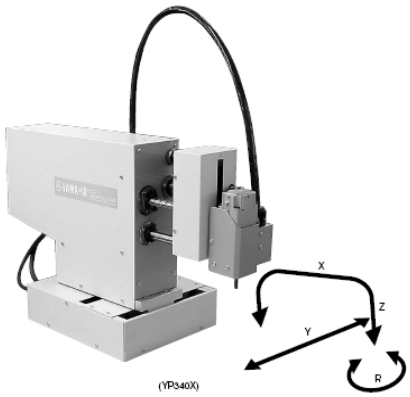
Drexel University
Goodwin College of Professional Studies
Engineering Technology
MET 205: Robotics and Mechatronics
Lab 2 Q-Robot Controller

Objective:

1. To learn the basics of a robot (YP Series)
2. To learn about the robot Controller. (QRC Series)
3. To learn to teach points.
4. To write a Simple program.

YP 330 A :

The YAMAHA YP-X series robot is Yamaha's original pick & place type robot... developed for higher speed, more compact size, and greater ease of use. The YP-X robot provides long life and quick cycles of a cam device, while providing full programmability that includes multiple pick/place locations, speed, and payload changes.

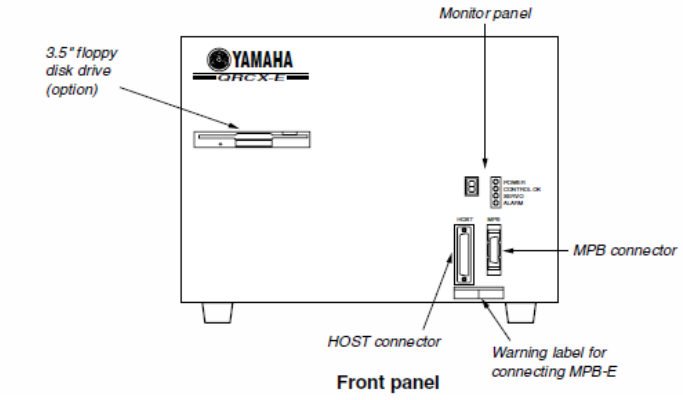


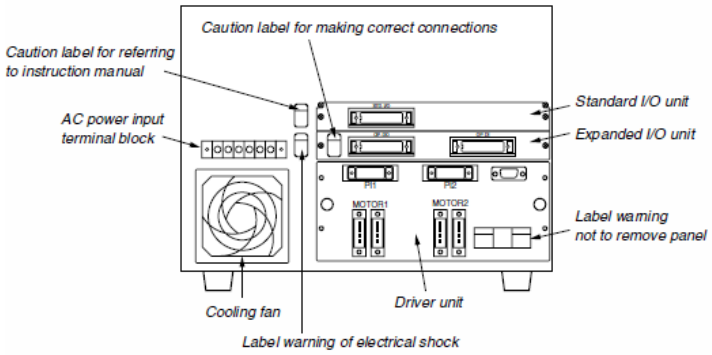
High speed 3 axes robot with YP320X used as the base and Y axis added

1. High speed type with 0.57sec cycle time as standard.
2. The operation area size is 330mm for X axis, 150mm for Y axis and 100mm for Z axis. Addition of the Y axis for horizontal movement makes palletizing possible.
3. Enhanced rigidity increased the payload to 3kg from 2kg of the conventional model. As the wiring and piping for installation of the end spindle are enclosed in the main unit and pipe shaft, there is no harness projecting upward, making installation in a smaller space possible.

The YP-X series robots use the QRCX, TRCX, and DRCX as their robot controllers. We are going to use DRCX series.

QRC series





Rear panel

Emergency Stop:
To stop the robot suddenly for any reason during operation, press the emergency stop button on the monitor panel of the controller or the programming device. When the emergency stop button is pressed, the root immediately stops and the movement command signal to the robot is cut off.

Basic Operation Modes:
The robot operation is classified into 5 basic modes as follows.

1. "SERVICE" mode
2. "AUTO" mode
3. "PROGRAM" mode
4. "MANUAL" mode
5. "SYSTEM" mode

(1) "SERVICE" mode
"SERVICE" mode is used to perform maintenance work using the MPB-E safely within the safeguard of the robot system.
• Robot is controlled only by MPB-E operation.
• Automatic operation is prohibited.
• Robot operating speed is set to below 3% of the maximum speed.
• Robot operation is possible only by hold-to-run control.

(2) "AUTO" mode
Select this mode to execute robot programs. Robot programs can be executed only in this mode. The operation contents in this mode change depending on the parameter settings in "SERVICE" mode.

(3) "PROGRAM" mode
Select this mode to create and edit robot programs. Robot programs can be edited on the MPB-E screen.

(4) "MANUAL" mode
Select this mode to move the robot manually or perform point teaching. Return to origin and manual movement can be executed only in this mode. The operation contents in this mode changes depending on the parameter settings in "SERVICE" mode.

(5) "SYSTEM" mode
Select this mode to perform maintenance and adjustment of the YAMAHA robot such as parameter settings for the robot and axis.

Auto Mode:
A. Start
1. Press the START key in Auto mode
Command statements are executed in order from the line number where the pointer is displayed.
B Stop
1. When pressing the stop key while the program is running, program execution is temporarily halted.
2. Press the ESC key to display a program list. The pointer indicates the line number of the next program to be executed.
3. Press the Start key to restart.
C. Program Reset

To restart the program halted with the start key from the beginning, reset the program.

Program Mode:

A. Program List Scroll

1) Pressing the cursor key (↑/↓) in "PROGRAM" mode scrolls through a program list a single line at a time up and down. Pressing the cursor key (←/→) scrolls through a program list a single character at a time, right and left. Holding down the cursor key scrolls the screen continuously.

2) Pressing the << , >> , << or >> or key scrolls one page (screen length) at a time.

B. Program Editing:

1. Press the F 1 (EDIT) key in "PROGRAM" mode.
2. Move the cursor to the position to be edited with the cursor keys and input a program with the MPB-E. Pressing the enter key quits the program input for a single line and the cursor moves to the beginning of the next line
3. When program editing quits, press the ESC key.

C. Directory:

When the F3 (DIR) key is pressed in program mode, each program data item is displayed.

Manual Mode:

When you write a program, you need to define the points first. There are two ways: (1) by providing coordinate points in mm, and (2) by moving the robot to a desired location. The length of travel for each axis is: x-axis: 330mm, y-axis: 150mm, z-axis: 100mm.

(1) Teaching points by specifying the coordinates (mm)

- Go to Manual
- Press F1 (point)
- Select point from the list
- Press Edit
- Enter x, y, z coordinates (the numbers should be in the format of ###.00)

(2) Teaching points by jogging the robot (recommended).

- Press F3 (Manual)
- Press F1(Point)
- Use down arrow key, move cursor to the empty point
- Jog the robot using x, y, z buttons to a desired location
- Press F2 (Teach)
- Press F4 (Yes) to overwrite the point

Some Common Commands:

1. Label Statement
   Syntax: * <label>:
   The label does not have to be included in the command. All labels begin with an asterisk ("*") and end with a colon (":").
2. ACCEL Statement
   Syntax: ACCEL <expression>
   The value of <expression 1> must be from 1 to 6 (axis number).
   This command changes the acceleration coefficient of the acceleration parameter for the main group to the value defined in the <expression>.
3. DELAY Statement
   Syntax: D E L A Y <expression>
   The value of <expression> must be from 10 to 655340. (Unit: ms)
   The DELAY statement will cause the robot to delay movement for the period of time defined by the <expression>. The delay time is set in milliseconds, and the lowest allowable value is 10 milliseconds.
4. HALT Statement
   Syntax: HALT
   This statement will stop the execution of the program and reset the robot.
5. MOVE Statement
   Syntax: MOVE P, <point definition>

This statement executes moving commands for the main robot.

6. SPEED Statement
   Syntax: SPEED<expression>
   The value of <expression> must be from 1 to 100. (Unit: %)
7. This command changes the moving command speed of the main groups after this statement, to the value specified by the <expression>.
8. ASPEED Statement (Automatic Moving Speed Setting Statement)
   Syntax: ASEED <expression>
   The value of <expression> must be from 1 to 100. (Unit: %)
   This command changes the automatic moving speed for the main group to the value defined in the <expression>.
9. GOTO Statement
   Syntax GOTO <label>
   This statement will cause the robot to jump unconditionally to the <label> specified.

EXAMPLE:

```
* L1 :
MOVE P, P1
MOVE P, P2
GOTO  *L1
```

Creating a New Program:

1. Press *Program [F2]* → *DIR [F3]* → *NEW [F1]* → *Enter Program Name* → *Press*  .
2. Press *EDIT [F1]* to enter command. To go to next line *press*  .
3. After writing the program is complete press *[ESC]* → *COMPILE [F5]* → *YES*
4. To run the program, go to initial screen by pressing *[ESC]* → *AUTO [F1]* → *[START]*.

Sample Program:
Move between 2 points (A and B) at with different speed.
Solution:

```
SPEED 70       //Move at 70 % of system speed//
ASPEED 100     //Move at 70% (=100%*70%) of moving speed from current position//
MOVE P, P70    //Move to P70//
DELAY 100      //Delay movement 1 sec//
ASPEED 50      //Move at 35 %( =50%*70%) of moving speed from current position//
MOVE P, P71    //Move to P71//
HALT           //Stop the program//
```

Exercise:
Write a program that defines three points and then keeps the robot moving in a loop from point 1 to point 2 to point 3 and then back. Each point has two second delay during movement. Keep the robot in the loop until the stop button is pressed.

Requirements: 1. Robotic calibration in XYZ coordinate: Gently but firmly tape a pencil or marker around the robot arm. Bring the robot to a position in which the pencil point touches a mark of a ruler. Calibrate if the robot moves to the positions (actual) as the positions programmed in teach pendant. Record the positions (mm) the robot moves.
2. Try 4 different speeds at 20%, 40%, 60%, and 80% of system speed for running the program and record the cycle time for each test. Plot a graph of cycle time vs. percent speed.
3. Calculate speeds in terns of mm/s and ipm (inch per minute). Plot graphs of speed vs. percent speed.