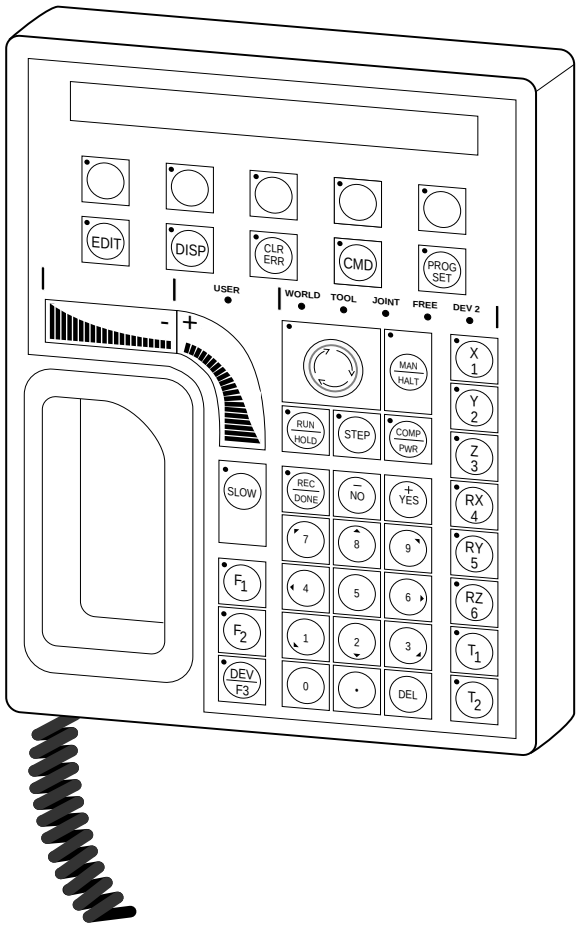
Manual Control Pendant

User's Guide



Part Number 00101-00010 Rev A
June, 1991

adept technology, inc.

150 Rose Orchard Way • San Jose, CA 95134 • USA • Phone (408) 432-0888 • Telex 171942 • Fax (408) 432-8707
Otto-Hahn-Strasse 23 • 4600 Dortmund 50 • Germany • Phone (49) 231/75 89 40 • Fax (49) 231/75 89 450
7, rue Victor Hugo • 92310 Sèvres • France • Phone 33 (1) 45 34 32 32 • Fax 33 (1) 45 34 76 16

Chapter 4
Moving a Robot or Motion Device With the MCP

4.1 Introduction

The MCP is used with a robot or motion device primarily to teach robot locations for use in application programs. The MCP is also used with custom applications that employ "teach routines" that pause execution at specified points and allow an operator to teach or re-teach the robot locations used by the program. The Adept AIM software system makes extensive use of the pendant for teaching robot locations.

When you move the robot using the MCP, motion will be in world state, tool state, joint state, or in free state.

When moving in world state, directions are sent from the MCP to move the robot in a Cartesian coordinate system centered at the base of the robot. When moving in tool state, directions are sent from the MCP to move the robot in a Cartesian coordinate system centered at the robot's end-of-arm tooling location.

In joint state, directions are sent from the MCP to move individual robot joints. In free state, selected joints of the robot are "freed" from servo control so they can be moved by hand.

Mode Control Buttons

The mode control buttons change the state being used to move the robot, switch control of the robot between the MCP and application programs, and enable ARM POWER (when necessary). The buttons are labeled in red.

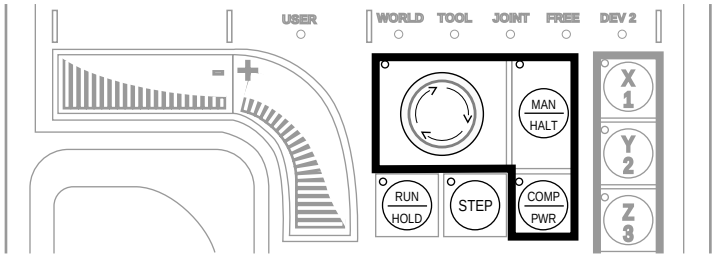


Figure 4-1. Mode Control Buttons

Emergency Stop Button

The emergency stop button will stop program execution and turn off ARM POWER. In the AdeptOne, AdeptThree, and Adept PackOne, the friction brakes will be activated.

COMP/PWR Button

If ARM POWER is enabled, the COMP/PWR button selects computer mode. If ARM POWER is disabled, the COMP/PWR button enables ARM POWER and selects computer mode. In computer mode, an executing program or the system terminal has control of the robot.[1]

MAN/HALT Button

When there is no program executing, or a program has paused for a pendant teach routine, pressing the "MAN/HALT" button selects manual mode. In manual mode, the MCP has control of the robot. If a program is executing, the MAN/HALT button will stop program execution (without shutting off ARM POWER).

Manual mode cannot be entered if ARM POWER is off (panic button LED not illuminated). To enable ARM POWER, press the "COMP/PWR" button. The MCP is in manual mode when:

1. The LED on the "MAN/HALT" button is illuminated, and
2. One of the manual state LEDs is also illuminated (the "Manual state" LEDs indicate the type of manual motion that has been selected, either World, Tool, Joint, or Free).

The system will remain in manual mode until ARM POWER is turned off, or the "COMP/PWR" button is pressed. When you have finished moving the robot manually, press the "COMP/PWR" button to return control to the controller. If a program attempts to execute with the MCP in manual mode, the error "Comp mode disabled" will be generated.

When the "MAN/HALT" button is pressed the first time, the MCP will be in world state. Pressing the "MAN/HALT" button again selects the next state to the right (tool, joint, free), eventually wrapping back to the left-most state (world). If manual mode is terminated and re-entered (without turning off system power) the last active state is selected.

Manual Control Buttons

The buttons on the far right side (outlined in blue) are the "Manual control" buttons. When the MCP is in manual mode, these buttons select

1. If the robot has not been calibrated and ARM POWER is turned on, the MCP emergency stop switch LED will be lit, and both the COMP/PWR and MAN/HALT LEDs will be off.

which robot joint will move, or the coordinate axis along which the robot will move. The X/1, Y/2, Z/3, RX/4, RY/5, and RZ/6 buttons are covered in section 4.2. (The MCP must be in manual mode before a manual control button can be selected.)

Speed Bars

The "speed bars" are used to control the robot's speed and direction. The joint(s) that will move when the speed bars are pressed depends on the "state" selected with the MAN/HALT button. Press the speed bars with your left thumb. Pressing the speed bars near the outer ends will move the robot faster, pressing the speed bar near the center will move the robot slower. See Section 4.2 for details on positive and negative directions.

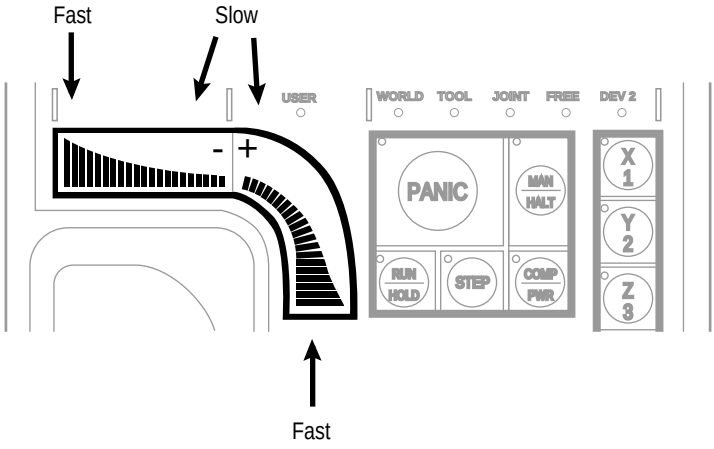


Figure 4-2. Speed Bars

Slow Button

The slow button selects between the two different speed ranges of the speed bars. When the slow button LED is lit, the slower speed range is selected.

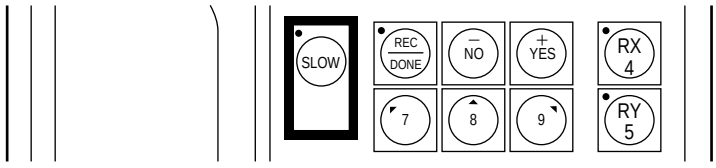


Figure 4-3. SLOW Button

4.2 Robot States

World State

When "world" state is selected, movement in the X, Y, or Z direction is parallel to an axis of the world coordinate system. Before the speed bars will move the robot, an axis of motion must be selected from the manual control buttons. The world coordinate system for a SCARA robot is shown in Figure 4-4. If "X1" is selected, pressing the "+" speed bar will move the robot tool flange in the positive X direction. Pressing the "–" speed bar will move the flange in the negative X direction. The world coordinate system for a Cartesian robot is shown in Figure 4-5. If "X1" is selected, pressing the "+" speed bar will move the robot tool flange in the positive X direction. Pressing the "–" speed bar will move the flange in the negative X direction.

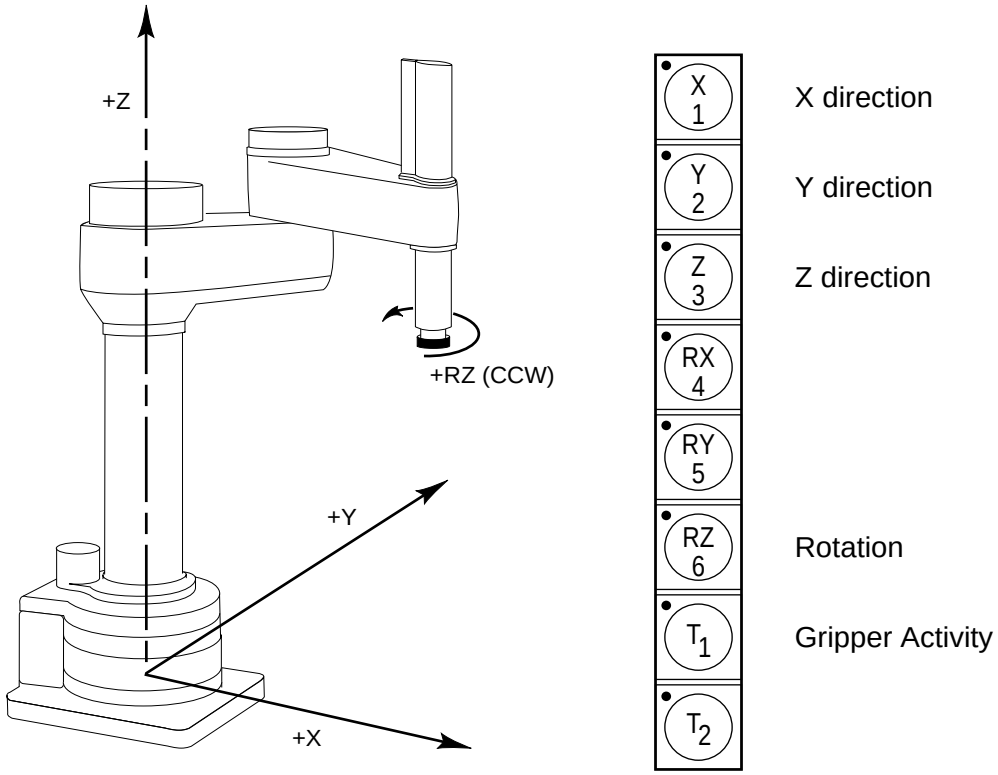


Figure 4-4. WORLD State (SCARA)

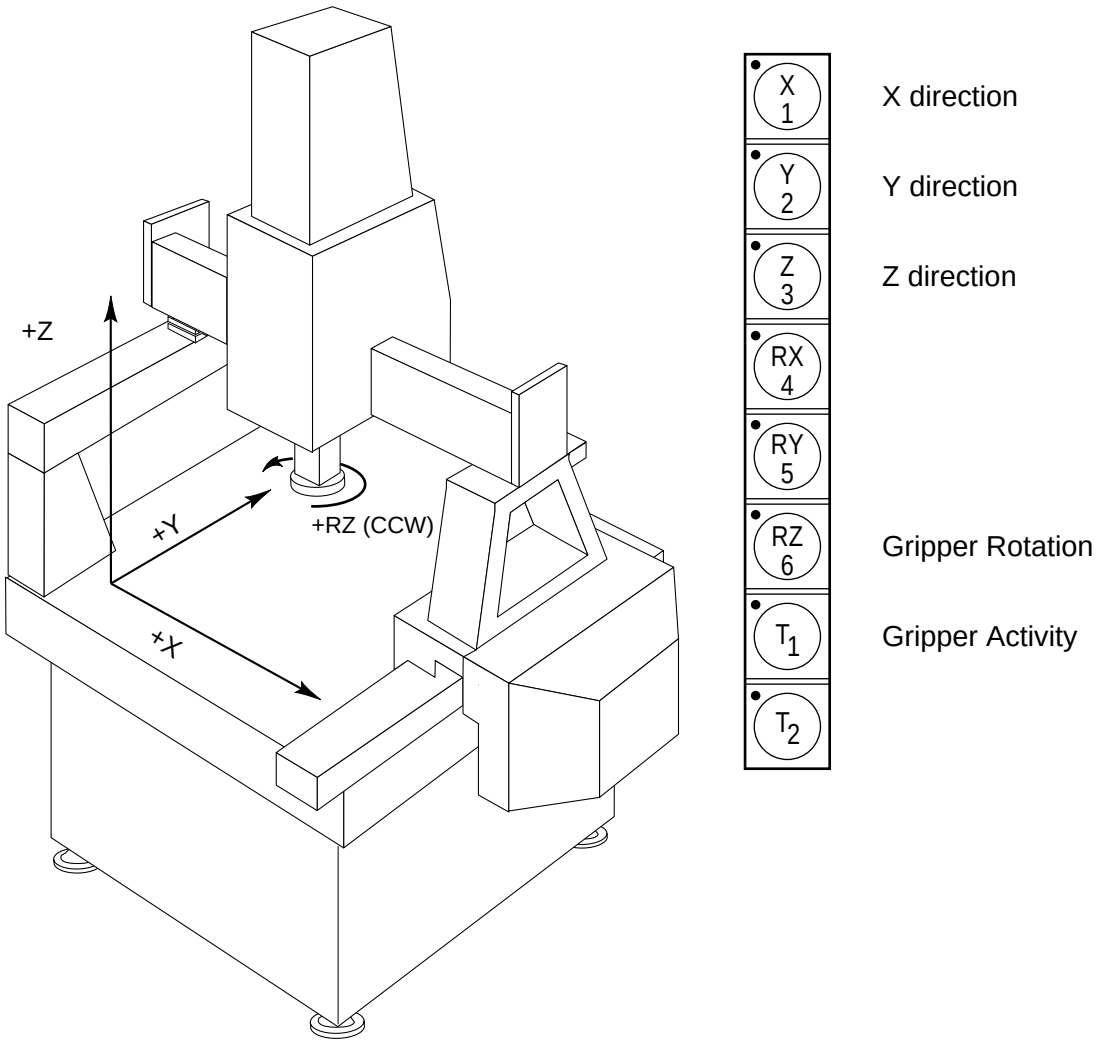


Figure 4-5. WORLD State (Cartesian)

The T_1 button cycles the gripper solenoids. Press anywhere on the "+" side of the speed bar to open the gripper, on the "–" side to close the gripper.

> **NOTE:** This is the most common gripper setup. The gripper solenoids may be configured so they operate differently (or they may not be configured at all). Place your robot in a safe location and cycle the gripper to verify which side of the speed bar opens the gripper.[2]

2. The utility CONFIG_R is used to configure gripper activity. See the *Instructions for Adept Utility Programs*.

Tool State

When "tool" state is selected, movement in the X, Y, or Z direction is along an axis of the tool coordinate system. The tool coordinate system is centered at the robot tool flange with the Z axis pointing away from the flange. The positive X axis is aligned with the center of the tool flange keyway. Before the speed bars will move the robot, an axis of motion must be selected from the manual control buttons. If "X1" is selected, pressing the "+" speed bar will move the robot tool flange in the positive X direction. Pressing the "–" speed bar will move the flange in the negative X direction.

In a four-axis robot, positive rotation of the gripper is clockwise as viewed from above. Figure 4-6 shows the tool state for a four-axis SCARA robot.

Figure 4-7 shows the tool coordinate system on a six-axis robot.

> **NOTE:** Figure 4-6 and Figure 4-7 are drawn with the assumption that the TOOL transformation is set to NULL (all values are 0). If a TOOL transformation is in effect, the tool coordinate system will be offset and rotated by the value of the TOOL transformation. Any motion in tool state will now be relative to the offset coordinate system, and not the center of the tool flange. See the *V and V+ Reference Guide* for details on TOOL transformations.

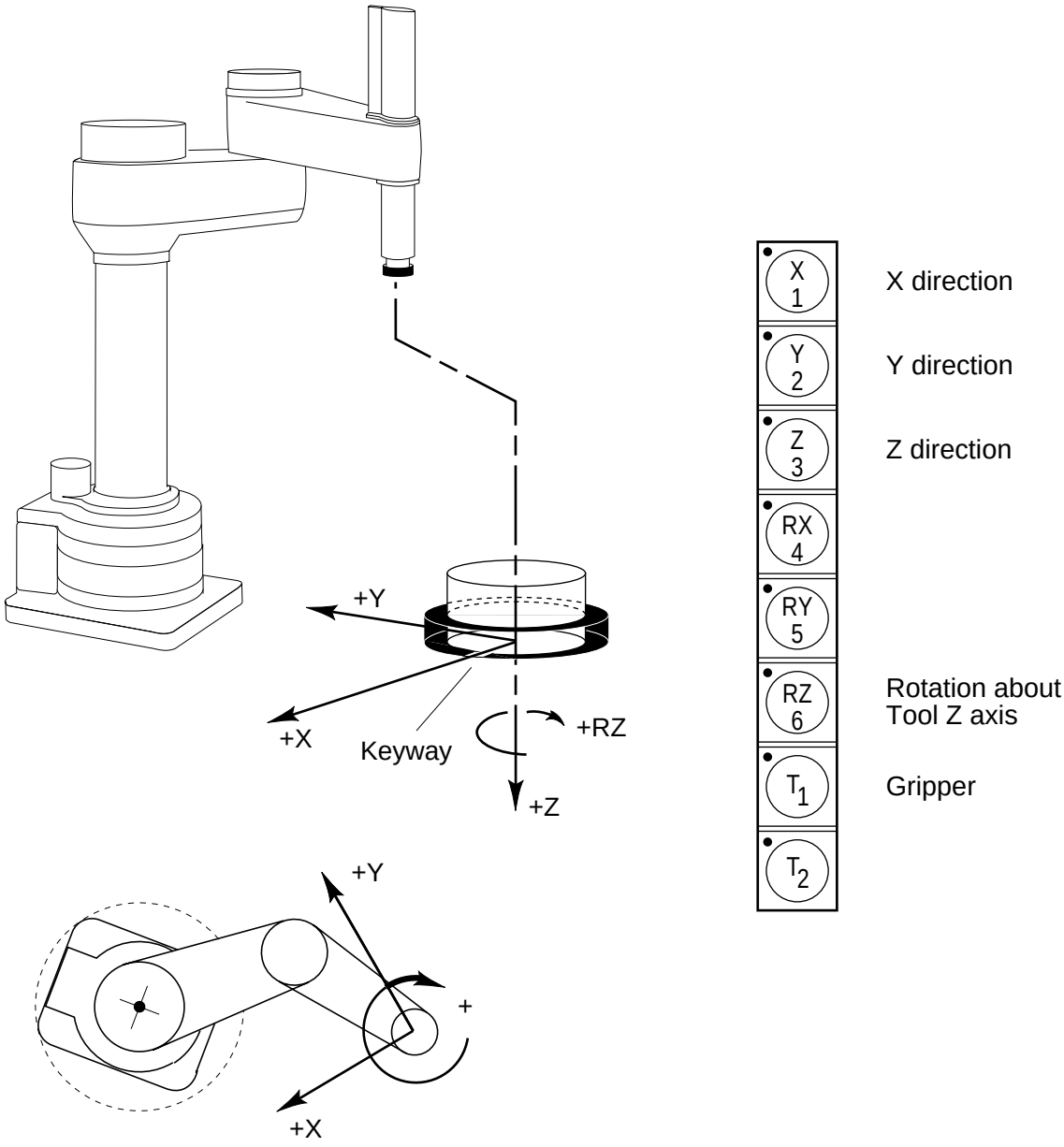


Figure 4-6. TOOL State

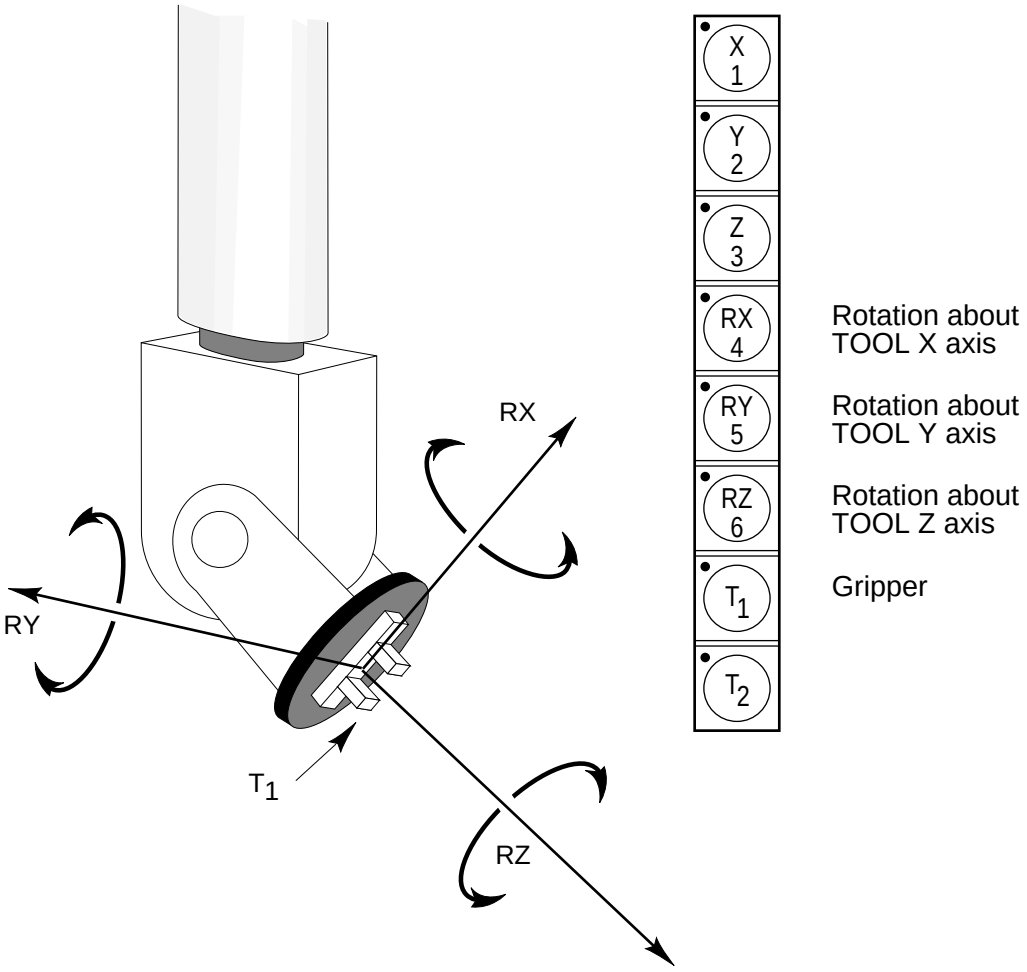


Figure 4-7. TOOL State (Six-Axis Robot)

Joint State

When joint state is selected, movement is about the axis of the specified joint. Figure 4-8 shows an Adept SCARA robot with three rotational joints (joints 1, 2, and 4) and one translational joint (joint 3). Positive rotation of joints 1 & 2 is counter-clockwise as viewed from above. Positive rotation of joint 4 is clockwise as viewed from above. Positive movement of joint 3 is downward. Before the speed bars will move a joint, the correct joint must be selected from the manual control buttons.

Different types of motion devices will have the different joint numbers assigned to their joints. When you first move an unfamiliar robot using joint state, set the monitor speed to 10 or lower, put the robot in a safe area, and carefully move the robot using the different joint numbers to verify how the MCP moves the robot. See the documentation for the motion devices you are using for details on their joint assignments.

Figure 4-9 shows an Adept Cartesian robot with three translational joints and one rotational joint.

Figure 4-10 shows the joint assignments for a typical six-axis robot (as always, the first time you move a robot, carefully verify the joint assignments).

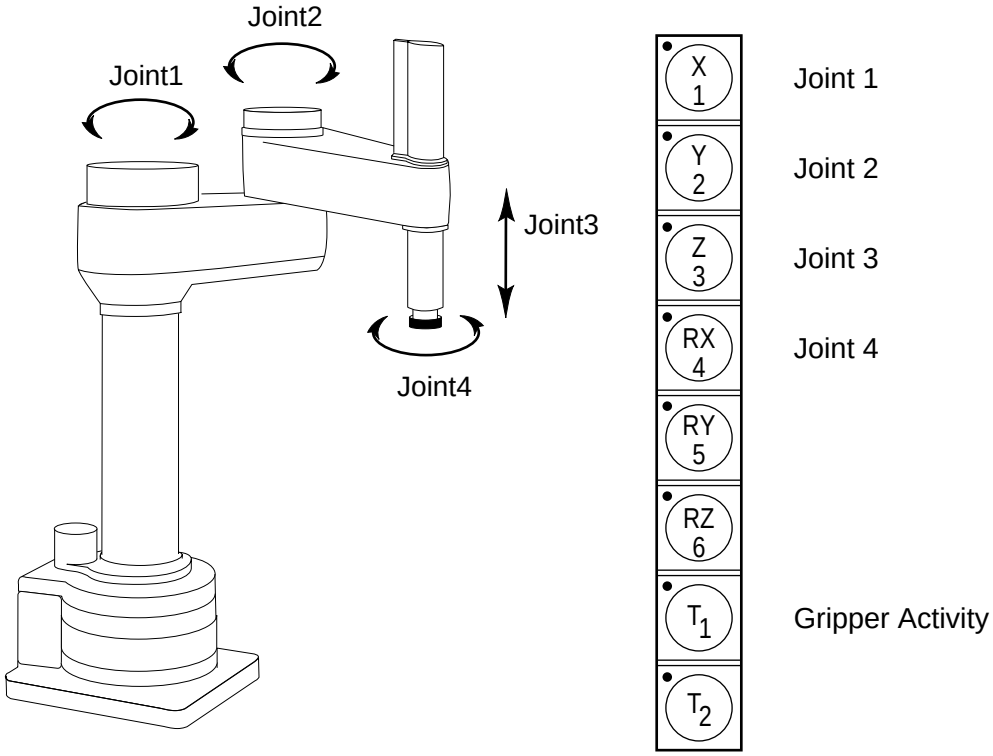


Figure 4-8. JOINT State (SCARA)

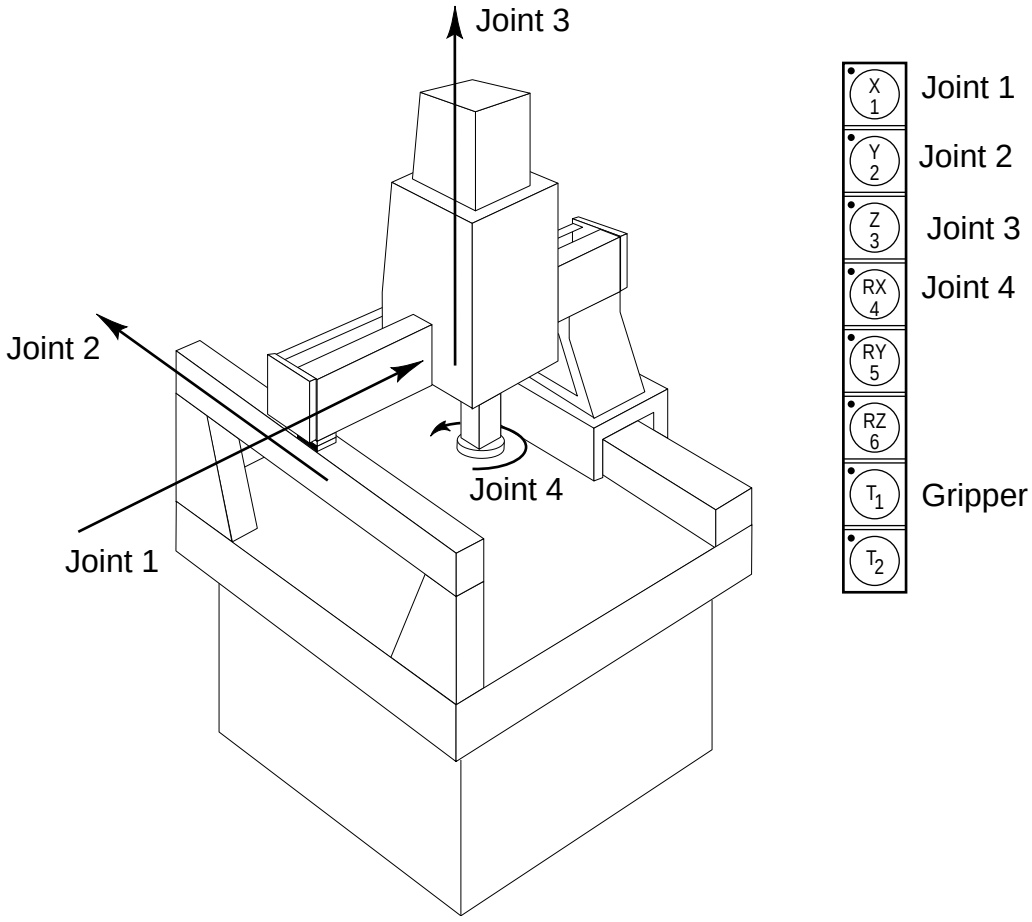


Figure 4-9. JOINT State (Cartesian)

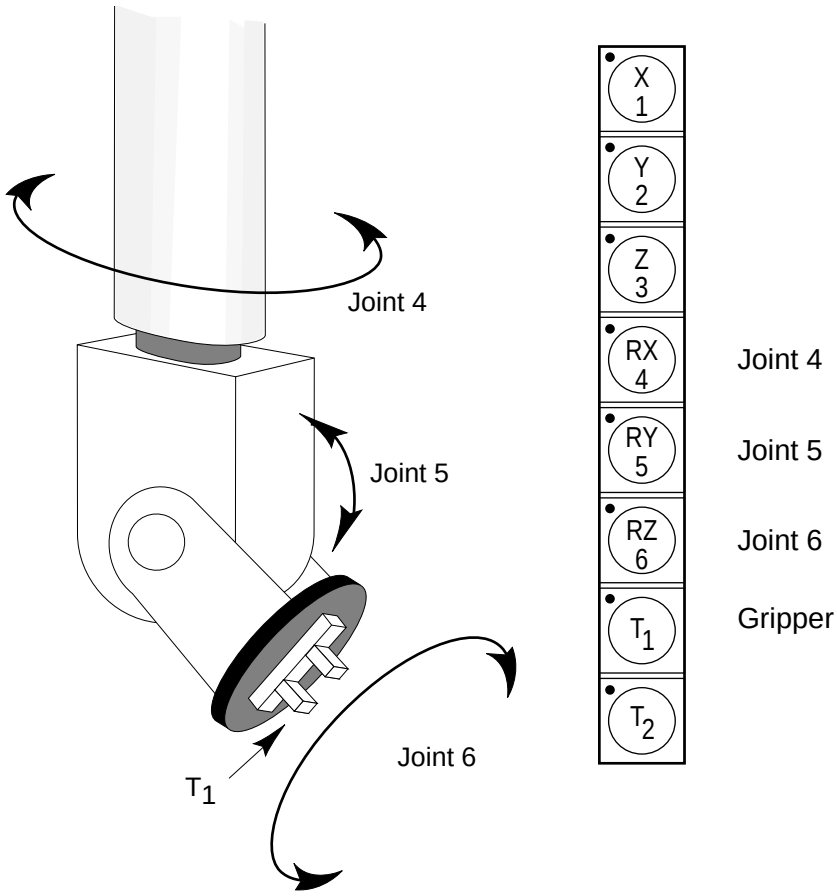


Figure 4-10. JOINT State (Six-Axis Robot)

Free State

When free state is selected, individual joints are freed from servo control, and the robot brakes (if any) are released.[3] Unlike the other states, you can make multiple selections from the manual control buttons to free as many joints as required. In some cases, such as joints 1 & 2 on a SCARA robot, multiple joints are freed by selecting a single button. As soon as the "COMP/PWR" button is pressed, or another selection is made from the manual control buttons, all joints are placed back under servo control and will not move freely.

Figure 4-11 shows the free state for a four-axis SCARA robot.

The joint assignments in the free state are the same as the joint assignments in joint state. See Figure 4-7 for the joint assignments in a typical six-axis robot.

WARNING: As soon as a joint is selected from the manual control buttons, the related joint is free to move (in some cases, multiple joints may be freed up). In many cases the weight on the joint will be sufficient to move the joint and cause damage or harm. For example, when joint 3 on a SCARA or Cartesian robot is freed, the joint is free to fall to the end of its travel. In articulated robots, multiple links of the robot may be free to fall when a single joint is freed up. Be extremely careful when selecting a joint in free mode.

3. On the Adept 604-S robot, the joint 3 brake is never released. To move this joint in free state, you must use enough pressure to overcome the friction brake.

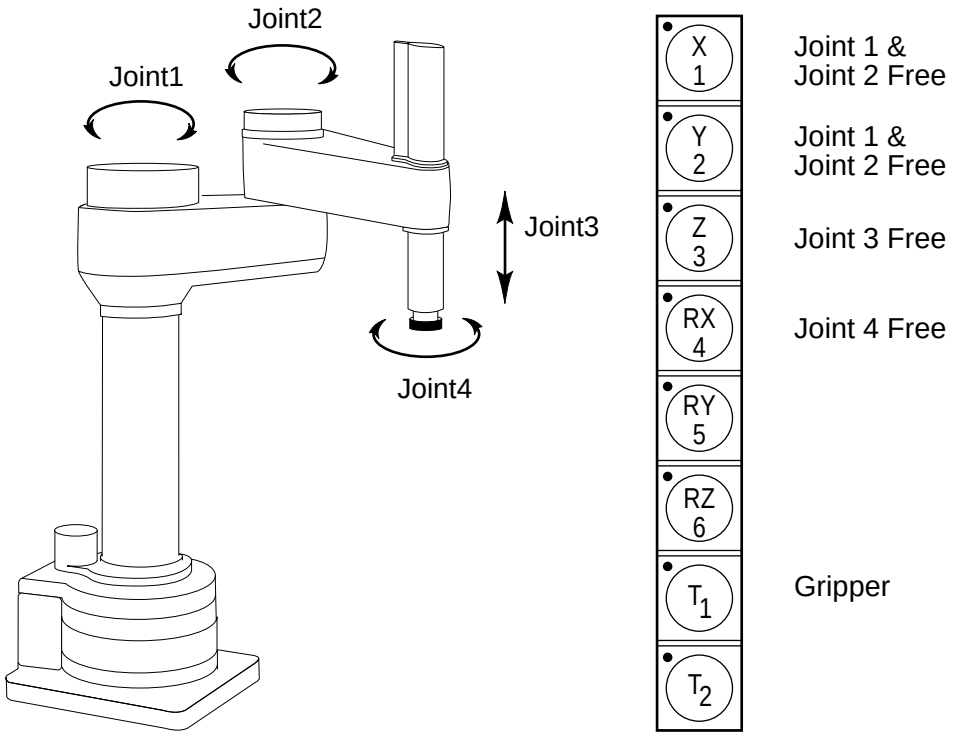


Figure 4-11. FREE State (Four-Axis SCARA)

4.3 Selecting Different Robots

If your system is equipped with more than one robot or motion device, you can select which device the manual control buttons will affect. When manual mode is first entered, device 1 will be selected. To select device number 2, press the DEV/F3 button. Device number 2 will now be selected, and the "DEV 2" light in the manual state LED group will be lit. To select device number 3, press the DEV/F3 button again. Device 3 will be selected, and the "DEV 2" LED will blink. To re-select device 1, press the DEV/F3 button.

Remember: When the "DEV 2" LED is off, device 1 is selected; when it is lit continuously, device 2 is selected; when it flashes, device 3 is selected.