

Robotics, Integration, and Automation

ROBOT FIRST STEPS

Name	Class/Period	Date

1. Overview

In this lab activity, you will perform initial setup steps for your robotic system including registering tool files and position variables.

2. Performance Objectives

After completing this lab activity, you will be able to:

- Register tool files for your gripper.
- Create position variables for the activity and project jobs.

3. Required Materials

You need the following materials to complete the lab activity:

- SmartCart 4.0
- Computer
- Ethernet cables

4. Required Software

No special software is required for this lab activity.

5. Inventory and Safety

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

- All hardware components are available for this lab activity.
- Hands, hair, and clothing are securely away from the work area.
- The work area is clean and devoid of food or drink.
- Review the SmartCart safety guidelines.
- Read through the entirety of this lab activity to familiarize yourself with the requirements.

6. Lab Activity

6.1. Tool Registration

In this section, you will register two end of arm tools on the controller: the gripper jaws and vacuum cup. You will manually enter the Tool Center Point (TCP) coordinates and orientation for the tools, however, the tools' weights, centers of gravity, and moments of inertia will be measured automatically by the robotic system.

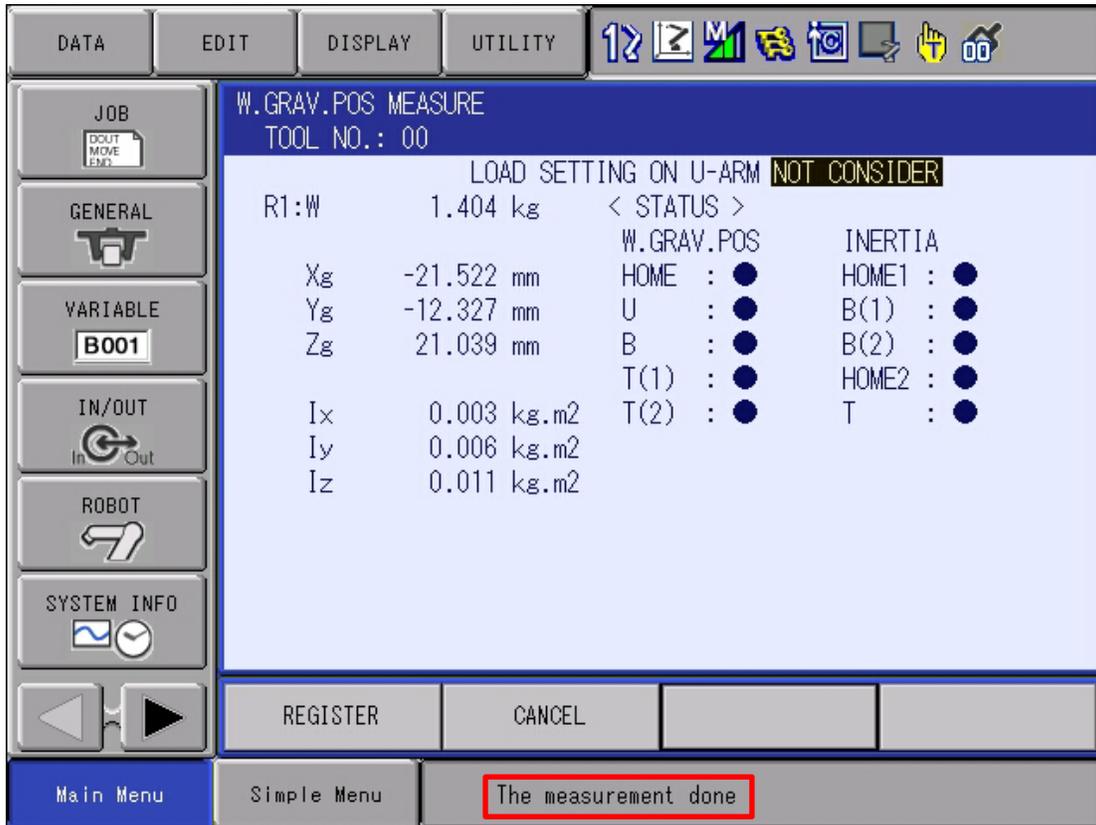
Perform these steps.

1. Power the robot controller on. Wait for the robot to boot up.
2. Ensure that the programming pendant mode key is set to Teach mode.
3. Using the pendant, navigate to **SETUP > TEACHING CONDITION SETTINGS**.
4. Ensure that **TOOL NO. SWITCH** is set to **PERMIT**.
5. In the main menu, navigate to **ROBOT > TOOL** to display the list of tools.
6. Select the first unregistered tool (the NO. column) and press ENTER. The specific tool number window is displayed.

TOOL					
TOOL NO. : 0					
NAME	STANDARD TOOL				
X	<input type="text" value="0.000"/>	mm	Rx	<input type="text" value="0.0000"/>	deg.
Y	<input type="text" value="0.000"/>	mm	Ry	<input type="text" value="0.0000"/>	deg.
Z	<input type="text" value="0.000"/>	mm	Rz	<input type="text" value="0.0000"/>	deg.
W	<input type="text" value="0.000"/>	kg			
Xg	<input type="text" value="0.000"/>	mm	Ix	<input type="text" value="0.000"/>	kg.m2
Yg	<input type="text" value="0.000"/>	mm	Iy	<input type="text" value="0.000"/>	kg.m2
Zg	<input type="text" value="0.000"/>	mm	Iz	<input type="text" value="0.000"/>	kg.m2

7. Name the tool *GRIPPER-JAWS* or similar.
8. Enter **107** mm (the length of the gripper) in the **Z** field.
9. Leave the rest of the dimensions in the top three rows (X, Y, Rx, Ry, and Rz) as **0**.

- Press and hold FWD and follow the prompts at the bottom of the screen until the INERTIA measurements are completed. The message “The measurement done” is displayed at the bottom of the screen.



- On the screen, press **REGISTER**.
- In the **WRITE DATA?** pop-up window, select **YES**.
The data is written to the tool.
- Press **PAGE** to navigate to the next tool (alternatively, press **DISPLAY > LIST** to return to the list of tools and then select Tool 01).
- Register the vacuum cup tool. Enter the measurements below, and then perform the automatic measuring procedure for center of gravity and inertia:
 - Name: **Vacuum cup** (or similar)
 - X: 104 mm
 - Y: 0 mm
 - Z: 20 mm
 - Rx: 0 mm
 - Ry: 90 mm
 - Rz: 0 mm

6.2. Position Variables

In this task, you will create position variables which you will later use to create jobs for the project application.

① **Note:** You will likely be sharing the robot with other course participants. Your instructor may tell you to share the same position variables, or they may allocate you a series of potential position variable numbers in the controller.

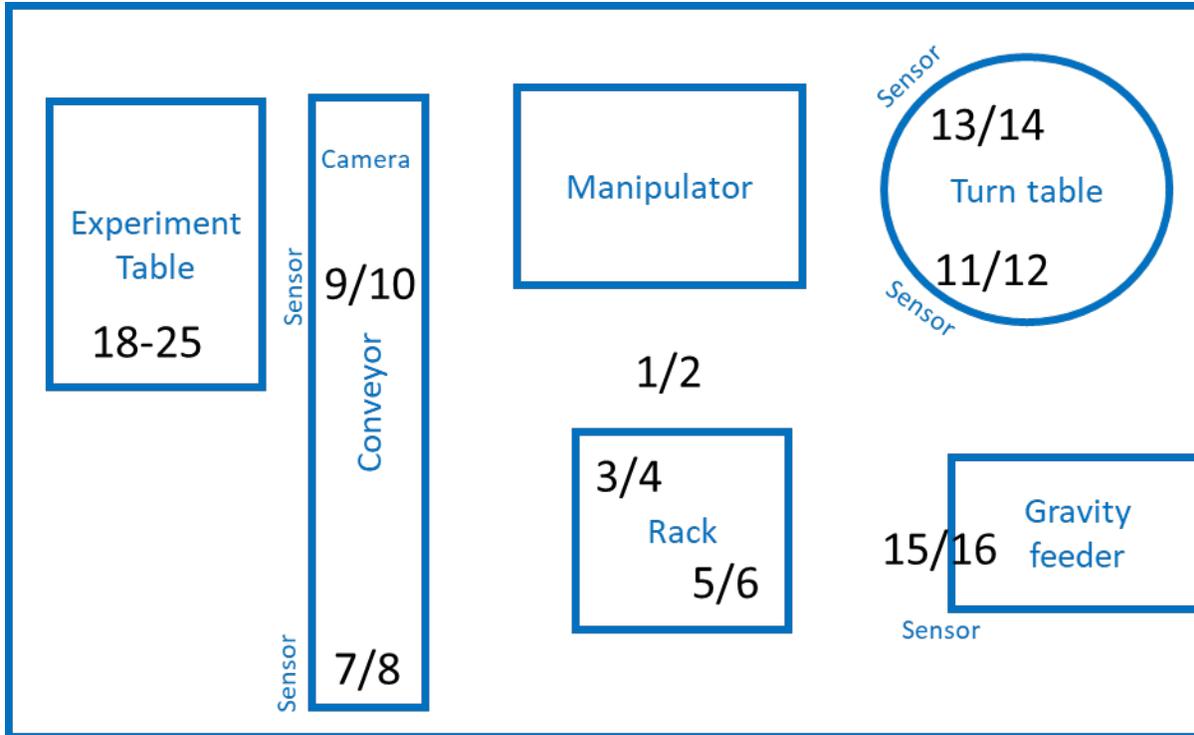
1. Think about the project application and where you believe your robot positions should be. On paper or a computer document, compile a list of the positions by *name only*. Consider also which of the gripper’s tools will be used at each position. Here are some examples of position names:

Position Name	Tool Referenced
Home	Gripper jaws
Rack position A	Vacuum cup
Above rack position A	Vacuum cup
Rotary table by sensor	Gripper jaws
Rotary table by sensor	Gripper jaws

Don’t worry if you’ve missed a position. You can always add them later.

2. Register each of the positions on the robot controller. To register a position variable:
 - a. Ensure that the pendant’s mode key is set to Teach mode.
 - b. On the pendant screen, navigate to **VARIABLE > POSITION**.
 - c. Move to a page with the desired position variable number (either press the PAGE key or press the onscreen PAGE button and then enter the desired number).
 - d. Turn servo power on and grip the enable switch.
 - e. Jog the robot to the desired position. (For pick positions, the workpiece [e.g., a block] should be placed in the position beforehand. For place positions, the workpiece should be grasped by the robot. Positions will be adjusted in future lab activities, so there is no need for each position to be absolutely perfect at this point.)
 - f. Select the variable type (the field next to the position number). **ROBOT** or **BASE** is recommended.
 - g. In the TOOL field, enter the number of the desired tool (leave it as TOOL 00 if you are using that tool).
 - h. Press MODIFY.
 - i. Press ENTER. The position variable is registered, and the coordinates are displayed on the screen.
 - j. In the NAME field, enter the name of the position.

- In order to help you visualize the layout of the positions on the smart cart, draw a rudimentary map with the numbers of the positions listed. Below is an example map with several positions. Note that the stacked numbers represent position variables with the same XY coordinate values (in the Cartesian coordinate system) but with different Z coordinate values.



- Review the map for areas that may need additional positions. Register those position variables and add the numbers to the map.
- Test all position variables. To do so:
 - Move to the page of a variable.
 - Turn servo power on and grip the enable switch.
 - Set the robot jog speed to low (L) or medium (M).
 - Press FWD until the manipulator reaches the position.
 - Adjust the position variable if necessary, either by jogging the robot (and then pressing MODIFY and then ENTER) or by modifying the coordinate values.
- Test again using the other tool: in the position variable's TOOL field, enter the other tool and then press FWD to jog the robot. The tool tip should reach or come very close to reaching the same position.
- Return the position variable's tool to the original tool.

In the next lab activity, you will use these position variables to create pick-and-place jobs.

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. Reset Steps

If someone else is going to be performing this lab activity after you, perform the reset steps below. Consult with your instructor before performing these procedures.

8.1. Clearing a Tool

Perform this procedure to unregister a tool:

1. Navigate to the tool list.
2. Edit the tool name and delete all characters.
3. Navigate to the tool's data page.
4. Set all measurement values to 0.

8.2. Deleting a Position Variable

The following is the procedure to clear the data of a position variable. Do not delete positions unless explicitly told to do so by your instructor. You will still need the position variables to complete job programming in the next lab activity.

1. In the pendant's main menu, navigate to **VARIABLE > POSITION**.
2. Move to the page of the desired position variable number.
3. In the menu at the top of the screen, select **DATA > CLEAR DATA**.

9. Shutdown

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

- Jog the robot to a safe position with the gripper jaws pointing downwards.
- Power down the robot controller.
- Ensure the pendant mode key is in Teach mode.
- Return the pendant to its storage hook on the side of the SmartCart.
- Power down the I/O box.