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Fundamentals of Robotics with the MHJF

LAB ACTIVITY A: GETTING STARTED

Name	Class/Period	Date

1. Overview

In this Skill Drill, you will connect the programming pendant (PP) to the MHJF robot and use the PP to control the six axes of the robot.

2. Performance Objectives

After completing this Skill Drill, you will be able to:

- Power on the FS100.
- Connect the MJHF robot to the programming pendant.
- Identify the function of several important PP keys.
- Identify several status symbols in the status display area.
- Manually rotate all six axes of the robot.
- Raise and lower the speed of manual axis rotation.

3. Background

3.1. The FS100 Controller and the Programming Pendant

Your MHJF robot is controlled by the FS100 controller, which includes the programming pendant (PP). The PP is the interface that an operator, such as yourself, uses to move the robot around, program the robot, and run or modify a program. Throughout this course, you will learn more and more about the functions of the PP and the ways that it can control the robot. As with anything else in life, learning to master the PP takes practice. Don't get frustrated if something doesn't work the first time!

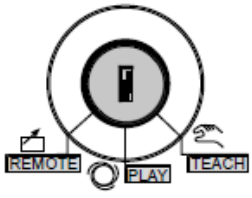
Note that the FS100 with the included PP is designed to control several different Motoman robots. Once you have mastered the operation of this set of controls, you will be able to operate just about any of the Motoman robots with relative ease.

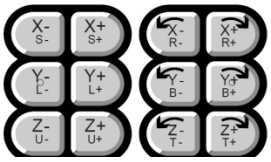
As this course can only convey so much information in the given time, feel free to access the **FS100 Operator's Manual** in the Resources section of the course page to learn about the PP and the controller in greater depth.

3.2. The Programming Pendant's Keys

The physical buttons on the PP are referred to as "**keys**." In lab activities, the name of a key is always written in capital letters. For example: the COORD key.

Take a look at the image and table below to learn about the keys that you will be using in this Skill Drill.

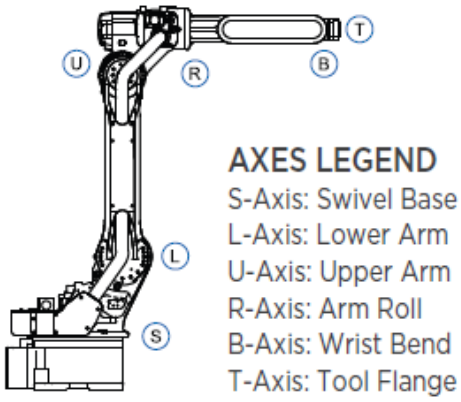
Key	Name of Key	Main Function(s)
	MODE key	Literally a key, the MODE key allows you to alternate between three different control modes. In this Skill Drill, you will work in **Teach** mode. You'll learn more about the other control modes in the future.
	Emergency Stop (E-stop)	The robot is disabled when the EMERGENCY STOP button is pressed. Turn the button clockwise to release it and enable robot movement.

Key	Name of Key	Main Function(s)
	Enable Switch	Also known as a dead man's switch, this is a trigger on the back of the PP that needs to be lightly squeezed for any teach actions to occur. If the switch is not squeezed at all or if it is firmly squeezed, servo power turns off.
	SERVO ON READY	This button enables robot movement by turning on the servo motors.
	COORD (Coordinate Systems Selection)	This key allows you to toggle between five different coordinate systems. In this Skill Drill, you will only use the joint coordinate system.
	Axis Keys	Also known as jog keys, these keys allow you to manually rotate the robot's axes. Pressing one of the buttons rotates the specified axis in the indicated direction (e.g. S-). Multiple axes can be operated simultaneously by pressing two or more keys at the same time.
	Manual Speed Keys	These keys set the speed for manual movement.

For more information about these and other PP keys, check out section 1.2. in the FS100 Operator's Manual.

3.3. The MHJF Robot

Today, you will operate the Motoman MHJF robot for the first time. The robot has six axes, or joints, which are shown in the figure below, allowing for six degrees of freedom within the robot's work envelope. Each axis can be controlled individually using the PP's axis keys. In this Skill Drill, you will be manipulating the robot using the joint coordinate system, which means that you can rotate the S, L, U, R, B, and T axes individually.



Take some time to the review the specifications of the MHJF robot, which can be found in a document in the Resources section of the course page.

4. Required Materials

You need these materials to complete the Skill Drill:

- Yaskawa MHJF robot
- FS100 controller
- Programming pendant

All three of the above elements must be installed and connected via the appropriate cables.

5. Inventory and Safety

Before beginning the Skill Drill, review this checklist and mark off each item as you complete it.

- ☐ All hardware components are available for this Skill Drill.
- ☐ Hands, hair, and clothing are securely away from the work area of any moving parts of the robot.
- ☐ You are standing at least 1 m / 39 inches away from the robot.
- ☐ The programming pendant is secured to your left hand with the Velcro strap.
- ☐ The work area is clean and devoid of food or drink.

6. Lab Activity

Perform the following steps:

1. Power on the controller. The controller's power switch is located at the front of the controller box. Flip it upwards to turn the controller on.

The programming pendant is on whenever the controller is on.

2. On the pendant's touch screen, press the **Connect to FS100** button.

3. When prompted, lightly squeeze (half press) the enable switch on the back of the pendant. Release the switch when prompted.

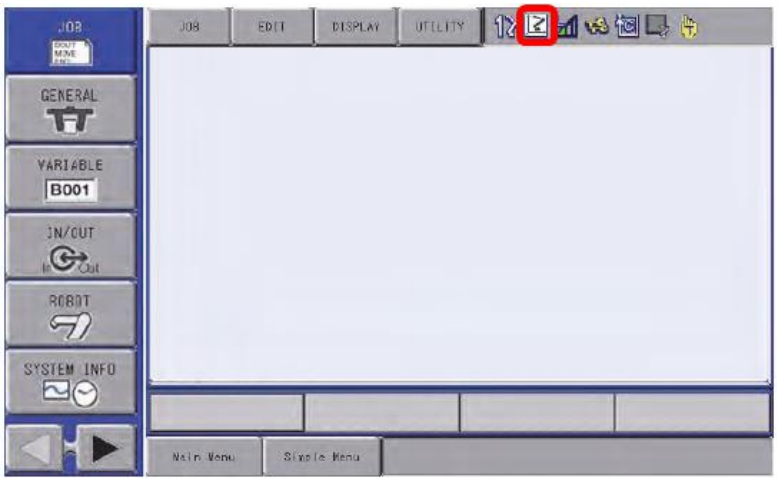
   The PP's display screen shows the menu areas and the general-purpose area. You will learn more about the display screen in future Skill Drills.

4. If the PP's EMERGENCY STOP button is pressed, turn it clockwise and pull to release it.

5. Turn the MODE key to **Teach** mode.

6. Press the SERVO ON READY key to initiate servo power. The **SERVO ON** light flashes green. You need to enable servo power each time you turn on the controller and each time you switch operation modes (Remote/Teach/Play).

ⓘ ***Note:*** *You will now rotate the axes of the robots. Later on in the course, you will learn about the different coordinate systems of the MHJF robot. For now, however, ensure that the joint coordinates mode is the active coordinate system/mode. You can view the active coordinate system in the status display area, which is at the top-right of the PP screen.*



The active coordinate mode is highlighted (in red).

This symbol represents the joint coordinates mode:

*If a different coordinate system is active, press the **COORD** key until the joint coordinates mode symbol is displayed.*

7. Lightly squeeze the enable switch to enable servo power. Keep squeezing for the remaining steps.

8. Use the manual speed keys to change the speed of axis rotation to medium or high speed. You can view the current teach speed (**I**nching, **L**ow, **M**edium, or **H**igh) in the PP screen's status display area. The triangular symbol is the speed symbol.

9. Experiment with the robot by trying the following:

   - Press the axis keys on the PP's touch screen to rotate the robot's axes one at a time. Identify where each of the joints (S, L, U, R, B, and T) are situated on the robot. Scan or click the QR code below to watch examples of axis rotation.

   - Press multiple axis keys to manipulate multiple axes simultaneously.
   - Use the manual speed keys to change the speed of axis rotation.

ⓘ ***Note:** Inching speed rotates an axis of the robot one encoder pulse at a time.*

Warning: *You are about to manually rotate the axes of the robot to their limits. Make sure that you do not cause any collisions between the robot and its surrounding environment. If a collision does occur, press* ***RESET*** *and manipulate the robot to safety.*

- Rotate each axis to its positive and negative limit. Can you estimate the maximum motion range of each axis (without cheating and looking at the specifications sheet) in degrees? When an axis reaches a motion limit, you will hear a high-pitched tone. Scan or click the QR code below to see an example of an axis limit.

10. Once you have finished manipulating the robot, turn off the controller. Recall that the ON/OFF switch is on the controller box and not on the PP. Place the PP in a secure area.

7. Authentic Skill Assessment

Have your instructor verify that your work meets the requirements in the Performance Objectives and sign below. Keep this lab activity sheet for future reference.

Instructor Signature	Date

8. Shutdown

Unless instructed otherwise by your teacher, review and complete each of the items on the checklist below.

- ☐ The robot and controller are powered off.
- ☐ The programming pendant is securely stowed away.
- ☐ The programming pendant is set to **Teach** mode.