F3000N SERIES ROBOT

OPERATING MANUAL

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Section 1: Safety

1. CE Certification Requirements

1. In order to meet the safety requirements of the CE directives (applicable in the countries of European Union) the robots must be placed in an enclosure which can be supplied by the Fisnar Inc. distributors.

2. The enclosure must prevent the access to the moving parts except through the enclosure door.

3. The enclosure door switch must be connected to the door switch connector on the robot I/O cable.

2. Safety Rules

1. In order to use a robot in safety conditions, the user should prepare the **safety work regulations** under the careful consideration of line layout and side-line establishments where the robot is installed, and the operator must adhere strictly to the safety work regulations to prevent accidents. Also, standard operation procedure about the robot must be written-up for safety, and appropriate measures for safe operation must be taken, such as safety training of the operators.

2. Teaching operation and maintenance procedure of the robot should be set according to the standards of the Industrial Safety and Health Law and Industrial Safety Regulations.

3. The user should prepare the safety operation regulations of the overall system and abide by them.

4. In order to secure the robot's safety, please observe the general provisions related to the safety operation of an industrial robot.

5. Prepare a safety management system, such as appointing operators responsible for the safe operation of robot or deciding on safety supervisors, and give them thorough safety training.

3. General Conditions for Safety

1. Please use robot within the standard requirements (such as payload, speed, operational range, user environment) as stated in the specification. Make sure specifically that the single phase is not over AC 230 V / 15A before turning the power on.
2. Make sure the operator has read the operation manual and other materials thoroughly, so that all problems can be solved, thus minimizing damage during operation.
3. Do not attach or detach the power cord while the power switch of the controller is turned ON.
4. Do not drop the teach pendant. Handle the pendant carefully.
5. Install the robot firmly so that it will not be shaken.
6. Install a safety fence around the robot's working area for a safe work environment.
7. Check electrical connections before turning on the electrical power of the controller. The machine may not work properly due to incorrect connection of electrical wires.
8. Install a Frame Ground to prevent electric shock.

4. Safety During Operation

1. To start operation of the robot, turn on the power switch of the robot controller device. Please read the following conditions for safety during operation.
2. Before starting the operation, make sure that there is no person or obstacle in the robot's working area.
3. Be ready to push the emergency stop switch if the robot does not function normally.
4. Before starting a repetitive operation, make sure that no obstacle is in the robot's working area enclosed by the safety fence.
5. When people and the robot are working together simultaneously, check for mutual safety, especially while the power is ON and during the manual operation.
6. During maintenance and inspection of the robot, pull out the power plug of the controller.

Section 2: System Installation

1. About System

1.1. Specifications

Desktop Robot Spec Sheet (AC servo type)							
Model		**F3300N**	**F3304N**	**F3400N**	**F3404N**	**F3350N**	**F3460N**
Range of operation	X(W) axis(mm)	300	300	400	400	300(300)	400(400)
	Y axis(mm)	300	300	400	400	500	600
	Z axis (mm)	100	100	150	150	100	100
	R axis(deg)		320		320		
Speed	PTP X(W) ,Y,Z (mm/sec)	500	500	500	500	500(500)	500(500)
	PTP R (degree/sec)		360		360		
	CP X,Y,Z (mm/sec)	500	500	500	500	500	500
Repeatability accuracy (max)	X(W), Y, Z axis (mm)	± 0.02	± 0.02	± 0.02	± 0.02	± 0.02 (± 0.02)	± 0.02 (± 0.02)
	R axis - Note1		± 0.11°		± 0.11°		
Position Command Resolution	All axis (mm)	0.001	0.001	0.001	0.001	0.001	0.001
Portable weight	Work X,(W) (kg)	15	15	15	15	15(15)	15(15)
	Tool Z (R)(kg)	7	(4)	7	(4)	7	7
Number of controllable axis (R)		3 Axis	4 Axis	3 Axis	4 Axis	4 Axis	4 Axis
Motion Program Language		Dispenser Language (Dispense Line / DOT / Arc / Circle, Various Brush Area, Step & Repeat ,Line Dispense Setup, Point Dispense Setup, Dispense End Setup, Z Clearance, Retract, Auto Purge, Round, PALLET, Mathematic calculation, Cycle Counter, ect.)					
PLC Program language		30 instruction sets					
Drive method		3Ø AC servo Motor					
Control method		PTP and CP (2D/3D Line,circle)					
External interface		RS232-C 2ch					
System input / output		IN : 4, OUT : 5					
User input / output		IN : 16, OUT : 15					
Extension (Option) User input / output		IN : 20, OUT : 20					
CPU performance		Main : 32bit ,1200MFLOFS, Servo : 16Bit, 40MIPS * 2					
PLC function		10 programs, 1000 steps/PGM					
Program capacity		100 programs, 1000 steps/PGM					
Data memory capacity		20,000 step / 20,000 points					
Program Storage		512KB Battery Backup SRAM					
Dimensions (mm)	Width	604	604	704	704	804	904
	Depth	680	680	780	780	680	780
	Height	730	754	730	754	730	730
Weight		56	61	65	70	73	82
Input power		Single phase AC 220V ± 10% , 60/50 Hz					
Power Consumption (include R)		400VA (500VA)	500VA (600VA)	400VA (500VA)	500VA (600VA)	600VA	600VA
Working ambient temperature		0-40°C					
Relative humidity		20-95%, no condensation					

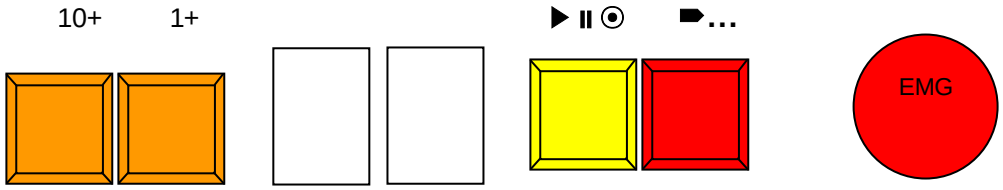
Notes) 1. R axis : include gear, 50:1

2. Installation of the Product

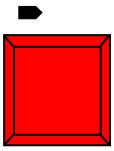
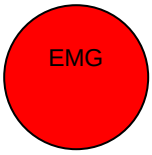
2.1. Basic Operation of Step Desktop

2.1.1. Basic Operation

This is the Operation Panel of the Robot.



Button	Mode	Action
+10		Increase Program Number By 10.
+1		Increase Program Number By 1.
▶ II ⦿	Run ▶	Start Origin Searching in Teach mode.
		First time, Start Origin Searching. If Origin Searching is completed, Run LED lamp turns on. If pressed again, it will start the current program. While program is running, Run LED will twinkle.
	Stop II	If it is pressed while the robot running, it will pause the current action. If pressed again, it will continue the current Action.

	Reset	If Error has occurred, press to reset.
	Org ⦿	If it is pressed for over 2 seconds when robot is stopped in Run Mode, it will start Origin searching.
		Used for manual dispense while robot is stopped, similar to a purge.
		Used for Emergency Stop. If it is pressed, an Error message will be displayed.

2.2. Initial Considerations.

1. Install the system in a well-ventilated area to avoid overheating.

2. Prevent vibration of the unit. Too much vibration may cause considerable damage to the controller.

3. Keep moisture level low. Avoid direct contact between water and the unit.

4. Protect unit against atmospheric agents.

5. Make all connected cables free from vibration.

6. Please install Frame Ground.

7. Make sure that the motor specification indicated on the backside of the controller and the one in the machine are matched.

8. Make sure that the power voltage is AC 220V.

9. Connect all cables appropriately and tie them to prevent disconnection.

Section 3: Teaching Overview

1. Teaching Overview

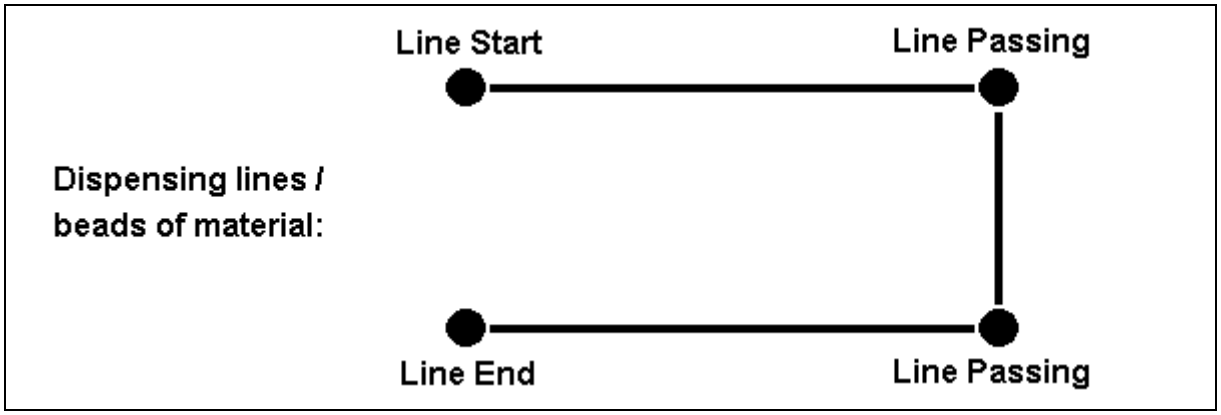
A program consists of a series of instructions stored in the main unit memory. Each instruction is stored in a numbered memory address. A memory address may record a point location, with an X, Y, Z and R (for 4-axis robots) value and point type or it may store an instruction which sets a parameter, such as a dispensing time or a line speed.

When the program is run, the robot will step through each memory address in sequence and execute the instruction found there. If the memory address contains a point location, the robot will move the X, Y and Z axes to that location and also will execute the rotation corresponding to the value of the R in that point. Depending on the type of point registered at that location, the robot may also perform other functions, such as turn the dispenser on or off.

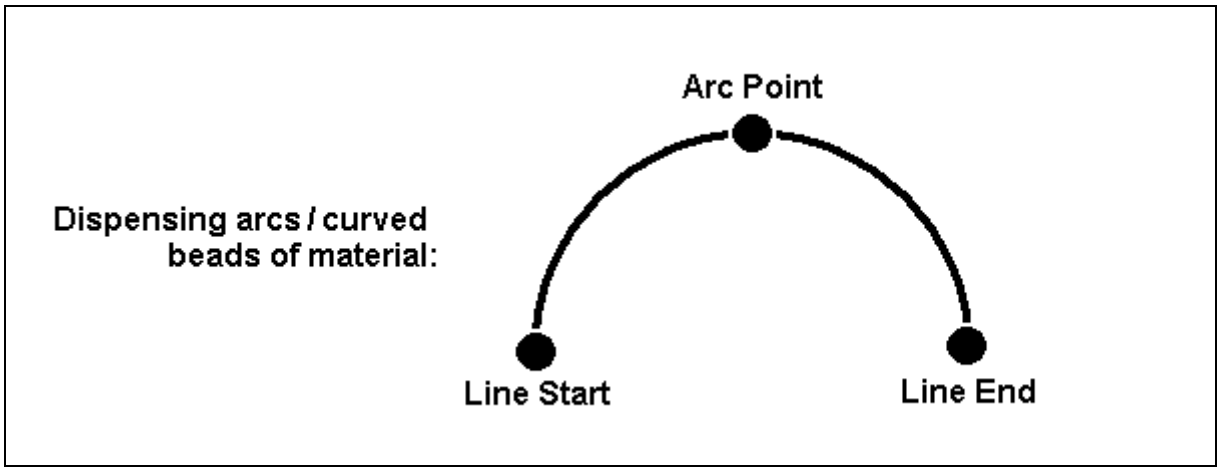
The most commonly used point types are: Dispense Dot, Line Start, Line Passing, Arc Point, and Line End.

To program the robot to dispense a ‘dot’ of material, the dispensing tip must be jogged to the desired XYZ location (and in the desired R position of the tip), then that location is registered as a DISPENSE DOT type by pressing the appropriate key on the Teach Pendant.

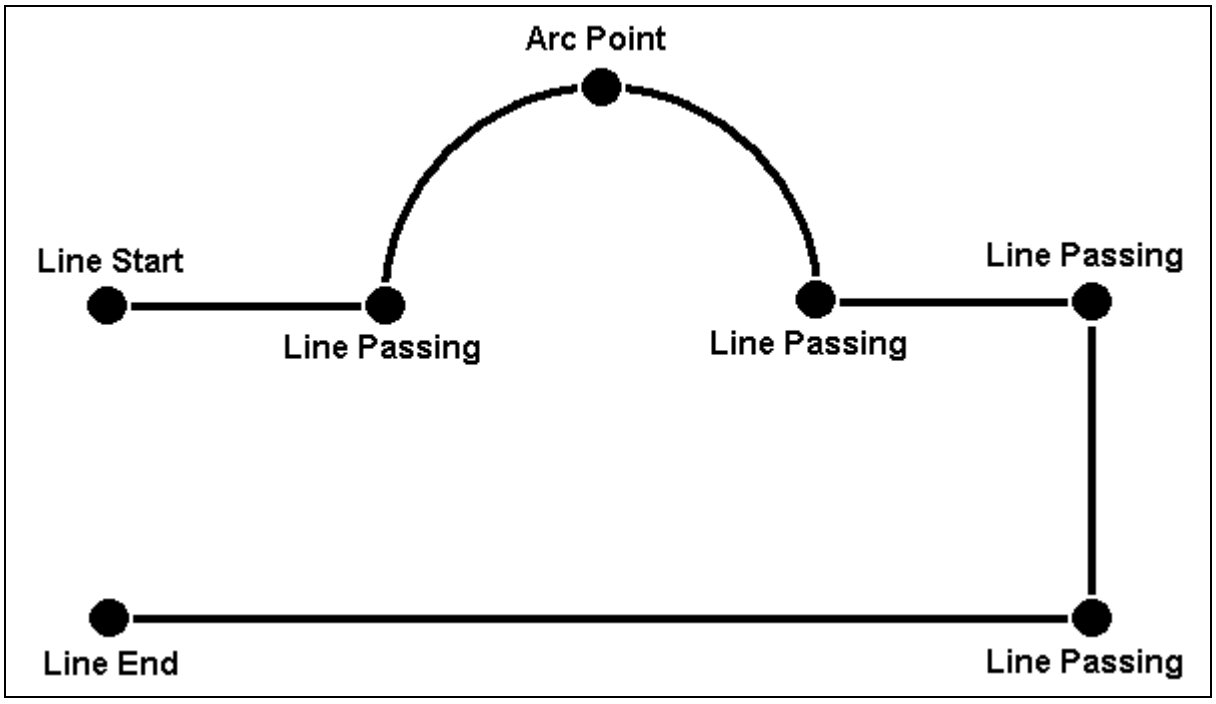
To program the robot to dispense a bead of material along a linear path, the XYZ location (and R position of the tip) of the start of the line is registered as a LINE START point. The locations where the tip changes direction (and position) are registered as LINE PASSING points. The end of the line is registered as a LINE END point:



To dispense a bead of material in an arc, the XYZ location (and R position of the tip) of the start of the line is registered as a LINE START point. The high point of the arc is registered as an ARC Point. The end of the arc is registered as a LINE END point:



Lines and arcs can also be combined to dispense a bead of material along a complex path:



Once the required point locations for your program have been taught, the teach pendant is no longer required. The unit can be switched to RUN mode and operated using the buttons and switches on the main unit control panel.

2. Using the Teach Pendant

The teach pendant enables the user to jog robot to input program data.

If **Shift/Char** is pressed, released, and next the Speed key is pressed, **Speed** is executed. When entering alphabetical Characters, if **Shift/Char** is pressed, released, this key is 'M'.

When entering numbers, this key is 7

2.1. Key Selection

There are several functions assigned to most keys on the teach pendant. When such a key is pressed alone, the function shown in the white colored area on the key is executed. The functions ***MENU 1***, ***MENU 2***, ***Setup***, and ***Condition*** are all the default key functions that are executed when their keys are pressed alone.

To access the function shown at the top of a blue key, press and release the **Shift /Char** key first, then press the desired key. To select a function shown in the black area of a key, like – for example - the **Speed** function, press and release **Shift/Char**, then press the **Speed** key.

When a number is required, the teach pendant will automatically switch to numeric entry mode. The number represented by each key is shown in the lower left corner of the key. When an Alphabetical character is required, press the **Shift/Char** key first. The character represented by each key is shown in the lower side or in the lower right side of the key.

2.2. Key Assignments

Menu Keys	
ENT	Opens the Point registration menu.
F1 Setup	Opens the Setup menu.
F2 Cond	Opens the Condition menu.
Inch Menu1	Opens Menu # 1. It is also used for the Inch Jog Mode by pressing the ***Shift/Char*** key first.
Mode Menu2	Opens Menu # 2. It is also used for the Mode Change by pressing the **Shift/Char k**ey first.
Jog Keys	
- 1X S	Jogs the X axis in the forward direction.
+ 1X X	Jogs the X axis in the backward direction.
- 2Y T	Jogs the Y axis in the left direction.
+ 2Y Y	Jogs the Y axis in the right direction.
- 3Z U	Jogs the Z axis UP.
+ 3Z Z	Jogs the Z axis DOWN.
- 4W V + 4W W	Jogs the Rotation axis.

◄ SPD - ► SPD+	Changes jog speed. Right arrow button is used for increasing jog speed. Left arrow button is used for decreasing jog speed.
Navigation Keys	
▼ +1	Moves forward (1) memory address.
▲ -1	Moves backward (1) memory address.
PgDn +10	Moves forward (10) memory addresses.
PgUp -10	Moves backward (10) memory addresses.

2.3. Navigation Menu

Pressing any of the keys shown on the right will open the corresponding menu.	F1 Setup, F2 Cond, Inch Menu1, Mode Menu2, ENT
Once the menu is open, use the up and down arrows to move through the items on the menu.	▲ -1, ▼ +1
Use the Page Up and Page Down keys to change to the next page or previous page of the menu.	PgUp -10, PgDn +10
Press **ENTER** to select the current item.	ENT

2.4. Jogging

The tip is jogged by pressing the jog buttons.	- 1X / S, + 1X / X, - 2Y / T, + 2Y / Y, - 3Z / U, + 3Z / Z, - 4W / V, + 4W / W
Jog speed has three velocity levels: low, middle and high. If the right arrow button is pressed, the jog speed changes to a faster level. If the left arrow button is pressed, the jog speed changes to a slower level. The value of the jog speed (at the velocity level: high) can be set using the function Jog Speed (Menu 1). (See Section 6: 4.6 Jog Speed). The Speed led display on the Teach Pendant shows the velocity level: high, middle or low.	◄ SPD - ► SPD + 
Changes to Inch Jog Mode.	Shift /Char + Inch Menu1

2.5. Data Entry

The Teach Pendant is used also to enter numeric data. If a numeric value is required, the Teach Pendant will automatically switch to numeric mode. Use the keys 0 – 9, (.), and (-) to enter the values.

2.6. LED Panel

This indicates the current system status and speed.

- **SERVO LED** : The light is turned on when the robot is run.
- **ORG LED** : The light is turned on after the function of **Origin** is performed.
- **CHAR LED** : The light is turned on when the **CHAR** key is pressed.
- **ERR LED** : The light is turned on when the **Error** occurs in the robot.
- **INCH LED** : The light is turned on when the current mode is **Inch Mode**.
- **LOW LED** : The light is turned on when the current jog speed is **low**.
- **MED LED** : The light is turned on when the current jog speed is **medium**.
- **HIGH LED** : The light is turned on when the current jog speed is **high**.

3. Teach Box Key Assignments

Key	*Function*
F1 Setup	Opens Setup Menu.
F2 Cond	Opens Condition Menu.
Inch Menu1	Opens Menu #1. With Shift/Char key, it is used for Inch Jog Mode.
Mode Menu2	Opens Menu #2. With Shift/Char key, it is used for Mode Change.
Servo A	See current position.
Brake B	Reserved.
Jump C	Jumps to a specified memory address.
STOP	Stops program running.

Key	*Function*
Prog Num	Goes to another program.
Move D	Moves the tip to the point location currently in the display.
Ins E	Inserts a memory address before the current address.
Del F	Deletes the current memory address.
Shift /Char	Changes to character mode or shift mode.
RESET	Resets current error.
ESC	Changes from Point List display mode to single point display when teaching point data. If pressed once, clears the current numeric value.
◄ SPD- ► SPD+	Jog speed has three velocity levels: low, middle and high. If the right arrow button is pressed, jog speed is changed to a faster level. If the left arrow button is pressed, jog speed is changed to a slower level. The Speed led display on the Teach Pendant shows the velocity level.
PgUp -10	Moves backward (10) memory addresses.
▲ -1	Moves backward (1) memory address.
PgDn +10	Moves forward (10) memory addresses.
▼ +1	Moves forward (1) memory address.

Key	*Function*
ENT	Confirms data entries. Also opens the Point registration menu.
Shift /Char + Dot 1 / G	Shortcut for registering a Dispense Dot.
Shift /Char + Start 2 / H	Shortcut for registering a Line Start point.
Shift /Char + Pass 3 / I	Shortcut for registering a Line Passing point.
Shift /Char + End 4 / J	Shortcut for registering a Line End point.
Shift /Char + Arc 5 / K	Shortcut for registering an Arc Point.
Shift /Char + End Pr 6 / L	Shortcut for registering the End Program command.
Shift /Char + Speed 7 / M	Shortcut for registering Line Speed.
Shift /Char + Setup 8 / N	Shortcut for registering a Point Dispense Setup.
Shift /Char + Setup 9 / O	Shortcut for registering a Line Dispense Setup.
First 0 / P	Changes the display to memory address number 0.
End . / Q	Changes the display to the last used memory address in the program.
Shift /Char + Mode Menu2	Changes to Run / Teach Mode.
Home - / R	Start Origin searching.

4. Point Type Functions Summary

4.1. Point Menu

Below is a list of Point type functions that are found under the **Enter** key (***Point*** menu):

Function	*Description*
Dispense Dot	Registers the current XYZ location (and R position of tip) as a Dispense point for dot dispensing.
Line Start	Registers the current XYZ location (and R position of tip) as a Line Start point for line dispensing.
Line Passing	Registers the current XYZ location (and R position of tip) as a Line Passing point. This is a location on the line where the tip changes direction, such as at the corner of a rectangle.
Line End	Registers the current XYZ location (and R position of tip) as a Line End point.
Arc Point	Registers the current XYZ location (and R position of tip) as an Arc Point. Arc Points are used to dispense material in an arc or circle.
Circle	Registers the current XYZ location (and R position of tip) as a Circle point. Circle points are used to dispense material in a circle.
Center	Registers the current XYZ location (and R position of tip) as a center point of circle. Center points are used to dispense material in a circle.
Dummy	Registers the current XYZ location (and R position of tip) as a Dummy point. The tip will simply pass through this point. This is useful for avoiding obstacles on the work piece.
End Program	Registers the current memory address as the end of the program.

Function	***Description***
Dispense ON / OFF	Registers an instruction which turns the dispenser on or off at the current memory address.
Home Point	Sets robot to home position.
Wait Point	Registers a Wait Point at the current X, Y, Z location (and R position of tip). When executed, the tip will move to that location and wait for the specified period of time.
Stop Point	Registers a Stop Point at the current X, Y, Z location (and R position of tip). When executed, the tip will move to that location and wait until the start button is pressed.
Brush Area	Causes the tip to 'paint' the defined area. The painted area can be in the form of a rectangle or a circle / spiral.
If	Registers an instruction that either sets the value of an output signal or checks the status of an input signal.
Output	Registers an instruction that sets the value of an output signal.
Input	Registers an instruction that waits for an input signal.
Pulse	Registers an instruction that sets the value of an output signal and Output Time.
Point	Sets point variable P0 ~ P99 by saving current position or input numerical data.

4.2. Setup Menu

Below is a list of functions that are found under the **Setup** key (***Setup*** menu):

Function	*Description*
Line Speed	Registers the LINE SPEED used for all lines from the current memory address forward until another Line Speed instruction is found.
Line Dis. Setup	Registers the LINE DISPENSE SETUP values which set dispensing wait time at the start of lines ('head' time), waiting time at the end of lines ('tail' time), and dispense off length ('head' length and 'tail' length). The registered values will be used from the current memory address forward until another Line Dispense Setup instruction is found.
Pnt Dis. Setup	Registers POINT DISPENSE SETUP values which set dispensing time and waiting time at the end of dispensing ('tail' time) for dots. The registered values will be used from the current memory address forward until another POINT DISPENSE SETUP instruction is found.
Dis. End Setup	Registers the height and speed the tip should rise at the end of dispensing. The registered values will be used from the current memory address forward until another DISPENSE END SETUP instruction is found.
Z Clearance	Registers the additional distance the tip should rise, beyond the height set in Dispense End Setup, to allow obstacles to be cleared as the tip moves from one figure to another. Values will be used until another Z Clearance instruction is found.
XY Move Speed	Sets the movement speed of the X and Y axes when moving from one figure to another in the program.
Z Move Speed	Sets the movement speed of the Z axis when moving from one figure to another in the program.

Function	***Description***
Home Position	Changes the position the robot moves to at the end of a program cycle.
Retract	Registers Retract values at the current XYZ location. Retract causes the tip to move up and back over the dispensed bead after line dispensing.
Auto Purge	Registers Wait time and Purge time, for purging the system at the end of a program.
Adjust Point #1	Saves current position and steps as a first data for Relocate Data function. Saves current position to temporary point #1.
Adjust Point #2	Saves current position and steps as a second data for Relocate Data function. Saves current position to temporary point #2.
CCD Shot	Used for Vision Application.
Relocate	Used for Vision Application.
Round	Sets radius of a line at a Line Passing point.
Z Lift	Select whether lifting Z axis or not when robot MOVE to a point in the TEACHING MODE.

4.3. Condition Menu

Below is a list of functions that are found under the F2 Cond key:

Function	Description
Goto Address	Causes the program to jump to the specified memory address when executed.
Step & Repeat X	Registers an instruction that will re-run a selected group of memory addresses, stepping by a user-defined distance in the X or Y axis after each copy. The matrix of parts is defined by specifying the number of rows, the number of columns, the X offset and the Y offset. Step & Repeat **X** indicates that the robot will give priority to the X axis, running the parts along the X axis first.
Step & Repeat Y	Registers an instruction that will re-run a selected group of memory addresses, stepping by a user-defined distance in the X or Y axis after each copy. The matrix of parts is defined by specifying the number of rows, the number of columns, the X offset and the Y offset. Step & Repeat **Y** indicates that the robot will give priority to the Y axis, running the parts along the Y axis first.
Call Subroutine	Causes the machine to jump to a specified memory address and execute the instructions found there. When the end program instruction is reached, program execution will continue at address just after the call Subroutine instruction.
Call Program	Executes the specified program number from within the current program. After the called program completes, the current program will continue execution.

Loop Address	Causes the program to execute a group of memory addresses a user-specified number of times.
Label	Sets Label. Label can be used instead of Address Number.
Arm	For TMB Series, it determines the position of the arm. For F9000 Series, it determines the XYZ coordinate or RYZ coordinate.
FixR	Fixes/unfixes the axis rotation while a linear movement is executed.
Calc	Arithmetic Instruction.
XMov	While moving, if a sensor signal is turned ON, robot will stop immediately, and save current position to P98.
Jmov/ Lmov	Registers current XYZ position or Point variable to Moving position.
IncJ / IncL	Registers current XYZ position or Point variable as an Offset position.
Pallet	Registers a pallet movement setting.
Offset	Set Offset to saved Position.
Pattern / End Pattern	It is similar with the Step & Repeat Instruction, but it can change the Repeat order.

4.4. Menu 1

Below is a list of functions that are found under the **Menu 1** key:

Function	*Description*
Program Name	Allows the user to register a name for the current program number.
Z Axis Limit	Sets the limits between which the Z axis will move during a program.
Initial Output	Sets the status of the output signals when the machine is initialized.
Cycle Counter	Enables or disables the program cycle counter shown in the display when in run mode.
Set Password	Sets Password to protect all programs from editing.
Jog Speed	Sets the value of the jogging speed, both the linear speed and the rotation speed (for 4-axis robots).
Run Mode	Determines whether the robot operates in Standalone mode (default) or Slave mode. Slave mode allows the robot to be controlled by commands sent over the RS232 port.
Adjust Position	Sets Adjust Position for Adjust Origin.
Parameter	Sets all parameters about machine and controller.
Resume	Determines if a program will restart from point #0 or the point at which it was interrupted if a program is stopped by an emergency stop or the enclosure door switch open signal.
Origin searching	Executes origin searching, making the robot to go to the position established as home position.
Hour Meter	Shows the working time and running time of the robot.
PLC File Edit	Edits PLC File.
I/O Monitor	Views Input/Output status.

Function	*Description*
Emg Mode	Selects SYS EMG mode.
Set Variable	Sets Variable that is used in arithmetic instruction.
Vision Set	N/A

4.5. Menu 2

Below is a list of functions that are found under the **Menu 2** key:

Function	*Description*
Point Utility	
MDI Mode	Changes Position value of each address by numerical key input.
Numerical Move	Allows the tip to be positioned numerically by entering numbers for the X, Y, Z and R values.
Save Temp Point	Saves the current XYZR position in a temporary memory area numbered 1 – 9.
Retr. Temp Point	Retrieves an XYZR position, which was stored with Save Temp Point.
Group Utility	
Group Edit	Allows a function to be applied to a user-defined group of memory addresses. Functions include copy, delete, move, multiply line speed, multiply dispense times, apply X offset, apply Y offset, apply Z offset.
Expand Step & Repeat	Expands the memory address locations which would be performed at a Step & Repeat instruction so individual memory addresses of the repeated instructions can be edited.
Relocate Data	Allows the position of a program to be corrected using two reference points. Corrects for X offset, Y offset, Z offset and angle of rotation.

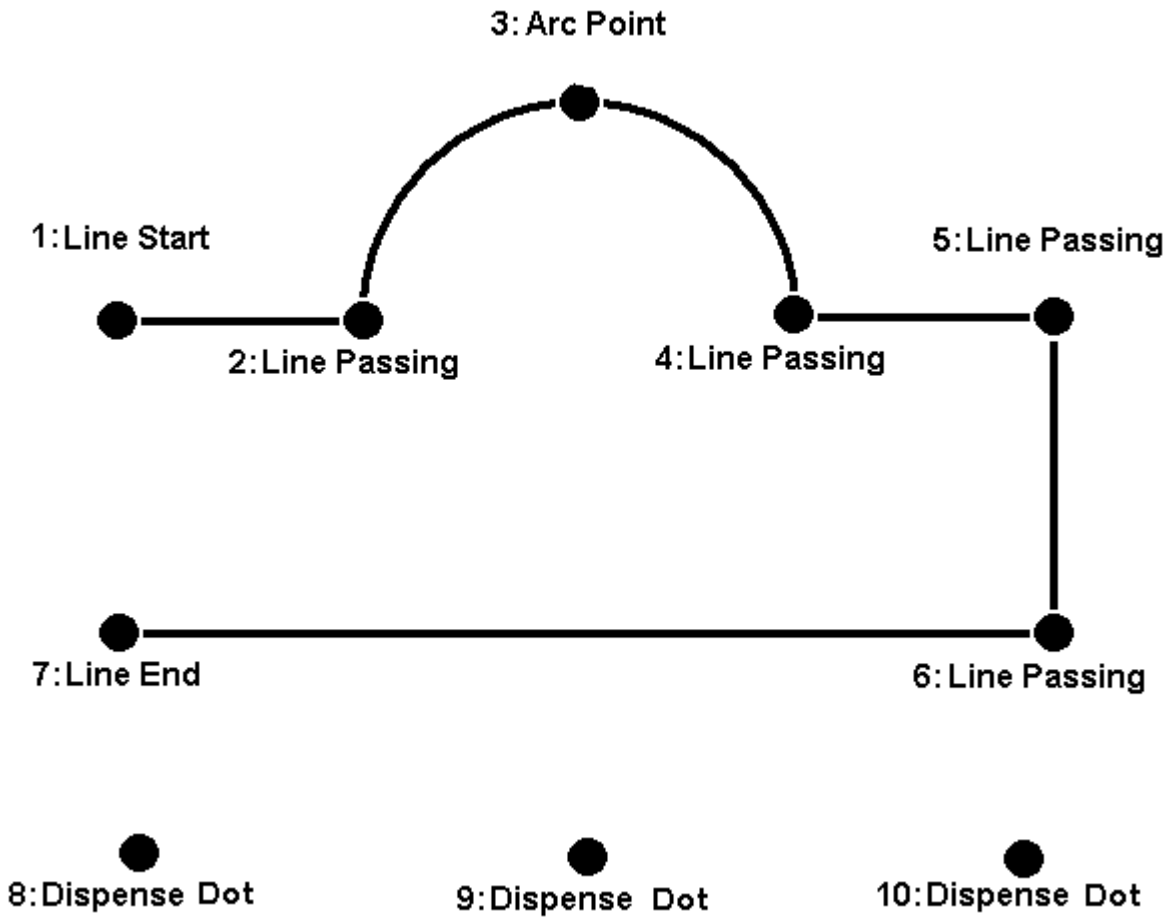
Function	*Description*
Adjust Origin	Adjusts origin position.
Program Utility	
Copy Program	Allows programs to be copied.
Delete Program	Allows programs to be deleted.
Memory Utility	
Delete Memory	Clears whole memory.

Note: Certain functions shown on the display are not applicable to these units and consequently they are marked as “N/A”.

Section 4: Programming Example

1. Programming Example

To help you become familiar with programming the robot, please follow the instructions below to create a program that dispenses in the following pattern:



Notes:

- We will create the pattern above in the program # 10.
- We will use a line speed of 40 mm/sec for the lines and arcs in the program.
- For dots, we will use a dispensing time of 0.50 seconds and a waiting (tail) time of 0.1 seconds after dispensing.

	Instruction	***Display Shows***
1	Turn on the controller.	PROG:00 AUTO Press Move Key Cycle Counter: 0 MODE PLC RESET EXIT
2	Select **EXIT** by pressing the **Menu2** key.	---------- Press Home Key To Find Origin ----------
3	Press the Home button. The robot will move to the home position.	ADDR:0 PROG:10 EMPTY X:0 Y:0 Z:0 R:0
4	Press the **F1/Setup** key, then **1** to select Line Speed (from page 1/4 of the Setup Menu) to register a line speed of 40 mm/second at memory address number 0.	Line Speed ---------- Speed: unit: mm/sec
5	The robot is now waiting for the speed to be registered. Press **40,** then **ENTER** to register a speed of 40 mm / second.	ADDR:1 PROG:10 EMPTY
6	The display shows that we are at memory address 1 and that it is empty. Jog the dispense tip to the first location in the diagram above (1: Line Start). To jog the X, Y, Z axes and R position of tip, press the respective Jog keys. Press the ► SPD+ key to jog fast. See Teaching Overview ***Section 3:2.4 Jogging*** for more information.	ADDR: 1 PROG: 10 X: 0 Y: 0 Z: 0 R: 0

	Instruction	***Display Shows***
7	Once the tip is at the correct X, Y, Z, R location for the first point (***1: Line Start***), press the **ENTER** key, then **2** (from page 1/5 of the Point Menu) to register the location as a Line Start point. **(Note:** From now on, the symbols and the values displayed for the X, Y, Z axes and R position will not be written in the column "Display Shows" of this example).	ADDR:2 PROG:10 EMPTY
8	The display will show that we are at memory address 2 and it is empty. Jog the tip to the X, Y, Z, R location of the second point (***2: Line Passing***). When the location is correct, press the **ENT** key, then **3** (from page 1/5 of the Point Menu) to register the location as a Line Passing point.	ADDR:3 PROG:10 EMPTY
9	Now jog the tip to the location of the third point (***3: Arc Point***). When the location is correct, press the **ENT** key, then **1**(from page 2/5 of the Point Menu) to register the location as an Arc Point.	ADDR:4 PROG:10 EMPTY
10	Jog the tip to the location of the fourth point (***4: Line Passing***). When the location is correct, press the **ENT** key, then **3** (from page 1/5 of the Point Menu) to register the location as a Line Passing point.	ADDR:5 PROG:10 EMPTY
11	Jog the tip to the location of the fifth point (***5: Line Passing***). When the location is correct, press the **ENT** key, then **3** (from page 1/5 of the Point Menu) to register the location as a Line Passing point.	ADDR:6 PROG:10 EMPTY
12	Jog the tip to the location of the sixth point (***6: Line Passing***). When the location is correct, press the **ENT** key, then **3** (from page 1/5 of the Point Menu) to register the location as a Line Passing point.	ADDR:7 PROG:10 EMPTY

	Instruction	***Display Shows***
13	Jog the tip to the location of the seventh point (***7: Line End***). When the location is correct, press the **ENT** key, then **4** (from page 1/5 of the Point Menu) to register the location as a Line End point.	`ADDR:8  PROG:10` `EMPTY`

14	The line is now complete. The next step is to register the dispense settings for the dots.
	Press the **F1/SETUP** key, then **3** to register the Point Dispensing Setup.
		`Point Disp Setup`
		`Dis. Time:  sec`
		`Tail Time:  sec`
		`unit: sec`

15	Type **0.5** to register a dispensing time of 0.5 seconds, then press **ENT**. Type **0.1** to register a waiting (tail) time after dispensing of 0.1 seconds, then press **ENT**.	`ADDR:9  PROG:10` `EMPTY`
16	Jog the tip to the location of the first dispense dot (***8: Dispense Dot***). When the location is correct, press the **ENT** key, then **1**(from page 1/5 of the Point Menu) to register the location as a Dispense Dot.	`ADDR:10  PROG:10` `EMPTY`
17	Jog the tip to the location of the second dispense dot (***9: Dispense Dot***). When the location is correct, press the **ENT** key, then **1** (from page 1/5 of the Point Menu) to register the location as a Dispense Dot.	`ADDR:11  PROG:10` `EMPTY`
18	Jog the tip to the location of the third dispense dot (***10: Dispense Dot***). When the location is correct, press the **ENT** key, then **1**(from page 1/5 of the Point Menu) to register the location as a Dispense Dot.	`ADDR:12  PROG:10` `EMPTY`
19	The program is now complete. Press **ENT**, then **4** (from page 2/5 of the Point Menu) to register address 12 as the END of the program.	`ADDR:13  PROG:10` `EMPTY`

To run the program, press Shift/Char key, then Mode/Menu 2 key and then Move/D key.

2. Editing a Program

You can move through the instructions in an existing program by using the following keys:

Key	*Function*
▼/+1	Moves forward (1) memory address.
▲/-1	Moves backward (1) memory address.
FIRST	Moves to the first memory address in the program.
END	Moves to the last programmed memory address in the program.
PgDn/+10	Jumps forward (10) memory addresses.
PgUp/-10	Jumps backward (10) memory addresses.
MOVE	Moves the tip to the X,Y,Z,R point location of the selected point.
JUMP	Jumps to display the specified memory address.

2.1. Changing a Point XYZ location

To change the X,Y,Z location of a point, press the ▼/**+1** or▲/ **–1** key until the point you want to change is shown in the display.

You can confirm that the correct point is in the display by pressing the **MOVE** key. This will cause the tip to move to the X,Y,Z position shown in the display.

Now use the Jog keys to jog the tip to the new location.

Once the location is correct, simply re-register the point as you did when it was first taught, by pressing the **ENT** and selecting the point type. The point will be re-registered at the new location.

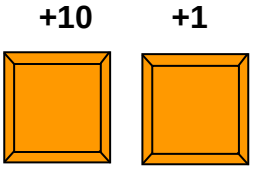
2.2. Insert / Delete an Instruction

To insert an instruction, press the **INS/E** key. The instruction currently shown in the display will be moved forward one memory address. A new memory address can be inserted at the current memory address, after pressing the **INS/E** key when the letter "I" appears on the right up corner of the display. Type the data of the new address to be inserted, then press the **ENT** key.

To delete an instruction currently shown in the display, press the **DEL/F** key, then press the **1/G** key when you are asked to confirm.

3. Changing the Program Number

The program number is selected using the program number selection switches on the main unit control panel (controller).



Press the +10 and +1 buttons to select the program number.

In Teach Pendant mode, press the Prog Num. key to change the program number, then type the new program number and press the **ENT** key.

4. Changing from Teach Mode to Run Mode

To switch between Teach mode and Run mode, press the Shift /Char + Mode Menu2 keys on the Teach Pendant.

When the machine is in Run mode, the Teach Pendant is not required. Programs can be selected and run using the switches on the front control panel of the main control unit (controller).

5. AUTO Mode and STEP Mode in Run Mode

In Run Mode, the two available modes are Auto mode and Step Mode.

- Auto Mode means that robot will run all program step automatically.
- Step Mode means that robot will run each step by start Input one by one.

In Auto Mode, pressing start key will run the program from the start address to the end address.

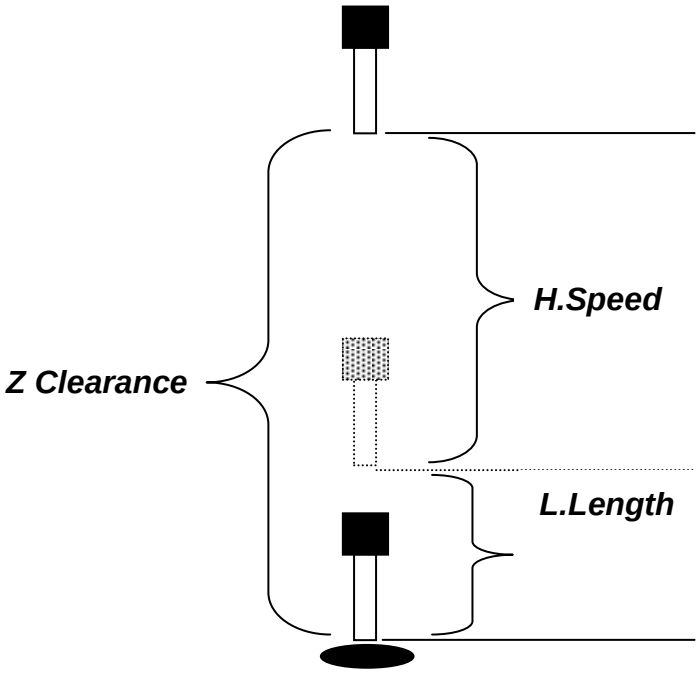
Section 5: Dispensing Parameters

1. Dispense End Setup

After dispensing a dot or line, it is often required to raise the tip a short distance at a slow speed. This allows the material to cleanly break free from the tip, without 'dragging' material where it is not wanted.

The distance and speed which the tip rises after dispensing is controlled by the ***L.Length*** and ***L.Speed*** settings.

After the tip rises the length specified by ***L.Length*** at the speed specified by ***L.Speed***, the tip will continue rising to the ***Z Clearance*** height at the speed specified by ***H.Speed***.
The purpose of specifying a Z Clearance height is to allow the tip to rise high enough to clear any obstacles it may encounter on the way to the next point.



Values for *H.Speed*, *L.Speed* and *L. Length* are registered with the *Dispense End Setup* function by pressing the **SETUP** key, then choosing ***Dispense End Setup***.

Once *Dispense End Setup* values have been registered at a memory address, all points after that memory address will use the values specified. If *Dispense End Setup* values are registered again, at a higher memory address, all the points from that memory address forward will use the new values.

2. Z Clearance

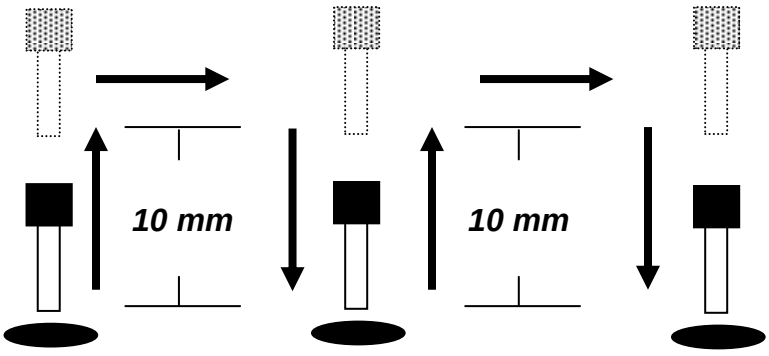
The purpose of the Z Clearance function is to cause the tip to rise high enough to clear all obstacles as it moves from one point to another. If there are no obstacles between any of the program points, a small Z Clearance value, such as 5 mm, can be used to minimize the program cycle time.

Values for the Z Clearance are registered by pressing the **SETUP** key, then choosing ***Z Clearance.*** All the points from that memory address forward will use the Z Clearance value until another Z Clearance value is found. Normally, a Z clearance instruction should be registered in the beginning of a program, in one of the first few memory addresses.

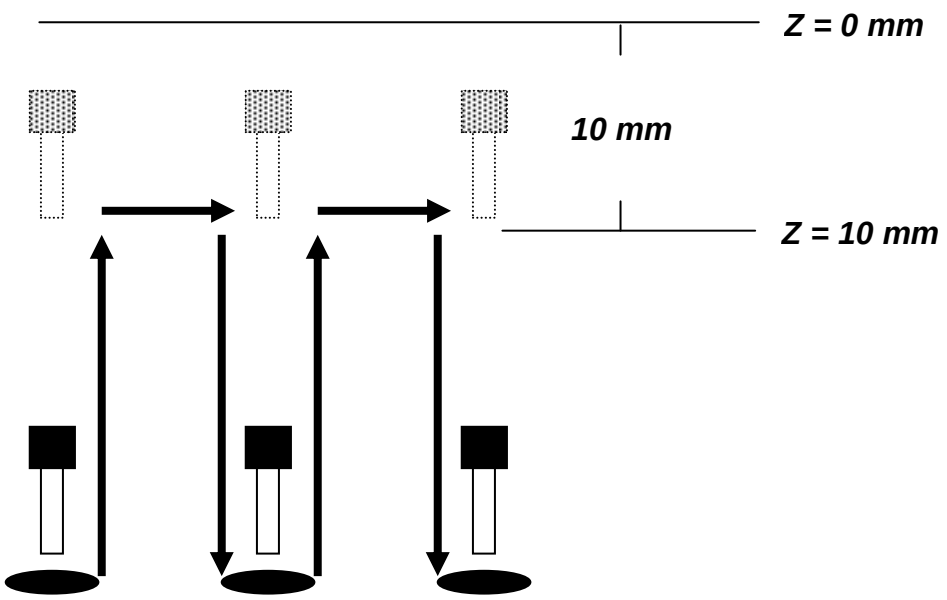
The Z Clearance value may be specified as a relative value or as an absolute value. When specified as a relative value, it is the distance to rise relative to the taught point location. When it is specified as an absolute value, it is the distance from the Z axis zero position which the tip will rise to, regardless of the Z axis value of the taught point location. For example:

Z Clearance = 10 mm RELATIVE:

Z = 0 mm



Z Clearance = 10 mm ABSOLUTE:



3. Line Dispense Setup

When dispensing high viscosity materials, there is often a delay from the moment the dispenser is turned on until the material begins to flow. The following parameters are set under this function: Head Time, Tail Time, Head Length and Tail Length.

The **Head Time** setting is a delay time used at the start of a line dispensing to prevent the tip from moving along the line path until the material is flowing.

The tip will move to the start of the line, turn on the dispenser and wait for the time period specified in the head time setting before moving. The time value can be adjusted to ensure that the material begins flowing at the same time as the line movement begins.

At the end of dispensing, a delay is often required after the dispenser is turned off, to allow the barrel pressure to equalize, before moving to the next point location. This prevents material from being 'spilled' where it is not wanted. This time delay at the end of dispensing is called the **Tail Time**.

Head Length defines the distance between the Line Start point and the point where the dispensing of the material has to begin. When the value of the Head Length is "0" the dispensing will begin from the Line Start point (when the value of the Head Time is "0").

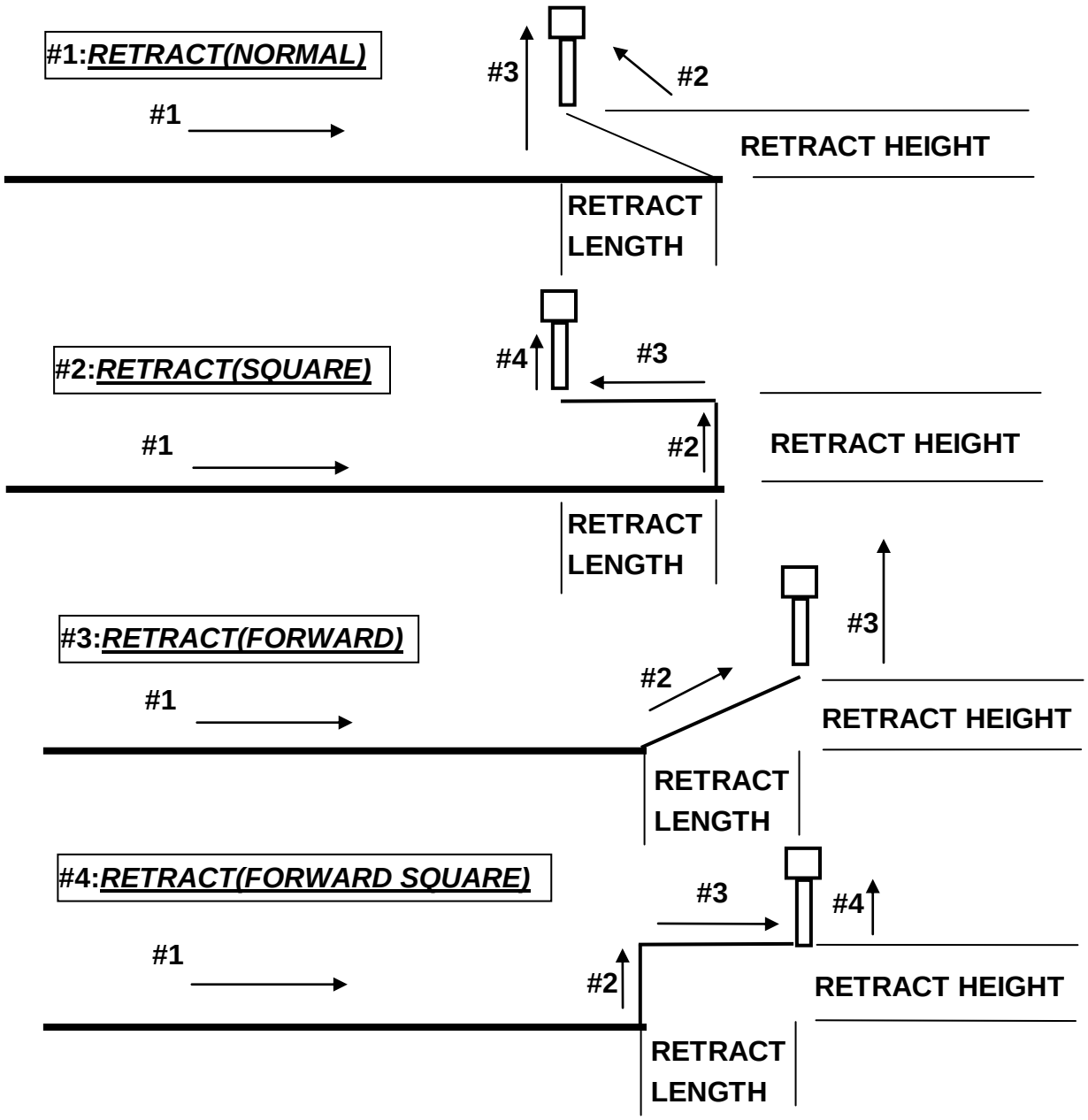
Tail Length defines the distance between the point where the dispensing is turned off (at the user's choice) and the Line End point, thus being prevented the excess of the material to be deposited at the end of the line. This is necessary because usually the material continues to flow for a while after the dispenser is turned off, due to the pressure built in the system.

Values for the Head Time, Tail Time, Head Length and Tail Length used when performing line dispensing are registered by pressing the **SETUP** key, then selecting **Line Dispense Setup**. The set values will be used by all lines from that memory address forward until a new set of Line Dispense Setup values is found.

4. Retract

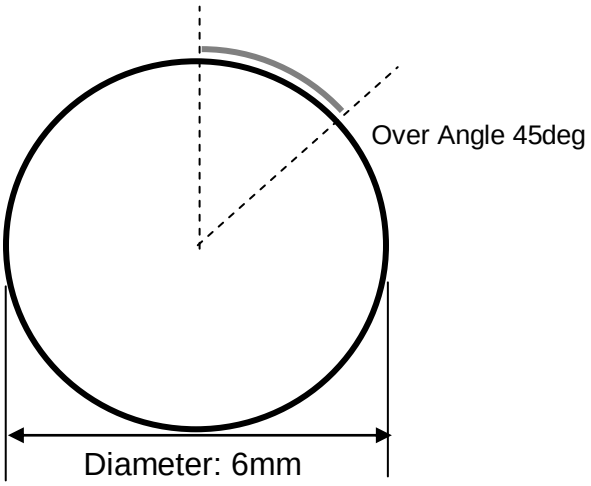
The Retract function gives the programmer the possibility to control the tip at the end of the dispensed line. It allows the tip to retract not only upward but also backward, forward or at an angle. This is useful when dispensing high viscosity or 'stringy' materials as it will lay the material tail down on the dispensed bead.

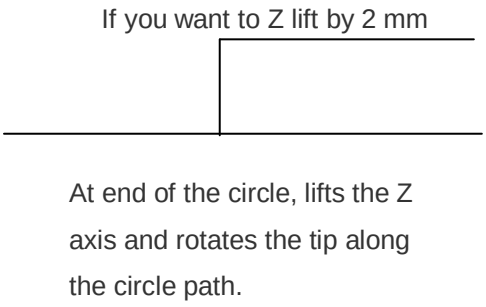
There are four retract forms under this Retract function: Normal, Square, Forward and Forward Square. The Retract forms can be selected after entering the values for: Retract Height, Retract Length and Retract Speed. The value of retract height must be smaller than the value of Z clearance in that point.
If "Cancel" option displayed is selected the tip will retract straight upwards (this could be considered as being the fifth retract form).



#5:***RETRACT(Over Ang.)***

Over Ang. function is only used for the center function. Please see section 6.1.6 more detailed information.





If you select Over Angle of 45 degrees at the end of a circle, it lifts the Z-axis and rotates the tip 45 degree on the circle path without dispensing to prevent excess material at the end of the circle.

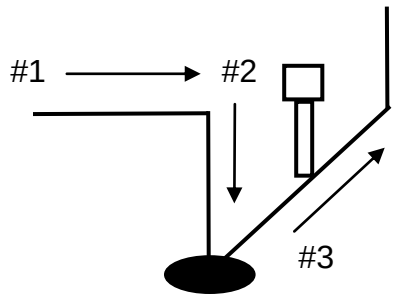
After inserting all data, press ENTER, then two addresses are saved.

Retract type: OverAngle Z Lift: 2mm
Center X: 100 Y: 100 Z: 100 Diameter: 6

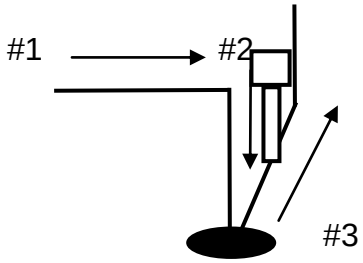
NOTE: If Over Angle value = zero, Retract step will not be saved.

#6:***RETRACT(DOT X, DOT Y)***

Dot X, Dot Y is a retract option for Dispensing Dot Motion.
If programmer needs an asymmetrical Dot, this option can be used.



DOT X



DOT Y

5. Adjust Origin

When the dispensing barrel or tip is removed and replaced, the new tip or barrel is often in a slightly different XYZR position than the old tip or barrel was.

The robot has a software utility to adjust a program's origin, thereby correcting the tip offset problem.

A reference should be chosen someplace on the work piece fixture or on the work piece itself. The reference point must be registered in the program data. This only needs to be done one time, for example when the program is originally created.

	Instruction	***Display Shows***
1	Jog the tip to the reference point (i.e.: X=10, Y=20, Z=30, R=40) OR If the reference point is an existing point in your program, press the **MOVE** key to bring the tip to that XYZ R location.	
2	Press the **Menu1** key, then on page two select **4.ADJUST *POSITION*** to save the location.	Set Adjust Position X: 10 Y: 20 Z: 30 R: 40

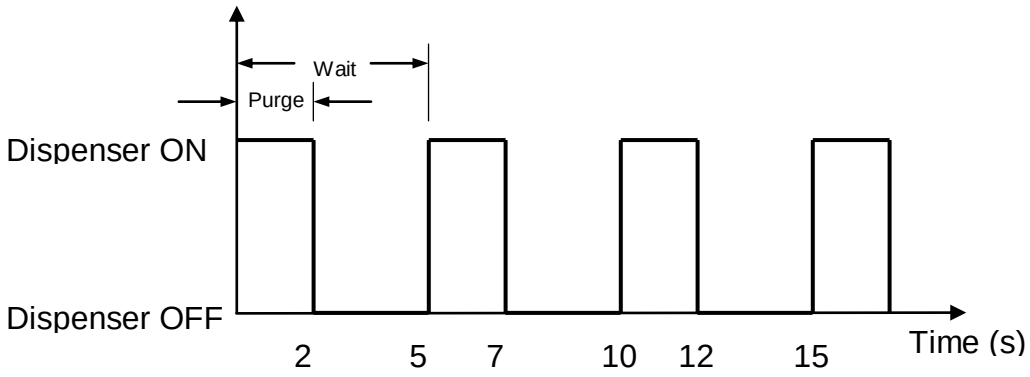
When the tip or barrel is changed, use the following procedure to adjust the program origin for the new tip location.

	Instruction	***Display Shows***
1	While in TEACH mode, press the **Menu 2** key, then **2** to select **Group Utility** menu.	1.Group Edit 2.Expand Step&Repeat 3.Relocate Data 4.Adjust Origin
2	Press **4** to select *Adjust Origin*.	Move to First Point X: Y: Z: R: Press any key
3	Press any key. The tip will move to the reference point that was recorded in the Adjust Position. If the new tip location is slightly different from the last tip location, you should see that the tip is not exactly at the reference point.	Adjust the First Point X: 10 Y: 20 Z: 30 R: 40
4	Jog the tip to the correct location for the reference point. When the location is correct, press **ENT**. The program origin will be adjusted for the new tip location.	Program Data Adjusted !!!

6. Auto Purge

After the end of a program, the tip will go to the home position and material will be purged in a continuous loop according to the parameters registered in the Auto Purge Setup command.
This command is very useful for two part materials that have a very short pot life.

For example, if a Wait Time of 5s and a Purge Time of 2s is registered in the Auto Purge Setup, the following chart shows the Purge pattern.



Section 6: Point Type & Function Reference

1. Point Menu

Below is a list of functions which are found under the **ENTER** key. These functions are 'point-type' functions. The values applied will occupy one memory address.

1.1. Dispense Dot

Registers the current XYZR location as a Dispense point for dispensing a dot.

The dispense time and wait time must be set in a previous memory address by registering a ***Point Dispense Setup*** instruction with the **SETUP** key.

The upward motion of the tip after dispensing can be controlled by registering a ***Dispense End Setup*** instruction and / or a ***Z Clearance*** instruction in a previous memory address.

Dispense End Setup and ***Z Clearance*** instructions are registered using the **SETUP** key.

See also ***Section 6:3.3 for Point Dispense Setup***, ***Section 6:3.4 for Dispense End Setup*** and ***Section 6:3.5 for Z Clearance***.

1.2. Line Start

Registers the current XYZR location as a Line Start point for dispensing a line.

The line speed must be set in a previous memory address by registering a ***Speed*** instruction using the **SETUP** key.

Dispense delay times used at Line Start point can be controlled by registering a ***Line Dis. Setup*** instruction in a previous memory address. The ***Line Dis. Setup*** instruction is registered by pressing the **SETUP** key.

See also ***Section 6:3.1 for Line Speed*** and ***Section 6:3.2 for Line Dispense Setup***.

1.3. Line Passing

Registers the current XYZR location as a Line Passing point, this being a location on the line where the tip changes direction, such as at the corner of a rectangle.

1.4. Arc Point

Registers the current XYZR location as an Arc point, this is used to dispense material along an arc or a circular path.

See **Section 4: *Programming Example***, for an example of the use of an Arc Point.

1.5. Circle

Registers the current XYZR location as a Circle point in order to dispense material along a circular path. For doing that, it is necessary to enter three points on the circle to be dispensed and to register them as: Line Start point (the first point), Circle point (the second point) and Line End point (the third point).

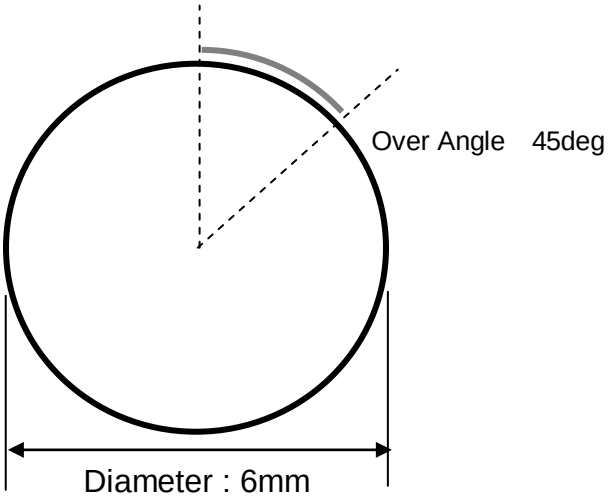
1.6. Center

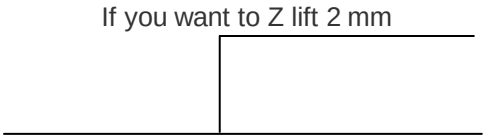
Centers function registers the current XYZR location as a Center point of circle in order to dispense material along a circular path. For doing that it is necessary to enter diameter, Over Angle, and lift Z. value.
Over Angle means that after dispensing the circle, while going through an extra part of the circle defined by the Over Angle, the dispenser will be turned OFF
If you want to lift the Z at the end of the dispense, input a Z lift value greater than zero.

Center

Diameter:	6 mm	{Type the diameter of the circle}
Over Angle:	45 degree	{Type the angle between the 1 to 360}
Z lift:	2 mm	{If you want to lift the Z end of the dispense}
Mode	0 (NONE)	{No tool correction}

1 (Outer) {Tip draw circle on the outside of circle}
2 (Inner) {Tip draw circle on the inside of circle}





End of the circle lift
the Z axis and
rotates the tip about

If you select Over Angle of 45 degrees at the end of a circle, it lifts the Z-axis and rotates the tip 45 degree on the circle path without dispensing to prevent excess material at the end of the circle.

After insert all column, press ENTER, then two addresses are saved.

Retract type: OverAngle Z Lift: 2mm
Center X: 100 Y: 100 Z: 100 Diameter: 6
If Over Angle value = zero, Retract step will not be saved.

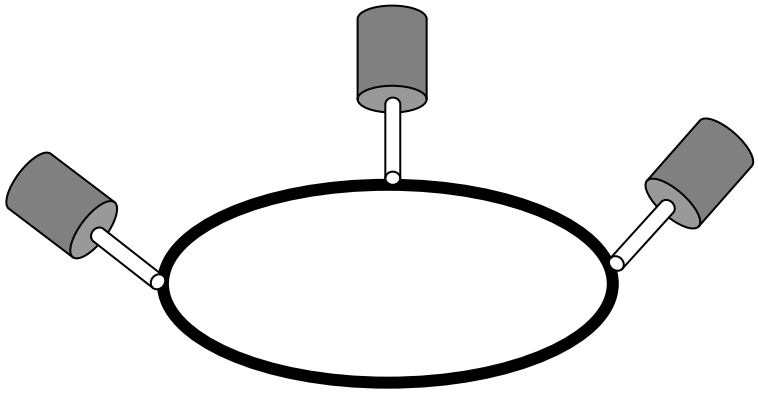
Mode option is used for robot that has a Rotation Axis.
Mode option can be used after tool correction.

See ***Section 5:3. Auto Tool Setting*** for a detailed description of Tool correction.

This function is used to prevent the barrel from crashing into an obstacle on the inside or outside of the circle.

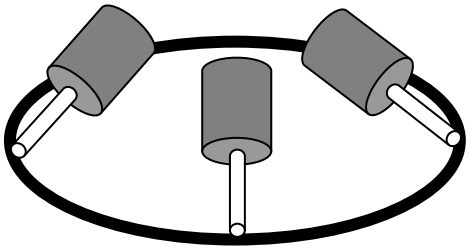
CASE 1: There is an obstacle inside of the circle.

Set the Mode as a 1.Outer. Then tip will move like next figure.



CASE 2: There is an obstacle outside of the circle.

Set the Mode as a 2.Inner. Then tip will move like next figure.



1.7. Line End

Registers the current XYZR location as a Line End point.

The dispense setting used at the end of the line can be controlled by registering a ***Line Dis. Setup*** instruction in a previous memory address. The ***Line Dis. Setup*** instruction is registered by pressing the **SETUP** key.

See also ***Section 6:3.2 Line Dispense Setup***.

The upward motion of the tip after dispensing can be controlled in several ways: 1) by registering a ***Dispense End Setup*** instruction, 2) and / or a ***Z Clearance*** instruction, 3) and/or a ***Retract*** instruction in a previous memory address.

Dispense End Setup and ***Z Clearance*** instructions are registered using the **SETUP** key.

1.8. Dummy

Registers the current XYZR location as a Dummy point, where the tip will simply pass through this point. A dummy point is useful for avoiding obstacles on the work piece.

1.9. End Program

Registers the current memory address as the end of the program. The End Program instruction will cause the tip to return to the home position at the end of the program cycle.

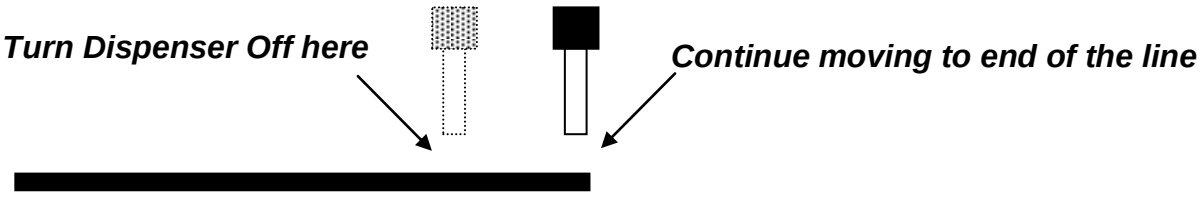
1.10. Dispense ON / OFF

The Dispense ON / OFF instruction will allow the user to program an instruction which will turn the dispenser ON or OFF.

This is useful for turning the dispenser OFF before the end of a line in order to prevent an excess of material at the end of that line.

Problem: Too much material at the end of the line

Solution: Turn the dispenser OFF before the end of the line



To register a Dispense OFF instruction, jog the tip to the XYZR location where you want the dispenser OFF, enter that location as a line passing point, then press the **ENTER** key, select ***Dispense OFF*** and press the **ENTER** key again.

Press **1** to select dispenser ON or press **2** to select dispenser OFF.

1.11. Home Point

Registers an instruction to 'home' all axes, sending them to the home position. See the **Setup** Menu for instructions on changing the location of the home position.

1.12. Wait Point

Registers a Wait Point at the current XYZR location which must be entered as a Line Passing point. When executed, the tip will move to that location and wait for the specified period of time.

1.13. Stop Point

Registers a Stop Point at the current XYZR location which must be entered as a Line Passing point. When executed, the tip will move to that location and wait until the start button is pressed.

1.14. Brush Area

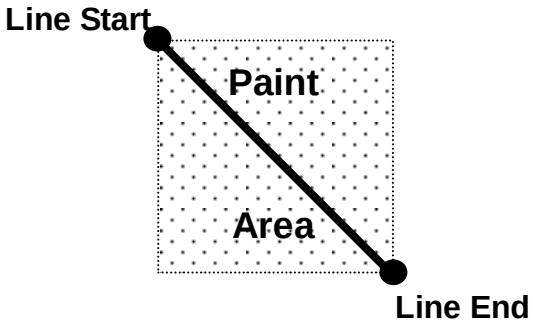
Brush Area causes the tip to 'paint' the defined area.

There are two Brush area shapes: rectangle and circle.

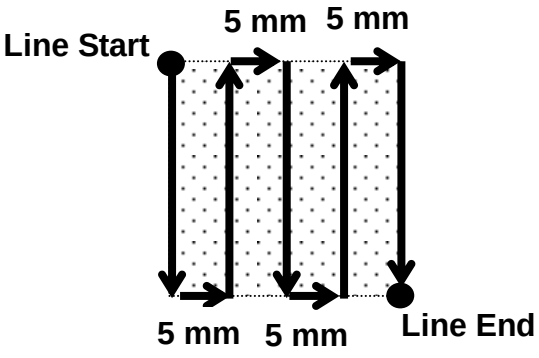
Brush Area: Rectangle

Press **ENT,** then press the **PgDn** key to scroll down to page 4/5 of the **Point** Menu.
Select ***Brush Area***, then press **1** to select **Rectangle**
You will be prompted to enter the *brush width* and the *brush distance*. The brush width is the distance between two consecutive passings of the tip during brushing.
The brush distance is the distance between the first and the last passings of the tip during brushing.
Enter the value you wish to use for the brush width and brush distance and press **ENT**.
(If "0" is entered for the brush distance, the entire area of the rectangle will be brushed).

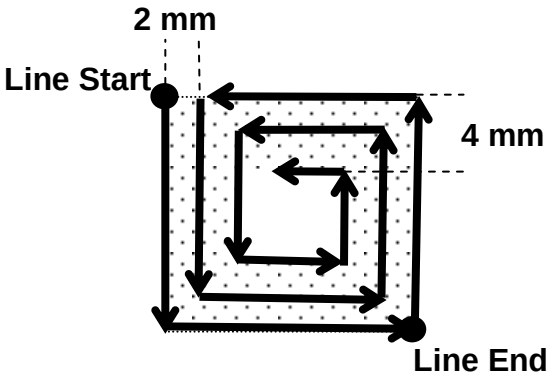
After registering the brush width and the brush distance, teach a Line Start point at the top left corner of the area to be brushed and a Line End point at the bottom right corner of that area. Note: The tip will NOT dispense a straight line between these two points, see below:



If, for example, a brush width of 5 mm and brush distance of 0 mm are entered, the tip will take the following path when the program is run:



If for example, a brush width of 2 mm and brush distance of 4 mm are entered, the tip will make the following path when the program is run:

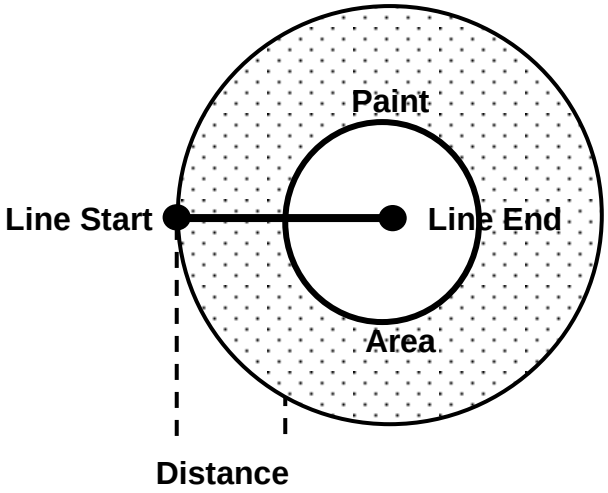


Brush Area: Circle

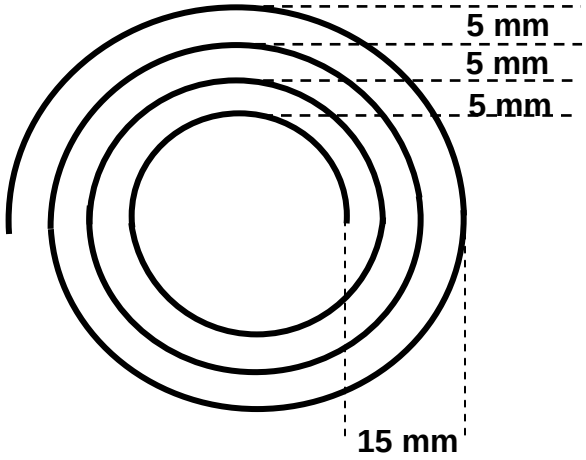
Press **ENT,** then press the **PgDn** key to scroll down to page 4/5 of the **Point** Menu. Select ***Brush Area***, then press **2** to select **Circle**.

You will be prompted to enter the *brush width* and the *brush distance*. The brush width is the distance between two consecutive passings of the tip during brushing.
The brush distance is the distance between the first and the last passings of the tip during brushing. Type the value you wish to use for the brush width and brush distance and press **ENT**.(If "0" is entered for the brush distance, the entire area of the circle will be brushed).

Then teach a Line Start point on the exterior line of the circular surface to be brushed and a Line End point in the center of that surface. Note: The tip will NOT dispense a straight line between these two points, see below:



If for example, a brush width of 5 mm and brush distance of 15 mm are entered, the tip will take the following path when the program is run:



1.15. If

If registers an instruction that either sets the value of an output signal, or checks the status of an input signal.

If ***If*** is selected, the user can enter the input port (input # 0 – 31), the input status (1 for open or 0 for closed) and the address to go to or Label if that input status occurs.

1.16. Output

If ***Output*** is selected, the user can enter the output port (output # 0 – 31), and whether the output should be turned ***ON*** or ***OFF***.

1.17. Input

If ***Input*** is selected, robot waits until the status of an input signal is set.

1.18. Pulse

Register the Output Port to be turned ON, and the output time. After the output time has expired, the Output Port will be turned OFF.

1.19. Point

Point sets Point Variable P0 – P99 by saving current position or input numerical data

2. Condition Menu

2.1. Goto Address

Causes the program to jump to the specified memory address or Label.

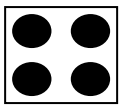
2.2. Step & Repeat Y

Step & Repeat Y allows a group of instructions to be run repeatedly, stepping a given distance in the X axis or Y axis between each cycle.

Step & Repeat Y is useful when a fixture is mounted on the robot that holds many identical work pieces aligned in rows and columns. The user needs only to create a program for the first work piece in the fixture, and then use the Step & Repeat function to dispense to the other work pieces.

The Step & Repeat function will allow the user to define the number of rows, the number of columns, the X offset between each part and the Y offset between each part.

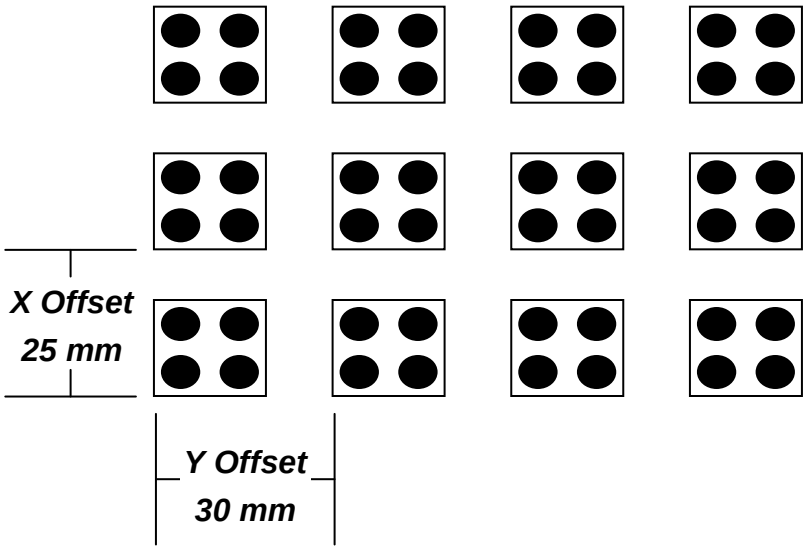
If, for example, we have a program (for instance: program number 20) which has to dispense four dots of material on a work piece:



The program would consist of the following eight instructions:

Address	***Instruction***
0	Dispense End Setup: H.Speed = 100 mm/s, L.Speed = 15 mm/s, L.Length = 5mm
1	Z Clearance: Relative 10 mm
2	Point Dispense Setup: Dis.Time = 0.25 s Tail Time = 0.10 s
3	Dispense Dot (the first dot)
4	Dispense Dot (the second dot)
5	Dispense Dot (the third dot)
6	Dispense Dot (the forth dot)
7	End Program

If a fixture is made to hold (12) work pieces, in four columns by three rows:



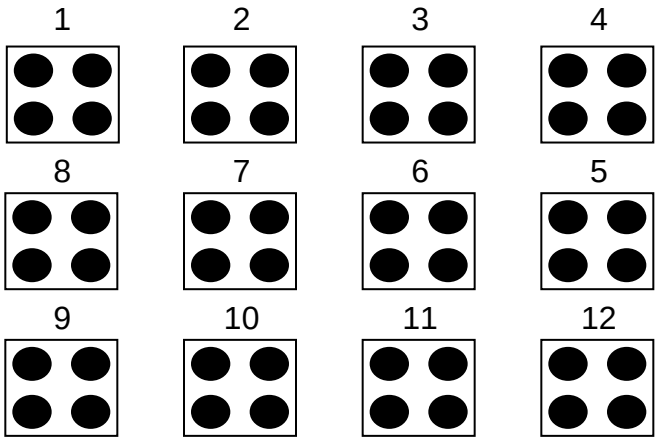
A Step & Repeat Y instruction can be used to repeat the program at the additional (11) locations.

The instruction at memory address 7 should be changed from End Program to Step & Repeat Y. To register a Step & Repeat Y instruction at memory address 7, follow these instructions:

	Instruction	***Display Shows***
1	Press the ▼/**+1** or▲/ **–1** keys until memory address 7 is shown in the display.	ADDR:7 PROG:20 End Program
2	Press the **F2/Cond** key, select ***Step & Repeat Y,*** select the Address, enter the number of the start address and press **ENT.** The start address is the memory address of the first instruction, which is part of this Step & Repeat group. In our example, we want to repeat all instructions starting with memory address number 3. Enter **3** to specify this memory address and then press **ENT**.	Step & Repeat Y Columns (X): Rows (Y):
3	Enter **3** again, this time to specify the three locations on the X axis direction and then press **ENT**. Although we are prompted here to enter the number of the columns, we will have to enter the number of locations on the X axis direction.	Step & Repeat Y Columns (X):3 Rows (Y) :
4	Enter **4** to specify the four locations on the Y axis direction and then press **ENT**. Although we are prompted here to enter the number of the rows, we will have to enter the number of locations on the Y axis direction.	Step & Repeat Y X Offset: (mm) Y Offset: (mm)
5	In the above example, the Y Offset between parts is 30 mm. Type **30** to specify a Y Offset of 30 mm, then press **ENT**.	Step & Repeat Y X Offset:30 (mm) Y Offset: (mm)
6	In the above example, the X Offset between parts is 25 mm. Type **25** to specify an X Offset of 25 mm, then press **ENT**.	Step & Repeat Y 1. N Path 2. S Path Select:

	Instruction	***Display Shows***
7	The display will prompt you to select between: 1. N Path and 2. S Path. Selecting N Path will determine the first row (columns 1 to 4) to be dispensed first, then the second row (columns 1 to 4), then the third row (columns 1 to 4). Selecting S Path will determine the first row (columns 1 to 4) to be dispensed first, then the second row (this time columns 4 to 1), then the third row (columns 1 to 4). Press **2** to select S Path.	ADDR: 8 PROG: 20 EMPTY
8	The program is now complete. Press **ENT**, then select End Program to mark address 8 as the new ***End Program*** instruction.	ADDR: 9 PROG: 20 EMPTY

The program will run in the following pattern and consists of the following instructions:



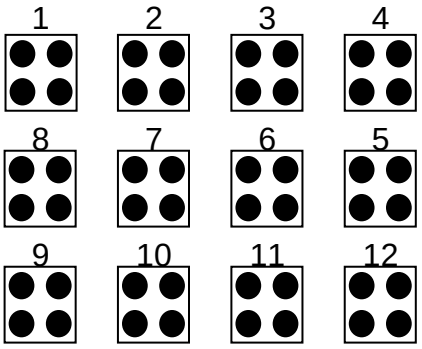
Address	***Instruction***
0	Dispense End Setup: H.Speed = 100 mm/s, L.Speed = 15 mm/s, L.Length = 5mm
1	Z Clearance: Relative 10 mm

2	Point Dispense Setup: Dis.Time = 0.25 s Tail Time = 0.10 s
3	Dispense Dot
4	Dispense Dot
5	Dispense Dot
6	Dispense Dot
7	Step & Repeat Y: Cols(X):3, Rows(Y):4, X Off: 25mm, Y Off: 30mm, Addr:3, S Path
8	End Program

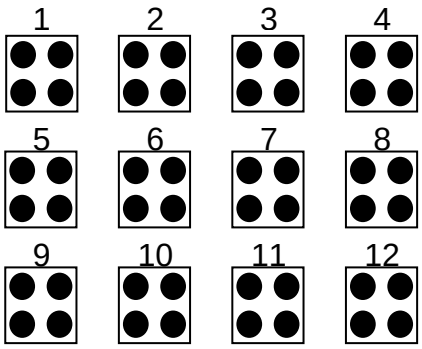
The above example was done using S Path. The difference between S Path and N Path is the order in which the pieces are run:

Step & Repeat Y:

S PATH



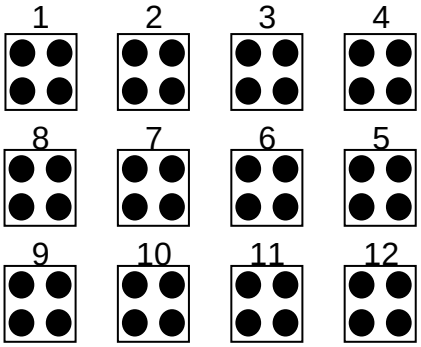
N PATH



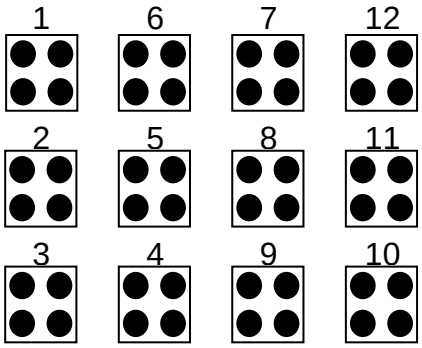
2.3. Step & Repeat X

Step & Repeat X works just as Step & Repeat Y does, with one difference: priority is given to the X axis instead of the Y axis.

Step & Repeat Y - S PATH



Step & Repeat X - S PATH



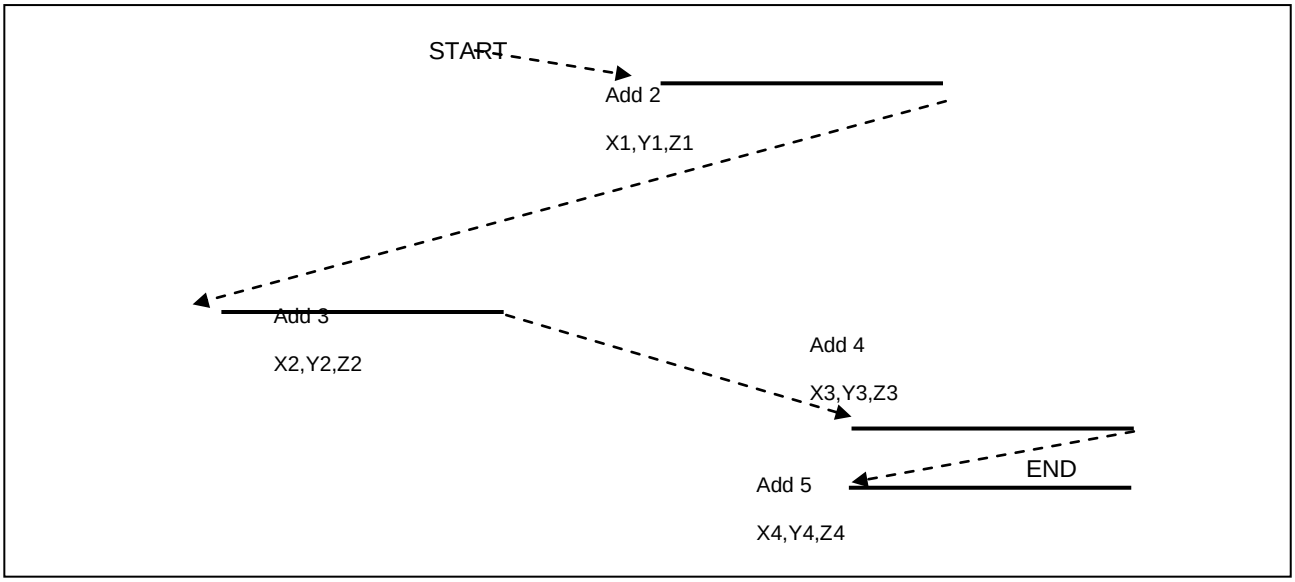
2.4. Call Subroutine

Call Subroutine causes the machine to jump to a specified memory address and execute the instructions found there using coordinates specified at the ***Call Subroutine*** instruction. When the *End Program* instruction for the subroutine is reached, program execution will continue at the address immediately after the ***Call Subroutine*** instruction.

The ***Call Subroutine*** function is most useful to repeat a pattern anywhere on the work-piece, as opposed to the *Step & Repeat* function where the pattern must be repeated in straight lines, at fixed distances from each other.
The following example illustrates the use of the *Call Subroutine* instruction. An explanation follows.

Address	***Instruction***
0	Line Speed = 20
1	Call Subroutine (X1,Y1,Z1) address 6
2	Call Subroutine (X2,Y2,Z2) address 6

3	Call Subroutine (X3,Y3,Z3) address 6
4	Call Subroutine (X4,Y4,Z4) address 6
5	End Program
6	Line Start (Xs,Ys,Zs)
7	Line End (Xe,Ye,Ze)
8	End Program



2.5. Call Program

Call Program will jump to the specified program number and execute the program data in the destination program until the End Program command is reached. When the destination program is executed, the robot will return to the calling program.

2.6. Loop Address

Registers an instruction that will execute a group of instructions a user-specified number of times.

When the ***Loop Address*** instruction is registered, the display will prompt for an ***Address/Label*** and ***Count***.

Address is the memory address to jump to from the current address. This address must be less than the current memory address.

Label is the address name to jump to from the current address. This address must be less than the current memory address.

Count is the number of times to execute the loop.

2.7. Label

Label is used instead of Address Number. A maximum of 64 Labels is permitted per program, and each label can have up to 8 characters.

2.8. Arm

Arm command is used both for TMB Series and for F3000N Series. The use of this command for TMB Series is different from that for F3000N Series.
In case of TMB Series, when robot moves with the command of ***Line/Arc***, ***Arm*** command determines position of the first and the second arm of the robot.
When ***Arm Left*** command is inserted before ***Line*** move command, the robot will move ***Line/Arc*** in the minus direction of the second arm. On the contrary, ***Arm Right*** will move in the opposite direction.
To disable ***Arm*** command**,** ***Arm No*** command is used.
In case of F3000N Series, it allows to select between XYZ interpolation and RYZ interpolation. ***Arm Left/No*** selects XYZ interpolation. ***Arm Right*** selects RYZ interpolation.

2.9. FixR

FixR command is used for rotational axis.
FixR Fix indicates that during **Line/Arc** movement R axis is fixed in the same direction.
FixR No indicates that R axis moves to the point whose position was saved while robot was moving in the **Linear/Arc** interpolation.

2.10. Calculation

For calculation, F3000 Series have 4 types of variables:
100 Integer Variables (I0 ~ I99),
100 Float Variables (F0 ~ F99),
2 Timer Variables (T0,T1) ,
100 Position Variables (P0 ~ P99).
All numeric formula must have a format like this:
Variables = Variables (OK)
or
Variables = Variables (Operator) Variables (OK).
But it is not allowed:
Variables = Variables (Operator) Variables (Operator) Variables (NO)

Example1)
I0=1
I1=I0+1
F0=I1+123.45
F1=F2/3
P0=P1

But it is not allowed:
I0=I1+I2XI3 (NO)

I4=I2XI3
I0=I1+I4 (OK)

Position Variable can be set like this:
Example2)
P0=P1
P0.X=P3.X+13
P4.Y=I3/10
P3.Z=123.45
It is possible to use array.
Only Integer Variable can be Index for array
Example3)
I0=5
F[I0]=3 (F5=3)
P[I1].X=123.4

Point Variable is used for IncJ,IncL,Jmov, Lmov
Example4)
Jmov P0
Jmov P[I0]

Variable I, F, T can be used for If command

Example5)
IF I < 50
IF F[I10] = 10
IF T0 < 100
IF I1 < I2

1) Input sequence for “I10=I11+123.45”.

	Instruction	***Display Shows***
1	Press **Cond** key and then press PgDn/+10 key until page 3/5 is displayed.	1. FixR 2. Calc 3. Jmov 4. Lmov
2	Select **Calc** command, by pressing 2 key.	Select Type ---------- I F P T
3	Select Variable Type, by pressing F1/Setup key corresponding to the letter “I” on the display.	Input Number ---------- I [I]
4	Input Variable Number (10) by Numeric key and then press ENT.	Select Type ---------- I10= I F P T
5	Select Variable Type, by pressing F1/Setup key.	Input Number ---------- I10=I [I]
6	Input Variable Number (11) by Numeric key and then press ENT.	Select Operator ---------- I10=I11 + - * /
7	Select Operator, by pressing F1/Setup key for “+”. If there is no need to use operator, press ENT.	Select Type ---------- I10=I11+ I F P T
8	Input Number (123.45) by Numeric key and then press ENT.	Input Number ---------- I10=I11+123.45 [I]

You can set variables in Menu1.

	Instruction	***Display Shows***
1	Press **Menu 1** key and then go to page 4 of the Menu.	1.Plc File Edit 2.I/O Monitor 3. Set Variable 4. Emg Mode
2	Select **3 Set Variable** from the above mentioned page. First view is Integer Variables.	I0 [1]INT I1 [2] I2 [13] I3 [2]
3	To see Float Variables, press F2.	F0 [1.2]REAL F1 [2.4] F2 [13.5] F3 [2.0]
4	To see POINT Variables, press F3 *i.e. press Inch/Menu1 key located under F3 sign.*	B0 [123.0]BUF B1 [200.1] B2 [13.2] B3 [2.5]
5	To Change value, Input Value by numeric key and press ENT.	B0 [223.0]BUF B1 [200.1] B2 [13.2] B3 [2.5]
6	To see another page of the Menu, press PgDn/PgUp.	I4 [1]INT I5 [2] I6 [13] I7 [2]
7	To jump specified Variable, press F4 (i.e. Mode/Menu 2 key) and input variable Number by numeric key.	Select Variable Num Var NO[ ]

If command can use variables, and here is an useful example:
If I0 < 100
If F[I10] < 123.45
If I12< I13

	Instruction	***Display Shows***
1	Select **ENT k**ey and find **If** command and select it.	If ---------- 1. Address 2. Label
2	Select **1 Address** and input address number, then press ENT.	Select Type ---------- Input I F T
3	To use user input, press F1/Setup key (for "Input"). If not, press Function key to select Type (I: F2 F:Inch T:Mode).	If Input ---------- Input No: On/Off (1/0)
4	Input Variable Number by pressing numeric key and then ENT key.	Select Operator ---------- I12 = < > !
5	Select Compare Operator. = (Equal), <(Less Than), >(Greater than),!(Not Equal)	Select Compare Type ---------- I12< I F
6	Press Function key to select Type (I:F1 F:F2)	Input Number ---------- I12<I [I]
7	Input Variable Number by pressing numeric key.	Input Number ---------- I12<I13 [I]

2.11. Jmov/Lmov

This command moves to Position which is saved in the Point Variable.
In case of Jmov P0, robot moves to the point that is stored in P0.

2.12. IncJ / IncL

IncJ/IncL command moves robot to the absolute position resulted from adding a relative position specified as an argument to the current position.

2.13. Offset

Set Offset value or point number. Every saved position after Offset command will be increased by Offset Value.

2.14. PALLET

Calculate Pallet position and input the result to Position Variable.

First of all, input the number of columns and rows of pallet. Three corner points of the Pallet are saved as three continuous Position Variables.

The first point is called “Base Point”. Base Point can be selected from P0 to P97.

If Base Point is in P1, last unit position of column direction is saved in P2. Last unit position of row direction is saved in P3.

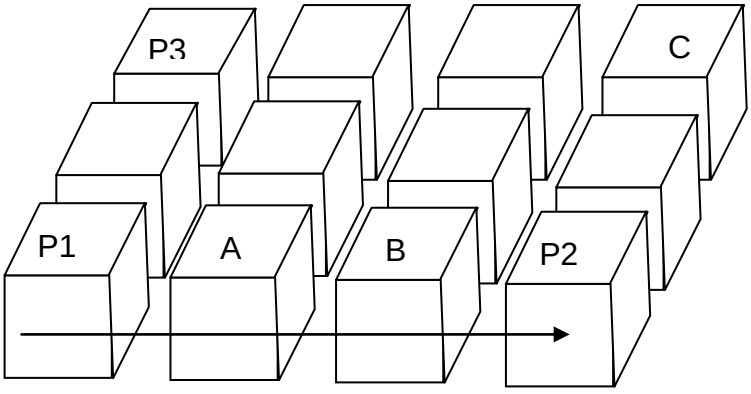
Set Point is Position Variable that will save Pallet position calculation results.

Input index variable to determine the work sequence number. Index variables use integer variables. Index variables can be selected from I0 to I99.

Next figure shows: 4 X 3 Pallet. Base Point is P1, Set Point is P0, Index is I0.

If value of I0 is 0, P0 has position of P1. If I0 is 1, P0 saves position of unit A. If I0 is 2, P0 saves position of unit C.

Value of I0 is not added automatically. Program must have command like: “I0=I0+1” in order to save position of P1, P2, P3:



	Instruction	***Display Shows***
1	Move to P1 position and press ENT. Select Point Command (page 5 of the Menu).	Point Point No :
2	Input “1” by numeric key and press ENT.	Point No 1 X:0 Y:0 Z:0 R:0 [Cur]
3	Display shows current saved position of P1. To save current position, press F1. To edit current saved position, insert new value by numeric key. Then press ENT key	---------- Current Position Saved ----------
4	Current position is saved for P1. For P2, P3 to be used the same way.	

Address	***Instruction***
1	I0=0
2	Jmov P4
3	Pallet Row:4 Col: 3 Base Point: P1 Set Point P0 Index I0
4	Jmov P0
5	I0=I0+1
6	If I0<12 Goto Address 2
7	End Program

	Instruction	***Display Shows***
1	Press **Cond** key and select Pallet Command (page 4 of the Menu).	Pallet ---------- Columns :4 Row :3
2	Input column, row number.	Pallet ---------- Base Point : Set Point : Index :
3	Input Base Point number.	Pallet ---------- Base Point :1 Set Point : Index :
4	Input Set Point number.	Pallet ---------- Base Point :1 Set Point :0 Index :
5	Input Index number.	Pallet ---------- Base Point :1 Set Point :0 Index :0

2.15. Pattern / Pattern End

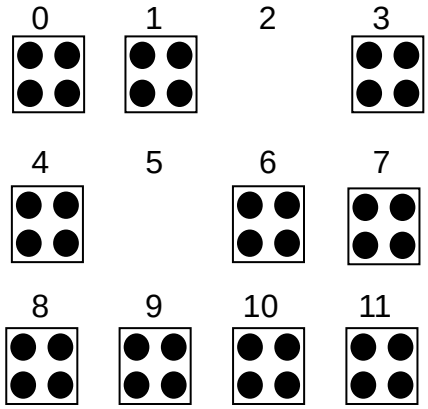
Pattern command works like the “Step & Repeat X/Y” command, but it is different only because it can skip, or change the order of the repeat.

Pattern command is useful for arranging similar shapes.

At the end of a Pattern, insert the Pattern End Command.

Pattern command has an Index Variable. The Index Variable can change the order of the repeat. Index number can be used form I0 to I99.

For example below, the third (number 2 below) and the sixth (number 5 below) “repeats” must be skipped:



We must enter:

Address	***Instruction***
0	I0=0
1	Pattern X Cols(X): 3, Rows(Y): 4, X Off: 25mm, Y Off: 30mm, Index IO
2	Dispense Dot
3	Dispense Dot
4	Dispense Dot
5	Dispense Dot
6	I0=I0+1
7	If I0 !=2 Goto 9
8	I0=I0+1
9	If I0 !=5 Goto 11
10	I0=I0+1
11	Pattern End
12	End Program

	Instruction	***Display Shows***

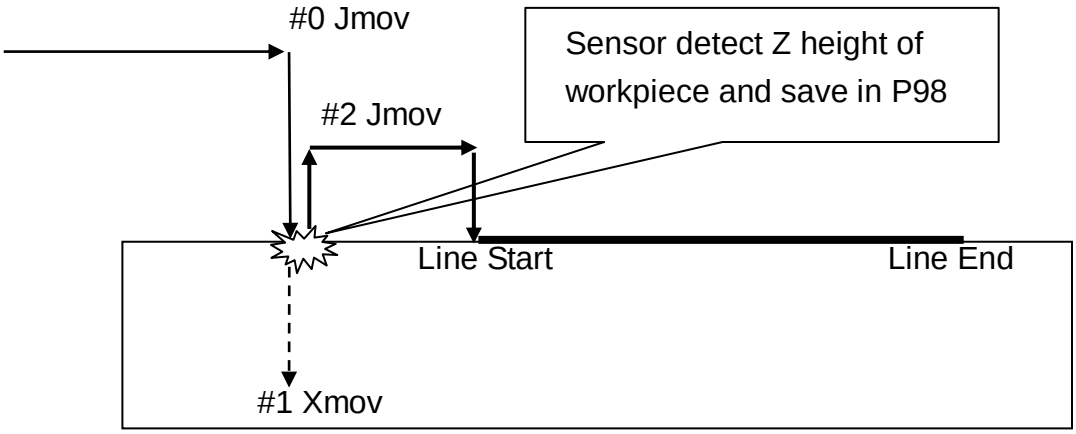
1	Press **Cond** key and select Pattern command.	`Pattern`
		`----------`
		`X Offset:`
		`Y Offset:`

2	Insert X Offset, Y Offset.	`Col :`
		`Row :`
		`Index:`

3	Input col, row value and Index Number.	`1. X Start` `2. Y Start`
4	Select X Start or Y Start	

2.16. Xmov

Xmov can be used for sensor detecting of different work piece. If the sensor input is on while moving, the robot will stop immediately and save the current position in P98.



`

Address	*Instruction*
0	Jmov (0,0,0)
1	Xmov (0,0,100) In0 sensor input 0
2	Jmov (0,0,10)
3	P0.X = 0
4	P0.Y = 0
5	P0.Z= P98.Z-50
6	Offset P0
7	Line Start (10,0,50)
8	Line End (100,0,50)

Example. If Z height of work piece is 45mm, after sensor detection, value of P98 is (0,0,45). So value of P0 is (0,0,-5). By offset command, Line Start is (10,0,45) and Line End is (100,0,45)

3. Setup Menu

Below is a list of functions that are found under the **F1/ SETUP** key. These functions are all related to the setup of dispensing parameters.

3.1. Line Speed

Registers the LINE SPEED used for all lines from the current memory address forward until another Line Speed instruction is found.

3.2. Line Dispense Setup

Registers the LINE DISPENSE SETUP values, which set the dispensing wait time at the start of lines (‘head’ time), waiting time at the end of lines (‘tail’ time) and dispense off distance (“tail length”). The registered values will be used from the current memory address forward until another Line Dispense Setup instruction is found.

See ***Section 5:3. Line Dispense Setup*** for a detailed description of this function.

3.3. Point Dispense Setup

Registers POINT DISPENSE SETUP values which set dispensing time and waiting time at the end of dispensing (‘tail’ time) for dots. The registered values will be used from the current memory address forward until another POINT DISPENSE SETUP instruction is found.

3.4. Dispense End Setup

Dispense End Setup allows the ***L.Length***, ***L. Speed*** and ***H. Speed*** values to be registered at a memory address. These values will affect how far and how fast the tip rises after dispensing. Please see ***Section 5:1. Dispense End Setup*** for a detailed description of this function.

3.5. Z Clearance

Z Clearance command sets the distance the tip will rise after dispensing, in order to avoid obstacles. It is registered at a memory address. Please see ***Section 5:1. Dispense End Setup*** and ***Section 5:2. Z Clearance*** for a detailed description of this function.

3.6. X/Y Move Speed

X/Y Move Speed sets default X and Y axes movement speed as the tip moves between figures in a program, such as from one dispensing dot to another or from the end of one dispensing line to the start of the next dispensing line.

3.7. Z Move Speed

Z Move Speed sets default Z axis movement speed as the tip moves between figures in a program, such as from one dispensing dot to another or from the end of one dispensing line to the start of the next dispensing line.

3.8. Home Position

Home Position allows the user to change the location of the program home position. The home position is the location to which the tip will move at the end of a program cycle.

To change the home position, jog the tip to the desired location for the new home position, press the **Setup** key, then press 

and select ***Home Position***.

NOTE: When executing a program in TEACH MODE, the robot will move to the mechanical home position (X=0, Y=0, Z=0, R=0) at the start of every program cycle. When executing a program in RUN MODE, the robot will move to the home position set under the Setup: Home Position.

3.9. Retract

The *Retract* function causes the tip to reverse direction backward along the dispensing path, and upward after a line dispensing. This is useful when dispensing high viscosity or 'stringy' materials, as it will lay the material tail down on the dispensed bead.
Please see ***Section 5: 4. Retract*** for additional information on the retract function.

3.10. Auto Purge

The *Auto Purge* function prevents the dispending material to become hardenned while robot is running. If there is no dispensing during 'Wait time', the robot will purge the material by 'Purge time'.

3.11. Adjust Point # 1

Saves the current position and steps as a first data for Relocate Data function. Saves the current position to temporary Point # 1.

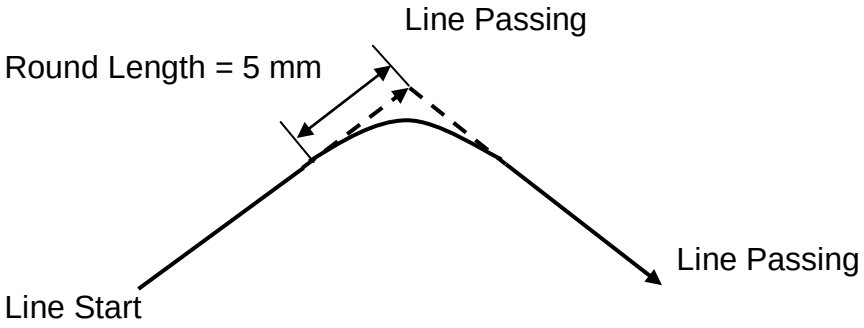
3.12. Adjust Point # 2

Saves the current position and steps as a second data for Relocate Data function. Saves the current position to temporary Point # 2.

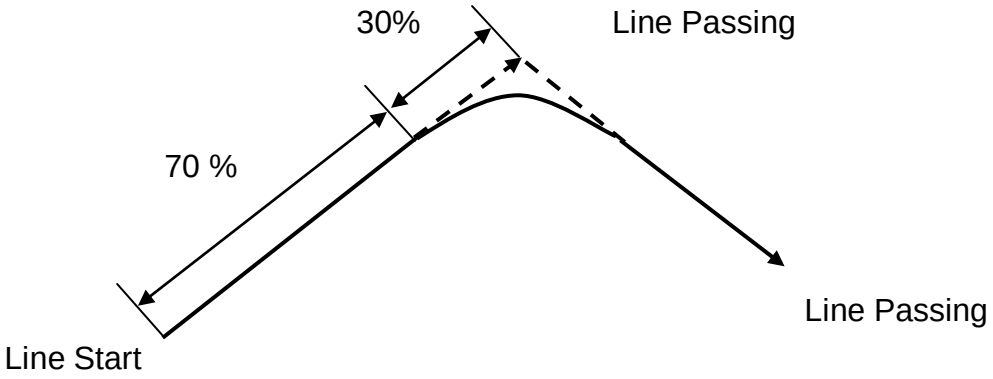
3.13. Round

A continuous path smoothly connects two separate motions of a robot without stopping by inserting a round path between the two motions. In order to make the smooth motion, the robot assumes that it has already moved to within a particular RANGE of the first target point, and executes a motion plan toward the next target point. Round commands are used for setting the particular RANGE.

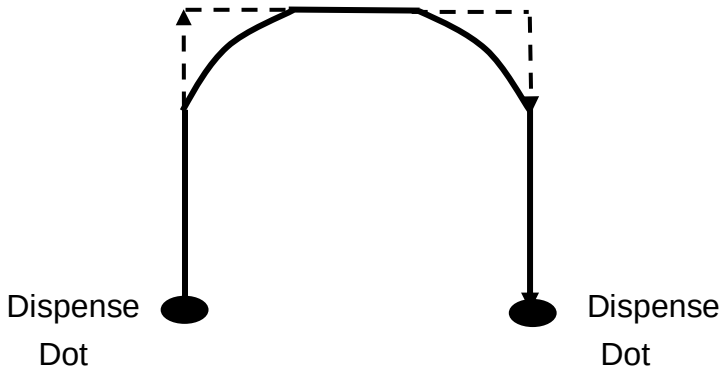
If value of Round Length is 5mm:



If value of Round Percent is 70%:



Round Percent also affects dispense dot motion.

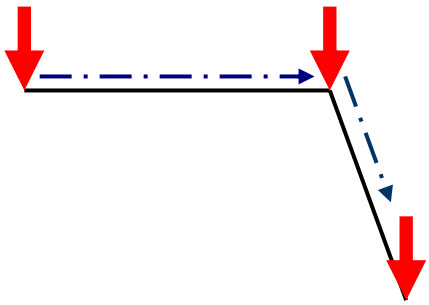


3.14. Z Lift

The Z-Lift function allows the user to move through the program from point to point without raising the Z-axis. The function also allows the user to set the distance that the Z-axis will move before going to the next point. This function is especially useful when adjusting pre-existing points that are defined, but are not accessible through direct Z-axis movement. The default value is OFF.

1. Lifting Z : **OFF**

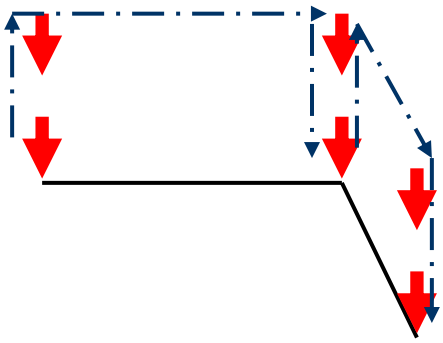
When Lifting Z is off, moving the tip from point to point will require the Z-axis to rise according to the specified lifting length. If lifting length is set to zero, the tip will execute a Z-axis movement to get to the next point.



Z-axis lift is **off** with the lifting length set to zero.

2. Lifting Z : **ON**

When lifting Z is on, moving the tip from point to point will require the Z-axis to rise to its maximum height (Z = 0) before traveling along the XY plane to get to the next point.



Here, the Z-axis lift is ON, so the tip moves to the home position first before going to the next point.

4. Menu 1

4.1. Program Name

Program Name allows the user to enter a name for the current program. If a program name is entered, it will appear on the display when that program is selected in Run mode. The name of a program can be named only after being created.

4.2. Z-Axis Limit

Z-Axis Limit allows the user to limit the range of the Z-Axis values.

Press **Menu 1** key and select 2 (on page 1/5) for Z-Axis Limit. You will be prompted to enter the new High and Low values for the Z-Axis range. Recall that Home Z position has a value of 0mm (zero), and is the highest physical position possible. A lower physical Z position will, therefore, possess a higher numerical value (= Home + some distance).

- High Value (the higher physical position of the Z travel) - When you are prompted to enter the High Value, you will have to enter the desired value of the Z-Axis while in its LOWEST physical position, which must be the lower numerical value of the new Z-Axis range.
- Low Value (the lower physical position of the Z travel) - When you are prompted to enter the Low Value, you will have to enter the desired value of the Z-Axis in its lower position, which will be – this time – the higher value than the new Z-Axis range.

The Z-Axis range will be limited to these new values.

4.3. Initial Output

Initial Output Status sets the ON/OFF status of the output signals at the start of each program cycle.

Initial Output Status value is the hexadecimal representation of an 8 character value controlling the 32 output signals.

For example,

Hexadecimal Value	***Output Status (1 = on, 0 = OFF)***							
	Bit31							Bit 0
0	0000	0000	0000	0000	0000	0000	0000	0000
1	0000	0000	0000	0000	0000	0000	0000	0001
2	0000	0000	0000	0000	0000	0000	0000	0010
4	0000	0000	0000	0000	0000	0000	0000	0100
8	0000	0000	0000	0000	0000	0000	0000	1000
A	0000	0000	0000	0000	0000	0000	0000	1010
B	0000	0000	0000	0000	0000	0000	0000	0000
AAAA	0000	0000	0000	0000	1010	1010	1010	1010
555555	0000	0000	0101	0101	0101	0101	0101	0101

4.4. Cycle Counter

When in Run mode, the third line of the display shows the number of program cycles that have run to completion for the current program number:

Cycle Counter : X

It is possible to reset this number by selecting **Menu 1**, ***Cycle Counter***. When prompted for the ***New Value:***, press **0** and **ENT** to reset the cycle counter.
It is also possible to cause an alarm to be generated after a fixed number of program cycles. Select Menu 1, ***Cycle Counter***. When prompted for the ***New Value:***, type the number of program cycles to complete before generating the alarm and press **ENT.**

In Run mode, when the set number of program cycles has been completed, the display will show ***Counter Full!*** and the start button will be disabled. The Cycle Counter must be reset before the program can be run again. The Cycle Counter can also be reset using the following steps:

	Instruction	***Display Shows***
1	While in Run mode, press F3 (i.e. Inch/Menu 1) key.	Prog: AUTO 1. Reset counter 2. Adjust position
2	Press 1 key to choose “Reset Counter” shown on display.	Prog: AUTO Press Move key Cycle Counter: 0

4.5. Set Password

Set Password allows the user to protect a program from editing. If the program is locked, the user will not be able to change any of the program data. Unlocking the program will allow the data to be changed.

4.6. Jog Speed

Sets the jog speed of the axes of the robot (namely, at the velocity level: high) including the linear speed and the rotation speed (for 4-axis robots). The level of the velocity can be reduced to other two limits: middle (50% of high level) and low (10% of high level). Speed is expressed as mm/sec on the Teach Pendant, and the rotation speed (when applicable) will be expressed in degrees/sec.
Note: For 4-axis robots, the rotation axis is marked with W on the keys and with R on the display of the Teach Pendant.

4.7. Run Mode

This determines whether the robot operates in Stand-alone mode (default) or Host mode or Console mode. Host mode allows the robot to be controlled by commands sent over the RS232 port.

4.8. Adjust Position

Sets the position for Adjust Origin.

4.9. Parameter

This sets the parameters of the unit. To have access to these data, you are prompted to insert the current password of the unit.

Robot Type Set

Select the robot model / type.

Motor Setting

Sets the motor power, motor brake, encoder (pulse/rev), and other specs.

Reduction Ratio

Sets the reduction ratio of each axis.

Origin Offset Set

Moves the Origin Position to proper position.

Gain Setting

Changes the Motor Gain.

Speed Set

Changes the maximum speed, acceleration time, inching speed, round set for velocity, acceleration option set.

Brake Time Set

Selects the brake On/Off delay.

Tool Setting

Sets: Tool Offset.

RS-232C

Changes the serial port setting.

Origin Setting

Changes the origin speed, origin process, origin mode.

H/W Test

Checks the hardware status: servo func., system input, servo R/W test, sensor, origin, servo led.

Encoder Preset (TMB Series Only)

Resets the absolute encoder error.

Inposition Set

Set INPOS output usage: Inpos (pulse), Inpos (time), Inrange, Inpos < - - >
INRNG Output by [Inpos].

Direction Setting

Set the positive or negative direction of each axis.

Axis Change

Selects the hardware channel and each axis

Limit Enable

Determine whether to use the limit sensor, or not.

Change Password

Change the password to enter the Parameter menu.

Set PLC Autorun

Set the PLC file autorun option.

S/W Limit Set

Select the Software limit area.

Bcode Set

Change/Edit the Buffer.

Parallel Set

Set the parallel axis.

Protocol Set

Select the Protocol while the robot is running.

Stop Output

Select the Output status when the robot stops moving.

Flash Burning

Upgrade the robot firmware.

4.10. Auto Tool Setting

This function can be used in Menu1>Parameter>Tool Setting.

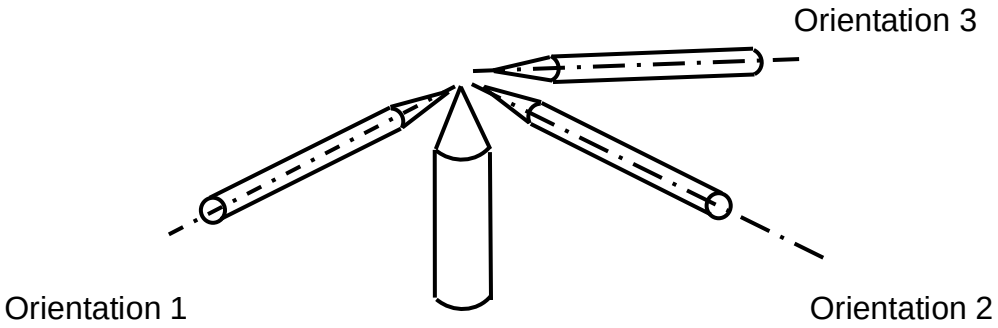
In order to get an accurate offset of a tool attached to the end of the rotational axis of a manipulator, three positions are necessary to be taught for one point with a different orientation of the manipulator.

This function automatically calculates and sets the X and Y value of the tool offset from the taught three positions.

Teach three positions one by one for one same position with the tool mounted on the end of a manipulator. The angle between three positions should be greater than 90 degree in the following figure so that the offset value of the tool can be calculated as accurately as possible.

In the menu, after teaching a point, press F4 PNT key to save the current position.
Each time the F4 key is pressed, the message “PNT1” for the first position will change to “PNT2” for the second position, and “PNT3” for the third position

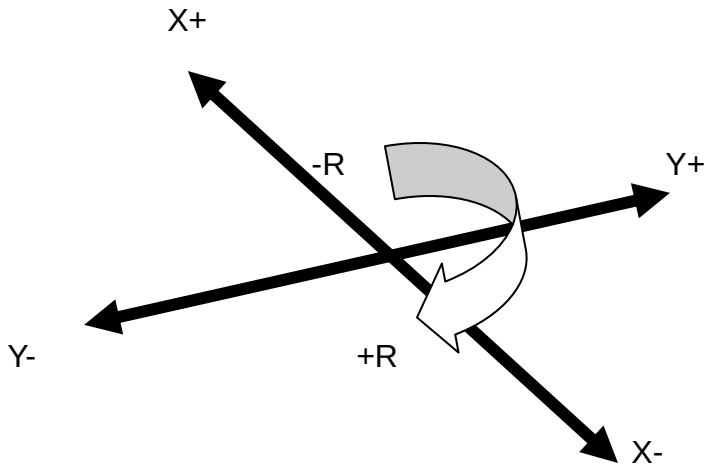
After teaching all three position with different orientations, press ESC key and select 1.Yes to calculate the offset of the attached tool.



	Instruction	***Display Shows***
1	Press the **MENU 1** key, then select Parameter and find Tool Setting Menu for tool correction function.	[TOOL OFFSET SET] 1.INPUT TOOL OFFSET 2.AUTO TOOL SET
2	Press 2 for Auto tool set.	[AUTO TOOL SETTING] A:5.3 B:4.5 Z:39.4 R:3.8 PNT
3	Move Tip to Orientation 1 position by hand or Jog key. And Press F4 to save current Position.	[AUTO TOOL SETTING] A:8.3 B:3.5 Z:39.4 R:6.8 [PNT1]
4	Move Tip to Orientation 2 position by hand or Jog key. And Press F4 to save current Position.	[AUTO TOOL SETTING] A:48.3 B:43.2 Z:39.4 R:36.8 [PNT2]
5	Move Tip to Orientation 3 position by hand or Jog key. And Press F4 to save current Position.	[AUTO TOOL SETTING] A:118.3 B:33.5 Z:39.4 R:36.8 [PNT3]
6	Press ESC key to calculate Tool offset. Then Select 1.Yes	[AUTO TOOL SETTING] A:8.3 B:3.5 Z:39.4 R:6.8 1.YES 2.NO
7	Check the value of tool offset in Input Tool Offset menu.	[TOOL SETTING] X Length : 10.3 mm Y Length : 4.5 mm Z Length : 0 mm
8	In Teach mode, select rectangular coordination by shift+F2 key. And press R+/- Jog key. If tool correction is right. Tip will move around current position as a center.	ADDR: 0 PROG:0 EMPTY X:113.2 Y:23.5 Z:14.3 R:8.5

For tool setting, next conditions must be satisfied.

1. The rotation direction of R axis must be from +X to +Y.



2. The angle between three Orientation positions should be greater than 90 degree.

4.11. Resume

Once a program has been interrupted, the **Resume** setting will determine if the program restarts from point # 1, or from the point at which it was interrupted, such as in the middle of a program.
If **Resume** is set to ***1*** and a program is stopped by an emergency stop signal or by the enclosure door switch open signal, the program will restart from the point at which it was interrupted when the start button is pressed.
If **Resume** is set to ***0*** and a program is stopped by an emergency stop signal or by the enclosure door switch open signal, the program will restart from point #1.
The default value is ***0***.

4.12. Origin Searching

This function makes the robot to go to the home position.

4.13. Hour Meter

This function shows the total time the controller has been on, as well as how long the manipulator has run.

4.14. PLC File Edit

Allows the user to create and edit PLC files. For more information refer to Section 7: PLC.

4.15. I/O Monitor

Displays current Input/Output status.

4.16. Set Variable

Allows the user to insert value to Variable which is used in CALC (arithmetic).

4.17. EMG Mode

EMG Mode selects System Emergency signal of System Input as: Interlock signal or Emergency Stop signal.

5. Menu 2

5.1. Point Utility

5.1.1. MDI Mode

MDI Mode allows you to modify the position of each address by numerical key input. After pressing **Menu 2** key and then entering Point Utility and MDI Mode, using the ▲/-1, ▼/+1 keys, find the address number that you want, and press the **ENT** key. The cursor will appear in the X position. Enter the value using the key pad on the Teach Pendant and press **ENT**. Then the cursor will move to the Y position. Enter the value using the key pad on the Teach Pendant and press **ENT**. The same procedure will be followed for Z and R (for 4-axis robots) positions. When finished, you will be asked if you want to save these changes.

5.1.2. Numerical Move

Allows the tip to be positioned numerically by entering the desired numbers for the X, Y, Z (&R for 4-axis robots) values.

5.1.3. Save Temp Point

Saves the current XYZ (&R for 4-axis robots) positions in a temporary memory area numbered 1 – 9. The Save Temp Point function is also used with the Relocate Data function. See ***Section 6:5.2.3 Relocate Data***.

5.1.4. Retrieve Temp Point

Retrieves an XYZ (&R for 4-axis robots) position that was stored with Save Temp Point.

5.2. Group Utility

5.2.1. Group Edit

Group Edit is a powerful utility that allows several different functions to be applied to a user-defined group of addresses. These functions include: copy, delete, move, multiply line speed, multiply dispense time, apply X Offset, apply Y Offset, apply Z Offset, and apply angle of rotation (for 4-axis robots).

5.2.1.1. Copy

For example, to use *Group Edit* to copy addresses 1 – 20 in the current program to memory addresses 21 - 40:

	Instruction	***Display Shows***
1	Press the **MENU 2** key, then **2** to select *Group Utility* and then **1** to select *Group Edit.* The display will prompt the user to enter the starting memory address of the group to edit (***From***) and the ending number of the group to edit (***To***).	GROUP EDIT FROM: ▒ TO : (0 <-> 2999)
2	Type **1** then press **ENT** to register 1 in *From*. Type **20** then press **ENT** to register 20 in *To*.	GROUP EDIT 1-20 1.Copy 4.Line SP 2.Delete 5.Disp.TM 3.Move 6.Offset
3	The *Group Edit* menu will then appear, allowing the user to select which function will apply to the range of points. Press **1** to select *Copy*.	GROUP COPY SOURCE 1-20 Destination:
4	The display will prompt the user to type the destination memory address where the data will be copied. Press the **Del** key when the cursor is on the old figure to erase it, then type **21** and press **ENT** to select destination memory address number 21. For moving the cursor to be used /SPD- and /SPD+ keys.	GROUP COPY SOURCE 1-20 Destination:21 1.Yes 2.No
5	The display will now prompt the user to confirm the copy. Press **1** to select *Yes* and perform the copy.	

5.2.1.2. Delete

For example, to use *Group Edit t*o delete addresses 15 – 25 in the current program:

	Instruction	***Display Shows***
1	Press the **MENU 2** key, then **2** to select *Group Utility* and then **1** to select *Group Edit.* The display will prompt the user to enter the starting memory address of the group to edit (***From***) and the ending number of the group to edit (***To***).	GROUP EDIT FROM : TO : (0 <-> 2999)
2	Type **15** then press **ENT** to register 15 in *From*. Type **25** then press **ENT** to register 25 in *To*.	GROUP EDIT 15-25 1.Copy 4.Line SP 2.Delete 5.Dispen.TM 3.Move 6.Offset
3	The *Group Edit* menu will then appear, allowing the user to select which function will apply to the range of points. Press **2** to select *Delete*.	GROUP DELETE SOURCE 15-25 SELECT 1. Yes 2.No
4	The display will now prompt the user to confirm the deletion. Press **1** to select *Yes* and delete the data.	

5.2.1.3. Move

For example, to use *Group Edit* to move addresses 10 – 20 in the current program to memory addresses 50 – 60:

	Instruction	***Display Shows***
1	Press the **MENU 2** key, then **2** to select *Group Utility* and then **1** to select *Group Edit.* The display will prompt the user to enter the starting memory address of the group to edit (***From***) and the ending number of the group to edit (***To***).	GROUP EDIT FROM : TO : (0 <-> 2999)
2	Type **10** then press **ENT** to register 10 in *From*. Type **20** then press **ENT** to register 20 in *To*.	GROUP EDIT 10-20 1.Copy 4.Line SP 2.Delete 5.Dispen.TM 3.Move 6.Offset
3	The *Group Edit* menu will then appear, allowing the user to select which function will apply to the range of points. Press **3** to select *Move*.	GROUP MOVE SOURCE 10-20 Destination:1
4	The display will prompt the user to type the destination memory address where the data will be moved. Press the **Del** key when the cursor is on the old figure to erase it, then type **50** and press **ENT** to select destination memory address number 50.	GROUP MOVE SOURCE 10-20 Destination:50 1.Yes 2.No
5	The display will now prompt the user to confirm the move. Press **1** to select *Yes* and move the data.	

5.2.1.4. Line SP (Line Speed)

For example, to use *Group Edit* to increase all line speed commands in memory addresses range 1 – 200 by 20 %:

	Instruction	***Display Shows***
1	Press the **MENU 2** key, then **2** to select *Group Utility* and then **1** to select *Group Edit.* The display will prompt the user to enter the starting memory address of the group to edit (***From***) and the ending number of the group to edit (***To***).	GROUP EDIT FROM : ▒ TO : (0<-> 2999)
2	Type **1** then press **ENT** to register 1 in *From*. Type **200** then press **ENT** to register 200 in *To*.	GROUP EDIT 1-200 1.Copy 4.Line SP 2.Delete 5.Dispen.TM 3.Move 6.Offset
3	The *Group Edit* menu will then appear, allowing the user to select which function will apply to the range of points. Press **4** to select *Line SP*.	GROUP LINE SP Multiple Value:
4	The display will prompt the user to type the multiple value to be applied to the line speeds. For example, a value of 1.2 will increase all speeds by 20%. A value of 0.8 will decrease all speeds by 20%. Type **1.2** and press **ENT** to select a multiplier of 1.2.	GROUP LINE SP Multiple Value:1.2 SELECT 1.Yes 2.No
5	The display will now prompt the user to confirm the change. Press **1** to select *Yes*. All line speed instructions in the selected range of addresses will now be multiplied by 1.2.	

5.2.1.5. Dispen.TM (Dispense Time)

For example, to use *Group Edit* to increase all dispensing times (Point Dispense Setup) in memory addresses range 1 – 200 by 15%:

	Instruction	***Display Shows***
1	Press the **MENU 2** key, then **2** to select *Group Utility* and then **1** to select *Group Edit.* The display will prompt the user to enter the starting memory address of the group to edit (***From***) and the ending number of the group to edit (***To***).	GROUP EDIT FROM : ▒ TO : (0 <-> 2999)
2	Type **1** then press **ENTER** to register 1 in *From*. Type **200** then press **ENTER** to register 200 in *To*.	GROUP EDIT 1-200 1.Copy 4.Line SP 2.Delete 5.Dispen.TM 3.Move 6.Offset
3	The *Group Edit* menu will then appear, allowing the user to select which function will apply to the range of points. Press **5** to select *Dispen.TM*.	GROUP DISPENSE TM SOURCE 1 - 200 Multiple Value:
4	The display will prompt the user to type the multiple value to be applied to the dispense times. For example, a value of 1.15 will increase all dispense times by 15%. A value of 0.85 will decrease all dispense times by 15%. Type **1.15** and press **ENTER** to select a multiplier of 1.15.	GROUP DISPENSE TM SOURCE 1 - 200 SELECT 1.Yes 2.No
5	The display will now prompt the user to confirm the change. Press **1** to select *Yes*. All the Point Dispense Setup instructions in the select range of addresses will now be multiplied by 1.15.	

5.2.1.6. Offset

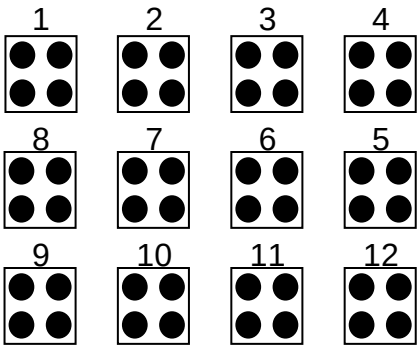
The Offset function allows all XYZ (&R for 4-axis robots) locations in a program to be shifted in new XYZR locations at distances (with values) defined by the user.
For example, to use *Group Edit* for adding 15 mm to all X axis values in memory addresses range 1 – 200:

	Instruction	***Display Shows***
1	Press the **MENU 2** key, then **2** to select *Group Utility* and then **1** to select *Group Edit.* The display will prompt the user to enter the starting memory address of the group to edit (***From***) and the ending number of the group to edit (***To***).	GROUP EDIT FROM : TO : (1 <-> 2999)
2	Type **1** then press **ENTER** to register 1 in *From*. Type **200** then press **ENTER** to register 200 in *To*.	GROUP EDIT 1-200 1.Copy 4.Line SP 2.Delete 5.Dispen.TM 3.Move 6.Offset
3	The *Group Edit* menu will then appear, allowing the user to select which function will apply to the range of points. Press **6** to select *Offset*.	GROUP OFFSET1-200 X: Y: Z: R: Unit: mm
4	The display will prompt the user to type the X, Y, Z and R offset amounts to be added to all points in address range 1 – 200. Type **15** and press **ENTER** to add 15 mm to the X axis values. Press **ENTER** three more times to leave the Y, Z and R offsets at zero.	GROUP OFFSET1-200 SELECT: 1.Yes 2.No
5	The display will now prompt the user to confirm the change. Press **1** to select *Yes*. 15 mm will be added to all of the X axis values in the selected range of addresses.	

5.2.2. Expand Step & Repeat

Expand Step & Repeat will expand a step and repeat instruction to the actual data it represents. For example, if the following program was created:

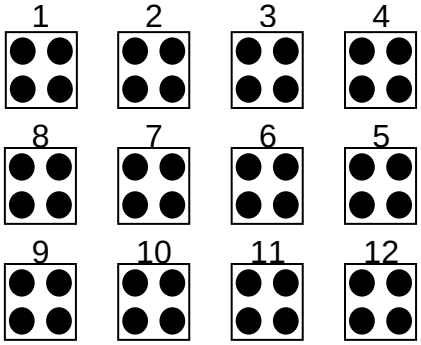
Before:



Address	Instruction
0	Dispense End Setup
1	Z Clearance
2	Point Dispense Setup
3	Dispense Dot
4	Dispense Dot
5	Dispense Dot
6	Dispense Dot
7	Step & Repeat X, Addr=4
8	End Program

The original program occupies 9 memory addresses. If the user brings memory address number 7 into the display and then selects **MENU 2→Group Utility→ *Expand Step & Repeat***, address 7 will be expanded into the 44 points which it represents, bringing the total number of memory addresses used to 51 (plus the End Program instruction at address 52).

After:



Address	Instruction
0	Dispense End Setup
1	Z Clearance
2	Point Dispense Setup
3	Dispense Dot
4	Dispense Dot
5	Dispense Dot
6	Dispense Dot
7	Dispense Dot
8	Dispense Dot
9	Dispense Dot
.	.
.	.
.	.
50	Dispense Dot
51	End Program

The Expand Step & Repeat function is useful in situations where the user must edit selected elements in a Step & Repeat group, although an expanded Step & Repeat instruction will occupy more memory space than a an un-expanded instruction.

5.2.3. Relocate Data

The *Relocate Data* function allows the position of a program to be corrected, including correction for X offset, Y, offset, Z offset and angle of rotation.

If, for example, the work piece fixture has been changed, the program position can be adjusted automatically for the new fixture.

The *Relocate Data* function requires two reference points for the calculations. Choose two point locations from your program that will be used as reference points. For example, to relocate the program after a fixture change:

	Instruction	***Display Shows***
1	In this example, memory address 3 is the first reference point and memory address 4 is the second reference point. Go to memory address 3.	

2	Jog the tip to the new, correct position for the first reference point.	`ADDR:3  PROG:20`
		`Line Start`
		`X:100.00  Y:12.54`
		`Z:23.65  R:`

3	Press the **Setup** key, then select **Adjust point#1** to save the location and address. This location is saved as location in temporary position #1.	---------- Adjust Positon 1 Saved ----------

	Instruction	***Display Shows***
4	Go to memory address 4.	ADDR:4 PROG:20 Line Passing X:200.00 Y:112.54 Z:23.65 R:
5	Jog the tip to the new, correct position for the second reference point.	
5	Press the **Setup** key, then select **Adjust point#2** to save the location and address. This location is saved as location in temporary position #2.	---------- Adjust Positon 2 Saved ----------
6	In Run mode, press **Menu1 key,** then select **2.Adjust Position.**	1.One Point 2.Two Points SELECT:
7	Press **2** to select Two *Points.*	1. All Points 2. Some Points SELECT:
8	Press 1 to select All Points	Point Relocated
9	The program location will be adjusted for X offset, Y offset, Z offset and angle of rotation.	

5.2.4. Adjust Origin

When the dispensing barrel or tip is removed and replaced, the new tip/barrel is often in a slightly different XYZ (&R for 4-axis robots) position than the old tip/barrel was.

The robot has a software utility to adjust a program's origin, thereby correcting the tip offset problem.

A reference should be chosen someplace on the work piece fixture or on the work piece itself. The reference point must be registered in the program data. This only needs to be done one time, for example when the program is originally created.

	Instruction	***Display Shows***
1	Jog the tip to the reference point or if the reference point is an existing point in your program, press the **MOVE** key to bring the tip to that XYZR location.	ADDR: PROG: EMPTY X: Y: Z: R:
2	Press the **Menu 1** key, and then on page two select ***ADJUST POSITION*** to save the location.	Set Adjust Position

When the tip/barrel is changed, use the following procedure to adjust the program origin for the new tip location.

	Instruction	***Display Shows***
1	While in TEACH mode, press the **MENU 2** key, then **2** to select *Group Utility* menu.	1.Group Edit 2.Expand Step&Repeat 3.Relocate Data 4.Adjust Origin
2	Press **4** to select *Adjust Origin*.	Move to First Point X: Y: Z: R: Press Any Key
3	Press any key. The tip will move to the reference point that was recorded in the Adjust Position. If the new tip location is slightly different from the last tip location, you should see that the tip is not exactly at the reference point.	Adjust the First Point X: Y: Z: R:

	Instruction	***Display Shows***
4	Jog the tip to the correct location for the reference point. When the location is correct, press **ENT**. The program origin will be adjusted for the new tip location.	`Program Data` `Adjusted !!!`

5.3. Program Utility

The *Program Utility* menu includes two options: *Copy Program* and *Delete Program.*

5.3.1. Copy Program / Delete Program

1. Copy Copies the current program number to a different program number

2. Delete Erases data in the current program number.

5.3.2. Auto Offset

Move the tip using the original coordinates stored in program memory with the MOVE button. The next step is to jog the tip to the where it should be and the robot calculates data points to align the tip/fixture with the original program

	Instruction	***Display Shows***

1	While in TEACH mode, press the **MENU 2** key, then **3** to select *Program Utility* menu.	`1.Copy Program`
		`2.Delete Program`
		`3.Auto Offset`

2	Press **3** to select *Auto Offset*.
	Then go to address that store reference position with cursor key.
		`ADDR:0 PROG: 0 L`
		`Line Start`
		`X: 100 Y:100`
		`Z: 100 R:100`

	Instruction	***Display Shows***

3	Press Move key. The tip will move to the saved position that was recorded in the current Address. If the new tip location is slightly different from the last tip location, you should see that the tip is not exactly at the reference point.	`Move New Point`
		
		`X: 100  Y:100`
		`Z: 100  R:100`

4	Jog the tip to the correct location for the reference point. When the location is correct, press **ENT**. The program origin will be adjusted for the new tip location.	`Program Data` `Adjusted !!!`

5.4. Memory Utility

5.4.1. Delete Memory

This Erases all programs.

Section 7: PLC

1. Creation of a PLC file

The robot controller has the mini- PLC function. Up to 10 programs can be created, and each program may contain up to 1000 Steps.
The contacts in PLC are classified as follows.

S : System Input	S0 ~ S6
X : General Input	X0 ~ X16
Y: General Output	Y0 ~ Y16
M : Internal Contact I/O	M16~ M336
T : Timer	64 ,Set from 1 to 9999
C : Counter	64, Set from 1 to 9999
D : 16 bit Register (non-Volatile Memory)	D0 ~ D600
H : System Control Contact	H0 ~ H31

The sampling time for the PLC program is 30msec.
To create a PLC file, follow the next steps:

	Instruction	***Display Shows***
1	Turn On the controller and set it in Run Mode.	PROG:00 AUTO Press Move Key Cycle Counter: 0 AU/ST PLC Clear Mode
2	Select **Mode** by pressing the **Mode/Menu 2** key.	---------- Press Home Key To Find Origin ----------
3	Press the Home/-/R key. The robot will move to the home position.	ADDR:0 PROG:00 EMPTY X:0 Y:0 Z:0 R:0

	Instruction	***Display Shows***
4	Press **Menu 1** key, then press **PgDn** key three times, to go to page 4 of the menu. Finally, press the numeric key **1** (for: PLC File Edit).	`PLC FILE NO [ ]`

5	Press any numeric key from 0 to 9, for example 1, and press the **ENT** key.	`ADDR:0 PLC_1 i`
		
		`EDIT GROUP PGDEL`

6	Select EDIT by pressing the **F1/Setup** key.	`ADDR:0 PLC_1 i`
		
		`PROG CTRL MV DMV`

7	The different commands can be accessed using the **F1, F2, Menu1** and **Menu2** keys.	

The following is a list of the commands found under **`PROG, CTRL, MV, DMV.`**
(Use /-1 and /+1 keys to go from one group of commands to another. Use ESC key to exit from the displayed group of commands).

PROGRAM

NAME	MEANING	FUNCTION
AND	And	Serial connection of logical operation (A contact).
OR	Or	Parallel connection of logical operation (A contact).
NOT	Negation	
LD	Load	Start operation at A (Normal open) contact.
OUT	Out	Output of the operation result.
PULS	Pulse	If input contact value changes to On status, this output will be given during 1 Scan Time.
SET	Set	If input is turned On, the output contact is maintained with On state.
RESET	Reset	If input is turned On, the output contact is maintained with Off state.

CTRL

NAME	MEANING	FUNCTION
T	Timer	This is used to control time and is On Delay Timer.
C	Counter	This is used to count the number and is Down Counter. When the enable signal is turned Off, the current value will be reset to the setting value. Input after counting is finished will be ignored.
MC		Master Control Set.
MCR	MC Reset	Master Control Reset.
D	Data	Sets Data value for counter and timer.
BK	Block	
END	End	Marks the end of the program.

MV

NAME	MEANING	FUNCTION
MOV	Move 16bit data	This is used to move data from a 16 bit register (B or D) to another 16 bit Register (B or D). ex: MOV B100 D100 (D100 = B100)
ADD	Add two 16bit data	This is used to add data of two 16 bit register (B or D) and store the result to another 16 bit Register (B or D). ex: ADD B100 D30 D40 (D40 = B100 + D30)
SUB	Subtract two 16bit data	This is used to subtract data of two 16 bit register (B or D) and store the result to another 16 bit Register (B or D). ex: SUB B100 D30 D40 (D40 = B100 - D30)
MUL	multiply two 16bit data	This is used to multiply data of two 16 bit register (B or D) and store the result to another 16 bit Register (B or D). ex: MUL B100 D30 D40 (D40 = B100 x D30)
DIV	divide two 16bit data	This is used to divide data of two 16 bit register (B or D) and store the quotient to another 16 bit Register (B or D), remainder to Next 16bit Register (B or D). ex: DIV B100 D30 D40 (D40 = B100 / D30 D41 = B100 % D30)

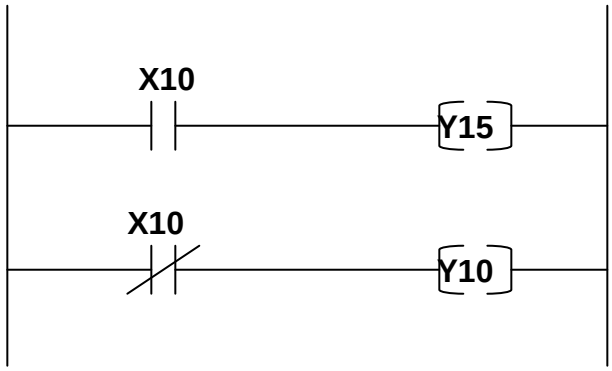
DMV is 32 bit operation of **MV** function.

2. Running a PLC file

	Instruction	***Display Shows***
1	Turn On the controller and set it in Run Mode. Press the **Shift/Char + Menu2** keys.	PROG:00 AUTO Press Move Key Cycle Counter: 0 AU/ST PLC Clear Mode
2	Select PLC by pressing the **F2** key.	PROG: PLC_0 [STOP] RUN
3	Use the arrow keys ▲▼ to select the program number, for example 1.	PROG: PLC_1 [STOP] RUN
4	Press **F1** to execute the program. If the **ESC** key is pressed, it will exit from the current display and return to Program selection display. However, the current **PLC program will continue running**.	PROG: PLC_1 [PLAY] RUN
5	To stop the program, press the **STOP** button.	PROG: PLC_1 [STOP] RUN

3. PLC Program Examples

3.1. LD / LDNOT /OUT



[Content]

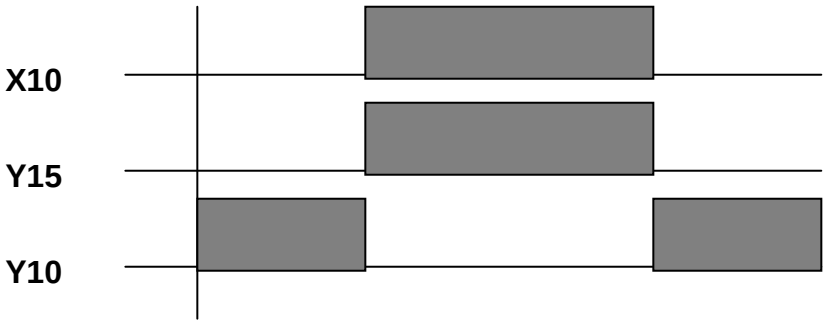
If the general input 10 is turned ON, then the general output 15 is turned ON, and the general output 10 is turned OFF.

If the general input 10 is turned OFF, then the general output 15 is turned OFF, and the general output 10 is ON.

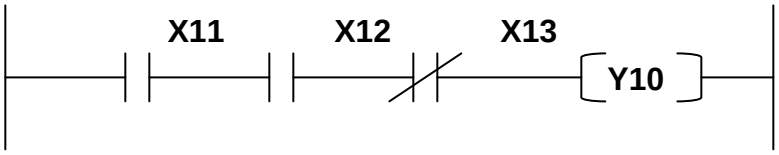
[Program]

LD X10
OUT Y15
LDNOT X10
OUT Y10
END

[Time Chart]



3.2. AND / ANDNOT



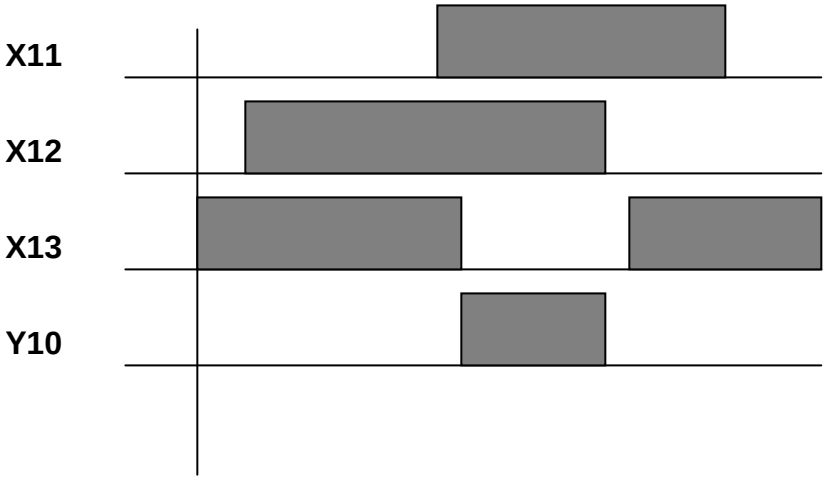
[Content]

If the general input 11 is turned ON, and the general input 12 is turned ON, and the general input 13 is turned OFF, then the general output 10 will be turned ON.

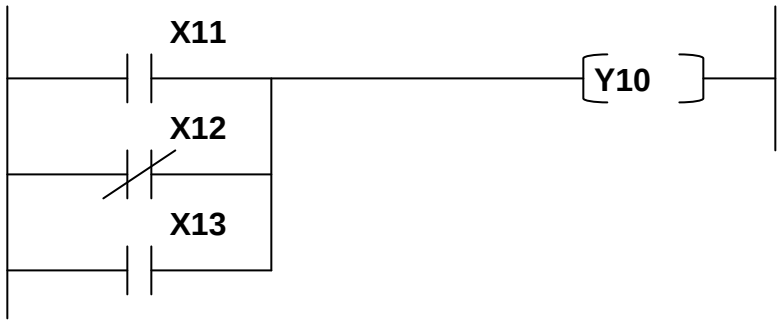
[Program]

LD X11
AND X12
ANDNOT X13
OUT Y10
END

[Time Chart]



3.3. OR / ORNOT



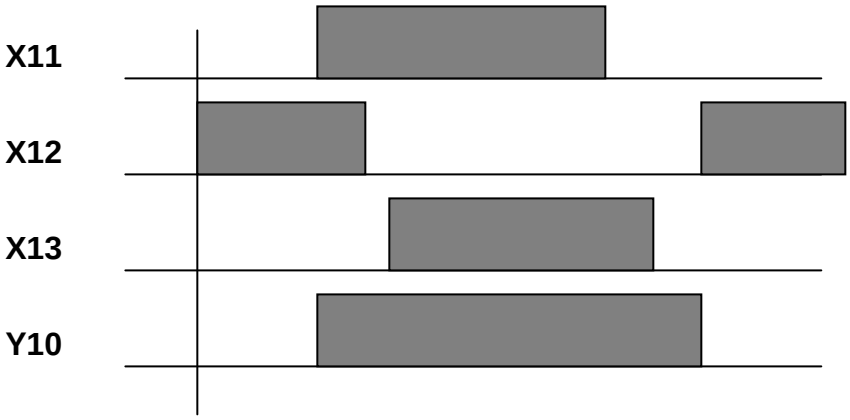
[Content]

If the general input 11 is turned ON, or the general input 12 is turned OFF, or the general input 13 is turned ON, then the general output 10 will be turned ON.

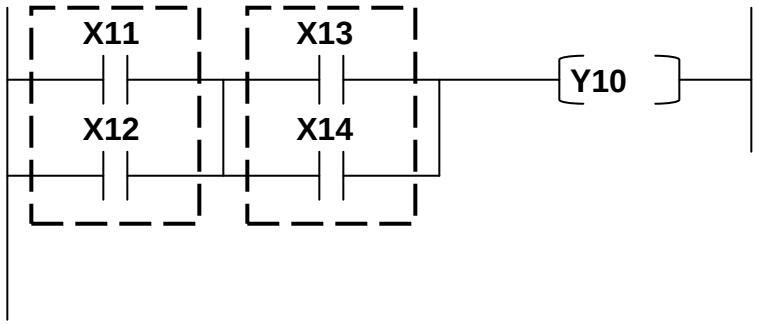
[Program]

LD X11
ORNOT X12
OR X13
OUT Y10
END

[Time Chart]



3.4. ANDBK



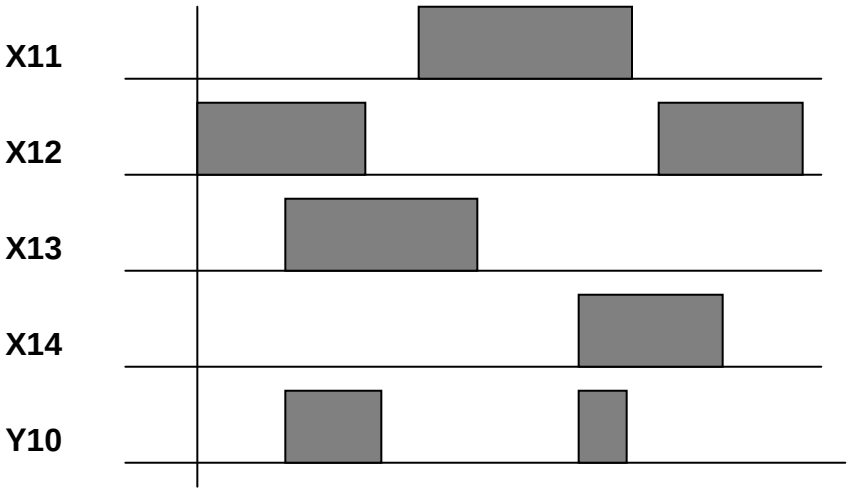
[Content]

If one of the general inputs 11 or 12 is turned ON and one of the general inputs 13 or 14 is turned ON, then the general output 10 will be turned ON.

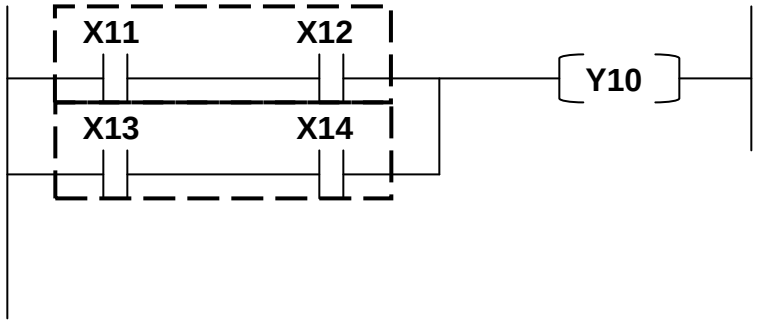
[Program]

LD X11
OR X12
LD X13
OR X14
ANDBK
OUT Y10
END

[Time Chart]



3.5. ORBK



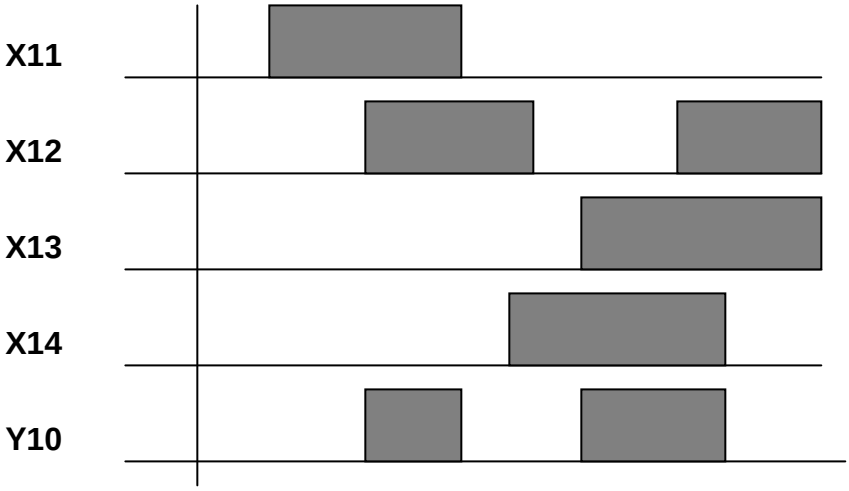
[Content]

If the general input 11 is turned ON, and 12 is turned ON, or the general input 13 is turned ON, and 14 is turned ON, then the general output 10 will be turned ON.

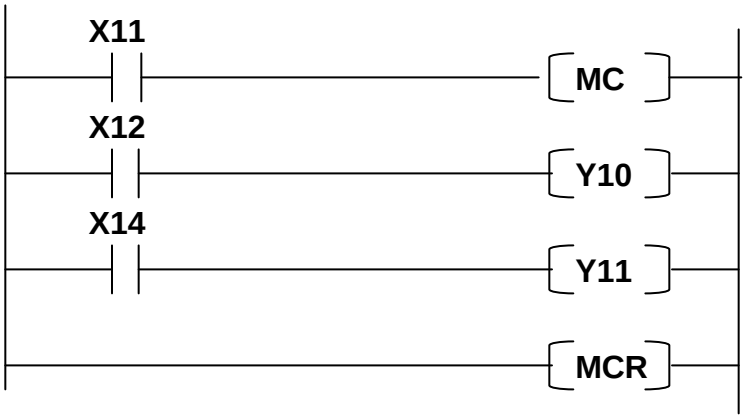
[Program]

LD X11
AND X12
LD X13
AND X14
ORBK
OUT Y10
END

[Time Chart]



3.6. MC/MCR



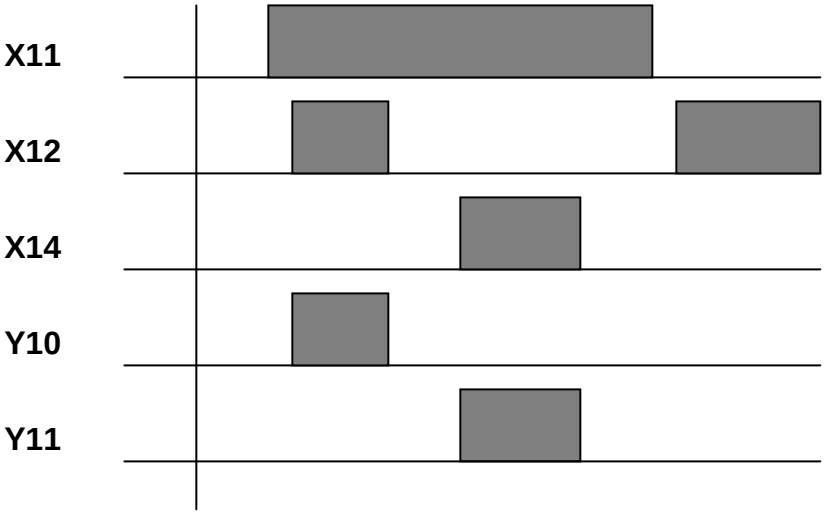
[Content]

Only if the input condition of MC is turned ON, will it run until the same MCR.

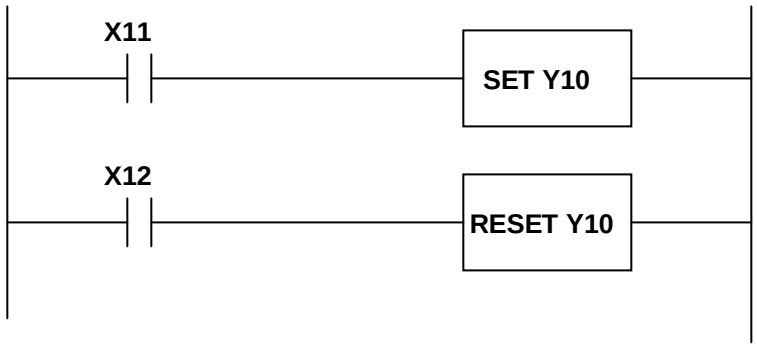
[Program]

LD X11
MC
LD X12
OUT Y10
LD X14
OUT Y11
MCR
END

[Time Chart]



3.7. SET/RESET



[Content]

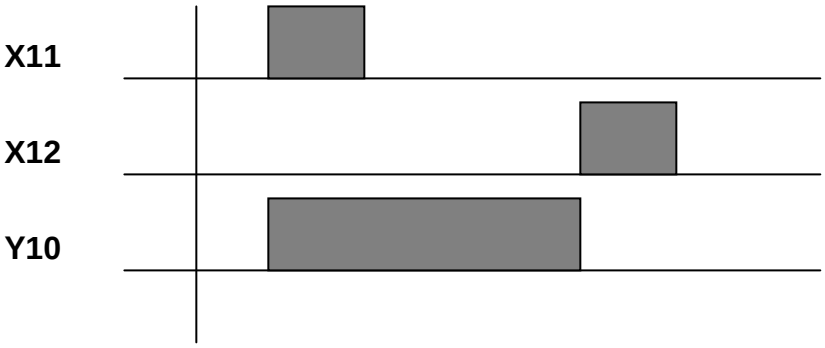
If the general input 11 is turned ON, the general output 10 will be turned ON and maintained in the ON state. **(Even if input is turned OFF, it will remain in the ON state).**

If the general input 12 is turned ON, the general output 10 will be turned OFF and maintained in the OFF state. **(Even if input is turned OFF, it will remain in the OFF state).**

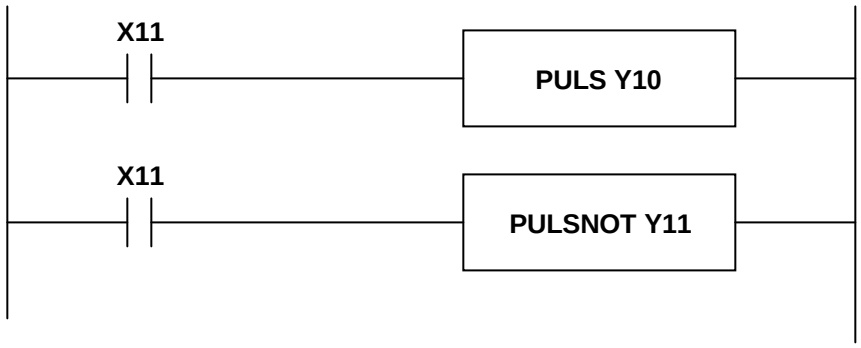
[Program]

LD X11
SET Y10
LD X12
RESET Y10
END

[Time Chart]



3.8. PULS/PULSNOT



[Content]

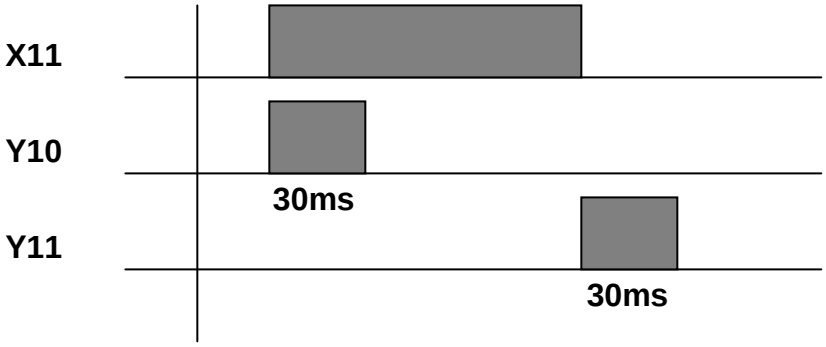
If the general input 11 is turned ON, then the general output 10 will be turned ON for 1PULSE (30ms).

If the general input 11 is turned OFF, then the general output 11 will be turned ON for 1PULSE (30ms).

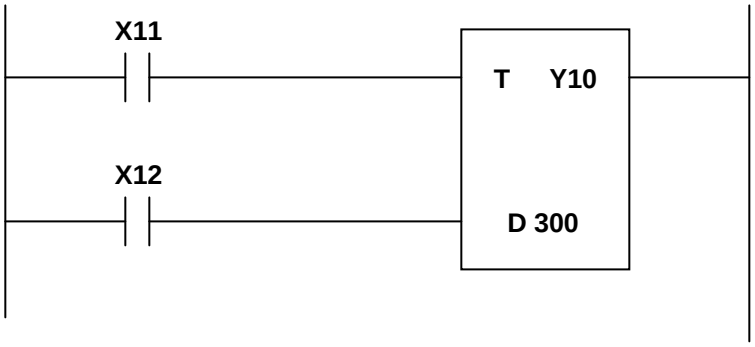
[Program]

LD X11
PULS Y10
LD X11
PULSNOT Y11
END

[Time Chart]



3.9. T (Timer)



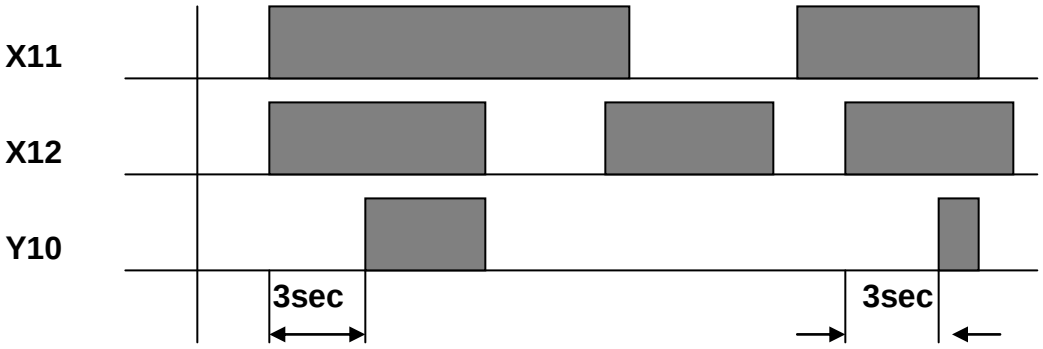
[Content]

When the general input 11 is turned ON, and if the general input 12 is turned ON for more than 3 seconds, then the general output 10 is turned ON.
Timer is based on 10ms.

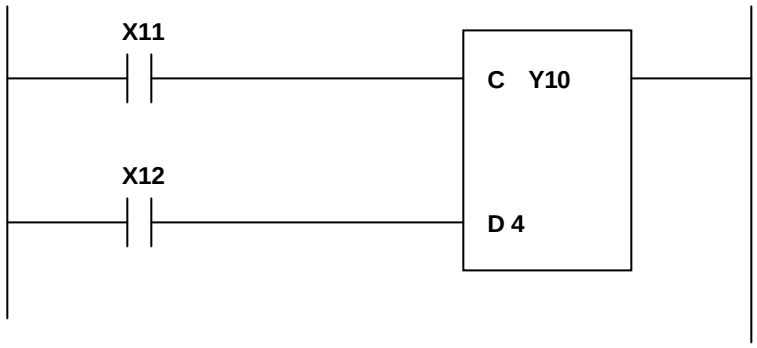
[Program]

LD X11
LD X12
T Y10
D 300 (D differs from D register. It means set timer 3 seconds).
END

[Time Chart]



3.10. C (Counter)



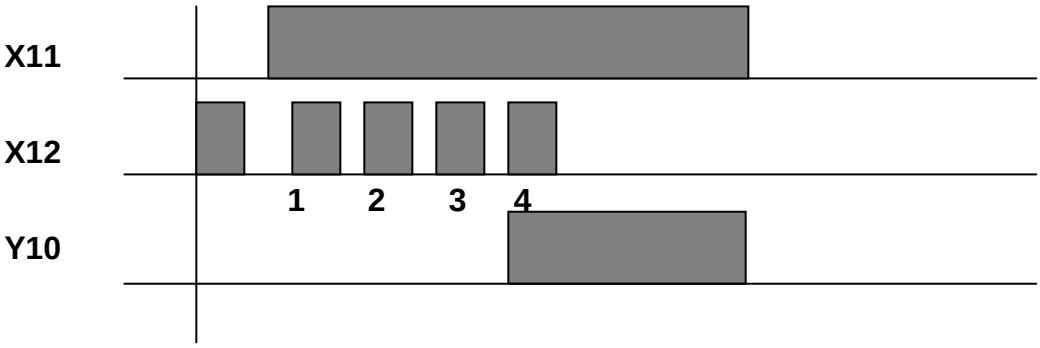
[Content]

When the general input 11 is turned ON, and if more than 4 PULSES come to the general input 12, then the general output 10 is turned ON.

[Program]

LD X11
LD X12
C Y10
D 4 (D differs from D register. It means set counter 4).
END

[Time Chart]

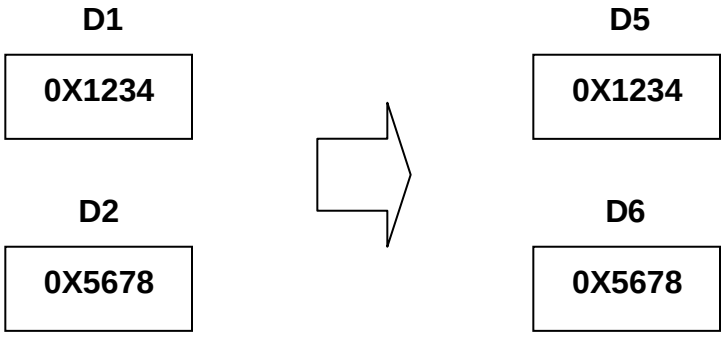


3.11. MOV / DMOV

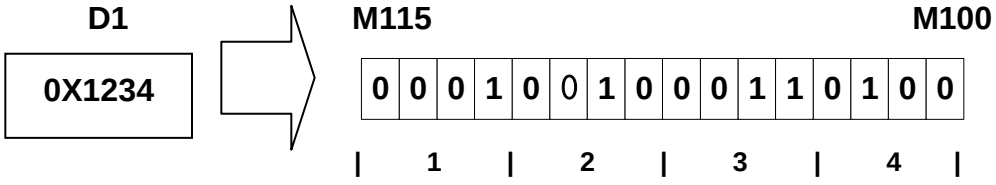
This is used to move data from a 16/32 bit register (B or D) to another 16/32 bit register (B or D).

MOV D1 D5

DMOV D1 D5



MOV D1 M100



3.12. ADD / DADD

This is used to add data of two 16 bit register (B or D) and store the result to another 16 bit register (B or D).

ADD D1 D5 D9

D1		D5		D9
1	+	5	=	6

DADD D1 D5 D9

D1 D2		D6 D7		D9 D10
100000	+	250000	=	350000

3.13. SUB / DSUB

This is used to subtract data of two 16/32 bit register (B or D) and store the result to another 16 /32 bit register (B or D).

SUB D1 D5 D9

D1		D5		D9
11	-	5	=	6

DSUB D1 D5 D9

D1 D2		D6 D7		D9 D10
400000	-	250000	=	150000

3.14. MUL/DMUL

This is used to multiply data of two 16/32 bit register (B or D)
and store the result to another 16/32 bit register (B or D).

MUL D1 D5 D9

D1		D5		D9
11	x	5	=	55

DMUL D1 D5 D9

D1 D2		D6 D7		D9 D10
4000	x	250	=	1000000

3.15. DIV / DDIV

This is used to divide data of two 16/32 bit register (B or D)
and store the quotient to another 16/32 bit register (B or D),
remainder to next 16bit register (B or D).

DIV D1 D5 D9

D1		D5		quotient D9	remainder D10
11	÷	5	=	2	1

DDIV D1 D5 D9

D1 D2		D6 D7		quotient D9 D10	remainder D11 D12
100000	÷	3	=	30000	10000

Section 8: Error list

1. Error list for Hardware

The following Error List is about Hardware or Mechanical error.

No	Error Display	Contents	
01	**ENVLOP ERR**	Meaning	The tracking error of the position/velocity profile exceeds the commanded value.
		Cause	1. The gains of position/velocity control loop are too low. 2. Motor connection is abnormal. 3. Servo Amp is damaged.
		Action	1. Increase the proportional gains of position / velocity control loop to more than 10% of the present value (PP/V_P). 2. Reconnect the motor connector. 3. Contact the manufacturer/sales agent.
02	**OVER SPEED**	Meaning	The velocity is over the commanded value.
		Cause	Electrical power lines of motor & encoder are connected to other channels.
		Action	Connect the connector properly and if error reoccurs, contact the manufacturer.
03	**ENC READ ERR**	Meaning	1. Failure to detect stimulus position of initial encoder. 2. Failure to detect position of initial absolute encoder.
		Cause	1. Disconnection or bad connection in encoder line. 2. Encoder power related abnormality.
		Action	1. Check encoder line. 2. Check encoder power line.

04	**ENC COUNT ERR**	Meaning	Difference in the encoder position during one motor rotation is over 5 pulses.
		Cause	1. Disconnection or bad connection in encoder line while driving. 2. Encoder setting abnormality.
		Action	1. Check/ Reconnect the encoder line. 2. Change encoder setting related to the counts of a rotation.
07	**MOTOR CUR ERR**	Meaning	Excessive electric current flow in motor.
		Cause	1. Acceleration and deceleration time is too short for inertia load. 2. The electric current loop gain is either too small or too big.
		Action	1. Reset parameter related to acceleration and deceleration. 2. Reset parameter related to gain.
08	**ENC ERR**	Meaning	Encoder Connection is abnormal.
		Cause	Encoder Cable Connection is bad.
		Action	Check Encoder Connection.
09	**OVER LOAD**	Meaning	Over load on rated load.
		Cause	1. Friction may be too high between machine and moving parts. 2. Acceleration and deceleration may be frequent in short distances. 3. Inertia load may be too high. 4. Brake malfunction.
		Action	1. Check moving parts in the machine. 2. Increase the acceleration and deceleration time. 3. Reduce inertia load. 4. Check motion or change brakes.
10	**MISS ABS INC**	Meaning	Encoder Type is not exact.
		Cause	Parameter setting is wrong.
		Action	Correct parameter.

11	**H/W LIMIT**	Meaning	Came in contact with limit sensor.
		Cause	1. Machine came in contact with the limit sensor. 2. Disconnection or Bad connection of limit sensor line. 3. Set limit sensor as point of contact A (N,O). 4. Improper parameter setting.
		Action	1. Move machine. 2. Check limit sensor line, dismount connector and then connect again. 3. Change limit sensor to point of contact B. 4. Change parameters related to limit setting.
12	**S/W LIMIT**	Meaning	Exceeded software limit.
		Cause	1. Machine has surpassed software limit area. 2. When point of teach is close to the software limit.
		Action	1. Move the machine. 2. Change parameters related to software limit or change point of teach.
13	**INPOS ERR**	Meaning	The tracking error of the position/ velocity profile exceeds over the In position value.
		Cause	1. The gains of position/velocity control loop are too low. 2. In position Value in Parameter is too small.
		Action	1. Increase the proportional gains of position/ velocity control loop to more than 10% of the present value. (PP/V_P). 2. Increase In position value in Parameter.
14	**ORG ERR**	Meaning	Opposite direction signal input of limit sensor during point of origin return process.
		Cause	Incorrect setting of origin sensor/direction.
		Action	Correct the parameter related to origin.

15	**ENC BATT ERR**	Meaning	Absolute encoder battery has been discharged. (Only SCARA robots)
		Cause	1. The encoder battery voltage may be lower than 2.6V. 2. Bad wiring of encoder line or bad connection.
		Action	1. Check the voltage. 2. Check the encoder line.
16	**ENC OVERFLOW**	Meaning	Overflow of absolute encoder count.
		Cause	1. The motor rotates continuously in one direction. 2. Preset was not initiated during initial setting.
		Action	1. Limit the motor rotation. 2. Initiate PRESET and reset zero point position.
17	**BRAKE ERR**	Meaning	Brake disconnection.
		Cause	1. Brake has not been properly set. 2. Actual brake line has bad connection or is disconnected. 3. Brake damage.
		Action	1. Reset brake parameter. 2. Check brake line. 3. Change brake.
18	**A LINE ERR**	Meaning	Disconnection/bad connection of encoder A phase line.
		Cause	Disconnection/bad connection of encoder line.
		Action	Check encoder line.
19	**B LINE ERR**	Meaning	Disconnection/bad connection of encoder B phase line.
		Cause	Disconnection/bad connection of encoder line.
		Action	Check encoder line.
20	**Z LINE ERR**	Meaning	Disconnection/bad connection of encoder Z phase line.
		Cause	Disconnection/bad connection of encoder line.
		Action	Check encoder line.

21	**ABS LINE ERR**	Meaning	Disconnection/bad connection of absolute encoder line.
		Cause	Disconnection/bad connection of encoder line.
		Action	Check encoder line.
22	**SENSOR ERR**	Meaning	Limit sensor is disconnected.
		Cause	1. Disconnection/bad connection of actual limit sensor line. 2. Incorrect parameter setting.
		Action	1. Check limit sensor line. 2. Reset parameters related to limit sensor.
42	**REGEN ERR**	Meaning	Revision time overtime.
		Cause	1. The inertia load may be excessive. 2. Too short acceleration/deceleration. 3. Abnormality in AMP board.
		Action	1. Reduce the inertia load. 2. Lengthen the time of acceleration/deceleration. 3. Change the AMP board.
43	**IPM ERR**	Meaning	Excessive electric current flow in IPM.
		Cause	1. Acceleration and deceleration times are too short for inertial load. 2. Bad wiring in motor. 3. Motor damage. 4. Problem in AMP board.
		Action	1. Increase acceleration and deceleration times. 2. Check wiring of motor power. 3. Contact the manufacturer/sales agent.
44	**CUR SEN ERR U**	Meaning	A Current feedback value is abnormal.
		Cause	1. Abnormality/bad connection of servo board. 2. Abnormality/bad connection of AMP board. 3. Abnormality in current sensor setting.
		Action	1. Reconnect servo board. 2. Change AMP board.

45	**CUR SEN ERR V**	Meaning	A Current feedback value is abnormal.
		Cause	1. Abnormality/bad connection of servo board. 2. Abnormality/bad connection of AMP board. 3. Abnormality in current sensor setting.
		Action	1. Reconnect servo board. 2. Change AMP board.
62	**PN 240V LOW**	Meaning	Voltage abnormality among PN.
		Cause	1. Bridge diode abnormality. 2. Disconnection/bad connection of PN line. 3. AMP board abnormality.
		Action	1. Change bridge diode. 2. Check PN line. 3. Change AMP.
63	**HEAT SINK ERR**	Meaning	Heat Sink is overheated.
		Cause	Acceleration and deceleration time is too short for inertia load.
		Action	Reset parameters related to acceleration and deceleration.
64	**TMS TIMEOVER**	Meaning	The servo board is not answering.
		Cause	1. Incorrect parameter setting. 2. Abnormality in servo board.
		Action	1. Change parameter setting. 2. Change the servo board.
65	**SEMA ERR SRV**	Meaning	The servo and the main board do not correlate.
		Cause	1. An unused axis may have been set. 2. Bad connection in servo board.
		Action	1. Reset parameters related to axis setting. 2. Dismount the servo board and reinstall.
66	**P12V FAIL**	Meaning	Abnormality in +12V power (Less than 10.5V).
		Cause	1. Bad connection. 2. Voltage drop (Abnormal SMPS).
		Action	1. Reconnect (SMPS/ Servo board). 2. Change SMPS.

67	**M12V FAIL**	Meaning	Input voltage -12V abnormality (Less than -10.5V).
		Cause	1. Bad connection. 2. Voltage drop (Abnormal SMPS).
		Action	1. Reconnect (SMPS/ Servo board). 2. Change SMPS.
68	**SEMA ERR MAIN**	Meaning	Main and servo board do not activate.
		Cause	1. Unused axes have been set as being in use. 2. Bad connection of servo board.
		Action	1. Reset axis parameter. 2. Dismount the servo board and then reinstall.
69	**AMP BD NONE**	Meaning	The AMP board does not exist.
		Cause	1. Incorrect axis setting. 2. Bad connection of board.
		Action	1. Change axis setting parameter. 2. Reconnect board.
80	**SYS EMG**	Meaning	System EMG signal is On.
		Cause	System EMG signal input.
		Action	Cancel system EMG.
81	**FRONT EMG**	Meaning	Front EMG signal is On.
		Cause	Front EMG signal input.
		Action	Cancel front EMG.
82	**T/P EMG**	Meaning	TP EMG signal is On.
		Cause	TP EMG signal input.
		Action	Cancel TP EMG.
84	**MAIN BATT ERR**	Meaning	The main board battery has been discharged.
		Cause	The main board battery voltage may be lower than 2.4 V.
		Action	Check / change the main board battery voltage.
86	**HOST EMG**	Meaning	Host EMG is On.
		Cause	Host EMG is On.
		Action	Reset Host EMG.

87	**AC POWER FAIL**	Meaning	Input voltage 220V abnormality (Less than 180V).
		Cause	1. Bad connection. 2. Voltage drop (Abnormal SMPS).
		Action	1. Reconnect (SMPS/ Servo board). 2. Change SMPS.
88	**5V POWER FAIL**	Meaning	Input power 5V is abnormal (less than 4.8V).
		Cause	1. Bad connection. 2. Voltage drop (Abnormal SMPS).
		Action	1. Reconnect (SMPS/ Servo Board). 2. Change SMPS.
89	**3.3V POWER FAIL**	Meaning	Input power 3.3V is abnormal (less than 3.1V).
		Cause	1. Bad connection. 2. Voltage drop (Abnormal SMPS).
		Action	1. Reconnect (SMPS/ Servo Board). 2. Change SMPS.

2. Error List For Program

2.1. Need LINE START

An attempt was made to register a Line Passing point, an Arc point or a Line End point without first registering a Line Start point.

Register a Line Start point before registering a Line Passing point, an Arc point or a Line End point.

2.2. Need LINE END

An attempt was made to run a program that registered a Line Passing point, an Arc point or a Line Start point without registering a Line End point.

Register a Line End point after registering a Line Passing point, an Arc point or a Line Start point.

2.3. Need Step & Repeat

The Expand Step & Repeat command was given but there is no Step & Repeat instruction currently in the display. Move to the Step & Repeat function you want to expand before selecting Expand Step & Repeat.

2.4. PROGRAM END ERROR

An attempt was made to run a program without registering a Program End.

2.5. LABL Not Exist

An attempt was made to call a label that does not exist.

Section 9: Appendix

1. Appendix A: User I/O 1 Board

1.1. Outline

User I/O board is the general Input/Output board used to interface controller and external device using I/O signal. The form of signal is as follows:

- Digital Input: SIO 3 contacts, UIO 16 contacts
- Digital Output: SIO 5 contacts, UIO 15 contacts

1.2. Structure

Input is received through photo coupler and output given by photo coupler as well.

1.3. Components of the structure

Device for the input: photo coupler

Device for the output: photo coupler (Darlington Transistor Output)

1.4. Specifications

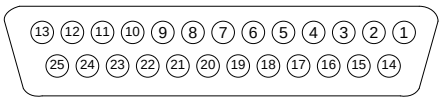
Items	User Input	User Output
Rated Input/Output voltage	D.C 24[V]	
Rated Input/Output current	Min. 5[mA] / 1 contact	Max. 50 [mA] / 1 contact
Insulation method (Photo coupler)	Input: Insulation voltage (2000 [Vrms]) Output: Insulation voltage (2000 [Vrms])	
Number of Input/Output contacts	16 contacts	15 contacts
Internal Input/Output voltage (Output current)	D.C 24[V] (Max. 600[mA])	

1.5. Connector position and specification

In Backside of Robot

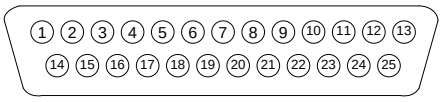
USER I/O-1

USER I/O 1



USER I/O-2

USER I/O 2

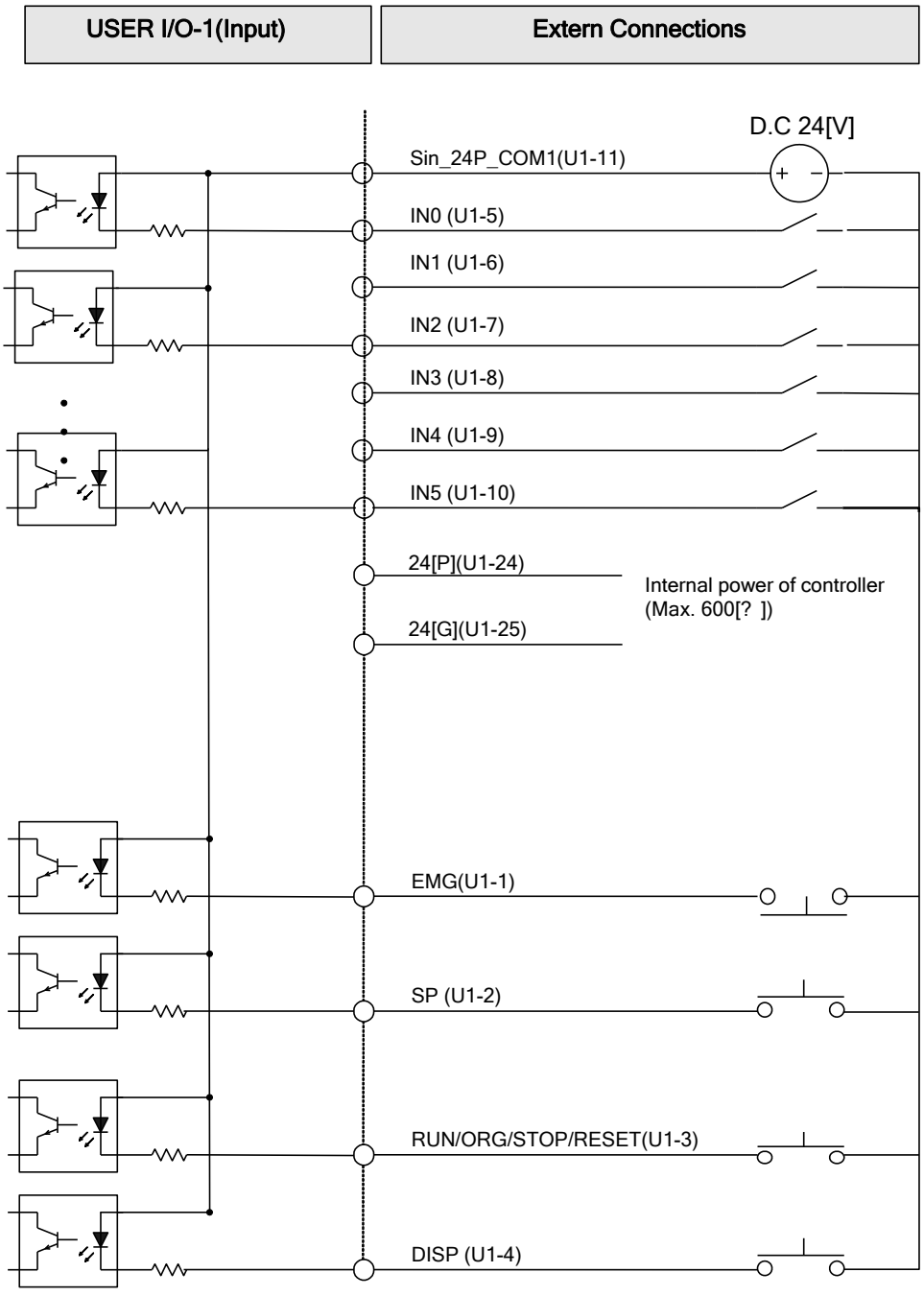


Connector Specification:
USER I/O-1: D-Sub, 25Pin, Female, Right Angle Type
USER I/O-2: D-Sub, 25Pin, Male, Right Angle Type

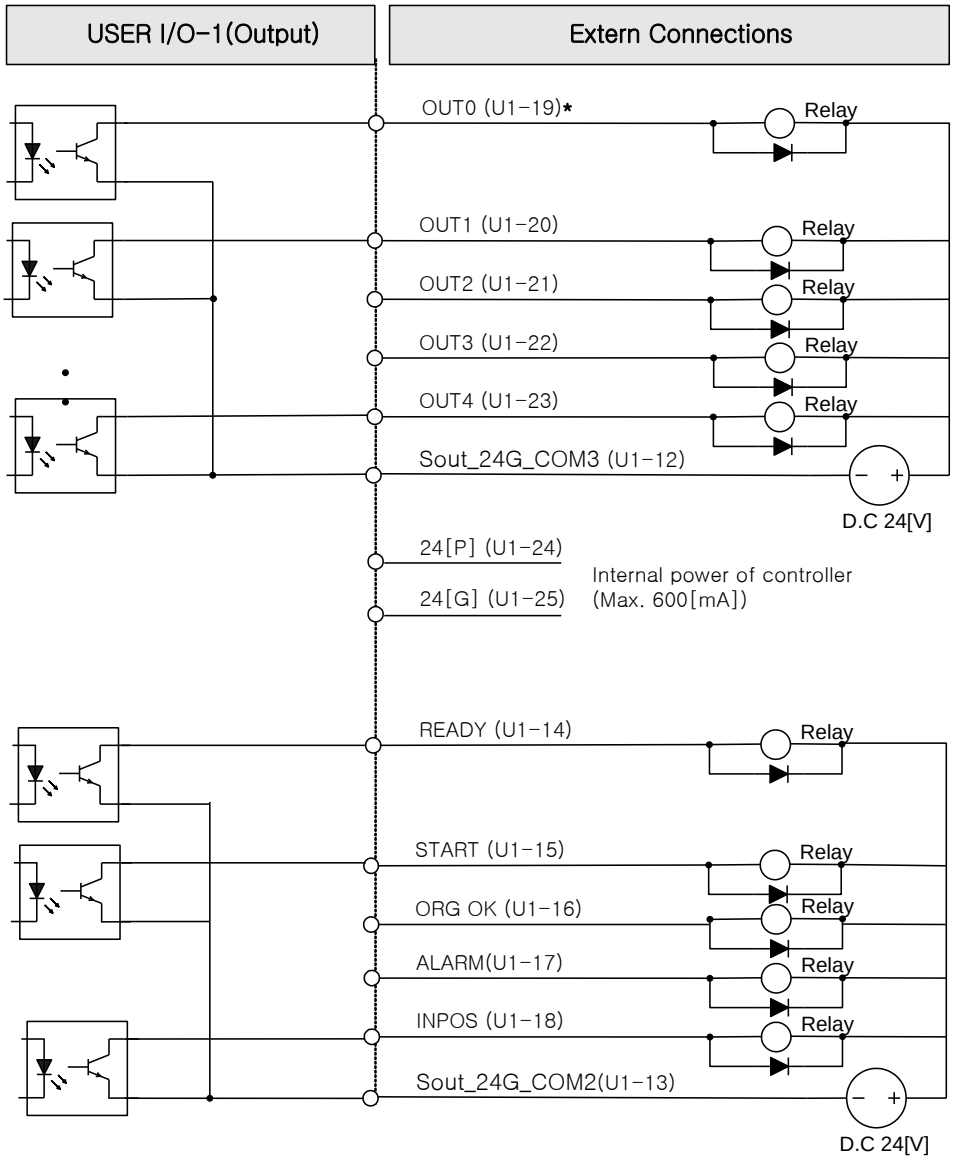
Note 1: When you wire the external power, please make sure the connection of D.C 24[V] polarity is properly assigned.
Note 2: If wiring is not properly done, the internal circuit element may be damaged. Take precaution of the polarity of the common terminal

1.5.1. USER I/O-1 connector In/Output Circuit and External Interface Circuit

Input Circuit and External Interface Circuit: USER I/O-1 Connector



Output Circuit and External Interface Circuit: USER I/O-1 Connector

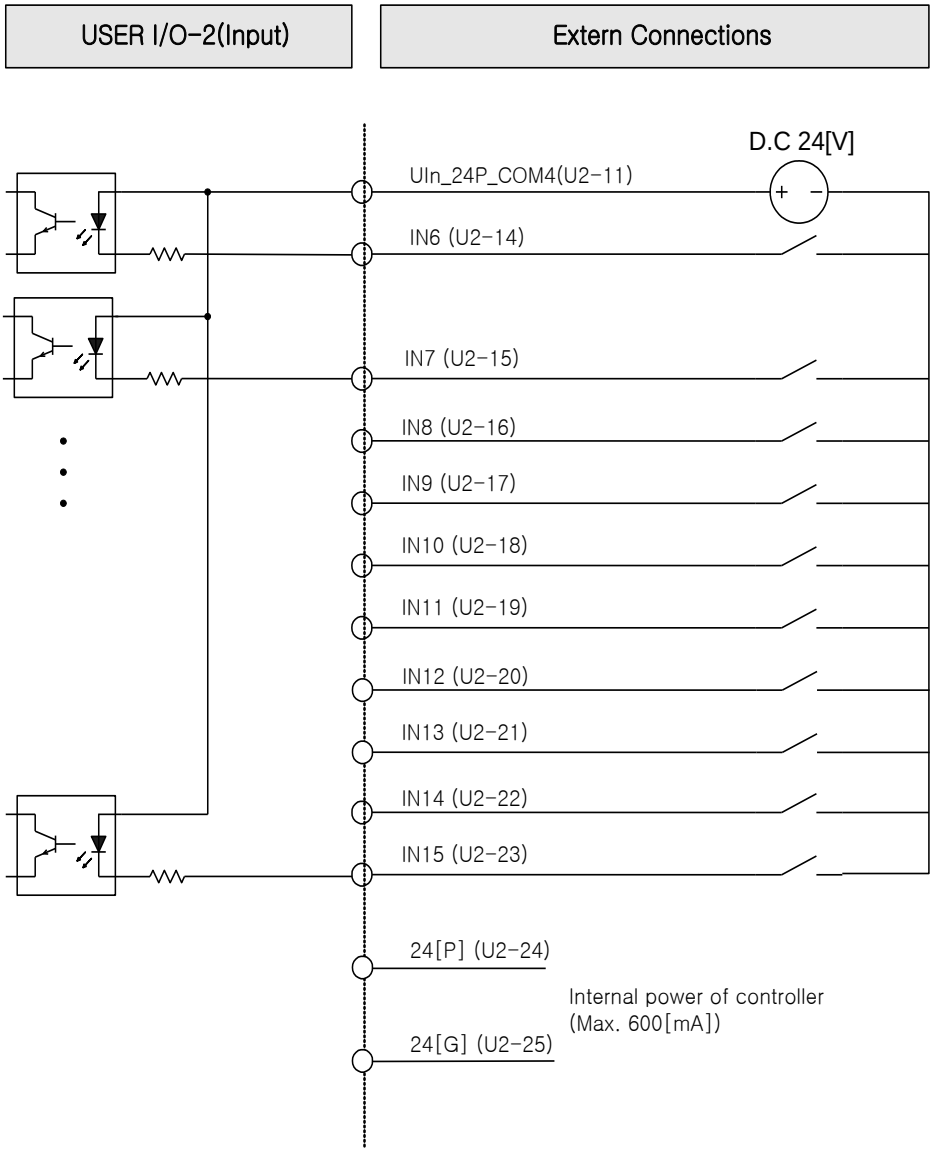


1.5.2. USER I/O-1 Connector Signal Name

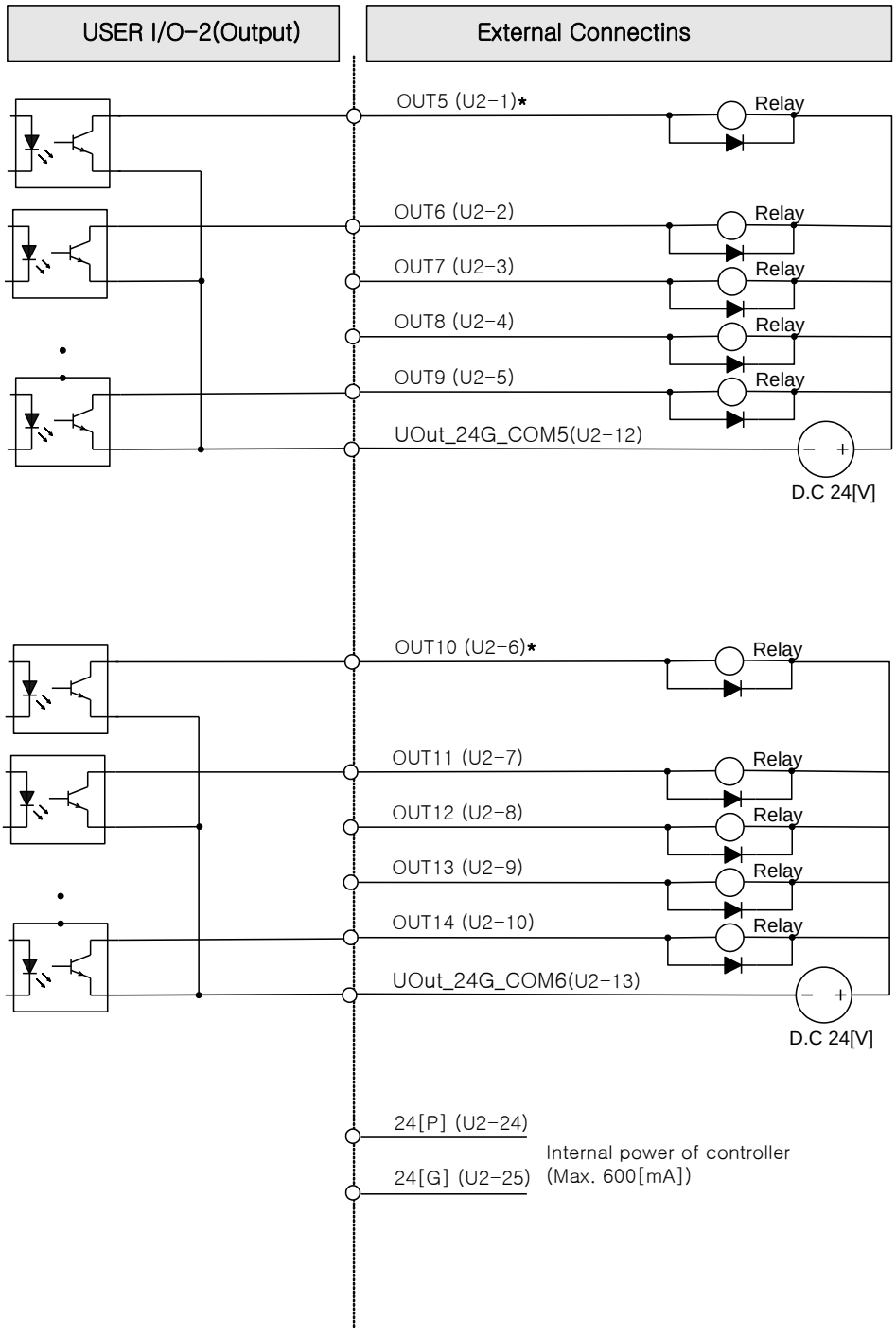
PIN No.	I/O	Sign	Explanation
U1- 1	Input	EMG	Emergency Stop
U1- 2	Input	SP	Reserved
U1- 3	Input	RUN/STOP /RESET/ORG	RUN/ORG/RESET
U1- 4	Input	DISP	Manual Purge
U1- 5	Input	IN 0	INPUT
U1- 6	Input	IN 1	INPUT
U1- 7	Input	IN 2	INPUT
U1- 8	Input	IN 3	INPUT
U1- 9	Input	IN 4	INPUT
U1- 10	Input	IN 5	INPUT
U1- 11	COMMON	Sin_24P_COM1	+24V input common
U1- 12	COMMON	Sout_24G_COM3	24G output common
U1- 13	COMMON	Sout_24G_COM2	24G output common
U1- 14	Output	READY	Ready
U1- 15	Output	START	Robot running
U1- 16	Output	ORG OK	Origin searching
U1- 17	Output	ALARM	Error
U1- 18	Output	INPOS	In position
U1- 19	Output	OUT 0	OUTPUT0
U1- 20	Output	OUT 1	OUTPUT1
U1- 21	Output	OUT 2	OUTPUT2
U1- 22	Output	OUT 3	OUTPUT3
U1- 23	Output	OUT 4	OUTPUT4
U1- 24	Internal power	24[P]	D.C 24[V] Internal Power
U1- 25	Internal Ground	24[G]	D.C 24[G] Internal Ground

1.5.3. USER I/O-2 Connector In/output circuit and External Interface Circuit

Input Circuit and External Interface Circuit : USER I/O-2 Connector



Output Circuit and External Interface Circuit: USER I/O-2 Connector



1.5.4. USER I/O-2 Connector Signal Name

No.	I/O	Sign	Explanation
U2-1	Output	OUT 5	OUTPUT
U2-2	Output	OUT 6	OUTPUT
U2-3	Output	OUT 7	OUTPUT
U2-4	Output	OUT 8	OUTPUT
U2-5	Output	OUT 9	OUTPUT
U2-6	Output	OUT 10	OUTPUT
U2-7	Output	OUT 11	OUTPUT
U2-8	Output	OUT 12	OUTPUT
U2-9	Output	OUT 13	OUTPUT
U2-10	Output	OUT 14	OUTPUT
U2-11	COMMON	UIn_24P_COM4	+24[V] Input Common
U2-12	COMMON	UOut_24G_COM5	24G Output Common
U2-13	COMMON	UOut_24G_COM6	24G Output Common
U2-14	Input	IN 6	INPUT
U2-15	Input	IN 7	INPUT
U2-16	Input	IN 8	INPUT
U2-17	Input	IN 9	INPUT
U2-18	Input	IN 10	INPUT
U2-19	Input	IN 11	INPUT
U2-20	Input	IN 12	INPUT
U2-21	Input	IN 13	INPUT
U2-22	Input	IN 14	INPUT
U2-23	Input	IN 15	INPUT
U2-24	Internal Power	24[P]	D.C 24[P] Internal Power
U2-25	Internal grounding	24[G]	D.C 24[G] Internal Ground

2. Appendix B: User I/O 2 Board

2.1. Outline

User I/O board is the general Input/Output board used to interface controller and external device using I/O signal. The form of signal is as follows:

- Digital Input: UIO 16 contacts
- Digital Output: UIO 15 contacts

2.2. Structure

Input is received through photo coupler and output given by photo coupler as well.

2.3. Components of the structure

Device for the input: photo coupler

Device for the output: photo coupler (Darlington Transistor Output)

2.4. Specifications

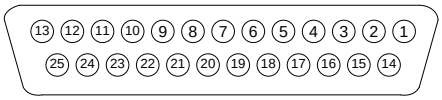
Items	User Input	User Output
Rated Input/Output voltage	D.C 24[V]	
Rated Input/Output current	Min. 5[mA] / 1 contact	Max. 50 [mA] / 1 contact
Insulation method (Photo coupler)	Input: Insulation voltage (2000 [Vrms]) Output: Insulation voltage (2000 [Vrms])	
Number of Input/Output contacts	16 contacts	15 contacts
Internal Input/Output voltage (Output current)	D.C 24[V] (Max. 600[mA])	

2.5. Connector position and specification

In Backside of Robot

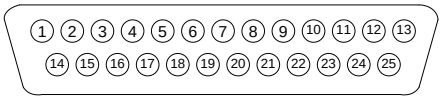
USER I/O-3

USER I/O-3



USER I/O-4

USER I/O-4

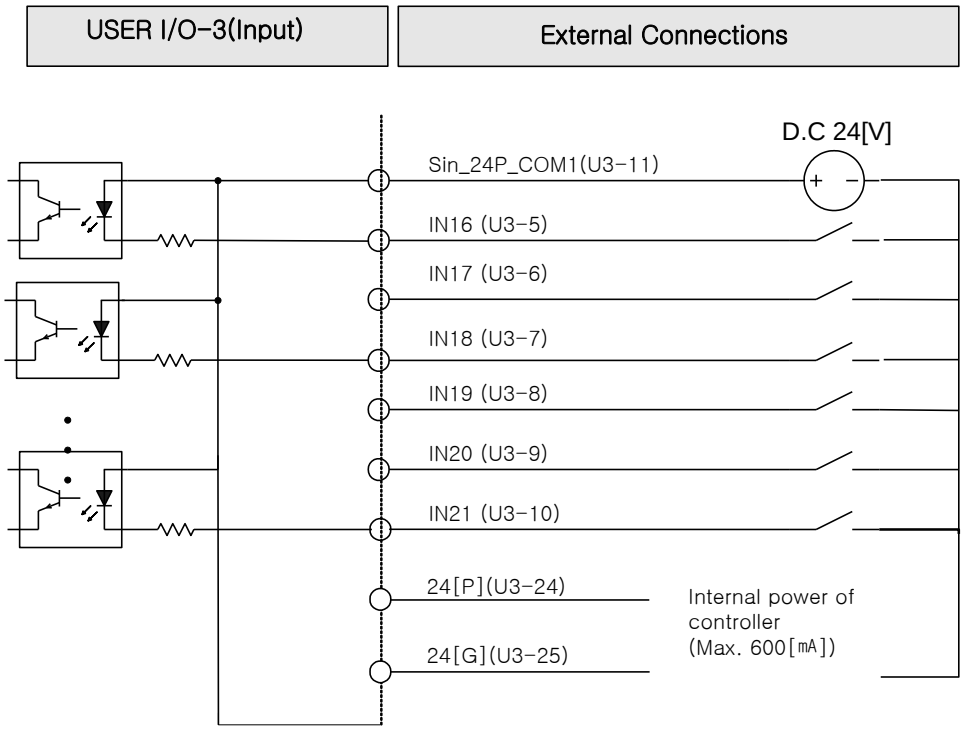


Connector Specification :
SYS I/O: D-Sub, 25Pin, Female, Right Angle Type
USER I/O: D-Sub, 25Pin, Male, Right Angle Type

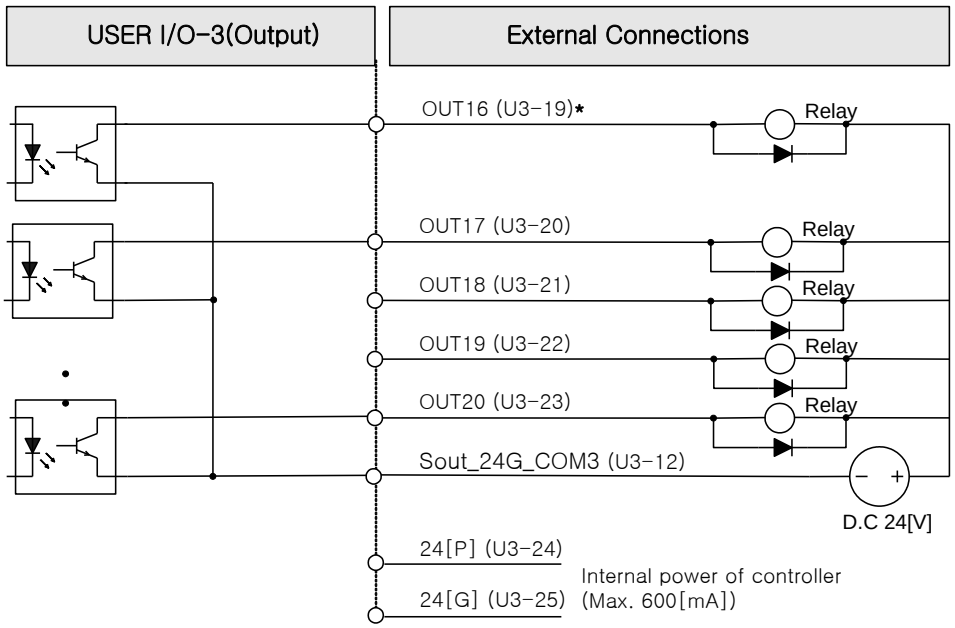
Note 1: When you wire the external power, please make sure the connection of D.C 24[V] polarity is properly assigned.
Note 2: If wiring is not properly done, the internal circuit element may be damaged. Take precaution of the polarity of the common terminal

2.5.1. USER I/O-3 connector In/Output Circuit and External Interface Circuit

Input Circuit and External Interface Circuit: USER I/O-3 Connector



Output Circuit and External Interface Circuit: USER I/O-3 Connector

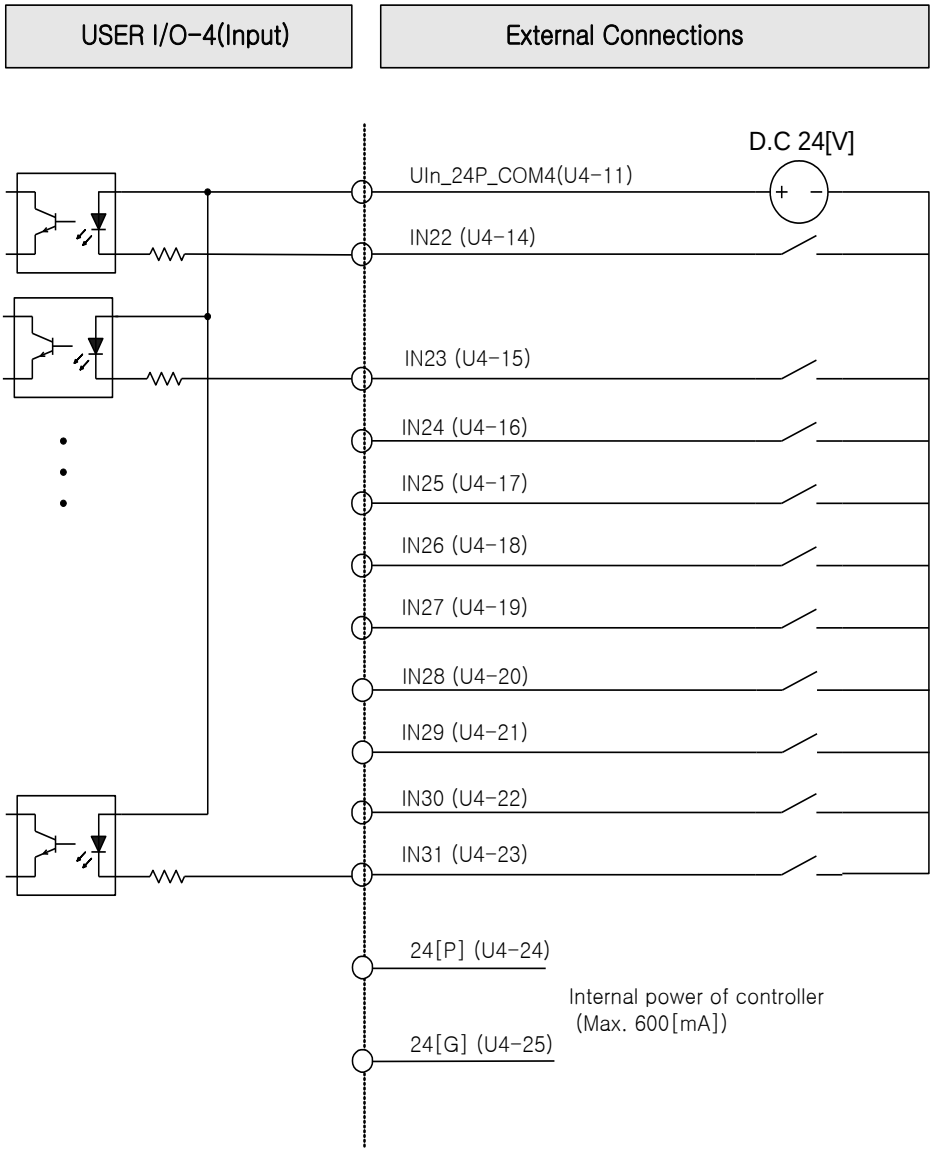


2.5.2. USER IO-3 Connector Signal Name

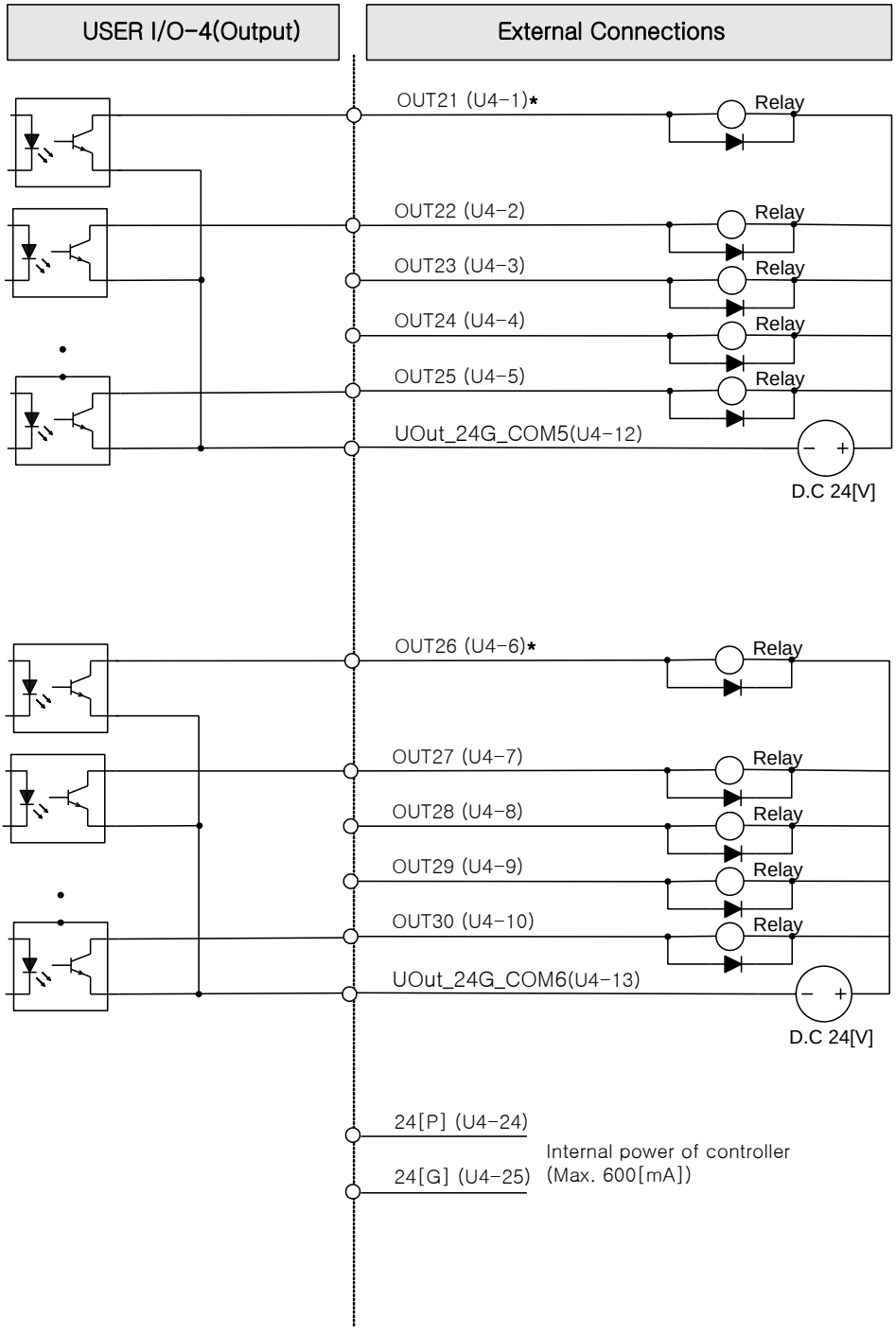
PIN No.	I/O	Sign	Explanation
U3- 5	Input	IN 16	INPUT
U3- 6	Input	IN 17	INPUT
U3- 7	Input	IN 18	INPUT
U3- 8	Input	IN 19	INPUT
U3- 9	Input	IN 20	INPUT
U3- 10	Input	IN 21	INPUT
U3- 11	COMMON	Sin_24P_COM1	+24V input common
U3- 12	COMMON	Sout_24G_COM3	24G output common
U3- 13	COMMON	Sout_24G_COM2	24G output common
U3- 19	Output	OUT 16	OUTPUT
U3- 20	Output	OUT 17	OUTPUT
U3- 21	Output	OUT 18	OUTPUT
U3- 22	Output	OUT 19	OUTPUT
U3- 23	Output	OUT 20	OUTPUT
U3- 24	Internal Power	24[P]	D.C 24[V] Internal Power
U3- 25	Internal Ground	24[G]	D.C 24[G] Internal Ground

2.5.3. USER I/O-4 connector In/output circuit and External Interface Circuit

Input Circuit and External Interface Circuit: USER I/O-4 Connector



Output Circuit and External Interface Circuit: USER I/O-4 Connector

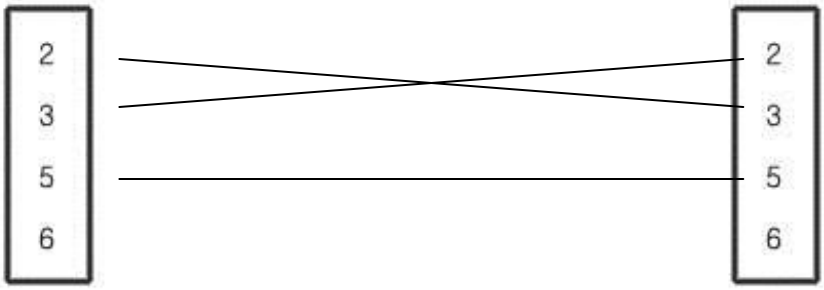


2.5.4. USER I/O-4 Connector Signal Name

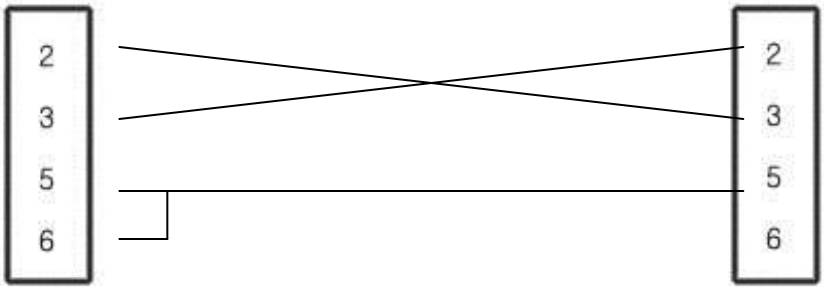
No.	I/O	Sign	Explanation
U4-1	Output	OUT 21	OUTPUT
U4-2	Output	OUT 22	OUTPUT
U4-3	Output	OUT 23	OUTPUT
U4-4	Output	OUT 24	OUTPUT
U4-5	Output	OUT 25	OUTPUT
U4-6	Output	OUT 26	OUTPUT
U4-7	Output	OUT 27	OUTPUT
U4-8	Output	OUT 28	OUTPUT
U4-9	Output	OUT 29	OUTPUT
U4-10	Output	OUT 30	OUTPUT
U4-11	COMMON	Uin_24P_COM4	+24[V] Input Common
U4-12	COMMON	Uout_24G_COM5	24G Output Common
U4-13	COMMON	Uout_24G_COM6	24G Output Common
U4-14	Input	IN 22	INPUT
U4-15	Input	IN 23	INPUT
U4-16	Input	IN 24	INPUT
U4-17	Input	IN 25	INPUT
U4-18	Input	IN 26	INPUT
U4-19	Input	IN 27	INPUT
U4-20	Input	IN 28	INPUT
U4-21	Input	IN 29	INPUT
U4-22	Input	IN 30	INPUT
U4-23	Input	IN 31	INPUT
U4-24	Internal Power	24[P]	D.C 24[P] Internal Power
U4-25	Internal grounding	24[G]	D.C 24[G] Internal Ground

2.6. Main Flash Program Burning

1. **Turn off the power of controller, and open upper cover of controller.**
2. **Connect Serial Port of Controller and Serial Port of NoteBook with Serial Cable.**



Non Auto Connect

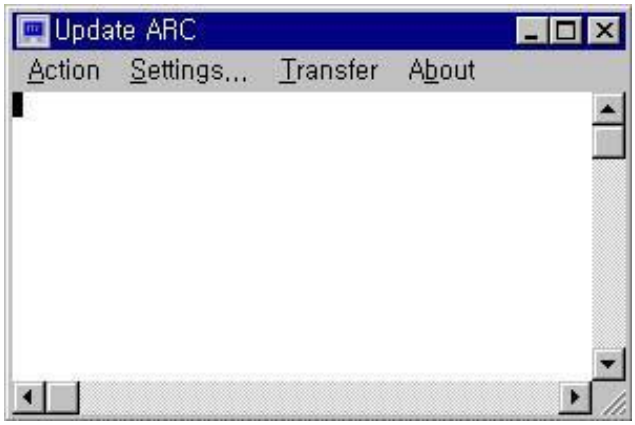


Auto Connect

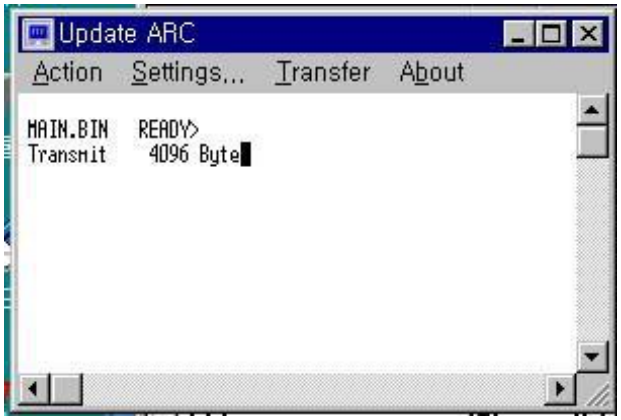
3. **Copy main.bin and ipram.bin file to the directory where UpdateARC.exe file exist.**
4. **Double click updateArc.exe file**

5. **Select 'Action' menu of Update ARC.exe and execute 'Connect'.**

6. **If it is normal, Cursor will disappear in Update ARC Screen.**



7. **Select Menu1>Parameter>Flash Burning and 1.YES**
8. **If it is right, 'MAIN.BIN READY>' message will appear in Update ARC screen, and it will start updating program.**



9. **Wait until Next message is displayed in Update ARC Screen. If it is longer than 10 minutes, retry from the first.**

10. **If all sequence is completed. Turn off controller.**

11. **Terminate UpdateARC.exe.**

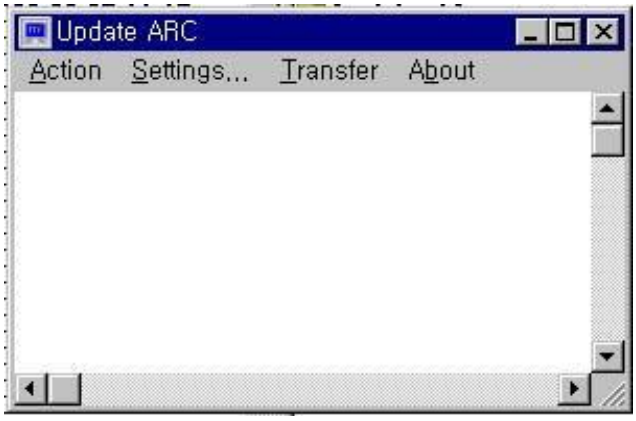
If you failed to upgrade software.

1.Turn off the power of controller, and open upper cover of controller.

2.Connect Serial Port of Controller and Serial Port of NoteBook with Serial Cable.

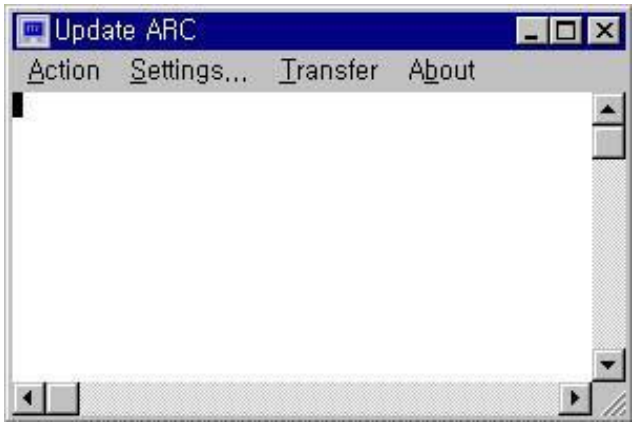
3.Copy main.bin and ipram.bin file to the directory where UpdateARC.exe file exist.

4.Double click updateArc.exe file

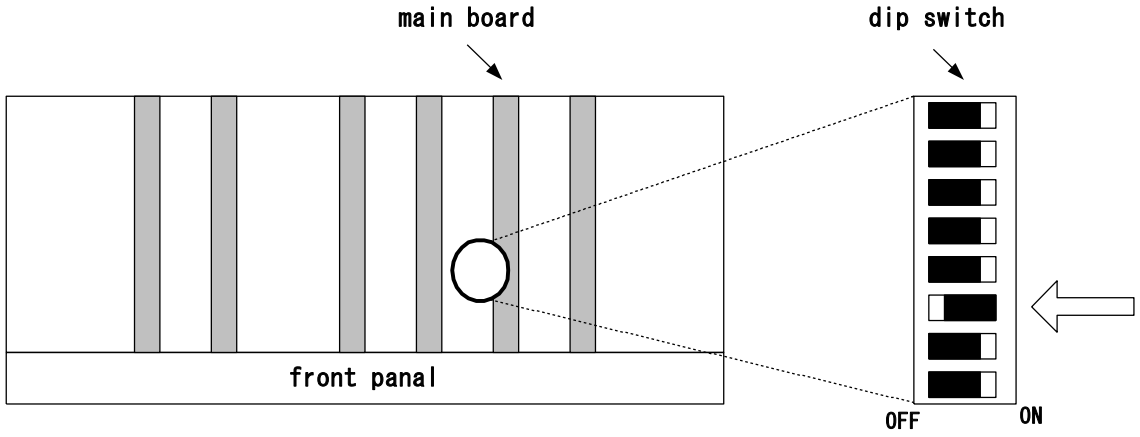


5. Select 'Action' menu of UpdateARC.exe and execute 'Connect'.

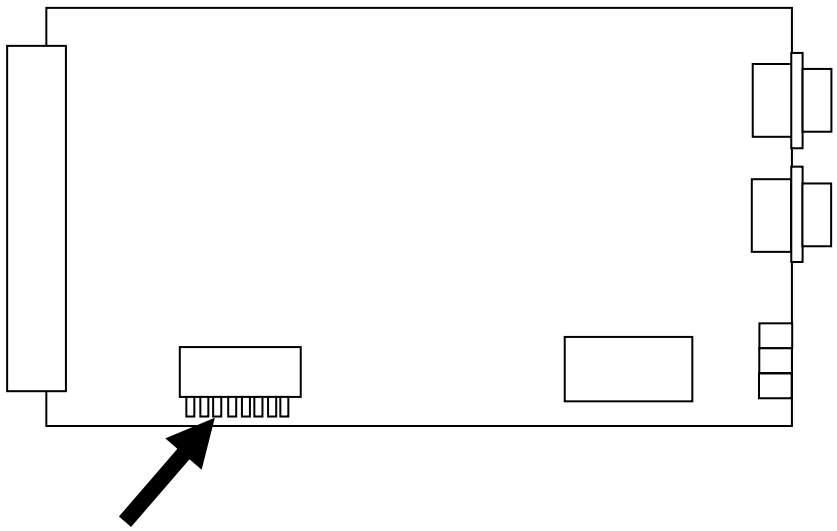
6.If it is normal, Cursor will disappear in Update ARC Screen.



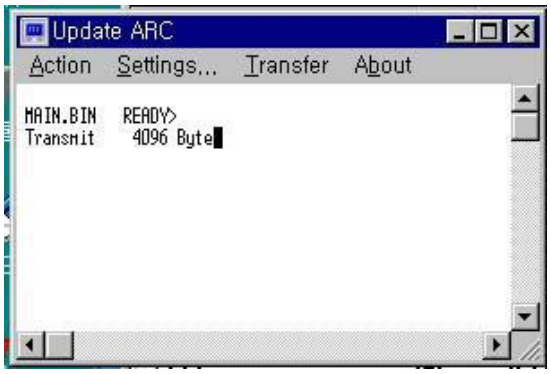
7. Turn off the Dip Switch's 3rd pin of upper side of main board.



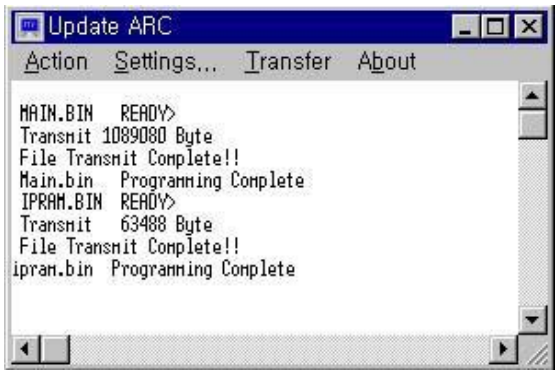
In case of desktop robot, open front cover and pull off the main board. The main board is the Lowest board.



8. **Turn on the Controller.**
9. **If it is right, 'MAIN.BIN READY>' message will appear in Update ARC screen, and it will start updating program.**



10. **Wait until next message is displayed in Update ARC Screen. If it is longer than 10 minutes, retry from the first.**

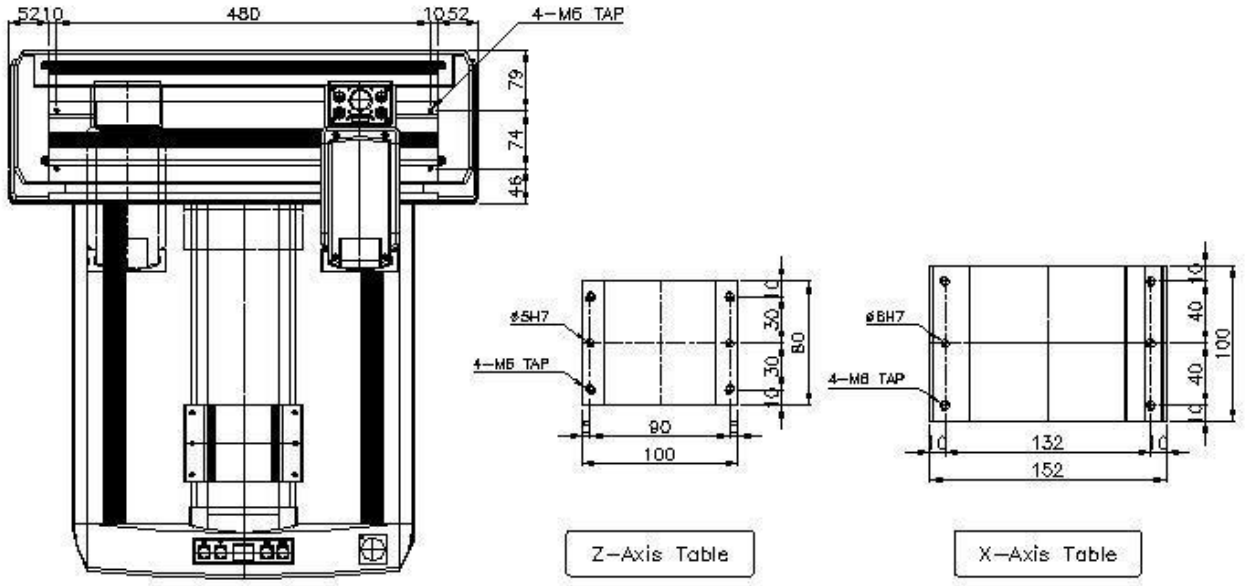


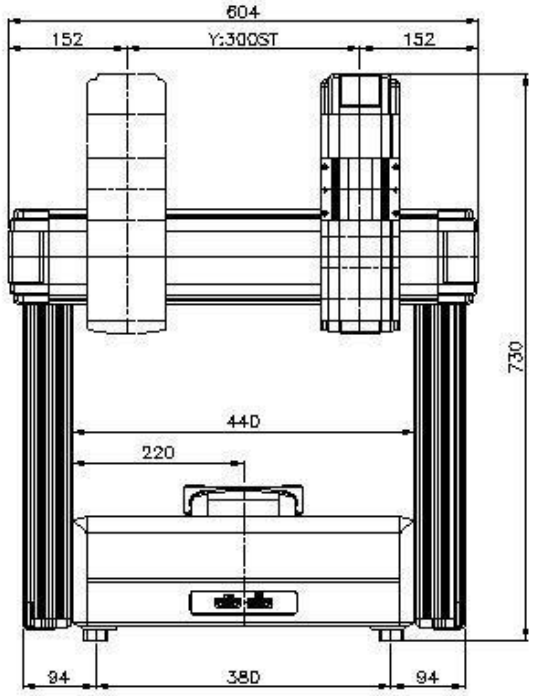
11. **If all sequence is completed, then turn off controller and Turn on the Dip switch 3rd pin.**

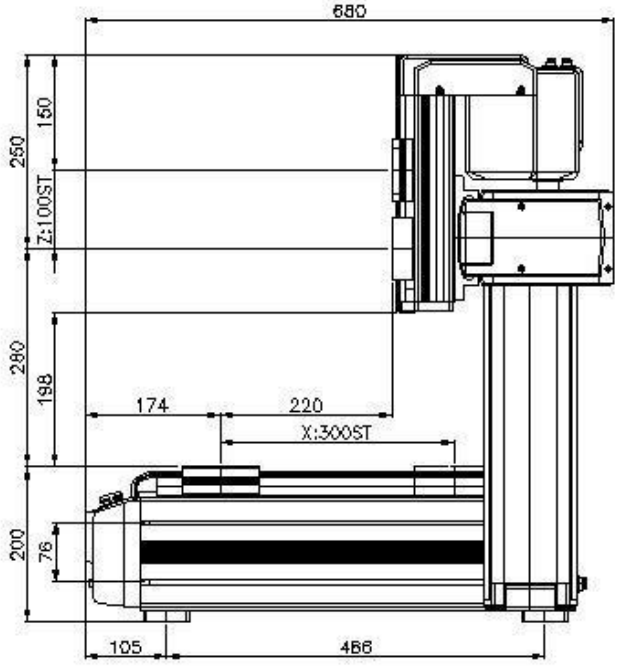
12. **Terminate UpdateARC.exe.**

3. Appendix C : Machine Dimensions

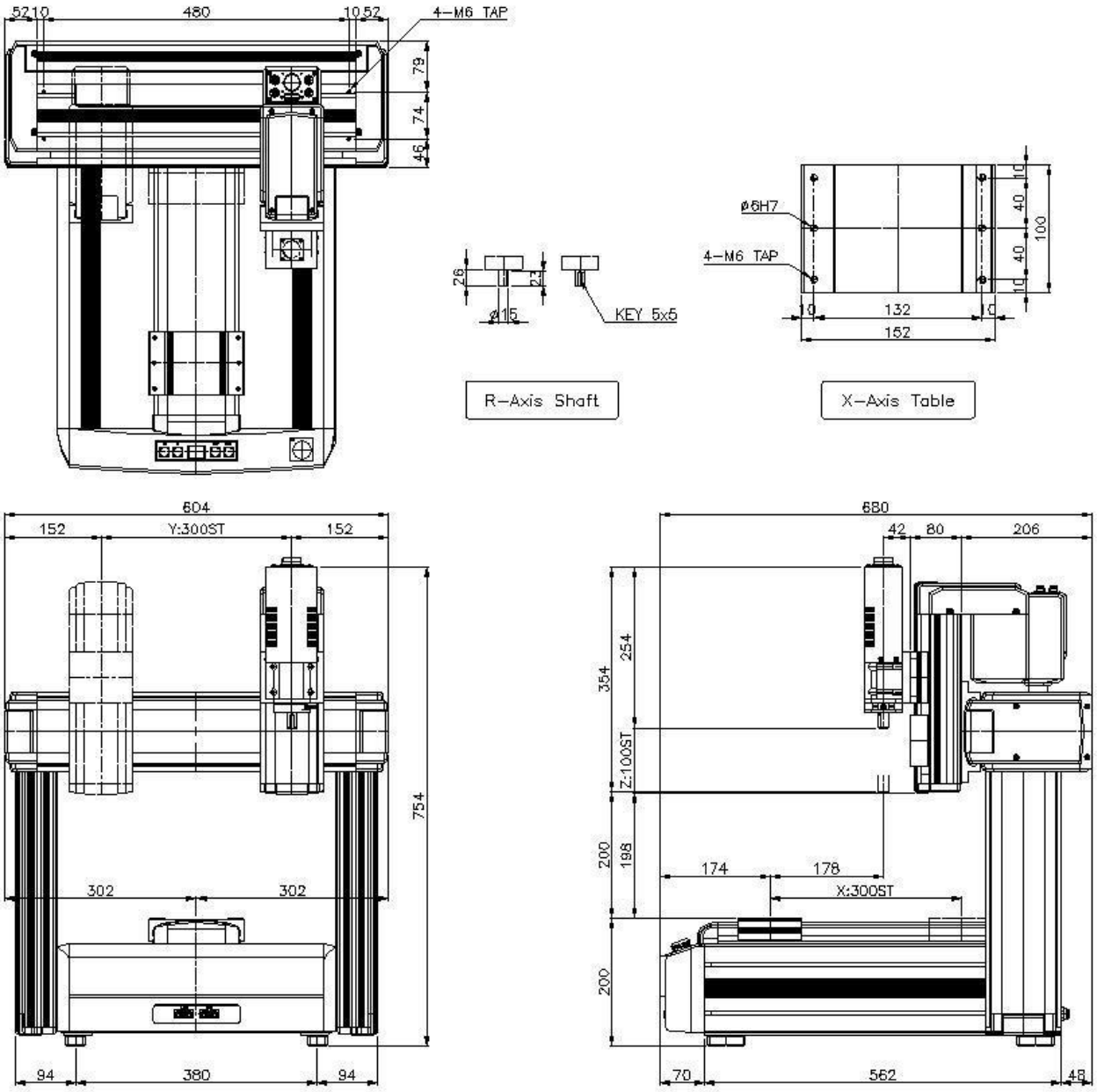
3.1. F3000N



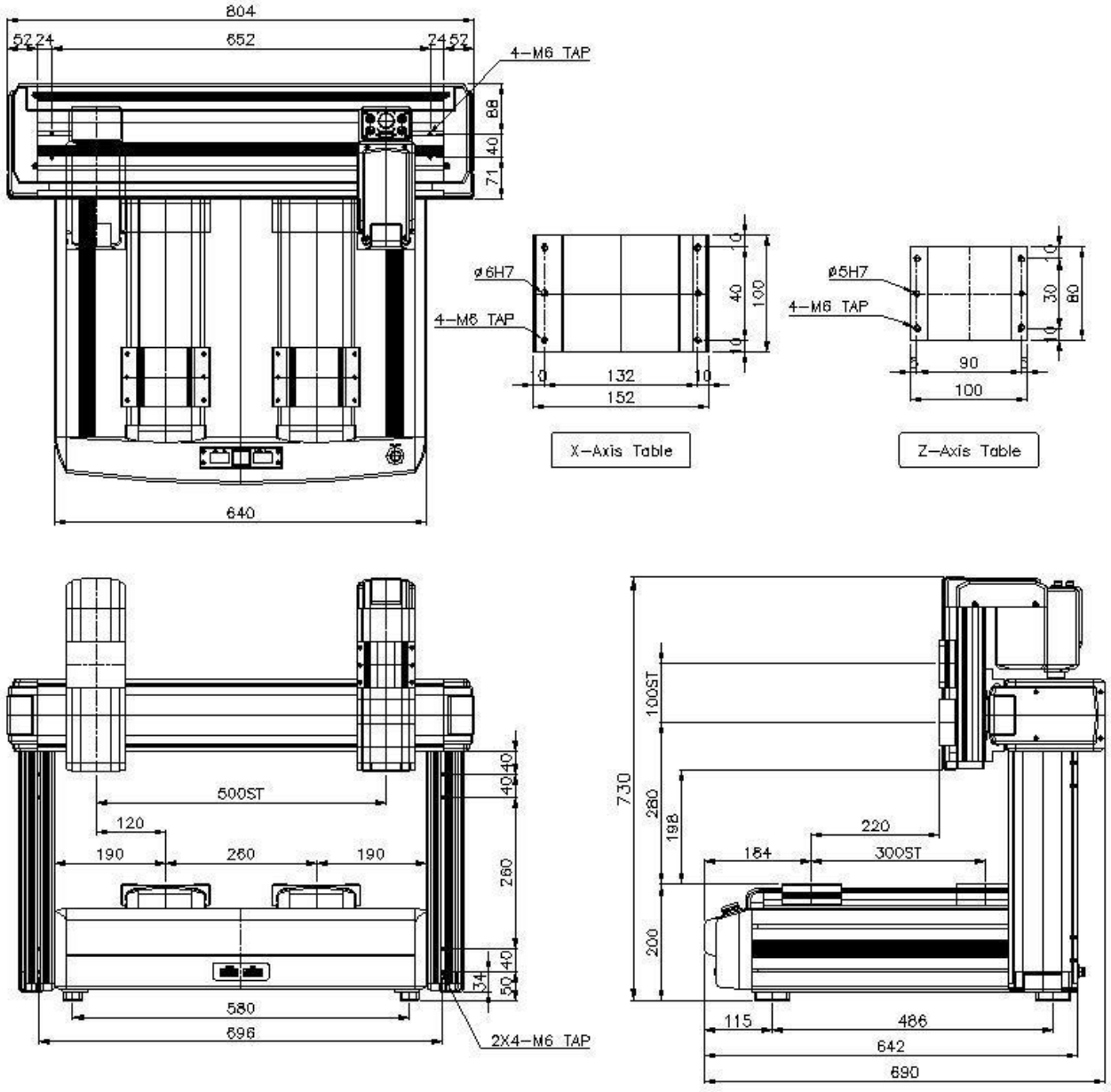




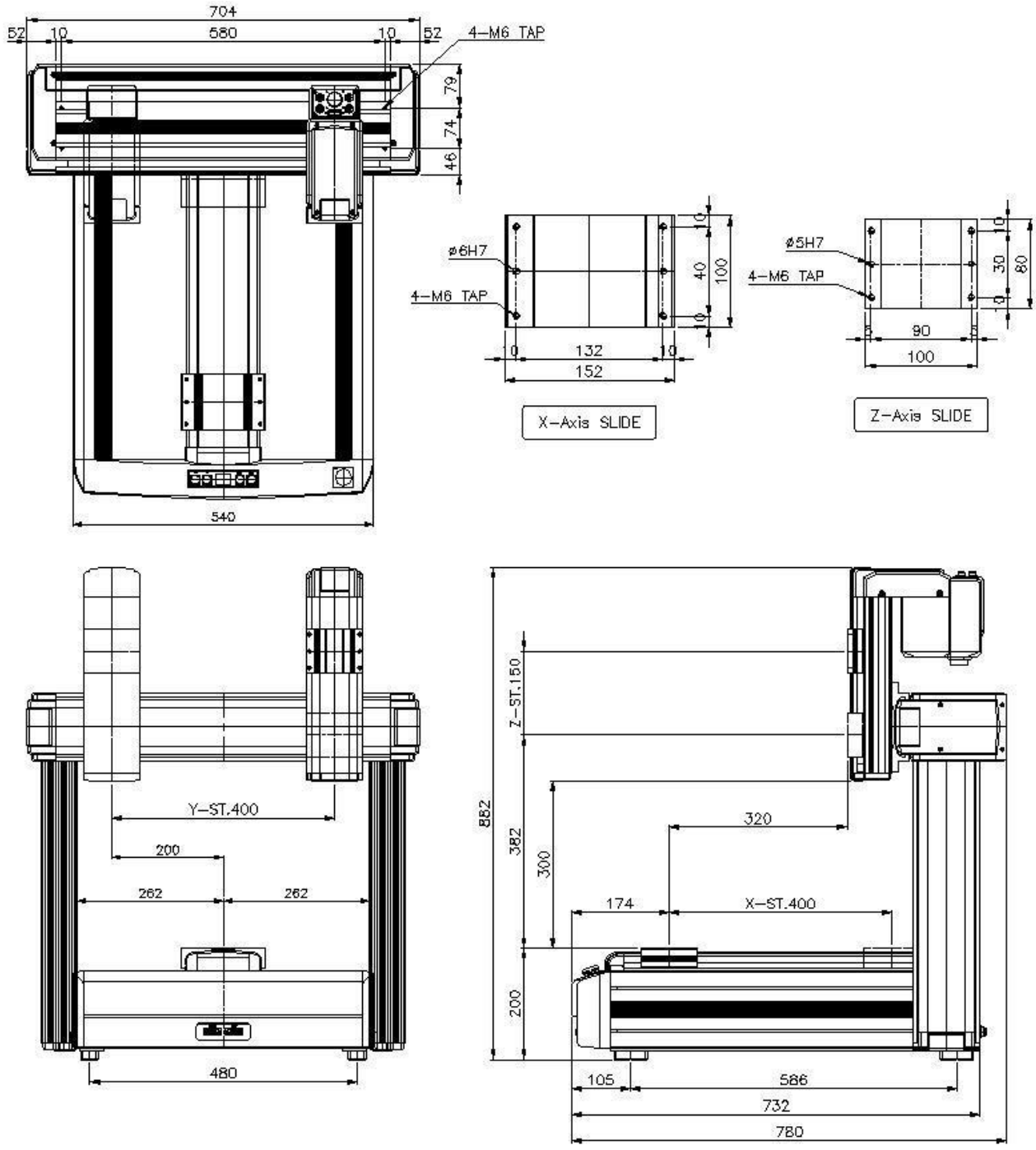
3.2. F3304N



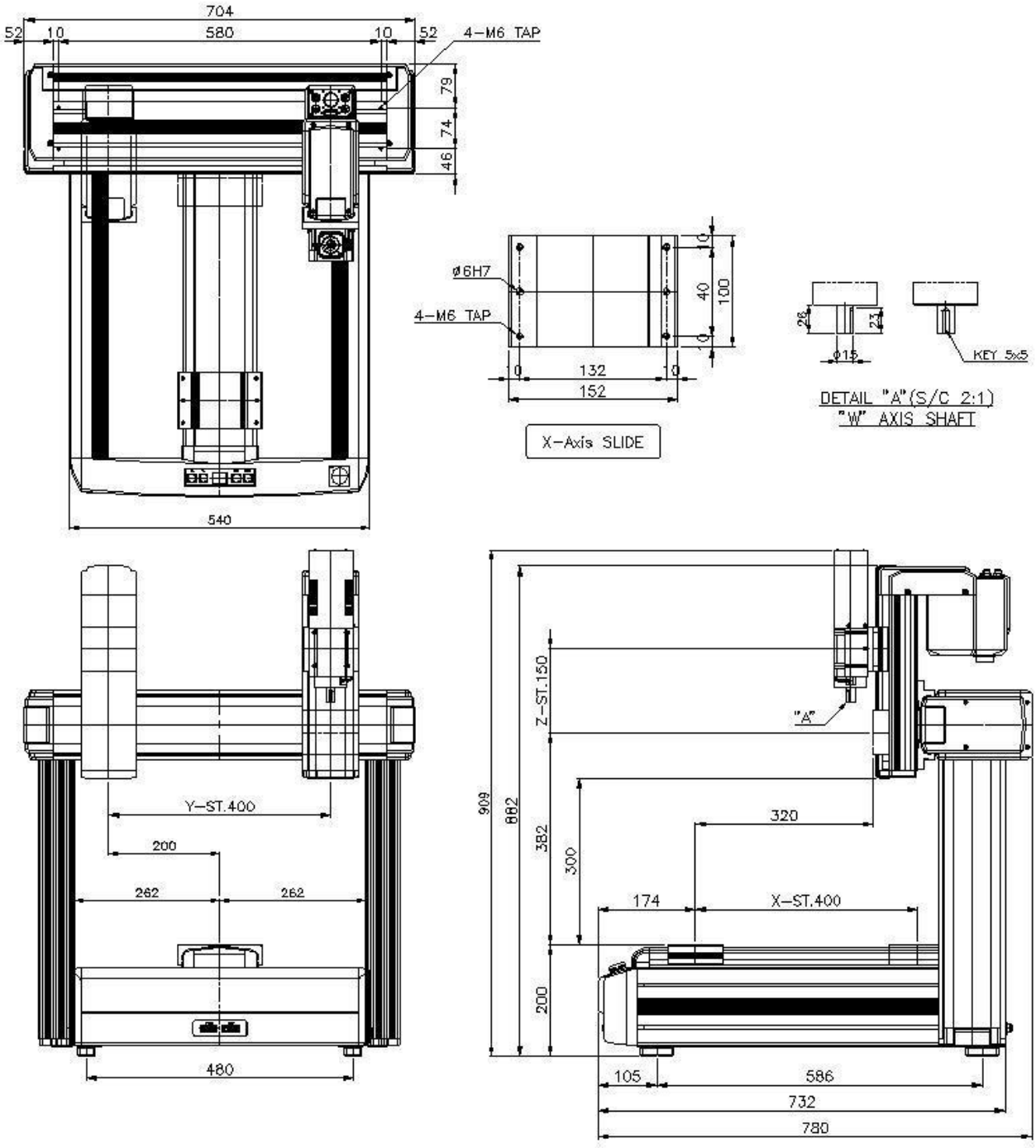
3.3. F3350N



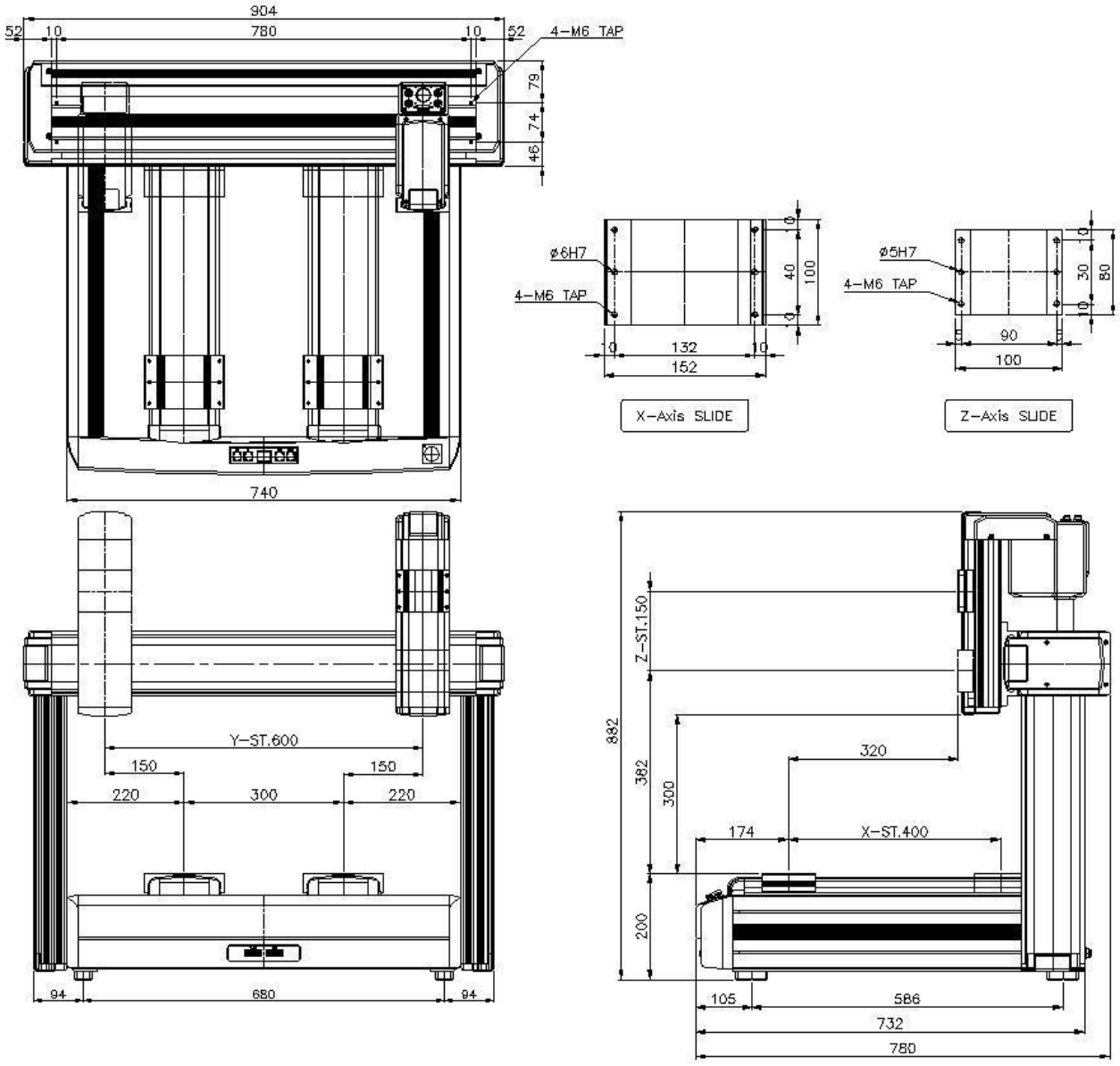
3.4. F3400N



3.5. F3404N



3.6. F3460N



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