 SELECT.		48	RI8 STATE	
49	RO3 SELECT.		49	RO1 STATE	
50	RO4 SELECT.		50	RO2 STATE	
51	RO5 SELECT.		51	RO3 STATE	
52	RO6 SELECT.		52	RO4 STATE	
53	RO7 SELECT.		53	RO5 STATE	
54	RO8 SELECT.		54	RO6 STATE	
55	ON		55	RO7 STATE	
56			56	RO8 STATE	
57	EXTERNAL INPUT 1		57	EXT. OUTPUT 1	
58	EXTERNAL INPUT 2		58	EXT. OUTPUT 2	
59	EXTERNAL INPUT 3		59	EXT. OUTPUT 3	
60	EXTERNAL INPUT 4		60	EXT. OUTPUT 4	
61	EXTERNAL INPUT 5		61	EXT. OUTPUT 5	
62	EXTERNAL INPUT 6		62	EXT. OUTPUT 6	
63	EXTERNAL INPUT 7		63	EXT. OUTPUT 7	
64	EXTERNAL INPUT 8		64	EXT. OUTPUT 8	
65	FOR CUSTOM PMC		65	FOR CUSTOM PMC	
66	FOR CUSTOM PMC		66	FOR CUSTOM PMC	
67	FOR CUSTOM PMC		67	FOR CUSTOM PMC	
68	FOR CUSTOM PMC		68	FOR CUSTOM PMC	
69	FOR CUSTOM PMC		69	FOR CUSTOM PMC	
70	FOR CUSTOM PMC		70	FOR CUSTOM PMC	
71	FOR CUSTOM PMC		71	FOR CUSTOM PMC	
72	FOR CUSTOM PMC		72	FOR CUSTOM PMC	
73	SYSTEM MODE ON		73		
74	IN RBT MANUAL OP.		74		
75	READY ON		75		

DI			DO		
Number	**Comment**		**Number**	**Comment**	
76	READY ON (RBT)		76		
77	CYCLE START (RBT)		77		
78	HOLD (RBT)		78		
79	ALARM (RBT)		79		
80	REF. POINT (RBT)		80		
81	TEACHING (RBT)		81		
82	BATTERY LOW (RBT)		82		
83	BUSY (RBT)		83		
84	SLAVE START		84		
85	SYSTEM STOP COMM.		85		
86			86		
87			87		
88			88		
89			89	SYSTEM MODE ON	
90			90	IN RBT MANUAL OP.	
91			91	READY ON	
92			92	EMG STOP (RBT)	
93			93	CYCLE TOP (RBT)	
94			94	RESET (RBT)	
95			95	SYSTEM START	
96			96	REF. POINT RETURN	
97			97	PNS 1 (RBT)	
98			98	PNS 2 (RBT)	
99			99	PNS 3 (RBT)	
100			100	PNS 4 (RBT)	
101			101	PNS 5 (RBT)	
102			102	PNS 6 (RBT)	
103			103	PNS 7 (RBT)	
104			104	PNS 8 (RBT)	
105	EMG STOP (RBT)		105		
106	HOLD (RBT)		106		
107	SAFETY SPD (RBT)		107		
108	CYCLE STOP (RBT)		108		
109	RESET (RBT)		109		
110	EXT. START (RBT)		110		
111			111		
112	OPERAT. OK (RBT)		112		
113	PNS 1 (RBT)		113		
114	PNS 2 (RBT)		114		
115	PNS 3 (RBT)		115		
116	PNS 4 (RBT)		116		
117	PNS 5 (RBT)		117		
118	PNS 6 (RBT)		118		
119	PNS 7 (RBT)		119		

DI			DO		
Number	**Comment**		**Number**	**Comment**	
120	PNS 8 (RBT)		120		
121	PNS REQUEST (RBT)		121		
122	START (RBT)		122		
123			123		
124			124		
125			125		
126			126		
127			127		
128			128		
129	SERVICE REQUEST	*	129	IN SERV. TO FRD1	*
130	WORK INSTALL.REQ.	*	130	CYCLE STOP OK	*
131	WORK REMOV. REQ.	*	131	SYSTEM STOP OK	*
132	NOTICE OF M30/M02	*	132	GATE CLOSE LOCK	*
133	CYCLE STOP REQ.	*	133	REF.POINT RTN OK	*
134	SYSTEM STOP REQ.	*	134	IN SERV. TO FRD1	*
135	ALARM (FRD)	*	135		*
136	GATE OPEN	*	136		*
137	WORK L/UL POS	*	137		*
138		*	138		*
139		*	139		*
140		*	140		*
141		*	141		*
142		*	142		*
143		*	143		*
144		*	144		*
145		*	145		*
146		*	146		*
147		*	147		*
148		*	148		*
149		*	149		*
150		*	150		*
151		*	151		*
152		*	152		*
153	JOG X+ (ROBOT)	*	153		*
154	JOG X- (ROBOT)	*	154		*
155	JOG Y+ (ROBOT)	*	155		*
156	JOG Y- (ROBOT)	*	156		*
157	JOG Z+ (ROBOT)	*	157		*
158	JOG Z- (ROBOT)	*	158		*
159	JOG J1+ (ROBOT)	*	159		*
160	JOG J1- (ROBOT)	*	160		*
161	JOG J2+ (ROBOT)	*	161		*
162	JOG J2- (ROBOT)	*	162		*

DI			DO		
Number	**Comment**		**Number**	**Comment**	
163	JOG J3+ (ROBOT)	*	163		*
164	JOG J3- (ROBOT)	*	164		*
165	JOG J4+ (ROBOT)	*	165		*
166	JOG J4- (ROBOT)	*	166		*
167	JOG J5+ (ROBOT)	*	167		*
168	JOG J5- (ROBOT)	*	168		*
169	JOG J6+ (ROBOT)	*	169	RI1 STATE	*
170	JOG J6- (ROBOT)	*	170	RI2 STATE	*
171	HAND ACT. REQUEST	*	171	RI3 STATE	*
172	HAND ON/OFF SEL.	*	172	RI4 STATE	*
173	MACRO 1 SELECT.	*	173	RI5 STATE	*
174	MACRO 2 SELECT.	*	174	RI6 STATE	*
175	RO1 SELECT.	*	175	RI7 STATE	*
176	RO2 SELECT.	*	176	RI8 STATE	*
177	RO3 SELECT.	*	177	RO1 STATE	*
178	RO4 SELECT.	*	178	RO2 STATE	*
179	RO5 SELECT.	*	179	RO3 STATE	*
180	RO6 SELECT.	*	180	RO4 STATE	*
181	RO7 SELECT.	*	181	RO5 STATE	*
182	RO8 SELECT.	*	182	RO6 STATE	*
183	ON	*	183	RO7 STATE	*
184		*	184	RO8 STATE	*
185	EXTERNAL INPUT 1	*	185	EXT. OUTPUT 1	*
186	EXTERNAL INPUT 2	*	186	EXT. OUTPUT 2	*
187	EXTERNAL INPUT 3	*	187	EXT. OUTPUT 3	*
188	EXTERNAL INPUT 4	*	188	EXT. OUTPUT 4	*
189	EXTERNAL INPUT 5	*	189	EXT. OUTPUT 5	*
190	EXTERNAL INPUT 6	*	190	EXT. OUTPUT 6	*
191	EXTERNAL INPUT 7	*	191	EXT. OUTPUT 7	*
192	EXTERNAL INPUT 8	*	192	EXT. OUTPUT 8	*
193	FOR CUSTOM PMC	*	193	FOR CUSTOM PMC	*
194	FOR CUSTOM PMC	*	194	FOR CUSTOM PMC	*
195	FOR CUSTOM PMC	*	195	FOR CUSTOM PMC	*
196	FOR CUSTOM PMC	*	196	FOR CUSTOM PMC	*
197	FOR CUSTOM PMC	*	197	FOR CUSTOM PMC	*
198	FOR CUSTOM PMC	*	198	FOR CUSTOM PMC	*
199	FOR CUSTOM PMC	*	199	FOR CUSTOM PMC	*
200	FOR CUSTOM PMC	*	200	FOR CUSTOM PMC	*
201		*	201	SYSTEM MODE ON	*
202		*	202	IN RBT MANUAL OP.	*
203		*	203	READY ON	*
204		*	204	READY ON (RBT)	*
205		*	205	CYCLE START (RBT)	*

DI			DO		
Number	**Comment**		**Number**	**Comment**	
206		*	206	HOLD (RBT)	*
207		*	207	ALARM (RBT)	*
208		*	208	REF. POINT (RBT)	*
209		*	209	TEACHING (RBT)	*
210		*	210	BATTERY LOW (RBT)	*
211		*	211	BUSY (RBT)	*
212		*	212	SLAVE START	*
213		*	213	SYSTEM STOP COMM.	*
214		*	214		*
215		*	215		*
216		*	216		*
217	SYSTEM MODE ON	*	217		*
218	IN RBT MANUAL OP.	*	218		*
219	READY ON	*	219		*
220	EMG STOP (RBT)	*	220		*
221	CYCLE STOP (RBT)	*	221		*
222	RESET (RBT)	*	222		*
223	SYSTEM START	*	223		*
224	REF. POINT RETURN	*	224		*
225	PNS 1 (RBT)	*	225		*
226	PNS 2 (RBT)	*	226		*
227	PNS 3 (RBT)	*	227		*
228	PNS 4 (RBT)	*	228		*
229	PNS 5 (RBT)	*	229		*
230	PNS 6 (RBT)	*	230		*
231	PNS 7 (RBT)	*	231		*
232	PNS 8 (RBT)	*	232		*
343	ROBODRILL ope Enabled		333	ROBODRILL Ope Req.	
344	ROBODRILL ope Rejected		334	ROBODRILL Ope Path 1	
345	ROBODRILL ope Reject 0		335	ROBODRILL Ope Path 2	
346	ROBODRILL ope Reject 1		336	ROBODRILL Ope Path 3	
347	ROBODRILL ope Reject 2		337	ROBODRILL Ope Path 4	
348	ROBODRILL ope Reject 3		338	ROBODRILL Ope Path 5	
471	RemOpe ENTRY		339	ROBODRILL Ope H.Beat	
472	RemOpe EXIT		340	Reserve	
505	Operation Enabled	*	341	ROBODRILL Jog ovr 0	
506	Operation Rejected	*	342	ROBODRILL Jog ovr 1	
507	Operation Reject Code 0	*	343	ROBODRILL Jog ovr 2	
508	Operation Reject Code 1	*	344	ROBODRILL Jog ovr 3	
509	Operation Reject Code 2	*	345	ROBODRILL Jog ovr 4	
510	Operation Reject Code 3	*	346	ROBODRILL Jog ovr 5	
1025	(reserved)		347	ROBODRILL Jog ovr 6	
1026	(reserved)		348	ROBODRILL Jog ovr 7	

DI			DO		
Number	Comment		Number	Comment	
1027	(reserved)		349	ROBODRILL Jog ovr 8	
1028	(reserved)		350	ROBODRILL Jog ovr 9	
1029	(reserved)		351	ROBODRILL Jog ovr 10	
1030	(reserved)		352	ROBODRILL Jog ovr 11	
1031	(reserved)		353	ROBODRILL Jog ovr 12	
1032	DIJog Enable		354	ROBODRILL Jog ovr 13	
1033	DIJog 1+		355	ROBODRILL Jog ovr 14	
1034	DIJog 1-		356	ROBODRILL Jog ovr 15	
1035	DIJog 2+		357	ROBODRILL Jog (1+)	
1036	DIJog 2-		358	ROBODRILL Jog (1-)	
1037	DIJog 3+		359	ROBODRILL Jog (2+)	
1038	DIJog 3-		360	ROBODRILL Jog (2-)	
1039	DIJog 4+		361	ROBODRILL Jog (3+)	
1040	DIJog 4-		362	ROBODRILL Jog (3-)	
1041	DIJog 5+		363	ROBODRILL Jog (4+)	
1042	DIJog 5-		364	ROBODRILL Jog (4-)	
1043	DIJog 6+		365	ROBODRILL Jog (5+)	
1044	DIJog 6-		366	ROBODRILL Jog (5-)	
1045	DIJog 7+		367	ROBODRILL Jog (6+)	
1046	DIJog 7-		368	ROBODRILL Jog (6-)	
1047	DIJog 8+		369	ROBODRILL Jog (7+)	
1048	DIJog 8-		370	ROBODRILL Jog (7-)	
1049	DIJog 9+		371	ROBODRILL Jog (8+)	
1050	DIJog 9-		372	ROBODRILL Jog (8-)	
1051	DIJog Joint		505	ROBODRILL Ope Req.	*
1052	DIJog Cart.		506	ROBODRILL Ope Path 1	*
1053	DIJog JF1		507	ROBODRILL Ope Path 2	*
1054	DIJog JF2		508	ROBODRILL Ope Path 3	*
1055	DIJog JF3		509	ROBODRILL Ope Path 4	*
1056	DIJog JF4		510	ROBODRILL Ope Path 5	*
			511	ROBODRILL Ope H.Beat	*
			512	Reserve	*
			513	ROBODRILL Jog ovr 0	*
			514	ROBODRILL Jog ovr 1	*
			515	ROBODRILL Jog ovr 2	*
			516	ROBODRILL Jog ovr 3	*
			517	ROBODRILL Jog ovr 4	*
			518	ROBODRILL Jog ovr 5	*
			519	ROBODRILL Jog ovr 6	*
			520	ROBODRILL Jog ovr 7	*
			521	ROBODRILL Jog ovr 8	*
			522	ROBODRILL Jog ovr 9	*
			523	ROBODRILL Jog ovr 10	*
			524	ROBODRILL Jog ovr 11	*

DI			DO		
Number	Comment		Number	Comment	
			525	ROBODRILL Jog ovr 12	*
			526	ROBODRILL Jog ovr 13	*
			527	ROBODRILL Jog ovr 14	*
			528	ROBODRILL Jog ovr 15	*
			529	MACHINE Jog (1st+)	*
			530	MACHINE Jog (1st-)	*
			531	MACHINE Jog (2nd+)	*
			532	MACHINE Jog (2nd-)	*
			533	MACHINE Jog (3rd+)	*
			534	MACHINE Jog (3rd-)	*
			535	MACHINE Jog (4th+)	*
			536	MACHINE Jog (4th-)	*
			537	MACHINE Jog (5th+)	*
			538	MACHINE Jog (5th-)	*
			539	MACHINE Jog (6th+)	*
			540	MACHINE Jog (6th-)	*
			541	MACHINE Jog (7th+)	*
			542	MACHINE Jog (7th-)	*
			543	MACHINE Jog (8th+)	*
			544	MACHINE Jog (8th-)	*
			1025	(reserved)	
			1026	(reserved)	
			1027	(reserved)	
			1028	(reserved)	
			1029	(reserved)	
			1030	(reserved)	
			1031	(reserved)	
			1032	(reserved)	

The items that marked * are set when the number of ROBODRILLs connected to the robot is 2.

6.3 ROBODRILL CONNECTION 2

In case that ROBODRILL Connection 2 is loaded and ROBODRILL Connection 2 function is enabled, when the button labeled “Load Standard Configuration” is pressed in Load I/O configuration screen, the following setting is done.

Table 6.3(a) System Variables

System Variable	Value	Remarks
$BLAL_OUT.$BATALM_OR	TRUE	
$E_STOP_DO	1026	
$MACROMAXDRI	15	
$MAX_DIG_PRT	1280	
$MTSERV_CFG.$NEEDSSETKR	1	
$MTSERV_CNC[1].$RECON_ENB	TRUE	

System Variable	Value	Remarks
$MTSERV_CNC[2].$RECON_ENB	TRUE	In case of two ROBODRILLs system
$MTSERV_CNC[3].$RECON_ENB	TRUE	In case of three ROBODRILLs system
$MTSERV_CNC[4].$RECON_ENB	TRUE	In case of four ROBODRILLs system
$MTSERV_CFG.$CNC_POW_IO[1]	11	
$MTSERV_CFG.$CNC_POW_IO[2]	267	
$MTSERV_CFG.$CNC_POW_IO[3]	523	
$MTSERV_CFG.$CNC_POW_IO[4]	779	
$MTSI.$DI_INDEX[1]	1032	
$MTSI.$DI_INDEX[2]	1051	
$MTSI.$DI_INDEX[3]	1052	
$MTSI.$DI_INDEX[4]	1053	
$MTSI.$DI_INDEX[5]	1054	
$MTSI.$DI_INDEX[6]	1055	
$MTSI.$DI_INDEX[7]	1056	
$MTSI.$DI_INDEX[8]	0	
$MTSI.$DI_INDEX[9]	1033	
$MTSI.$DI_INDEX[10]	1034	
$MTSI.$DI_INDEX[11]	1035	
$MTSI.$DI_INDEX[12]	1036	
$MTSI.$DI_INDEX[13]	1037	
$MTSI.$DI_INDEX[14]	1038	
$MTSI.$DI_INDEX[15]	1039	
$MTSI.$DI_INDEX[16]	1040	
$MTSI.$DI_INDEX[17]	1041	
$MTSI.$DI_INDEX[18]	1042	
$MTSI.$DI_INDEX[19]	1043	
$MTSI.$DI_INDEX[20]	1044	
$MTSI.$DI_INDEX[21]	1045	
$MTSI.$DI_INDEX[22]	1046	
$MTSI.$DI_INDEX[23]	1047	
$MTSI.$DI_INDEX[24]	1048	
$MTSI.$DI_INDEX[25]	1049	
$MTSI.$DI_INDEX[26]	1050	
$OPWORK.$UOP_DISABLE	0	
$PARAM_GROUP[1].$PPABN_ENBL	FALSE	
$REFPOS1[1].$COMMENT	REF POSITION	
$REFPOS1[1].$ENABLED	FALSE	
$REFPOS1[1].$DOUT_TYPE	2	
$REFPOS1[1].$DOUT_INDX	0	
$REFPOS1[2].$COMMENT	DRILL1 INTFZONE	
$REFPOS1[2].$ENABLED	FALSE	
$REFPOS1[2].$DOUT_TYPE	2	
$REFPOS1[2].$DOUT_INDX	7	

System Variable	Value	Remarks
$REFPOS1[3].$COMMENT	DRILL2 INTFZONE	In case of two ROBODRILLs system
$REFPOS1[3].$ENABLED	FALSE	
$REFPOS1[3].$DOUT_TYPE	2	
$REFPOS1[3].$DOUT_INDX	263	
$REFPOS1[3].$COMMENT	DRILL3 INTFZONE	In case of three ROBODRILLs system
$REFPOS1[3].$ENABLED	FALSE	
$REFPOS1[3].$DOUT_TYPE	2	
$REFPOS1[3].$DOUT_INDX	519	
$REFPOS1[3].$COMMENT	DRILL4 INTFZONE	In case of four ROBODRILLs system
$REFPOS1[3].$ENABLED	FALSE	
$REFPOS1[3].$DOUT_TYPE	2	
$REFPOS1[3].$DOUT_INDX	775	
$REMOTE_CFG.$REMOTE_TYPE	1	
$SEMIPOWERFL	FALSE	
$SHELL_CFG.$CONT_ONLY	TRUE	
$SHELL_CFG.$USE_ABORT	TRUE	
$SHELL_CFG.$PNS_ENABLE	TRUE	
$SHELL_CFG.$PRODSTARTYP	1	
$SHELL_CFG.$CSTOPI_ALL	TRUE	

Table 6.3(b) FL-net Configuration (1) own node

Item	Value	Remarks
MAX DIGITAL PORT NUM	1280	
USING PORT	INTERNAL1 or INTERNAL2	The port selected on Setup screen.
IP ADDRESS	192.168.250.1	
MUTICAST	DISABLE	
TOKEN WATCH TIME	30	
FRAME INTERVAL	50	
AREA1 WORD OFFSET	0	
AREA1 WORD SIZE	26 (, 38, 50, 62)	This value depends on the number of ROBODRILLs
DO BYTE OFFSET1	12	
DO BYTE SIZE 1	40 (, 64, 88, 112)	This value depends on the number of ROBODRILLs

Table 6.3(c) FL-net Configuration(2) NODE LIST

Node	Area1 Word Offset	Area1 Word Size	DI BYTE SIZE1	DI BYTE OFFSET1	
2	62	22	32	12	
3	84	22	32	12	*
4	106	22	32	12	*
5	128	22	32	12	*

The items that marked * are set when two or more ROBODRILLs are connected.

Table6.3(d) Safety function by FL-net configuration (1) own node

Item	value
Enable/Disable	Enable
Own node number	1
Timer for receive data	500
Mode	2

Table 6.3(e) Safety function by FL-net configuration (2) node list

Node	Enable/Disable	IDnum	
1	DISABLE	1	
2	ENABLE	1	
3	ENABLE	1	*
4	ENABLE	1	*
5	ENABLE	1	*
6	DISABLE	1	
...	...	...	
30	DIABLE	1	

The items that marked * are set when two or more ROBODRILLs are connected.

Table 6.3(f) Safe I/O connect

FSO[1] = SSI[2:FENCE] FSO[2] = SSI[8:T1] FSO[3] = SSI[6:OPEMG] (FSO[3] = SSI[3:EXEMG] on R-30*i*B Mate)

Table 6.3(g) TCP/IP parameter(1)

TCP/IP parameter	Value
IP Address	192.168.250.1
Subnet mask	255.255.255.0

Table 6.3(h) TCP/IP parameter (2) hostname

	Host Name (LOCAL)	Internet Address
1	D1	192.168.250.2
2	D2	192.168.250.3
3	D3	192.168.250.4
4	D4	192.168.250.5

Table 6.3(i) Clients

	Tag	Protocol	CNC Number	Rmote
1	C1:	MTCOM	1	D1
2	C2:	MTCOM	2	D2
3	C3:	MTCOM	3	D3
4	C4:	MTCOM	4	D4

Table6.3(j) Macros

Macro Number	Macro Name	Program	Assign		
121	HANDOP01	M_HAND11	MF	31	
122	HANDOP02	M_HAND12	MF	32	
123	HANDOP03	M_HAND13	MF	33	

Macro Number	Macro Name	Program	Assign		
124	HANDOP04	M_HAND14	MF	34	
125	HANDOP05	M_HAND15	MF	35	
126	HANDOP06	M_HAND16	MF	36	
127	HANDOP07	M_HAND17	MF	37	
128	HANDOP08	M_HAND18	MF	38	
129	HANDOP09	M_HAND21	MF	39	
130	HANDOP10	M_HAND22	MF	40	
131	HANDOP11	M_HAND23	MF	41	
132	HANDOP12	M_HAND24	MF	42	
133	HANDOP13	M_HAND25	MF	43	
134	HANDOP14	M_HAND26	MF	44	
135	HANDOP15	M_HAND27	MF	45	
136	HANDOP16	M_HAND28	MF	46	
137	MANL_OP	MANL_OP	DI	40	
138	MANL_OP2	MANL_OP2	DI	296	*
139	MANL_OP3	MANL_OP3	DI	552	*
140	MANL_OP4	MANL_OP4	DI	808	*
141	REM_ENT	REM_ENT	DI	1025	
142	REM_EXT	REM_EXT	DI	1026	
143	OVRUP	OVRUP	DI	1028	
144	OVRDOWN	OVRDOWN	DI	1029	
145	OVR100	OVR100	DI	1057	
146	OVRLOW	OVRLOW	DI	1058	

The items that marked * are set when two or more ROBODRILLs are connected.

Table6.3(k) DI/DO, UI/UO Configuration

I/O Type	Range (Start)	Range (End)	Rack	Slot	Start Point	
DI	1	256	68	2	1	
DI	257	512	68	3	1	*2
DI	513	768	68	4	1	*3
DI	769	1024	68	5	1	*4
DI	1025	1064	34	1	25	
DI	1065	1075	36	3	1	
DI	1075	1080	0	0	0	
DO	1	64	68	1	129	
DO	65	128	0	0	0	
DO	129	256	68	1	193	
DO	257	320	68	1	321	
DO	321	384	0	0	0	*2
DO	385	512	68	1	385	*2
DO	513	576	68	1	513	*3
DO	577	640	0	0	0	*3
DO	641	768	68	1	577	*3
DO	769	832	68	1	705	*4
DO	833	896	0	0	0	*4
DO	897	1024	68	1	769	*4

I/O Type	Range (Start)	Range (End)	Rack	Slot	Start Point	
DO	1025	1128	68	1	25	
DO	1129	1132	68	1	21	
UI	1	18	34	1	1	
UO	1	20	68	1	1	

The items that marked *2,*3,*4 are set according to number of ROBODRILLs.

Table6.3(l) GI/GO Configuration

I/O Type	Range	Rack	Slot	Start Point	Num	
GO	1	68	1	49	8	

Table6.3(m) Interconnect

No.	Input	Output
1	RI[1]	DO[1033]
2	RI[2]	DO[1034]
3	RI[3]	DO[1035]
4	RI[4]	DO[1036]
5	RI[5]	DO[1036]
6	RI[6]	DO[1038]
7	RI[7]	DO[1039]
8	RI[8]	DO[1040]

Table6.3(n) Flag Comments

Name	Comment	Name	Comment
F[1]	UI[1]	F[33]	DI[1033]
F[2]	UI[2]	F[34]	DI[1034]
F[3]	UI[3]	F[35]	DI[1035]
F[4]	UI[4]	F[36]	DI[1036]
F[5]	UI[5]	F[37]	DI[1037]
F[6]	UI[6]	F[38]	DI[1038]
F[7]	UI[7]	F[39]	DI[1039]
F[8]	UI[8]	F[40]	DI[1040]
F[9]	UI[9]	F[41]	DI[1041]
F[10]	UI[10]	F[42]	DI[1042]
F[11]	UI[11]	F[43]	DI[1043]
F[12]	UI[12]	F[44]	DI[1044]
F[13]	UI[13]	F[45]	DI[1045]
F[14]	UI[14]	F[46]	DI[1046]
F[15]	UI[15]	F[47]	DI[1047]
F[16]	UI[16]	F[48]	DI[1048]
F[17]	UI[17]	F[49]	DI[1049]
F[18]	UI[18]	F[50]	DI[1050]
F[19]		F[51]	DI[1051]
F[20]		F[52]	DI[1052]
F[21]		F[53]	DI[1053]
F[22]		F[54]	DI[1054]
F[23]		F[55]	DI[1055]

Name	Comment	Name	Comment
F[24]		F[56]	DI[1056]
F[25]	DI[1025]	F[57]	DI[1057]
F[26]	DI[1026]	F[58]	DI[1058]
F[27]	DI[1027]	F[59]	DI[1059]
F[28]	DI[1028]	F[60]	DI[1060]
F[29]	DI[1029]	F[61]	DI[1061]
F[30]	DI[1030]	F[62]	DI[1062]
F[31]	DI[1031]	F[63]	DI[1063]
F[32]	DI[1032]	F[64]	DI[1064]

Table6.3(o) GO Comments

Name	Comment	*
GO[1]	Override	

Table 6.3(p) DI/DO Comments(1)

DI			DO		
Name	**Comment**		**Name**	**Comment**	
1	SERVICE REQUEST		1	SERVICE OK (RBT)	
2	WORK INSTALL.REQ.		2	IN SERV. TO FRD1	
3	WORK REMOV. REQ.		3	CYCLE STOP OK	
4	NOTICE OF M30/M02		4	SYSTEM STOP OK	
5	CYCLE STOP REQ.		5	SIDE GATE CLOSE LOCK	
6	SYSTEM STOP REQ.		6	FRONT GATE CLOSE LOCK	
7	ALARM (FRD)		7	REF.POINT RTN OK	
8	SIDE GATE OPEN		8	Robot Assigned	
9	WORK L/UL POS		9	SIDE GATE OPEN Req.	
10	FRONT GATE OPEN		10	SIDE GATE OPEN Req.	
11	ROBODRILL Power On		11	FRONT GATE OPEN Req.	
12	ROBODRILL System Running		12	FRONT GATE CLOSE Req.	
13	SYSTEM MODE ON		13	L/UL POS Return Req.	
14	MANUAL OPE REQ.		14	Parts Count Up	
15	READY ON		15	Cycle Stop Req.	
16	SYSTEM START REQ.(slave)		16	(Reserved)	
17	JOG 1+ (ROBOT)		17	ROBODRILL Jog ovr 0	
18	JOG 1- (ROBOT)		18	ROBODRILL Jog ovr 1	
19	JOG 2+ (ROBOT)		19	ROBODRILL Jog ovr 2	
20	JOG 2- (ROBOT)		20	ROBODRILL Jog ovr 3	
21	JOG 3+ (ROBOT)		21	ROBODRILL Jog ovr 4	
22	JOG 3- (ROBOT)		22	ROBODRILL Jog ovr 5	
23	JOG 4+ (ROBOT)		23	ROBODRILL Jog ovr 6	
24	JOG 4- (ROBOT)		24	ROBODRILL Jog ovr 7	
25	JOG 5+ (ROBOT)		25	ROBODRILL Jog ovr 8	
26	JOG 5- (ROBOT)		26	ROBODRILL Jog ovr 9	
27	JOG 6+ (ROBOT)		27	ROBODRILL Jog ovr 10	
28	JOG 6- (ROBOT)		28	ROBODRILL Jog ovr 11	
29	JOG 7+ (ROBOT)		29	ROBODRILL Jog ovr 12	

DI			DO		
Name	**Comment**		**Name**	**Comment**	
30	JOG 7- (ROBOT)		30	ROBODRILL Jog ovr 13	
31	JOG 8+ (ROBOT)		31	ROBODRILL Jog ovr 14	
32	JOG 8- (ROBOT)		32	ROBODRILL Jog ovr 15	
33	Joint Jog Selection		33	ROBODRILL Ope Req.	
34	Cartesian Jog Selection		34	(Reserved)	
35	Robot Jog Enable		35	ROBODRILL Jog (1+)	
36	Override Up		36	ROBODRILL Jog (1-)	
37	Override Down		37	ROBODRILL Jog (2+)	
38	Override 100%		38	ROBODRILL Jog (2-)	
39	Override Low		39	ROBODRILL Jog (3+)	
40	HAND ACT. REQUEST		40	ROBODRILL Jog (3-)	
41	RO1 SELECT.		41	ROBODRILL Jog (4+)	
42	RO2 SELECT.		42	ROBODRILL Jog (4-)	
43	RO3 SELECT.		43	ROBODRILL Jog (5+)	
44	RO4 SELECT.		44	ROBODRILL Jog (5-)	
45	RO5 SELECT.		45	(Reserved)	
46	RO6 SELECT.		46	(Reserved)	
47	RO7 SELECT.		47	(Reserved)	
48	RO8 SELECT.		48	(Reserved)	
49	Robot Jog Entry		49	(Reserved)	
50	Robot Jog Exit		50	(Reserved)	
51	ROBODRILL ope Enabled		51	(Reserved)	
52	ROBODRILL ope Rejected		52	(Reserved)	
53	ROBODRILL ope Reject 0		53	(Reserved)	
54	ROBODRILL ope Reject 1		54	(Reserved)	
55	ROBODRILL ope Reject 2		55	(Reserved)	
56	ROBODRILL ope Reject 3		56	(Reserved)	
57	EMG STOP (RBT)		57	(Reserved)	
58	HOLD (RBT)		58	(Reserved)	
59	SAFETY SPD (RBT)		59	(Reserved)	
60	CYCLE STOP (RBT)		60	(Reserved)	
61	RESET (RBT)		61	(Reserved)	
62	EXT. START (RBT)		62	(Reserved)	
63	HOME		63	(Reserved)	
64	OPERAT. OK (RBT)		64	(Reserved)	
65	PNS 1 (RBT)		65		
66	PNS 2 (RBT)		66		
67	PNS 3 (RBT)		67		
68	PNS 4 (RBT)		68		
69	PNS 5 (RBT)		69		
70	PNS 6 (RBT)		70		
71	PNS 7 (RBT)		71		
72	PNS 8 (RBT)		72		
73	PNS REQUEST (RBT)		73		
74	START (RBT)		74		

DI			DO		
Name	**Comment**		**Name**	**Comment**	
75	(Reserved)		75		
76	(Reserved)		76		
77	(Reserved)		77		
78	(Reserved)		78		
79	(Reserved)		79		
80	Master ROBODRILL		80		
81	ROBODRILL Program Num.0		81		
82	ROBODRILL Program Num.1		82		
83	ROBODRILL Program Num.2		83		
84	ROBODRILL Program Num.3		84		
85	ROBODRILL Program Num.4		85		
86	ROBODRILL Program Num.5		86		
87	ROBODRILL Program Num.6		87		
88	ROBODRILL Program Num.7		88		
89	ROBODRILL Program Num.8		89		
90	ROBODRILL Program Num.9		90		
91	ROBODRILL Program Num.10		91		
92	ROBODRILL Program Num.11		92		
93	ROBODRILL Program Num.12		93		
94	ROBODRILL Program Num.13		94		
95	ROBODRILL Program Num.14		95		
96	ROBODRILL Program Num.15		96		
97	Peripherals Macro 1		97		
98	Peripherals Macro 2		98		
99	Peripherals Macro 3		99		
100	Peripherals Macro 4		100		
101	Peripherals Macro 5		101		
102	Peripherals Macro 6		102		
103	Peripherals Macro 7		103		
104	Peripherals Macro 8		104		
105	(Reserved)		105		
106	(Reserved)		106		
107	(Reserved)		107		
108	(Reserved)		108		
109	(Reserved)		109		
110	(Reserved)		110		
111	(Reserved)		111		
112	(Reserved)		112		
113	(Reserved)		113		
114	(Reserved)		114		
115	(Reserved)		115		
116	(Reserved)		116		
117	(Reserved)		117		
118	(Reserved)		118		
119	(Reserved)		119		

DI			DO		
Name	**Comment**		**Name**	**Comment**	
120	(Reserved)		120		
121	(Reserved)		121		
122	(Reserved)		122		
123	(Reserved)		123		
124	(Reserved)		124		
125	(Reserved)		125		
126	(Reserved)		126		
127	(Reserved)		127		
128	(Reserved)		128		
129	(Reserved)		129	(Reserved)	
130	(Reserved)		130	(Reserved)	
131	(Reserved)		131	(Reserved)	
132	(Reserved)		132	(Reserved)	
133	(Reserved)		133	(Reserved)	
134	(Reserved)		134	(Reserved)	
135	(Reserved)		135	(Reserved)	
136	(Reserved)		136	(Reserved)	
137	(Reserved)		137	(Reserved)	
138	(Reserved)		138	(Reserved)	
139	(Reserved)		139	(Reserved)	
140	(Reserved)		140	(Reserved)	
141	(Reserved)		141	(Reserved)	
142	(Reserved)		142	(Reserved)	
143	(Reserved)		143	(Reserved)	
144	(Reserved)		144	(Reserved)	
145	(Reserved)		145	(Reserved)	
146	(Reserved)		146	(Reserved)	
147	(Reserved)		147	(Reserved)	
148	(Reserved)		148	(Reserved)	
149	(Reserved)		149	(Reserved)	
150	(Reserved)		150	(Reserved)	
151	(Reserved)		151	(Reserved)	
152	(Reserved)		152	(Reserved)	
153	(Reserved)		153	(Reserved)	
154	(Reserved)		154	(Reserved)	
155	(Reserved)		155	(Reserved)	
156	(Reserved)		156	(Reserved)	
157	(Reserved)		157	(Reserved)	
158	(Reserved)		158	(Reserved)	
159	(Reserved)		159	(Reserved)	
160	(Reserved)		160	(Reserved)	
161	FOR CUSTOM PMC		161	FOR CUSTOM PMC	
162	FOR CUSTOM PMC		162	FOR CUSTOM PMC	
163	FOR CUSTOM PMC		163	FOR CUSTOM PMC	
164	FOR CUSTOM PMC		164	FOR CUSTOM PMC	

DI			DO		
Name	**Comment**		**Name**	**Comment**	
165	FOR CUSTOM PMC		165	FOR CUSTOM PMC	
166	FOR CUSTOM PMC		166	FOR CUSTOM PMC	
167	FOR CUSTOM PMC		167	FOR CUSTOM PMC	
168	FOR CUSTOM PMC		168	FOR CUSTOM PMC	
169	FOR CUSTOM PMC		169	FOR CUSTOM PMC	
170	FOR CUSTOM PMC		170	FOR CUSTOM PMC	
171	FOR CUSTOM PMC		171	FOR CUSTOM PMC	
172	FOR CUSTOM PMC		172	FOR CUSTOM PMC	
173	FOR CUSTOM PMC		173	FOR CUSTOM PMC	
174	FOR CUSTOM PMC		174	FOR CUSTOM PMC	
175	FOR CUSTOM PMC		175	FOR CUSTOM PMC	
176	FOR CUSTOM PMC		176	FOR CUSTOM PMC	
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178	FOR CUSTOM PMC		178	FOR CUSTOM PMC	
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190	FOR CUSTOM PMC		190	FOR CUSTOM PMC	
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203	FOR CUSTOM PMC		203	FOR CUSTOM PMC	
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205	FOR CUSTOM PMC		205	FOR CUSTOM PMC	
206	FOR CUSTOM PMC		206	FOR CUSTOM PMC	
207	FOR CUSTOM PMC		207	FOR CUSTOM PMC	
208	FOR CUSTOM PMC		208	FOR CUSTOM PMC	
209	FOR CUSTOM PMC		209	FOR CUSTOM PMC	

DI			DO		
Name	**Comment**		**Name**	**Comment**	
210	FOR CUSTOM PMC		210	FOR CUSTOM PMC	
211	FOR CUSTOM PMC		211	FOR CUSTOM PMC	
212	FOR CUSTOM PMC		212	FOR CUSTOM PMC	
213	FOR CUSTOM PMC		213	FOR CUSTOM PMC	
214	FOR CUSTOM PMC		214	FOR CUSTOM PMC	
215	FOR CUSTOM PMC		215	FOR CUSTOM PMC	
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221	FOR CUSTOM PMC		221	FOR CUSTOM PMC	
222	FOR CUSTOM PMC		222	FOR CUSTOM PMC	
223	FOR CUSTOM PMC		223	FOR CUSTOM PMC	
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225	FOR CUSTOM PMC		225	FOR CUSTOM PMC	
226	FOR CUSTOM PMC		226	FOR CUSTOM PMC	
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228	FOR CUSTOM PMC		228	FOR CUSTOM PMC	
229	FOR CUSTOM PMC		229	FOR CUSTOM PMC	
230	FOR CUSTOM PMC		230	FOR CUSTOM PMC	
231	FOR CUSTOM PMC		231	FOR CUSTOM PMC	
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237	FOR CUSTOM PMC		237	FOR CUSTOM PMC	
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241	FOR CUSTOM PMC		241	FOR CUSTOM PMC	
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245	FOR CUSTOM PMC		245	FOR CUSTOM PMC	
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249	FOR CUSTOM PMC		249	FOR CUSTOM PMC	
250	FOR CUSTOM PMC		250	FOR CUSTOM PMC	
251	FOR CUSTOM PMC		251	FOR CUSTOM PMC	
252	FOR CUSTOM PMC		252	FOR CUSTOM PMC	
253	FOR CUSTOM PMC		253	FOR CUSTOM PMC	
254	FOR CUSTOM PMC		254	FOR CUSTOM PMC	

DI			DO		
Name	**Comment**		**Name**	**Comment**	
255	FOR CUSTOM PMC		255	FOR CUSTOM PMC	
256	FOR CUSTOM PMC		256	FOR CUSTOM PMC	

Table 6.3(q) DI/DO Comments(2)

DI			DO		
Name	**Comment**		**Name**	**Comment**	
257	SERVICE REQUEST	*	257	SERVICE OK (RBT)	*
...		*	...		*
512	FOR CUSTOM PMC	*	512	FOR CUSTOM PMC	*
513	SERVICE REQUEST	*	513	SERVICE OK (RBT)	*
...		*	...		*
768	FOR CUSTOM PMC	*	768	FOR CUSTOM PMC	*
769	SERVICE REQUEST	*	769	SERVICE OK (RBT)	*
...		*	...		*
1024	FOR CUSTOM PMC	*	1024	FOR CUSTOM PMC	*

The items that marked * are set according to number of ROBODRILLs.

Table 6.3(r) DI/DO Comments(3)

DI			DO		
Name	**Comment**		**Name**	**Comment**	
1025	REM OPE Entry		1025	Robot Power On	
1026	REM OPE Exit		1026	In E.Stop state	
1027	(reserved)		1027	Safety Fence Open	
1028	OVR UP		1028	Robot Peripherals Ready	
1029	OVR DOWN		1029	Robot In Motion	
1030	(reserved)		1030	System Stop Req.	
1031	(reserved)		1031	ROBODRILL Ope H.Beat	
1032	DIJog Enable		1032	(Reserved)	
1033	DIJog 1+		1033	RI1 STATE	
1034	DIJog 1-		1034	RI2 STATE	
1035	DIJog 2+		1035	RI3 STATE	
1036	DIJog 2-		1036	RI4 STATE	
1037	DIJog 3+		1037	RI5 STATE	
1038	DIJog 3-		1038	RI6 STATE	
1039	DIJog 4+		1039	RI7 STATE	
1040	DIJog 4-		1040	RI8 STATE	
1041	DIJog 5+		1041	RO1 STATE	
1042	DIJog 5-		1042	RO2 STATE	
1043	DIJog 6+		1043	RO3 STATE	
1044	DIJog 6-		1044	RO4 STATE	
1045	DIJog 7+		1045	RO5 STATE	
1046	DIJog 7-		1046	RO6 STATE	
1047	DIJog 8+		1047	RO7 STATE	
1048	DIJog 8-		1048	RO8 STATE	
1049	DIJog 9+		1049	Robot override0	

DI			DO		
Name	**Comment**		**Name**	**Comment**	
1050	DIJog 9-		1050	Robot override1	
1051	DIJog Joint		1051	Robot override2	
1052	DIJog Cart.		1052	Robot override3	
1053	DIJog JF1		1053	Robot override4	
1054	DIJog JF2		1054	Robot override5	
1055	DIJog JF3		1055	Robot override6	
1056	DIJog JF4		1056	Robot override7	
1057	OVR 100		1057	Robot Ope. Access1	
1058	OVR LOW		1058	Robot Ope. Access2	
1059	(Reserved)		1059	Robot Ope. Access3	
1060	(Reserved)		1060	Robot Ope. Access4	
1061	(Reserved)		1061	Robot Ope. Access5	
1062	(Reserved)		1062	Robot Ope. Access6	
1063	(Reserved)		1063	Robot Ope. Access7	
1064	(Reserved)		1064	Robot Ope. Access8	
1065	SSI[1]		1065	(Reserved)	
1066	SSI[2]		1066	(Reserved)	
1067	SSI[3]		1067	(Reserved)	
1068	SSI[4]		1068	(Reserved)	
1069	SSI[5]		1069	(Reserved)	
1070	SSI[6]		1070	(Reserved)	
1071	SSI[7]		1071	(Reserved)	
1072	SSI[8]		1072	(Reserved)	
1073	SSI[9]		1073	(Reserved)	
1074	SSI[10]		1074	(Reserved)	
1075	SSI[11]		1075	(Reserved)	
1076	(Reserved)		1076	(Reserved)	
1077	(Reserved)		1077	(Reserved)	
1078	(Reserved)		1078	(Reserved)	
1079	(Reserved)		1079	(Reserved)	
1080	(Reserved)		1080	(Reserved)	
			1081	FOR CUSTOM PMC	
			1082	FOR CUSTOM PMC	
			1083	FOR CUSTOM PMC	
			1084	FOR CUSTOM PMC	
			1085	FOR CUSTOM PMC	
			1086	FOR CUSTOM PMC	
			1087	FOR CUSTOM PMC	
			1088	FOR CUSTOM PMC	
			1089	FOR CUSTOM PMC	
			1090	FOR CUSTOM PMC	
			1091	FOR CUSTOM PMC	
			1092	FOR CUSTOM PMC	
			1093	FOR CUSTOM PMC	
			1094	FOR CUSTOM PMC	

DI			DO		
Name	**Comment**		**Name**	**Comment**	
			1095	FOR CUSTOM PMC	
			1096	FOR CUSTOM PMC	
			1097	FOR CUSTOM PMC	
			1098	FOR CUSTOM PMC	
			1099	FOR CUSTOM PMC	
			1100	FOR CUSTOM PMC	
			1101	FOR CUSTOM PMC	
			1102	FOR CUSTOM PMC	
			1103	FOR CUSTOM PMC	
			1104	FOR CUSTOM PMC	
			1105	FOR CUSTOM PMC	
			1106	FOR CUSTOM PMC	
			1107	FOR CUSTOM PMC	
			1108	FOR CUSTOM PMC	
			1109	FOR CUSTOM PMC	
			1110	FOR CUSTOM PMC	
			1111	FOR CUSTOM PMC	
			1112	FOR CUSTOM PMC	
			1113	FOR CUSTOM PMC	
			1114	FOR CUSTOM PMC	
			1115	FOR CUSTOM PMC	
			1116	FOR CUSTOM PMC	
			1117	FOR CUSTOM PMC	
			1118	FOR CUSTOM PMC	
			1119	FOR CUSTOM PMC	
			1120	FOR CUSTOM PMC	
			1121	FOR CUSTOM PMC	
			1122	FOR CUSTOM PMC	
			1123	FOR CUSTOM PMC	
			1124	FOR CUSTOM PMC	
			1125	FOR CUSTOM PMC	
			1126	FOR CUSTOM PMC	
			1127	FOR CUSTOM PMC	
			1128	FOR CUSTOM PMC	
			1129	(Reserved)	
			1130	(Reserved)	
			1131	(Reserved)	
			1132	(Reserved)	

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