Adept Viper s1700D Robot

User's Guide

adept®

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User's Guide

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1 Introduction

1.1 Product Description

Adept Viper s1700D™ Robots

The Adept Viper s1700D is a high-performance, six-axis robot. Its speed and precision make it ideal for material handling, packaging, machine tending, and many other operations requiring fast and precise automation.

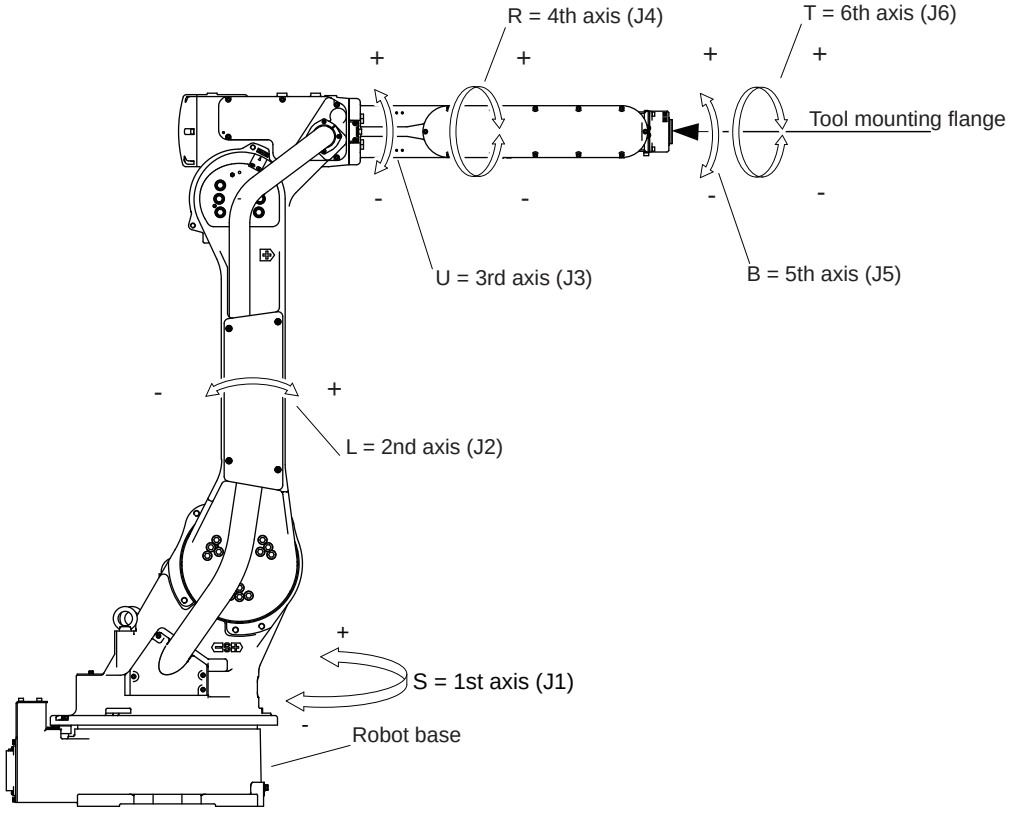


Figure 1-1. Robot Axis Identification

Axis Naming Conventions

The robot's six axes are referred to throughout this documentation as either Axis 1-6 or Joint (J) 1-6. These terms are used interchangeably. For legacy reasons, these axes are labeled on the robot as S-axis, L-axis, U-axis, R-axis, B-axis, and T-axis. The table below shows how these current axis labels correspond to the legacy labels.

Table 1-1. Axis Naming Conventions

Current Axis Labels	Legacy Axis Labels
1st Axis (J1)	S-axis
2nd Axis (J2)	L-axis
3rd Axis (J3)	U-axis
4th Axis (J4)	R-axis
5th Axis (J5)	B-axis
6th Axis (J6)	T-axis

See **Figure 1-1 on page 11** for a drawing that identifies the various axes.

Adept SmartController CX™

The SmartController CX motion controller is the foundation of Adept's family of high-performance distributed motion controllers. The SmartController CX is designed for use with Adept Cobra s600 and s800 robots, Adept Python Modules, Adept Viper robots, Adept Quattro robots, and the Adept sMI6 Module for the SmartMotion product.

The SmartController CX supports a conveyor-tracking option. It offers scalability and support for IEEE 1394-based digital I/O and general motion expansion modules. The IEEE 1394 interface is the backbone of Adept SmartServo, Adept's distributed controls architecture supporting Adept products. The controller also includes Fast Ethernet and DeviceNet.

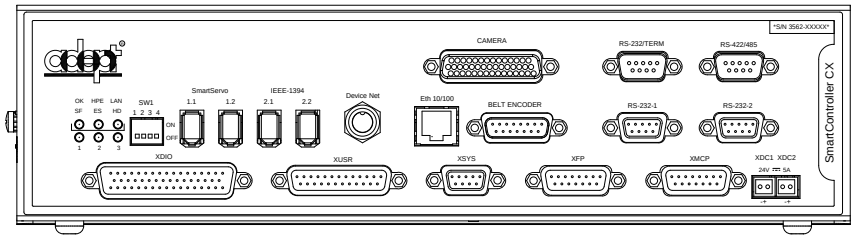


Figure 1-2. Adept SmartController CX Motion Controller

Adept PA-4™ CAT-3 Power Chassis

The PA-4 CAT-3 includes AC-DC power conversion electronics that support a range of Adept power amplifiers and robot control modules. In addition, the PA-4 CAT-3 includes dual (redundant) high-power AC contactors. The PA-4 is configured with H and I Amplifier modules to support the Adept Viper 1700D robot systems.

The H and I amplifiers in the Adept Viper 1700D robot system are controlled by the sDAI (HP) distributed control module. The sDAI module resides in the PA-4 chassis and contains a RISC microprocessor and interface circuitry that close the servo loops for high-performance robot motion. The sDAI is connected to a host Adept SmartController via the SmartServo interface (based on IEEE 1394).

1.2 Dangers, Warnings, Cautions, and Notes

There are six levels of special alert notation used in Adept manuals. In descending order of importance, they are:

DANGER: This indicates an imminently hazardous electrical situation which, if not avoided, will result in death or serious injury.

DANGER: This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: This indicates a potentially hazardous electrical situation which, if not avoided, could result in injury or major damage to the equipment.

WARNING: This indicates a potentially hazardous situation which, if not avoided, could result in injury or major damage to the equipment.

CAUTION: This indicates a situation which, if not avoided, could result in damage to the equipment.

NOTE: Notes provide supplementary information, emphasize a point or procedure, or give a tip for easier operation.

1.3 Safety Precautions

DANGER: The Adept Viper s1700D robot can cause serious injury or death, or damage to itself and other equipment, if the following safety precautions are not observed:

- All personnel who install, operate, teach, program, or maintain the system must read this guide, read the ***Adept Robot Safety Guide***, and complete a training course for their responsibilities in regard to the robot.
- All personnel who design the robot system must read this guide, read the ***Adept Robot Safety Guide***, and must comply with all local and national safety regulations for the location in which the robot is installed.
- The robot system must not be used for purposes other than described in **Section 1.6**. Contact Adept if you are not sure of the suitability for your application.
- The user is responsible for providing safety barriers around the robot to prevent anyone from accidentally coming into contact with the robot when it is in motion.
- Power to the robot and its power supply must be locked out and tagged out before any maintenance is performed.

1.4 What to Do in an Emergency Situation

Press any E-Stop button (a red push-button on a yellow background/field) and then follow the internal procedures of your company or organization for an emergency situation. If a fire occurs, use CO_2 to extinguish the fire.

1.5 Additional Safety Information

Adept provides other sources for more safety information:

Manufacturer's Declaration of Compliance (MDOC)

This lists all standards with which each robot complies. **See "Manufacturer's Declaration" on page 15.**

Adept Robot Safety Guide

The ***Adept Robot Safety Guide*** provides detailed information on safety for Adept robots. It also gives resources for more information on relevant standards.

It ships with each robot manual, and is also available from the Adept Document Library. **See "Adept Document Library" on page 17.**

1.6 Intended Use of the Robot

The Adept Viper s1700D robot is intended for use in parts assembly and material handling for payloads not to exceed 20 kg. See **Chapter 2** for complete information on tooling and payloads.

1.7 Installation Overview

The system installation process is summarized in the following table. Refer also to the system cable diagram in **Figure 3-1 on page 39**.

> **NOTE:** For dual-robot installations, see the ***Adept Viper Dual Robot Configuration Procedure***, which is available in the Adept Document Library.

Table 1-2. Installation Overview

Task to be Performed	Reference Location
1. Mount the robot on a flat, secure mounting surface.	See Section 2.5 on page 26.
2. Install the SmartController, Front Panel, and Adept ACE software.	See Section 3.2 on page 40.
3. Install the PA-4 power chassis.	See Section 3.5 on page 41.
4. Install the IEEE 1394 and XSYS cables between the PA-4 and SmartController.	See Section 3.5 on page 41.
5. Install the Power and Encoder cables between the PA-4 and the robot.	See Section 3.5 on page 41.
6. Connect AC power to the PA-4 power chassis.	See Section 3.6 on page 43.
7. Start the Adept ACE software, connect to the controller, and turn on power to the system.	See Section 4.1 on page 47.

1.8 Manufacturer's Declaration

The Manufacturer's Declaration of Incorporation and Conformity lists all standards for which the Adept Viper robot system complies. It can be found on the Adept Web site, in the Download Center of the Support section.

ftp://ftp1.adept.com/Download-Library/Manufacturer-Declarations/

Each Manufacturer's Declaration is supplied in PDF format and stored on the website in a ZIP archive. To access the PDF document:

1. Click on the appropriate .zip file. You are prompted to Open or Save the file.
2. Click Open to open the file and display the archive contents.

3. Double-click on a .pdf file to open it.

1.9 How Can I Get Help?

Refer to the *How to Get Help Resource Guide* (Adept P/N 00961-00700) for details on getting assistance with your Adept software and hardware. Additionally, you can access information sources on Adept's corporate web site:

http://www.adept.com

- For Contact information:
  http://www.adept.com/contact/americas
  http://www.adept.com/contact/asiapacific-rim
  http://www.adept.com/contact/europe
- For Product Support information:
  http://www.adept.com/support/service-and-support/main
- For user discussions, support, and programming examples:
  http://www.adept.com/forum/
- WEEE/RoHS, Policy:
  ftp://ftp1.adept.com/Download-Library/Regulatory/
- WEEE Drop-off Sites:
  http://www.adept.com/contact/americas
  http://www.adept.com/contact/asiapacific-rim
  http://www.adept.com/contact/europe

  The Download Center (ID # 500080) provides Adept WEEE/RoHS Policy. The Contact area of the web site gives locations of WEEE drop-off sites.

Related Manuals

This manual covers the installation, operation, and maintenance of an Adept Viper s1700D robot system. There are additional manuals that cover programming the system, reconfiguring installed components, and adding other optional components; see **Table 1-3**. These manuals are available on the Adept Document Library CD-ROM shipped with each system.

Table 1-3. Related Manuals

Manual Title	Description
Adept Robot Safety Guide	Contains safety information for Adept robots.
Adept SmartController User's Guide	Contains complete information on the installation and operation of the Adept SmartController and the optional sDIO product.
Adept PA-4 Power Chassis User's Guide	Contains complete information on the installation and operation of the PA-4 Power Chassis.
Adept T2 Pendant User's Guide	Describes the Adept T2™ pendant product.

Table 1-3. Related Manuals (Continued)

Manual Title	Description
Adept IO Blox User's Guide	Describes the IO Blox™ product.
Adept Viper Dual Robot Configuration Procedure	Contains cable diagrams and configuration procedures for a dual-robot system.
Instructions for Adept Utility Programs	Describes the utility programs used for advanced system configurations, system upgrades, file copying, and other system configuration procedures.
V+ Operating System User's Guide	Describes the V+ operating system, including disk file operations, monitor commands, and monitor command programs.
V+ Language User's Guide	Describes the V+ language and programming of an Adept control system.

Adept Document Library

The Adept Document Library (ADL) contains documentation for Adept products. You can access the ADL from:

- the Adept Software CD shipped with your system
- the Adept Web site. Select Document Library from the Adept home page. To go directly to the Adept Document Library, type the following URL into your browser:

  http://www.adept.com/Main/KE/DATA/adept_search.htm

To locate information on a specific topic, use the Document Library search engine on the ADL main page. To view a list of available product documentation, select the Document Titles option.

2 Robot Installation

2.1 Unpacking and Inspecting the Adept Equipment

Before Unpacking

Carefully inspect all shipping crates for evidence of damage during transit. Pay special attention to tilt and shock indication labels on the exteriors of the containers, if installed. If any damage is indicated, request that the carrier's agent be present at the time the container is unpacked.

Upon Unpacking

Before signing the carrier's delivery sheet, please compare the actual items received (not just the packing slip) with your equipment purchase order and verify that all items are present and that the shipment is correct and free of visible damage.

If the items received do not match the packing slip, or are damaged, do **not** sign the receipt. Contact Adept as soon as possible.

If the items received do not match your order, please contact Adept immediately.

Inspect each item for external damage as it is removed from its container. If any damage is evident, contact Adept (see **Section 1.9 on page 16**).

Retain all containers and packaging materials. These items may be necessary to settle claims or, at a later date, to relocate equipment.

2.2 Environmental and Facility Requirements

The Adept robot system installation must meet the operating environment requirements shown in Table 2-1.

Table 2-1. Robot System Operating Environment Requirements

Item	Condition
Flatness of the mounting surface	0.5 mm or less
Installation type	Floor-mount or inverted (ceiling-mount)
Ambient temperature	During operation: 0° to 45° C (32° to 113° F) During storage and transportation: -10° to 60° C (14° to 140° F)
Humidity	During operation: 20 to 80% (no moisture at constant temperature allowed). During storage and transportation: 75% or less (non-condensing).
Vibration	During operation: 4.9 m/s^2 (0.5G) or less During storage and transportation: 29.4 m/s^2 (3G) or less
Safe Installation Environment	The robot should not be installed in an environment where: • there are flammable gases or liquids • there are any acidic, alkaline, or other corrosive gases • there is sulfuric or other types of cutting or grinding oil mist, or • there are any large-sized inverters, high-output/high-frequency transmitters, large contactors, welders, or other sources of electrical noise • there are any shavings from metal processing or other conductive material flying about • it may be directly exposed to water, oil, or cutting chips
Working space, etc.	• Sufficient service space must be available for inspection and disassembly. • Keep wiring space (230 mm or more) behind the robot, and fasten the wiring to the mounting face or beam so that the weight of the cables will not be directly applied to the connectors.
Installation conditions	Grounding resistance: 100 milliohms or less See Section 2.6 on page 30.

2.3 Transporting the Robot

Precautions

When transporting the robot, note the following:

- Check that the eyebolts are securely fastened.
- Use a wire sling or forklift that is strong enough to withstand the weight. (The weight of the robot is approximately 268 kg (590 lb) including the shipping bolts and brackets.)
- Attached eyebolts are designed to support the robot's weight. Do not use them for anything other than transporting the robot.
- Mount the shipping bolts and brackets for transporting the robot. See **Figure 2-1 on page 22**.
- Avoid exerting force on the arm or motor unit when transporting.
- Have at least two workers transport and install the robot.
- Workers should wear helmets, safety shoes, and gloves during transport.

CAUTION: Sling and crane or forklift operations must be performed by authorized personnel only.

CAUTION: Avoid excessive vibration or shock during transporting. The system consists of precision components, so failure to observe this caution my adversely affect performance.

DANGER: Pass the hoisting wires through the specified eyebolts as illustrated below. Passing them through other sections may drop the robot unit, resulting in injuries to personnel or damage to the robot.

Using a Crane

As a rule, when removing the robot from the package and moving it, a crane should be used. The robot should be lifted using wire slings threaded through the attached eyebolts. Make sure the robot is fixed with shipping bolts and brackets before transporting, and lift it into the position shown in **Figure 2-1 on page 22**.

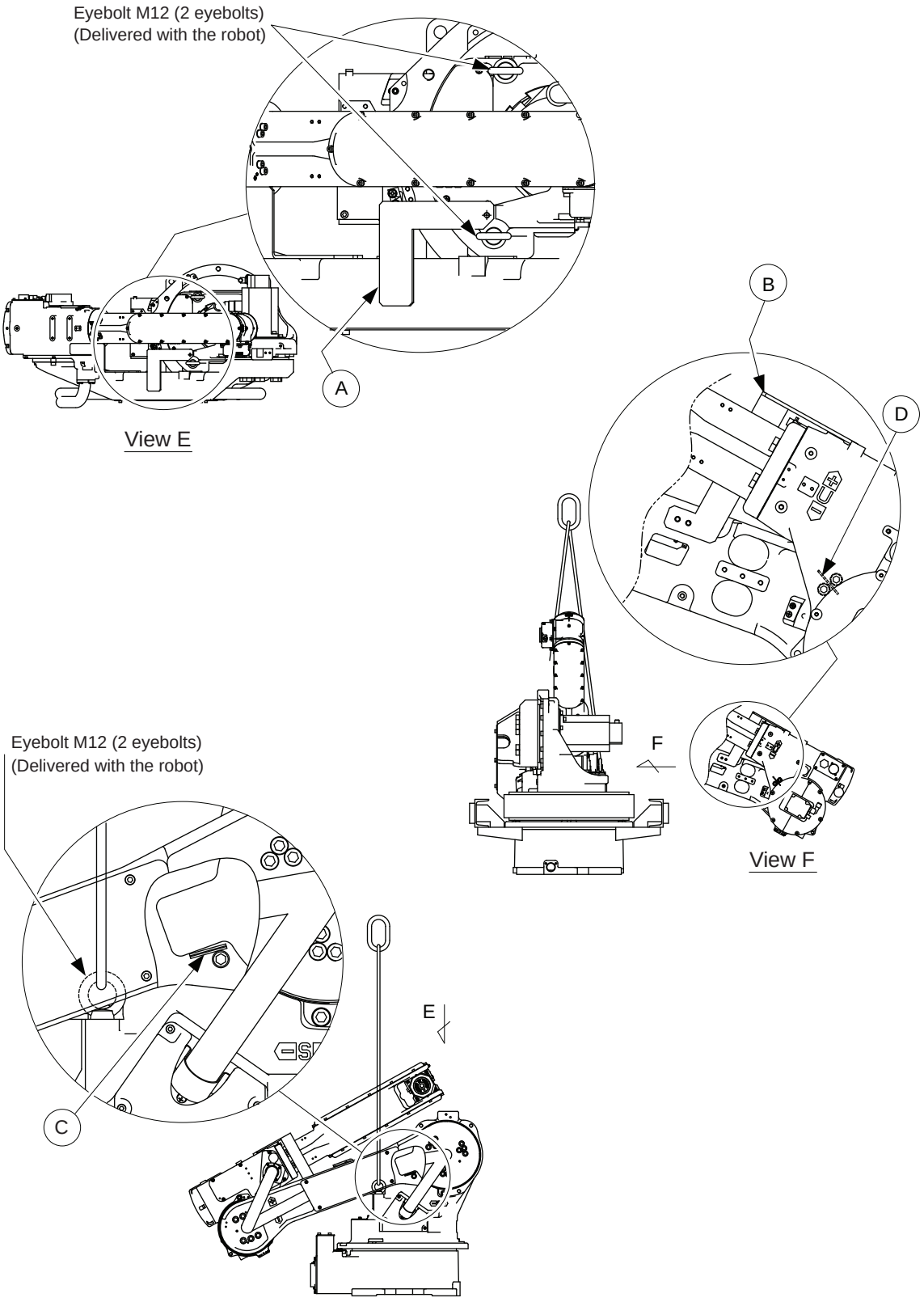


Figure 2-1. Robot in Hoisting Sling

Using a Forklift

When using a forklift, the robot should be fixed on a pallet with shipping bolts and brackets, as shown in **Figure 2-2**. Insert the forklift blades under the pallet and lift it. The pallet must be strong enough to support the robot. Transportation of the robot must be performed slowly in order to avoid overturning, slippage, or damage.

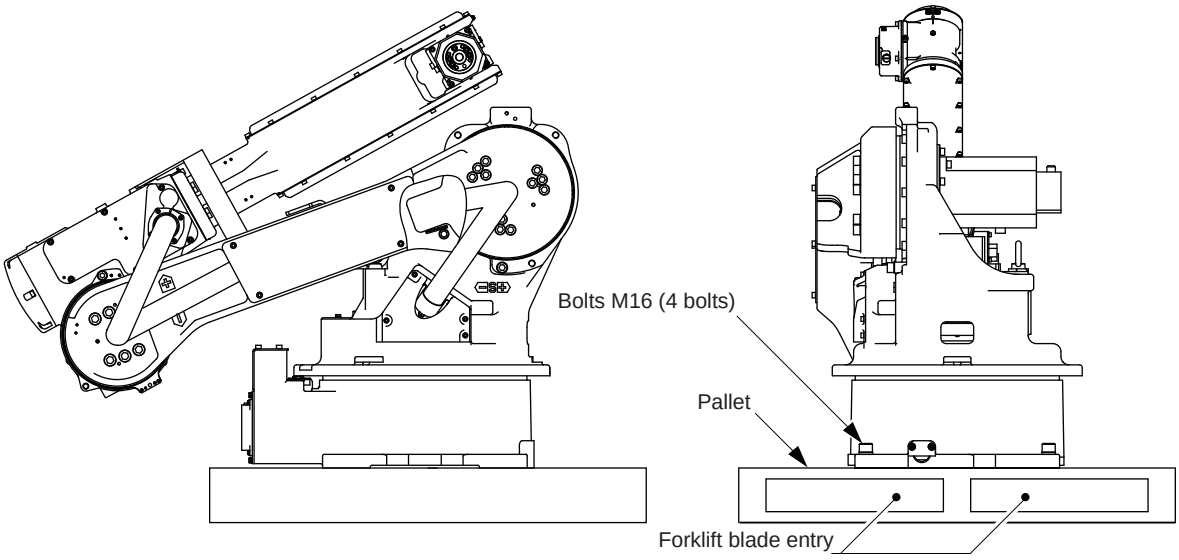


Figure 2-2. Using a Forklift

2.4 Shipping Bolts and Brackets

The robot is provided with shipping bolts and brackets at points A and B (see **Figure 2-3**).

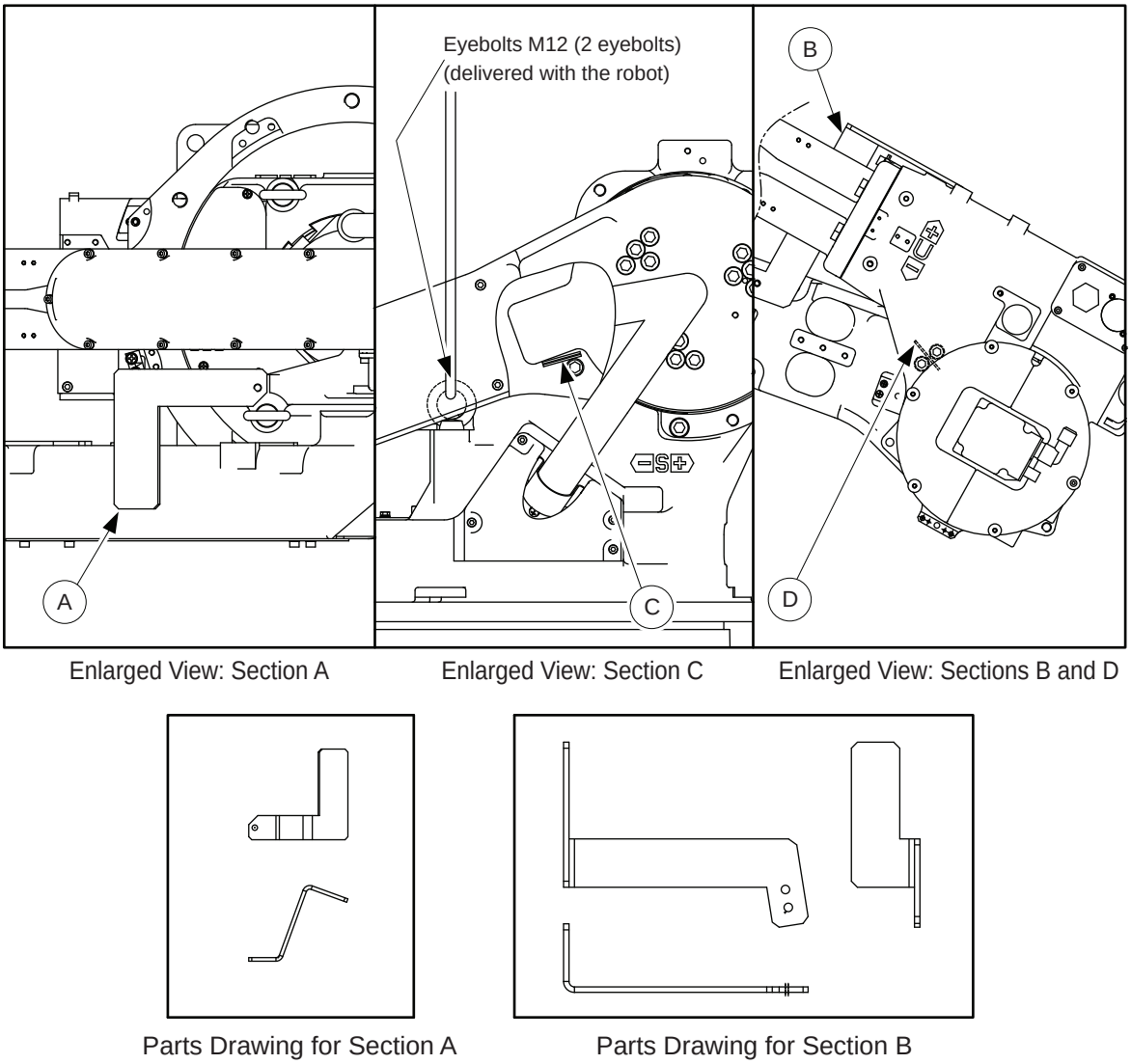


Figure 2-3. Shipping Bolts and Brackets

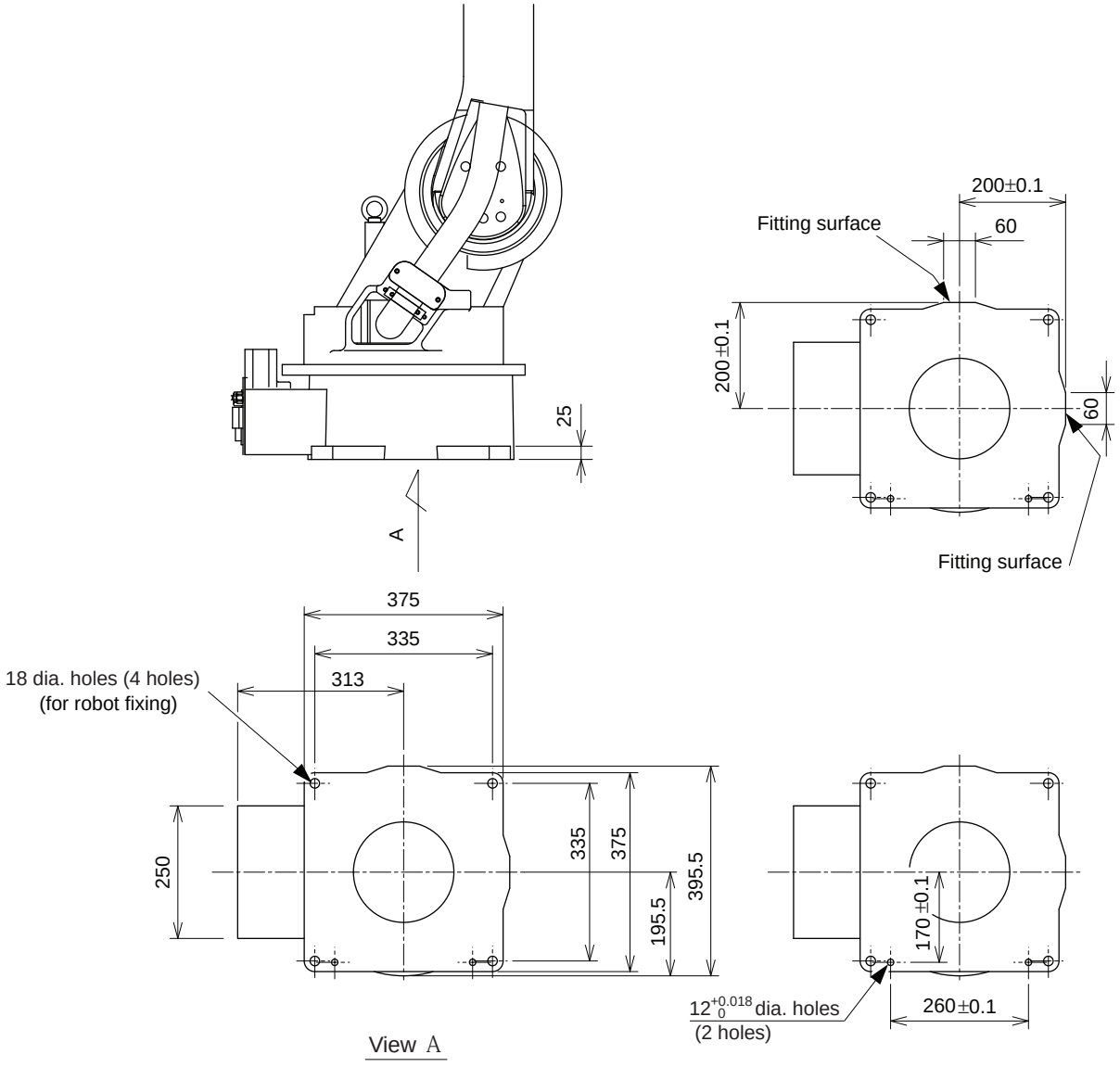
- The shipping brackets (A and B) are painted yellow (see **Figure 2-3 on page 24**).
- A hexagon socket head cap screw (M8) is attached at point A, and two hexagon socket head cap screws (M6) are attached at point B, as fixing jigs (see **Figure 2-3 on page 24**).
- A rubber cushion is wedged at points C and D (see **Figure 2-3 on page 24**).

CAUTION: Before turning on the power, make sure that the robot is securely mounted to its mounting base and that the shipping bolts, brackets, and rubber cushions have been removed. Then store these parts for future use (in the event that the robot must be moved again).

2.5 Mounting the Robot

Types of Mounting

The robot can be mounted in two different ways: floor-mounted (standard) and ceiling-mounted types are available. For ceiling mounting, see also **"Mounting on a Ceiling" on page 29**.



Units: mm

Figure 2-4. Robot Base Dimensions

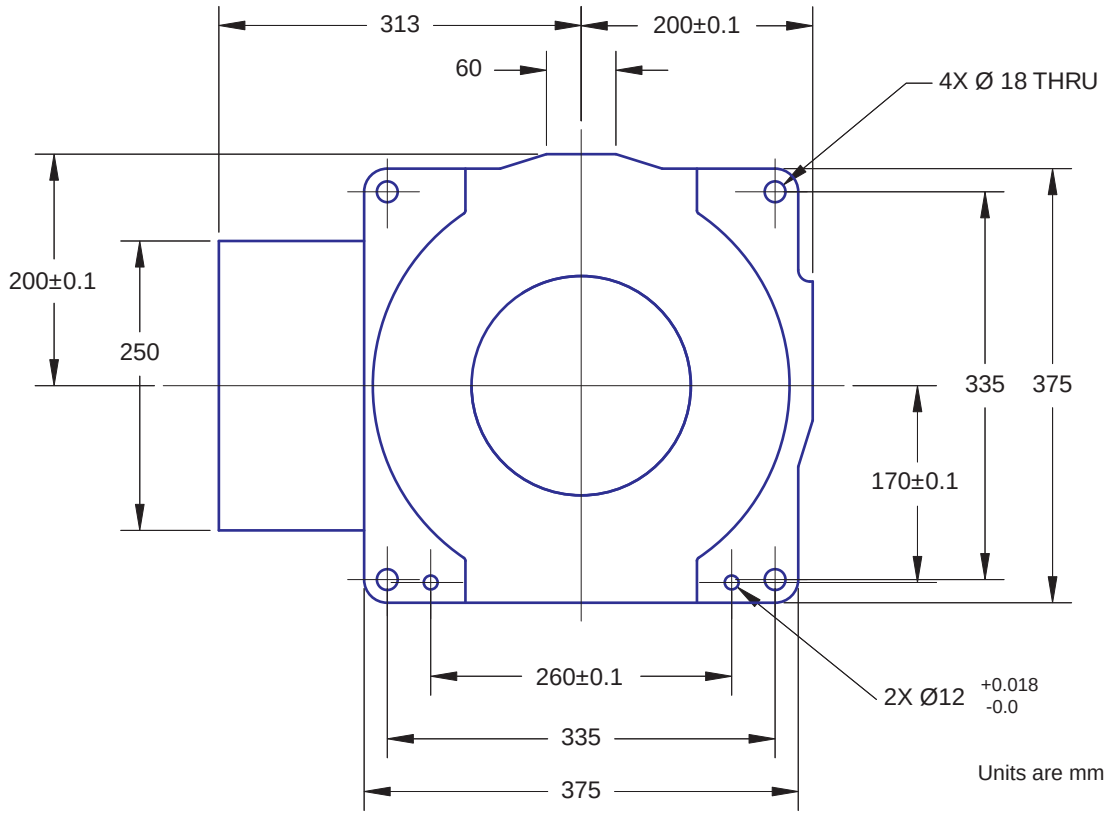


Figure 2-5. Mounting Hole Pattern for Robot

Mounting the Robot Base

Mount the robot on a base or foundation strong enough to support the robot and withstand repulsion forces during acceleration and deceleration. Refer to **Table 2-2** and **Table 2-3** to construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the robot. During installation, if the flatness is not correct, the robot shape may change and its functional ability may be compromised. The flatness for installation must be kept at 0.5 mm or less. Mount the robot base as described below.

Table 2-2. Maximum Repulsion Forces of Robot at Emergency Stop

Maximum horizontal rotating torque (direction of motion Axis 1)	8000 N•m (5900 ft•lbf)
Maximum vertical rotating torque (direction of motion Axes 2 and 3)	5000 N•m (3688 ft•lbf)

Table 2-3. Endurance Torque in Operation

Maximum horizontal torque (direction of motion Axis 1)	1700 N•m (1254 ft•lbf)
Maximum vertical torque (direction of motion Axes 2 and 3)	3775 N•m (2784 ft•lbf)

1. Fix the base plate with the anchor bolts on the floor. The base plate should be rugged and durable. It is recommended that the thickness of the base plate be 32 mm or more and the anchor bolt size be M16 or larger.
2. Fix the robot base with the hexagon socket head cap screws on the base plate.
3. There are four mounting holes on the robot base. Fix the robot securely with the hexagon socket head cap screws M16 (60 mm long recommended; tensile strength: 1200 N/mm^2 or above). Tighten the bolts to 206 N•m torque.

   NOTE: Tighten the anchor bolts and hexagon socket head cap screws securely so that they do not work loose during operation.

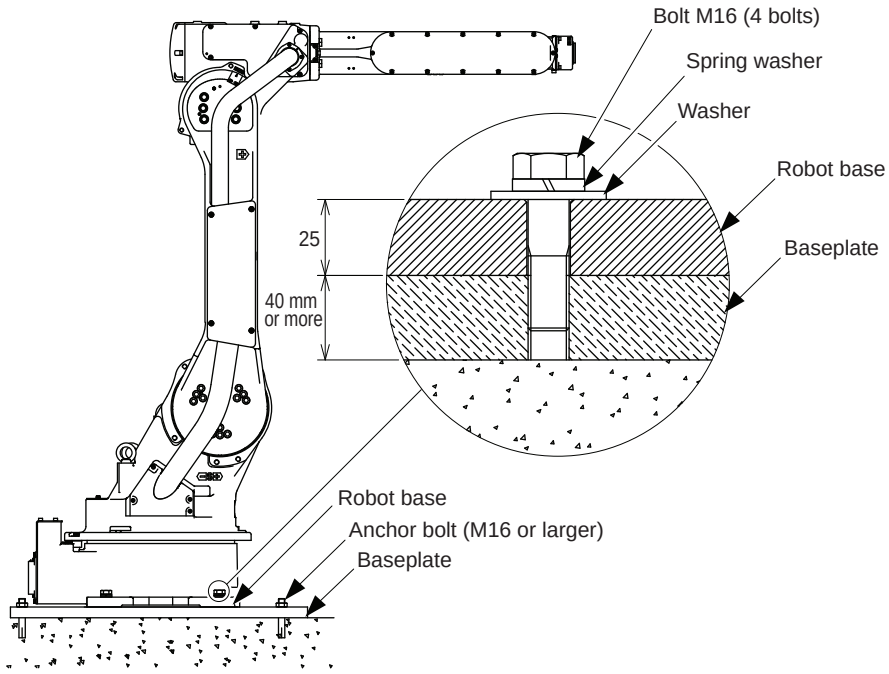


Figure 2-6. Mounting the Robot Baseplate

NOTE: See **Figure 2-5 on page 27** for the mounting hole pattern.

Mounting on a Ceiling

NOTE: For ceiling-mounted installations, contact Adept.

For ceiling-mounted types, the following points apply:

- Affixing the robot base
- Precautions to prevent the robot from falling

See the sections below for details.

NOTE: For ceiling mounted installations, environmental resistance for the main part of the robot does not conform to IP-54. For the wrist part, the resistance conforms to IP-67.

Affixing the Robot Base

When performing a ceiling mount, use four M16 hexagon socket head cap screws (tensile strength: 1200 N/mm^2). Tighten to a torque of 206 N•m.

Precautions to Prevent the Robot from Falling

When performing a ceiling mount, for safety purposes, take measures to keep the robot from falling. See **Figure 2-7** for details.

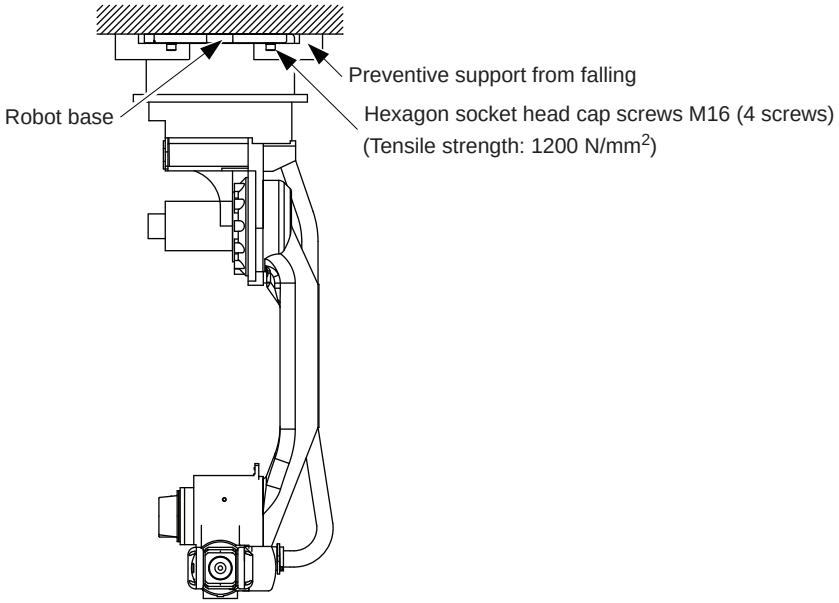


Figure 2-7. Ceiling Mounting

2.6 Grounding the Robot

DANGER: Ground the grounding terminal of the robot unit with a wire of 5.5 mm^2 or more. Ground resistance must be less than 100 milliohms.

NOTE: Use a dedicated grounding wire and grounding electrode. Do not share them with any other electric power or power equipment, such as a welder. When metal ducts, metallic conduits, or distributing racks are used for laying cable, ground in accordance with Electric Equipment Technical Standards.

WARNING: Wiring must be performed by authorized or certified personnel. Failure to observe this caution may result in fire or electric shock.

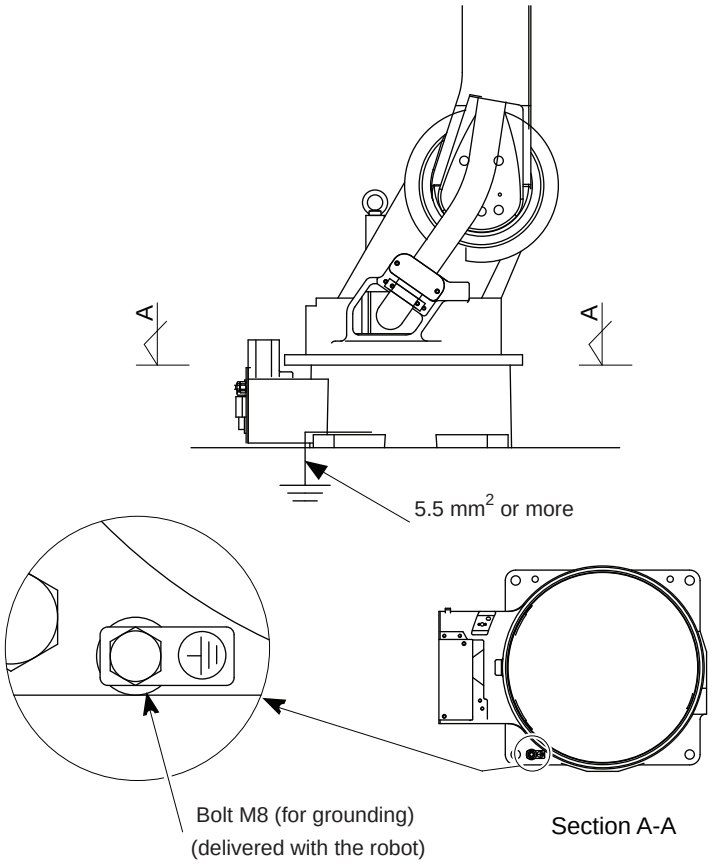


Figure 2-8. Ground Point on Robot

2.7 Connectors on Robot Interface Panel

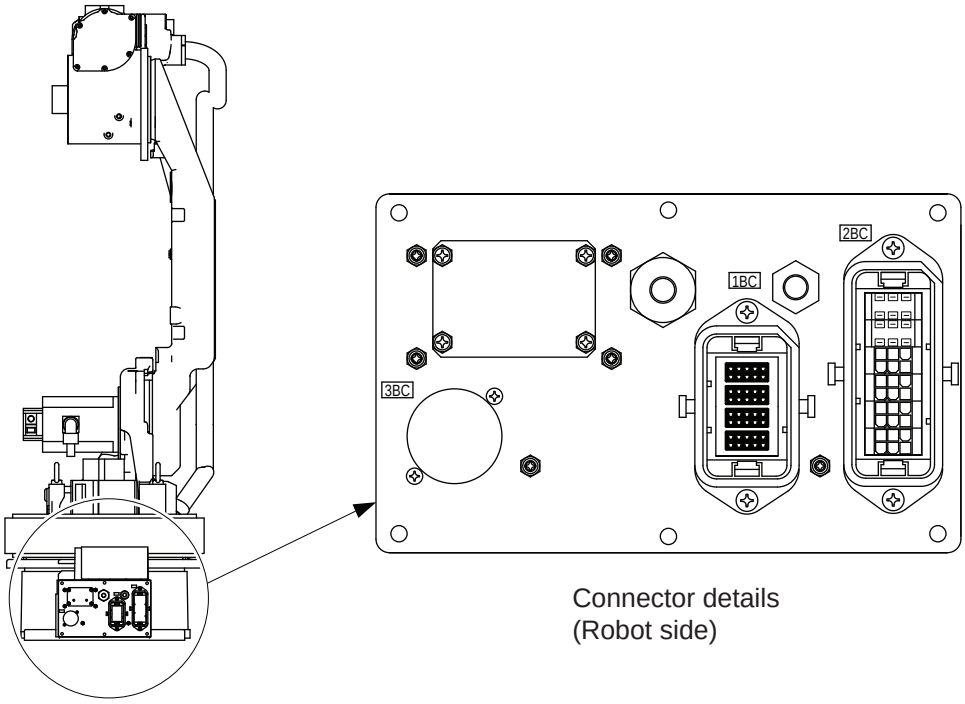


Figure 2-9. Robot Interface Panel

1BC - the Encoder cable from the PA-4 is installed at this connector.

2BC - the Power cable from the PA-4 is installed at this connector.

3BC - Internal user I/O wiring harness (0.2 mm^2 x 10 conductors and 1.25 mm^2 x 6 conductors). Pins 1 to 16 are wired directly to corresponding pins 1 to 16 on the upper arm. The connector pins are assigned as shown in **Figure 2-11 on page 33**. The user must perform the wiring. The allowable current for cables is 3 A or less for each cable. The total current value for pins 1 to 16 must be 40 A or less. See also **Figure 2-10 on page 33**.

AIR inlet - air piping connector (PT 3/8 with pipe plug) for driving peripheral devices on the upper arm. See also **Figure 2-10 on page 33**. The maximum pressure for the air lines is 490 kPa (4.9 Bar) or less. The inside diameter is 6.5 mm.

2.8 Air Lines and Signal Wiring

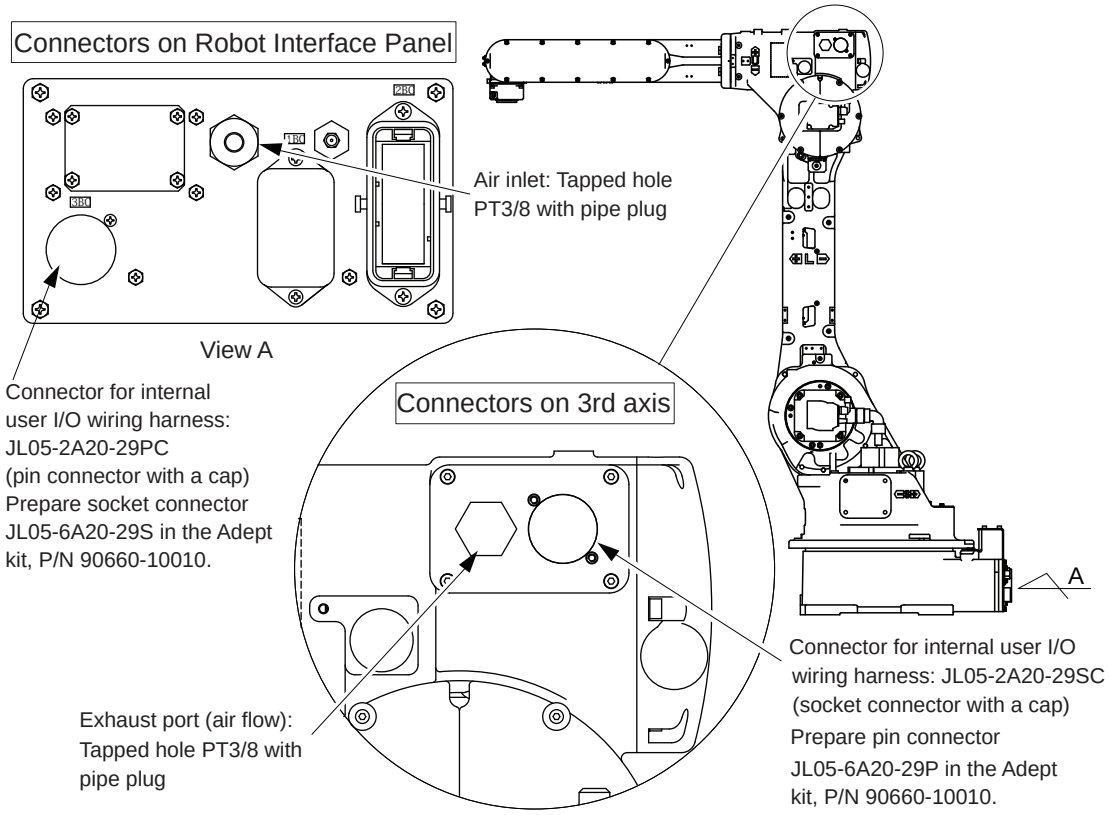


Figure 2-10. Internal User I/O Wiring Harness and Air Line

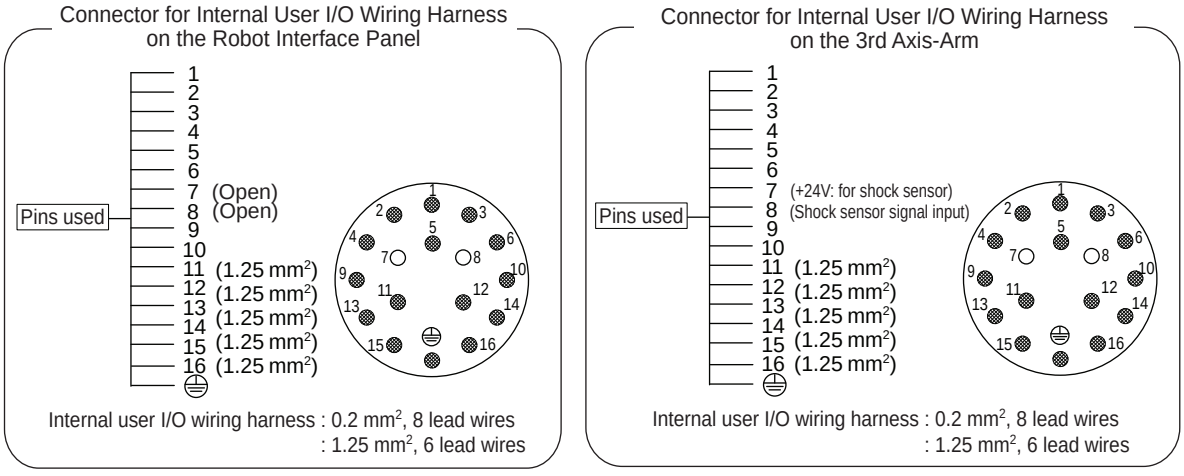


Figure 2-11. Connector Pin Numbers

External Mounting Locations on Robot

When attaching external equipment to the 3rd axis, install the equipment as described in this section.

Allowable Load

The maximum allowable load on the 3rd axis is 31 kg, including the wrist load. For example, when the mass installed on the wrist point is 20 kg, the allowable mass that can be installed on the upper arm is 11 kg.

Installation Position

Observe the limitations on the installation position shown in **Figure 2-12**. **Figure 2-13** shows the distance between the center of the 3rd-axis rotation and the load gravity.

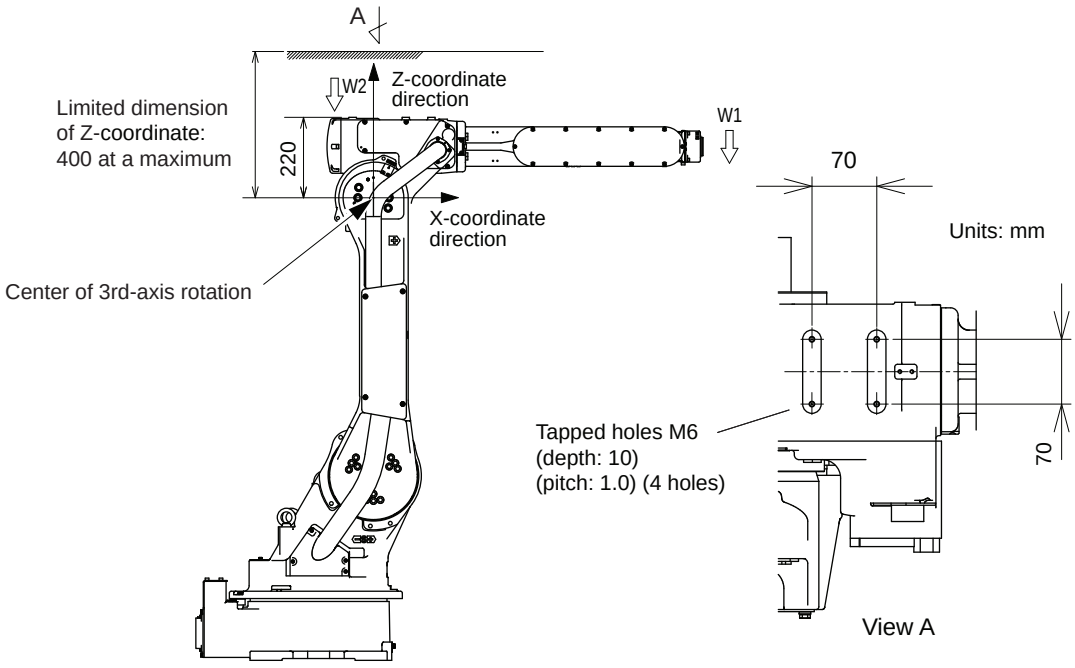


Figure 2-12. Installing External Equipment Mounts

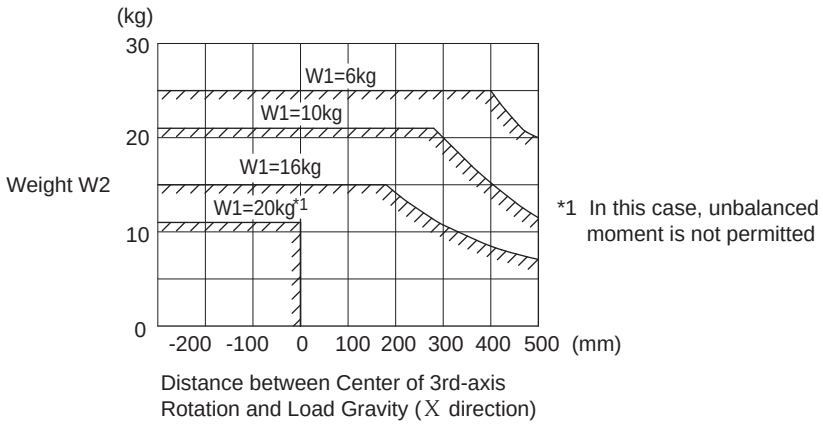


Figure 2-13. Allowable Load on Third Axis

2.9 Designing End-Effectors

Design an end-effector such that it is in compliance with items described in this section.

CAUTION: If the end-effector design precautions are not observed, the clamped parts of the robot may become loose, rattle, or be out of position. In the worst case, the mechanical parts of the robot and robot controller may become damaged.

Mass of End-Effector

Design the end-effector so that the total mass of the end-effector (including workpiece) will be lighter than the maximum payload capacity of the robot. The total mass includes the wiring, tubing, etc.

Maximum total mass of the end-effector (including workpiece) must be less than or equal to the maximum payload capacity (20 kg).

If force is applied to the 5th axis instead of the payload, force on the 4th, 5th, and 6th axes should be within the values shown in **Table 2-4**. Contact Adept Customer Service for additional information.

Table 2-4. Allowable Moment and Inertia

Axis	Moment N•m (ft•lbf)[a]	Inertia kg•m^2
4th axis	39.2 (29.0)	1.05
5th axis	39.2 (29.0)	1.05
6th axis	19.6 (14.5)	0.75

[a] (): Gravitational unit

When the volume load is small, refer to the moment arm rating shown in **Figure 2-14**.

The allowable inertia is calculated when the moment is at the maximum. Contact Adept Customer Service when only load moment is small and inertia moment is large. Also, contact Customer Service when the load mass is combined with an outside force.

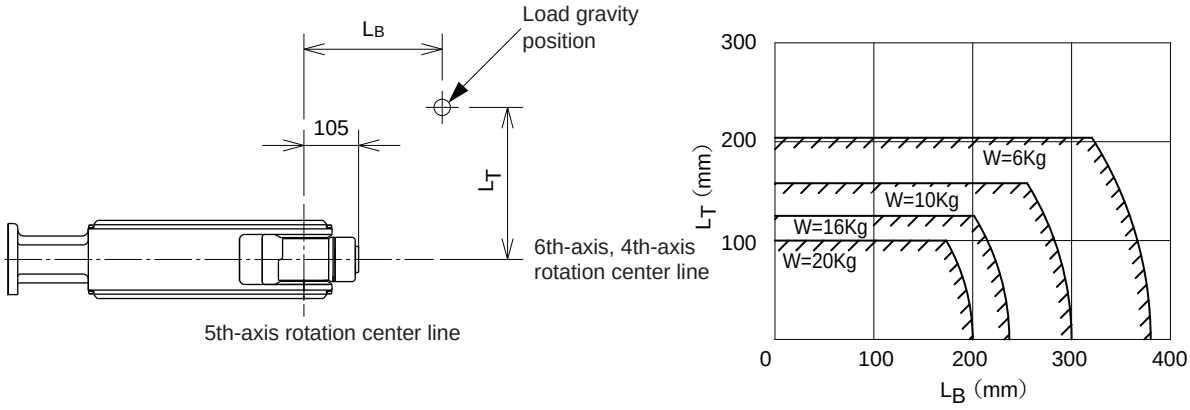


Figure 2-14. Moment Arm Rating

Wrist Tool Flange

See **Figure 2-15** for the dimensions of the wrist tool flange. To see the alignment marks, it is recommended that the attachment be mounted inside the fitting. The fitting depth of the inside and outside fittings must be 5 mm or less.

NOTE: Use thinner or light oil to clean off the anti-corrosive material on the tool flange area prior to mounting the end-of-arm tooling.

NOTE: Mount the attachment with the mounting bolts (length: 10 mm or less). Failure to due this may affect robot performance.

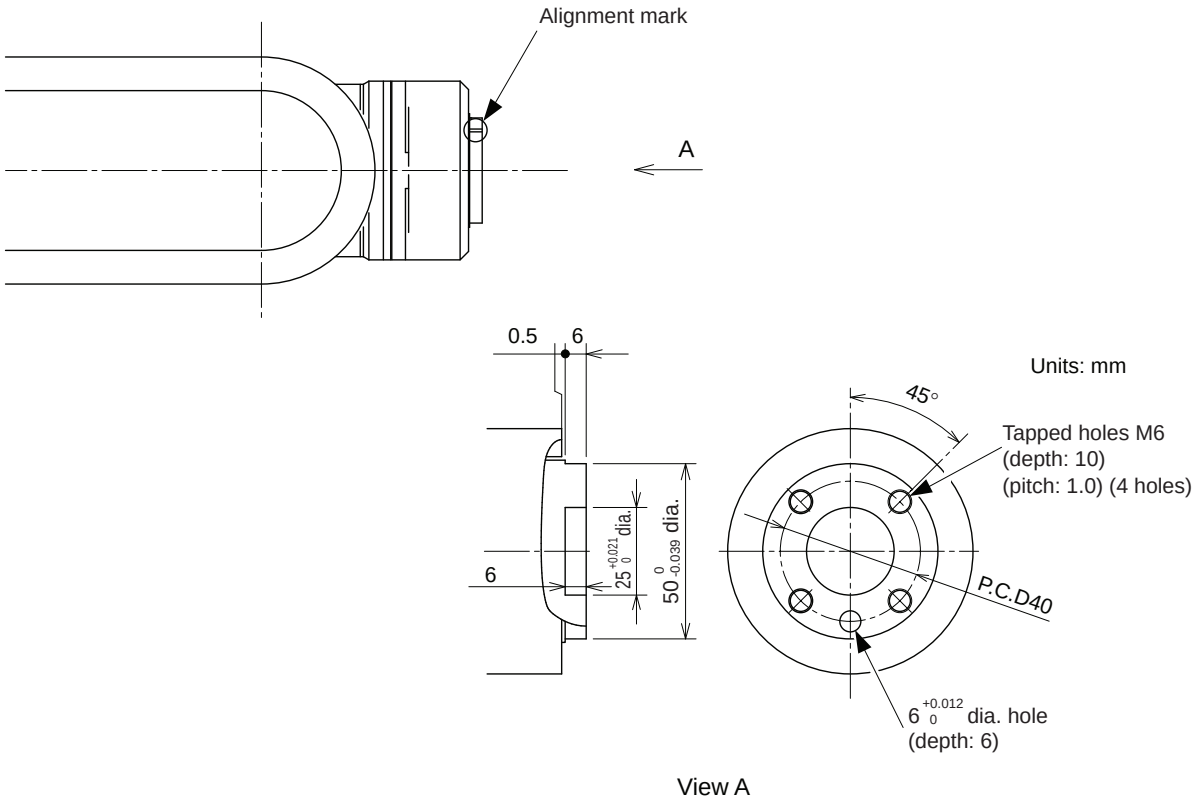


Figure 2-15. Wrist Tool Flange

3 System Installation

3.1 System Cable Diagram

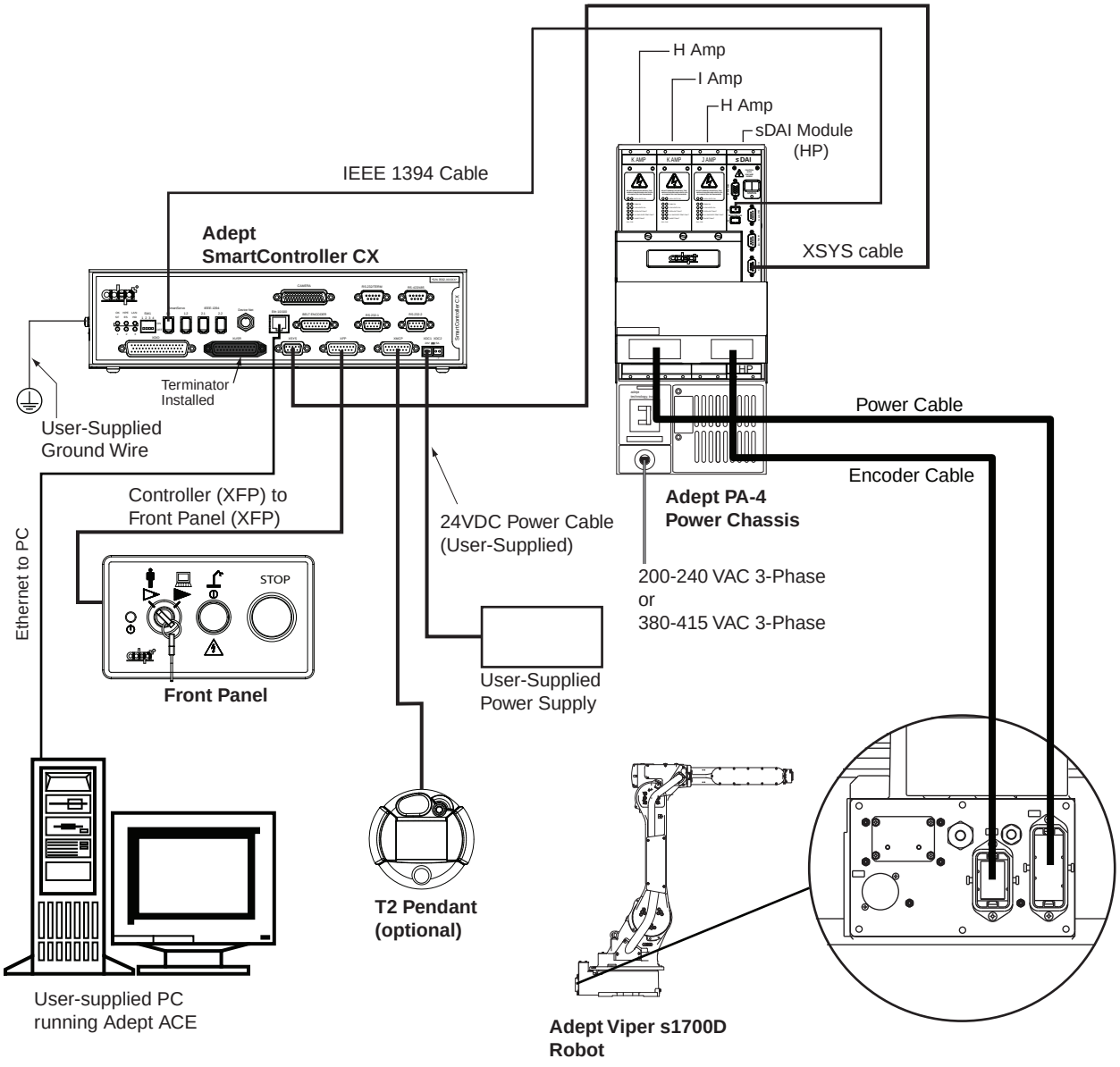


Figure 3-1. System Cable Diagram for Adept Viper s1700D Robot

3.2 Installing the SmartController

Refer to the *Adept SmartController User's Guide* for complete information on installing the Adept SmartController. This list summarizes the main steps.

1. Mount the SmartController and Front Panel.
2. Connect the Front Panel to the SmartController.
3. Connect the optional pendant to the SmartController, if included.
4. Connect user-supplied 24 VDC power to the controller.
5. Install a user-supplied ground wire between the SmartController and ground.
6. Install the Adept ACE PC software on the user-supplied PC. This includes connecting the supplied Ethernet crossover cable between the user-supplied PC and the Ethernet port on the SmartContoller.

3.3 Installing the Adept ACE Software

The Adept ACE software is installed from the Adept ACE software CD-ROM.

1. Insert the CD-ROM into the CD-ROM drive of your PC.

   If Autoplay is enabled, the Adept software CD-ROM menu is displayed. If Autoplay is disabled, you will need to manually start the CD-ROM.

2. Especially if you are upgrading your Adept ACE software installation: from the Adept ACE software CD-ROM menu, click Read Important Information.
3. From the Adept ACE software CD-ROM menu, select:

   Install the Adept ACE Software

   The Adept ACE Setup wizard opens.

4. Follow the online instructions as you step through the installation process.
5. When the installation is complete, click Finish.
6. After closing the Adept ACE Setup wizard, click Exit on the CD-ROM menu to close the menu.

   NOTE: You will have to restart the PC after installing the Adept ACE software.

3.4 Connecting the PC to the SmartController

The Adept SmartController motion controller must be connected to a user-supplied PC or the Adept SmartVision EX processor for setup, control, and programming.

- Connect an Ethernet crossover cable between the PC and the SmartController motion controller

  or

- Use two standard Ethernet cables with a network hub or switch in place of the Ethernet crossover cable.

  NOTE: Do not use an Ethernet crossover cable with a network hub or switch.

For more details, refer to the Adept ACE User's Guide.

3.5 Installing the PA-4 Power Chassis

Refer to the *Adept PA-4 Power Chassis User's Guide* for complete information on the PA-4 chassis. This list summarizes the main steps.

1. Mount the PA-4 chassis.

   NOTE: For the PA-4 in an Adept Viper system, only the panel-mounting option is available.

2. Locate these cables, shipped in the cable/accessories box.
   - IEEE 1394 cable (length 4.5 M)
   - XSYS cable (length 4.5 M)
   - Power cable (length 7 M)
   - Encoder cable (length 7 M)

   NOTE: The IEEE 1394 and XSYS cables should be routed away from the AC power and robot Power and Encoder cables.

3. Install one end of the IEEE 1394 cable into the SmartServo port 1.1 connector on the SmartController, and install the other end into the SmartServo port 1 connector on the sDAI module in the PA-4. See **Figure 3-1 on page 39** and **Figure 3-2 on page 42**. Make sure the plug is oriented correctly to the connector.
4. Install the XSYS cable between the XSYS connector on the SmartController, and the XSLV connector on the sDAI module, and tighten the latching screws.
5. Install the Power cable between the 2BC connector on the robot and the power connector shown in **Figure 3-2** on the PA-4. Insert the connector and then push down the lever until you hear a click.
6. Install the Encoder cable between the 1BC connector on the robot and the encoder connector shown in **Figure 3-2** on the PA-4. Insert the connector and then push down the lever until you hear a click.

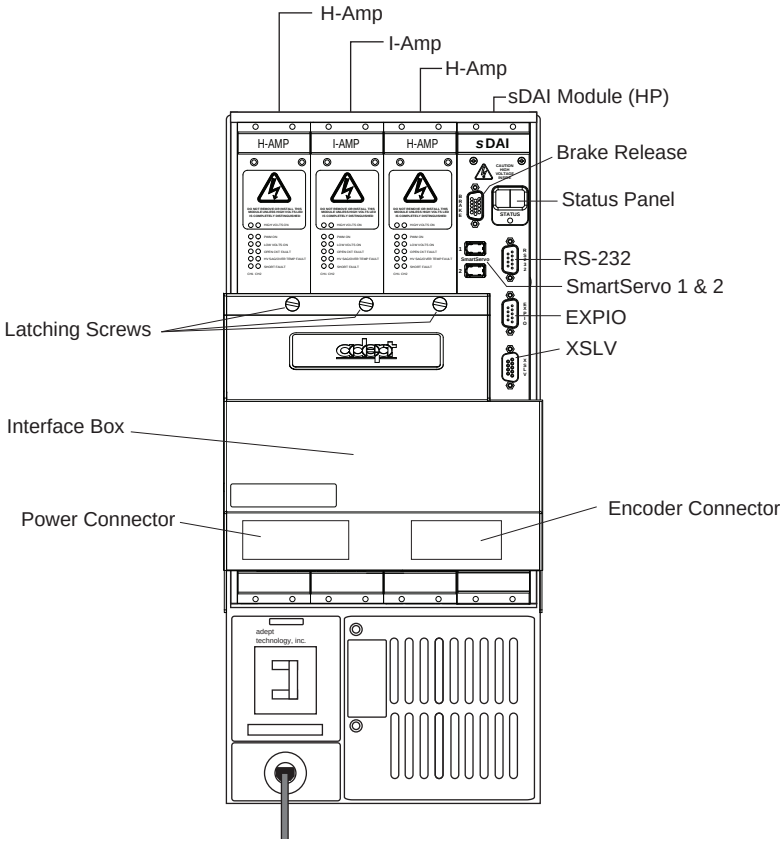


Figure 3-2. Adept PA-4 Power Chassis with sDAI (HP) Module

NOTE: In Adept Viper s1700D systems, the sDAI module must be an HP version. A standard sDAI will not work.

3.6 Connecting 3-Phase AC Power to PA-4

PA-4 3-Phase Power Requirements

Table 3-1. Adept PA-4 Power Chassis 3-Phase Power Requirements

Nominal Voltage Range	Frequency/ Phasing	Minimum Operating Voltage	Maximum Operating Voltage	Recommended External Circuit Breaker (user-supplied)
200 to 240 VAC	50-60Hz, 3-phase	180 VAC	245 VAC	20 amps
380 to 415 VAC	50-60Hz, 3-phase with neutral	342 VAC	424 VAC	20 amps

Table 3-2. Typical Robot Power Consumption[a]

Robot	Move	Average Power (W)	Peak Power (W)[b]
Adept Viper s1700D	No load - Adept cycle[c]	429	1750
	20.0 kg - Adept cycle[c]	532	2498
	20.0 kg - all joints move	1306	6140

[a] Typical power data is with 380 VAC, 60Hz, 3-phase nominal input.
[b] For short durations (100 ms)
[c] Adept cycle: the robot tool performs continuous path, straight-line motions 25 mm up, 305 mm over, 25 mm down, and back along the same path. COARSE is enabled and BREAKs are used at each end location. Not achievable over all paths.

The Adept PA-4 power chassis can be shipped from the factory configured for either 3-phase 200-240 VAC or 380-415 VAC operation, depending on your sales order.

A voltage setting label is located on the front of the chassis below the circuit breaker. The voltage setting is also shown on the ID label on the side of the chassis. Verify that the setting matches your facility power before installation.

If you need to change the AC voltage setting from 200-240 VAC to 380-415 VAC, or vice versa, see the *Adept PA-4 Power Chassis User's Guide*.

WARNING: Verify the voltage settings are correct before turning on power. Operating the Adept PA-4 power chassis with incorrect voltage settings can cause damage or injury.

Connecting the PA-4 3-Phase AC Power Cord to AC Supply

The user end of the cord is unterminated. Connect each conductor of the power cord securely to your AC power source, using the color code shown in **Table 3-3**. The installation must meet all applicable European, international, and national standards and regulations.

Table 3-3. 3-Phase AC Power Cord Specifications for PA-4

Cord length	3 meters ±0.1 m (9 ft 10 in ±4 in)
Cord rating	25 amps
Number and size of conductor size	5 x 2.5 mm^2
Color code: 200 - 240 VAC	
line 1	black
line 2	black (or gray)[a]
line 3	brown
no connection	**blue** (must be insulated)
ground	green/yellow
Color code: 380 - 415 VAC	
line 1	black
line 2	black (or gray)[a]
line 3	brown
neutral	blue
ground	green/yellow

[a] Note: The two black wires can also be one black and one gray wire, but the functionality is the same for either case.

DANGER: Electrical hazard!
The installation of the power cord must be done by a skilled person. The power supply can injure or kill the person who installs the cord. An incorrect installation can injure or kill anyone that touches the equipment in the robot workcell.

The protective ground conductor (colored green/yellow) of the Adept PA-4 power chassis is internally connected to the accessible metal parts of the power chassis. To ensure electrical-shock protection, the ground conductor must be connected to a properly grounded power source.

WARNING: Ensure that a proper protective ground connection exists before turning on the power.

Typical 3-Phase AC Power Installation Diagrams

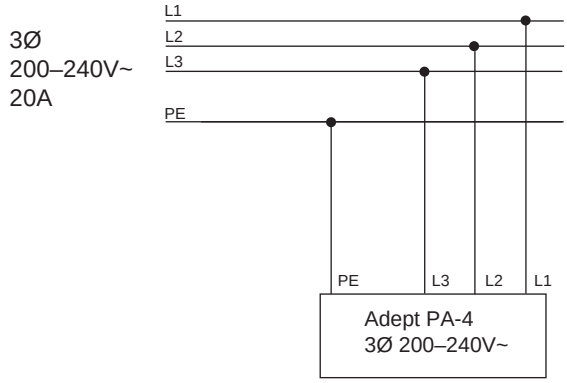


Figure 3-3. Typical 3-Phase 200-240 VAC Connection for PA-4 System

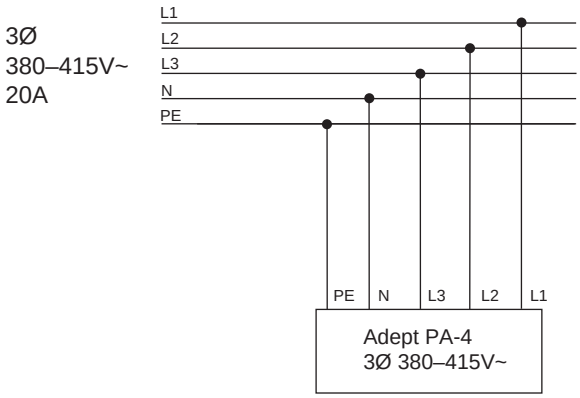


Figure 3-4. Typical 3-Phase 380-415 VAC Connection for PA-4 System

4 System Operation

4.1 Commissioning the System

Turning on the robot system for the first time is known as "commissioning the system." Follow the steps in this section to safely bring up your robot system. The steps include:

- Verifying installation, to confirm all tasks have been performed correctly
- Starting up the system by turning on power for the first time
- Verifying all E-Stops in the system function correctly
- Moving each axis of the robot to confirm it moves in the proper directions

Verifying Installation

Verifying that the system is correctly installed and that all safety equipment is working correctly is an important process. Before using the robot, make the following checks to ensure that the robot and controller have been properly installed.

DANGER: After installing the robot, you must test it before you use it for the first time. Failure to do this could cause death or serious injury or equipment damage.

Mechanical Checks

- Verify that the robot is mounted level and that all fasteners are properly installed and tightened.
- Verify that any end-of-arm tooling is properly installed.
- Verify that all other peripheral equipment is properly installed and in a state where it is safe to turn on power to the robot system.

System Cable Checks

Verify the following connections:

- Front Panel to the SmartController.
- Pendant to the SmartController, via the pendant adapter cable.
- User-supplied 24 VDC power to the controller.
- User-supplied ground wire between the SmartController and ground.
- One end of the IEEE 1394 cable into the SmartServo port 1.1 connector on the SmartController, and the other end into the SmartServo port 1 connector on the robot interface panel.

- XSYS cable between the robot interface panel XSLV safety interlock connector and XSYS connector on the SmartController, and the latching screws tightened.
- User-supplied AC power to the PA-4.

User-Supplied Safety Equipment Checks

Verify that all user-supplied safety equipment and E-Stop circuits are installed correctly.

System Start-up Procedure

Once the system installation has been verified (see **"Verifying Installation" on page 47**), you are ready to start up the system.

1. Switch on AC power to the PA-4.
2. Switch on the 24 VDC power to the SmartController.
3. Turn on power to the robot.
4. Follow the instructions, beginning with Starting the Adept ACE Software, in the following section.

Running the Adept ACE Software

Starting the Adept ACE Software

The robot should be on, and the status panel should display OK before proceeding.

1. Turn on the PC and start the Adept ACE software.
   - Double-click the Adept ACE icon on your Windows desktop

     or, from the Windows Start menu bar,
   - Select **Start > Programs > Adept Technology > Adept ACE > Adept ACE**.
2. On the Adept ACE Startup menu, click New SmartController Workspace.
3. Click-select the SmartController you want to use, and click OK.

Enabling High Power

After you have started the Adept ACE software and connected to the controller, enable high power to the robot motors:

1. From the Adept ACE main menu, click the Enable High Power icon: 
2. If the High Power button on the Front Panel is blinking, press and release it.

   NOTE: The use of the blinking High Power button can be configured (or eliminated) in software. Your system may not require this step.

   The Front Panel, which is mounted just outside the workcell safety barrier, is shown in the following figure. If enabled, the High Power button must be pressed while blinking (default time-out is 10 seconds). If the button stops blinking, you must enable power again.

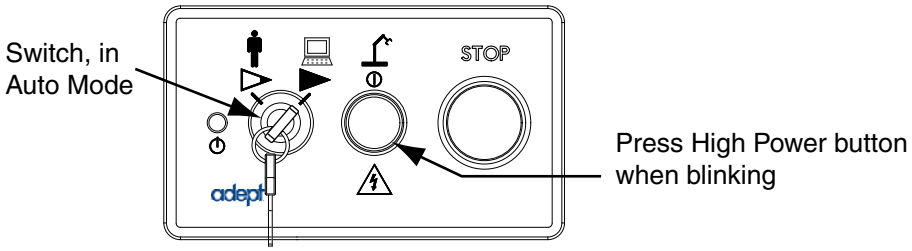


Figure 4-1. High Power Button on Front Panel

This step turns on high power to the robot motors and calibrates the robot.

- The amplifier status LED blinks green rapidly (a slow green blink has a different meaning).

  In addition, for Adept IP-65 Viper robots, the lamps on the robot glow solid amber.

- The status panel on the robot or amplifier chassis displays ON.

Verifying E-Stop Functions

Verify that all E-Stop devices are functional (pendant, Front Panel, and user-supplied). Test each mushroom button, safety gate, light curtain, etc., by enabling high power and then opening the safety device. The High Power push button/light on the Front Panel should go out.

Verify Robot Motions

Use the pendant to test the motion of each axis on the robot to confirm it moves in the proper directions. Refer to the *Adept SmartController User's Guide* and the *T2 Pendant User's Guide* for complete instructions on using the pendant.

NOTE: If the optional pendant is not installed in the system, you can move the robot using the Robot Jog Control in the Adept ACE software. For details, see the *Adept ACE User's Guide*.

4.2 Learning to Program the Robot

To learn how to use and program the robot, see the *Adept ACE User's Guide*, which provides information on robot configuration, control and programming through the Adept ACE software "point and click" user interface.

For V+ programming information, refer to the following optional manuals:

- *V+ Language User's Guide*
- *V+ Language Reference Guide*
- *V+ Operating System Reference Guide*

NOTE: When using an Adept pendant with an Adept Viper robot, the Free Mode is disabled for safety reasons.

4.3 Connecting Digital I/O to the System

You can connect digital I/O to the system in several different ways. See **Table 4-1** and **Figure 4-2**.

Table 4-1. Digital I/O Connection Options

Product	I/O Capacity	For more details
XDIO Connector on SmartController	12 inputs 8 outputs	see *Adept SmartController User's Guide*
Optional IO Blox Device, connects to sDAI in PA-4	8 inputs, 8 outputs per device; up to four IO Blox devices per robot	see *Adept IO Blox User's Guide*
Optional sDIO Module, connects to controller	32 inputs, 32 outputs per module; up to four sDIO per system	see *Adept SmartController User's Guide*

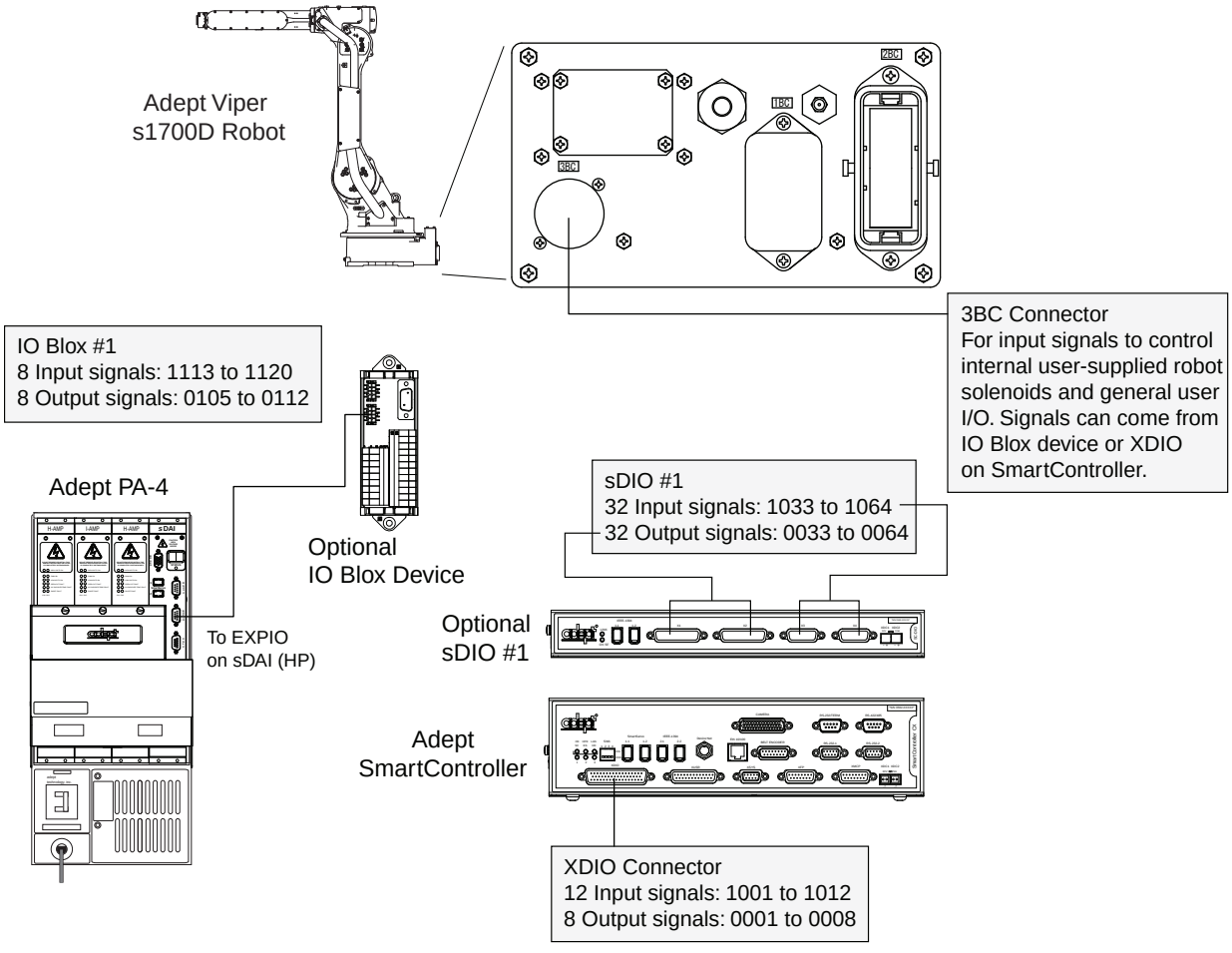


Figure 4-2. Connecting Digital I/O to the System

Table 4-2. Default Digital I/O Signal Configuration, Single Robot System

Location	Type	Signal Range
Controller XDIO connector	Inputs	1001 - 1012
	Outputs	0001 - 0008
sDIO Module 1	Inputs	1033 - 1064
	Outputs	0033 - 0064
sDIO Module 2	Inputs	1065 - 1096
	Outputs	0065 - 0096
sDIO Module 3 (recommended)	Inputs	1201 - 1232
	Outputs	0201 - 0232
sDIO Module 4 (recommended)	Inputs	1233 - 1264
	Outputs	0233 - 0264
IO Blox 1	Inputs	1113 - 1120
	Outputs	0105 - 0112
IO Blox 2	Inputs	1121 - 1128
	Outputs	0113 - 0120
IO Blox 3	Inputs	1129 - 1136
	Outputs	0121 - 0128
IO Blox 4	Inputs	1137 - 1144
	Outputs	0129 - 0136

4.4 Status Panel Codes on sDAI (HP) Module

The status panel display on the sDAI module in the PA-4 displays alpha-numeric codes that indicate the operating status of the robot, including detailed fault codes. See **Table 4-3** for definitions of the status codes. These codes provide details for quickly isolating problems during troubleshooting. See the ***Adept PA-4 Power Chassis User's Guide*** for additional information on the sDAI module.

Table 4-3. Status Panel Codes

LED	Status Code	LED	Status Code
OK	No Fault	h#	High Temp Amp (Joint #)
ON	High Power ON Status	H#	High Temp Encoder (Joint #)
MA	Manual Mode	hV	High Voltage Bus Fault
24	24V Supply Fault	I#	Initialization Stage (Step #)
A#	Amp Fault (Joint #)	M#	Motor Stalled (Joint #)
B#	IO Blox Fault (Address #)	NV	Non-Volatile Memory
AC	AC Power Fault	P#	Power System Fault (Code #)
D#	Duty Cycle Exceeded (Joint #)	PR	Processor Overloaded
E#	Encoder Fault (Joint #)	RC	RSC Fault
ES	E-Stop	SW	Watchdog Timeout
F#	External Sensor Stop	S#	Safety System Fault (Code #)
FM	Firmware Mismatch	T#	Safety System Fault (Code 10 + #)
FW	IEEE 1394 Fault	V#	Hard Envelope Error (Joint #)

For more information on status codes, go to the Adept Document Library on the Adept Web site, and in the Procedures, FAQs, and Troubleshooting section, look for the *Adept Status Code Summary* document.

4.5 Installing and Using the Brake Release Box

The manual brake release box can be used to release the brakes on a specific axis of the robot. This procedure describes how to install and use this device. See **Figure 4-3 on page 53**.

WARNING: Secure the robot prior to releasing the brakes on axes 2 and 3, to prevent injury to personnel or equipment damage.

1. Make sure that high power is disabled (off).
2. Connect the 15-pin male D-sub connector into the 15-pin female D-sub connector marked Brake on the sDAI board.
3. Press one of the E-Stops (Pendant, Front Panel, or external).
4. Using the axis selector switch, select the axis that you want to release the brake.
5. Depress the brake release push button, to release the brake.
6. Repeat steps 4 and 5 above for releasing the brakes on another axis.

NOTE: When the Status LED (Green) is on, it indicates that the circuit is enabled, when the brake release push button is pressed.

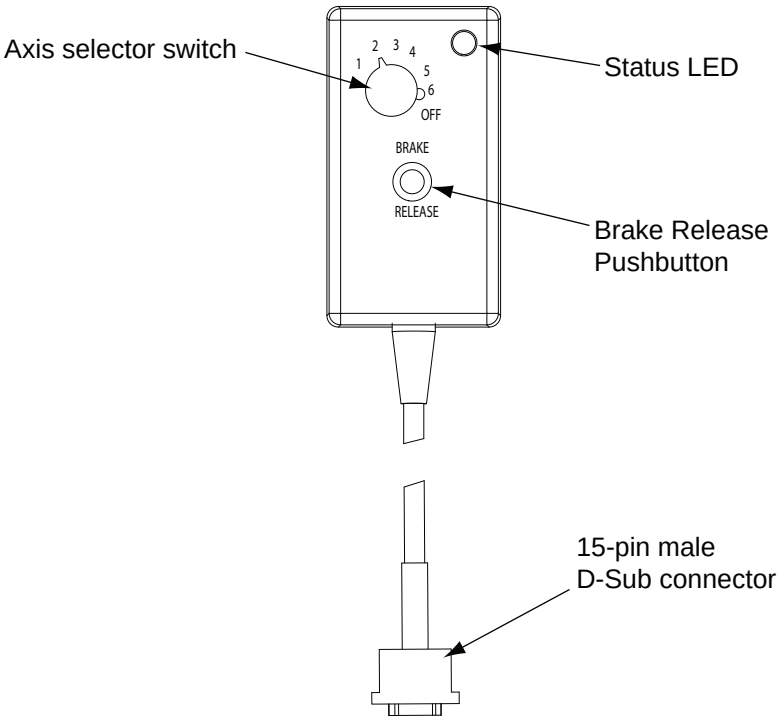


Figure 4-3. Manual Brake Release Box

5 Maintenance and Inspection

5.1 Inspection Schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation. Inspection intervals are displayed in six levels. Conduct periodic inspections according to the inspection schedule in **Table 5-2 on page 56**.

In **Table 5-2**, the inspection items are classified into three types of operations: operations which can be performed by personnel authorized by the user, operations which can be performed by trained personnel, and operations which can be performed by service company or factory-trained personnel. Only specified personnel are to do inspection work

WARNING: Before maintenance or inspection, make sure to switch off the main power supply, and place a warning sign (for example, *Do not switch on the power*). Failure to observe this warning may result in electric shock or injury.

WARNING: Maintenance and inspection must be performed by specified personnel. Failure to observe this caution may result in electric shock or injury.

CAUTION: For disassembly or repair, contact your Adept representative.

CAUTION: The battery pack must be connected before removing the detection connector when performing maintenance and inspection. Failure to observe this caution may result in the loss of home-position data.

NOTE: The inspection interval must be based on the servo power supply ON time.

NOTE: The inspection schedules were developed for applications where the robot was used for arc welding work. For different or special applications, the inspection process should be developed on a case-by-case basis. For axes that are used very frequently (handling applications, etc.) it is recommended that inspections be conducted at shorter intervals. Contact Adept Customer Service for information.

Table 5-1. Daily Inspection Items

	Items [a]	Daily	Schedule - Hours					Method	Operation	Inspection Charge		
			1k	6k	12k	24k	36k			Specified Person	Licensee	Service Company
1	Alignment mark	●						Visual	Check for damage on each axis via the joint alignment mark at the "home" position.	●	●	●
2	External cables and harnesses	●						Visual	Check for damage to the external cables and harnesses.	●	●	●
3	Robot Work Area	●						Visual	Clean the work area and robot of any dust or debris; check for any signs of damage.	●	●	●
4	Axes 1, 2, and 3 motors	●						Visual	Check for grease leakage.[b]	●	●	●

[a] Inspection item numbers correspond to the numbers in Figure 5-1 on page 60 and Figure 5-2 on page 61.

[b] The occurrence of grease leakage indicates the possibility that grease has seeped into the motor. This can cause a major breakdown. Contact your Adept representative.

Table 5-2. Inspection Items

	Items [a]	Daily	Schedule - Hours					Method	Operation	Inspection Charge		
			1k	6k	12k	24k	36k			Specified Person	Licensee	Service Company
5	Robot base mounting bolts		●					Wrench	Tighten loose bolts. Replace if necessary.	●	●	●

Table 5-2. Inspection Items

Items [a]		Daily	Schedule - Hours					Method	Operation	Inspection Charge		
			1k	6k	12k	24k	36k			Specified Person	Licensee	Service Company
6	Cover mounting screws				●			Phillips screw-driver, Wrench	Tighten loose bolts. Replace if necessary.	●	●	●
7	Connector base				●			Manual	Check for loose connectors.	●	●	●
8	Axes 5 and 6 timing belts				●			Manual	Check for belt tension and wear.		●	●
9	Wire harness in robot (Axes 1, 2, and 3) (Axes 4, 5, and 6)				●			Visual, Multi-meter	Check for conduction between the main connector of the connector base and the intermediate connector by manually shaking the wire. Check the protective spring for wear. [b]		●	●
						●			Replace [c]			
10	Wire harness in robot (Axes 5 and 6)				●			Visual, Multi-meter	Check for conduction between terminals Check the protective spring for wear. [c]			●
						●			Replace [d]			

Table 5-2. Inspection Items

Items [a]		Daily	Schedule - Hours					Method	Operation	Inspection Charge		
			1k	6k	12k	24k	36k			Specified Person	Licensee	Service Company
11	Battery pack in robot						●		Replace the battery unit.		●	●
12	Axis 1 speed reducer			●	●			Grease Gun	Check for malfunction. Exchange grease [d] (12000 H cycle). See Section 5.2 on page 62.		●	●
13	Axes 2 and 3 speed reducer			●	●			Grease Gun	Check for malfunction. Exchange grease [e] (12000 H cycle). See Section 5.3 on page 63 and Section 5.4 on page 64.		●	●
14	Axes 4, 5, and 6 speed reducer			●				Grease Gun	Check for malfunction (replace if necessary). Supply grease [e] (6000 H cycle). See Section 5.5 on page 66 and Section 5.6 on page 67.		●	●
15	Axis 6 gear			●				Grease Gun	Check for malfunction (replace if necessary). Supply grease [e] (6000 H cycle). See Section 5.7 on page 68.		●	●

Table 5-2. Inspection Items

Items [a]		Daily	Schedule - Hours					Method	Operation	Inspection Charge		
			1k	6k	12k	24k	36k			Specified Person	Licensee	Service Company
16	Axis 4 cross roller bearing			●				Grease Gun	Check for malfunction (replace if necessary). Supply grease [e] (6000 H cycle). See Section 5.8 on page 69.		●	●
17	Overhaul						●					●

[a] Inspection item numbers correspond to the numbers in Figure 5-1 on page 60 and Figure 5-2 on page 61.
[b] When checking for conduction with a multimeter, connect the battery to "BAT" and "OBT" of the connectors on the motor side for each axis, and then remove the connectors from the motor on the detector side for each axis. Otherwise, the home position will be lost. (Refer to Section 5.9 on page 69 for more information.)
[c] Replace the wire harness in the robot at the 24000 H inspection.
[d] Refer to Table 5-3 for grease information.

Table 5-3. Inspection Parts and Grease Used

No.	Grease Used	Inspected Parts
12, 13	VIGO Grease RE No. 0	Axes 1, 2, and 3 speed reducers
14, 15	Harmonic Grease SK-1A	Axes 4, 5, and 6 speed reducers Axis 6 gear
16	Alvania EP Grease 2	Axis 4 cross roller bearing

The numbers in the above table correspond to the item numbers in Table 5-2, "Inspection Items," on page 56.

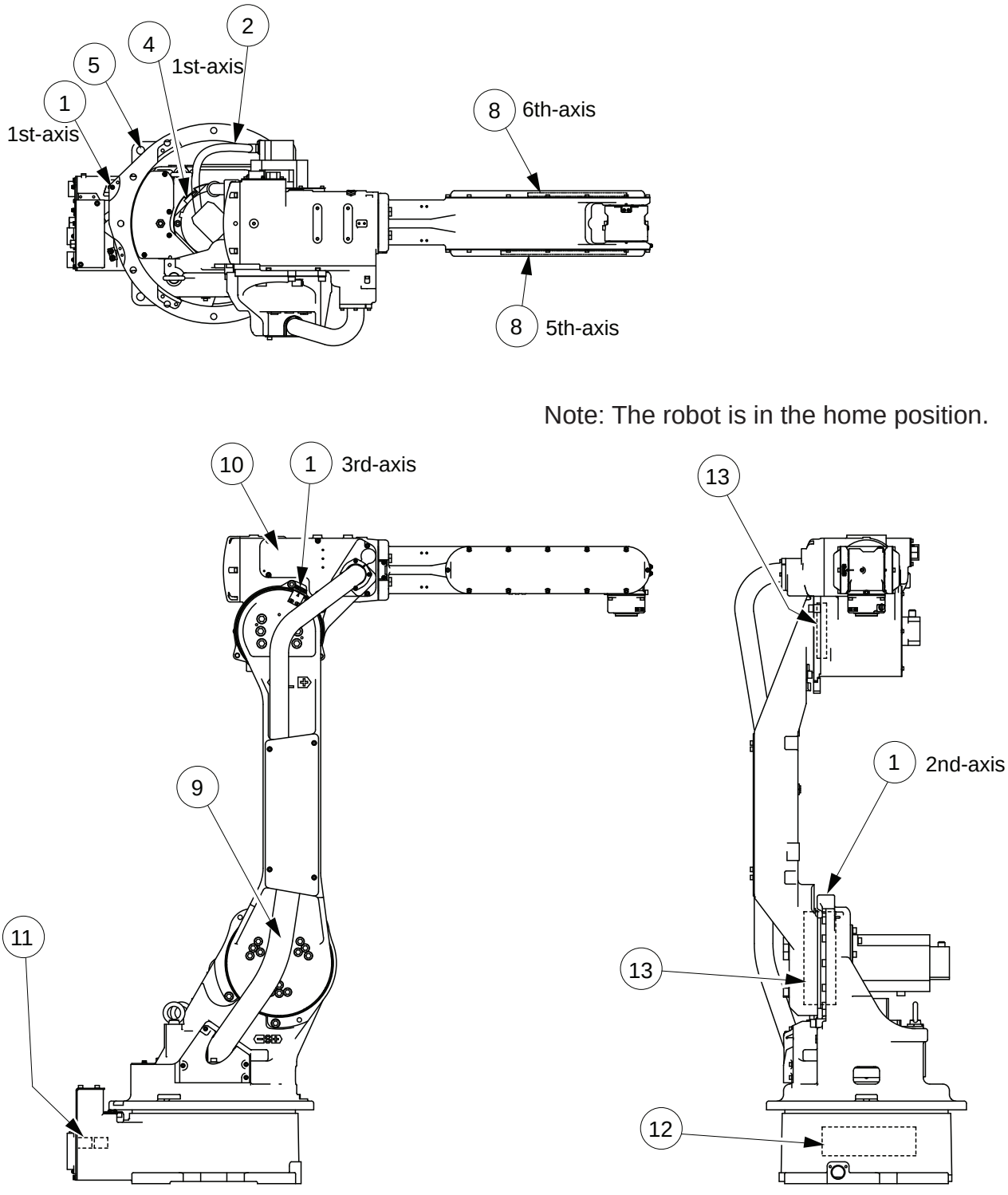


Figure 5-1. Inspection Parts and Numbers (1 of 2)

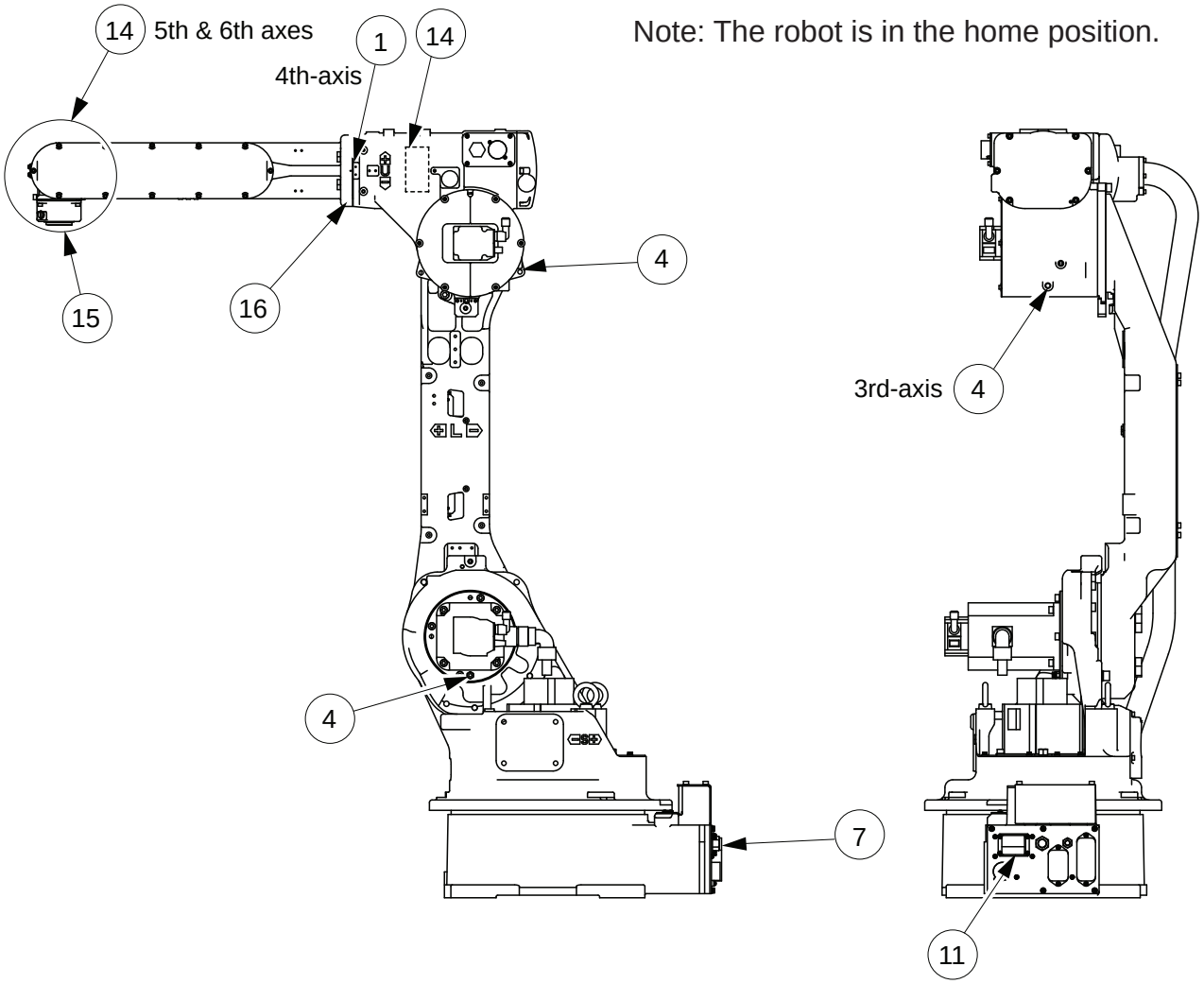


Figure 5-2. Inspection Parts and Numbers (2 of 2)

Note for Maintenance

The motor and encoder units are provided with the wrist unit. To prevent fumes from penetrating into the wrist unit, the matched parts are sealed with sealing bond. Therefore, if the wrist cover is disassembled, reseal with sealing bond (silicon caulk). Contact Adept Customer Service for more information.

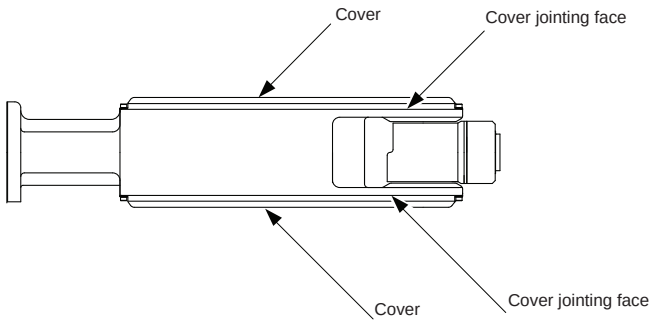


Figure 5-3. Sealing Part of Wrist Unit

5.2 Grease Exchange for 1st-Axis Speed Reducer

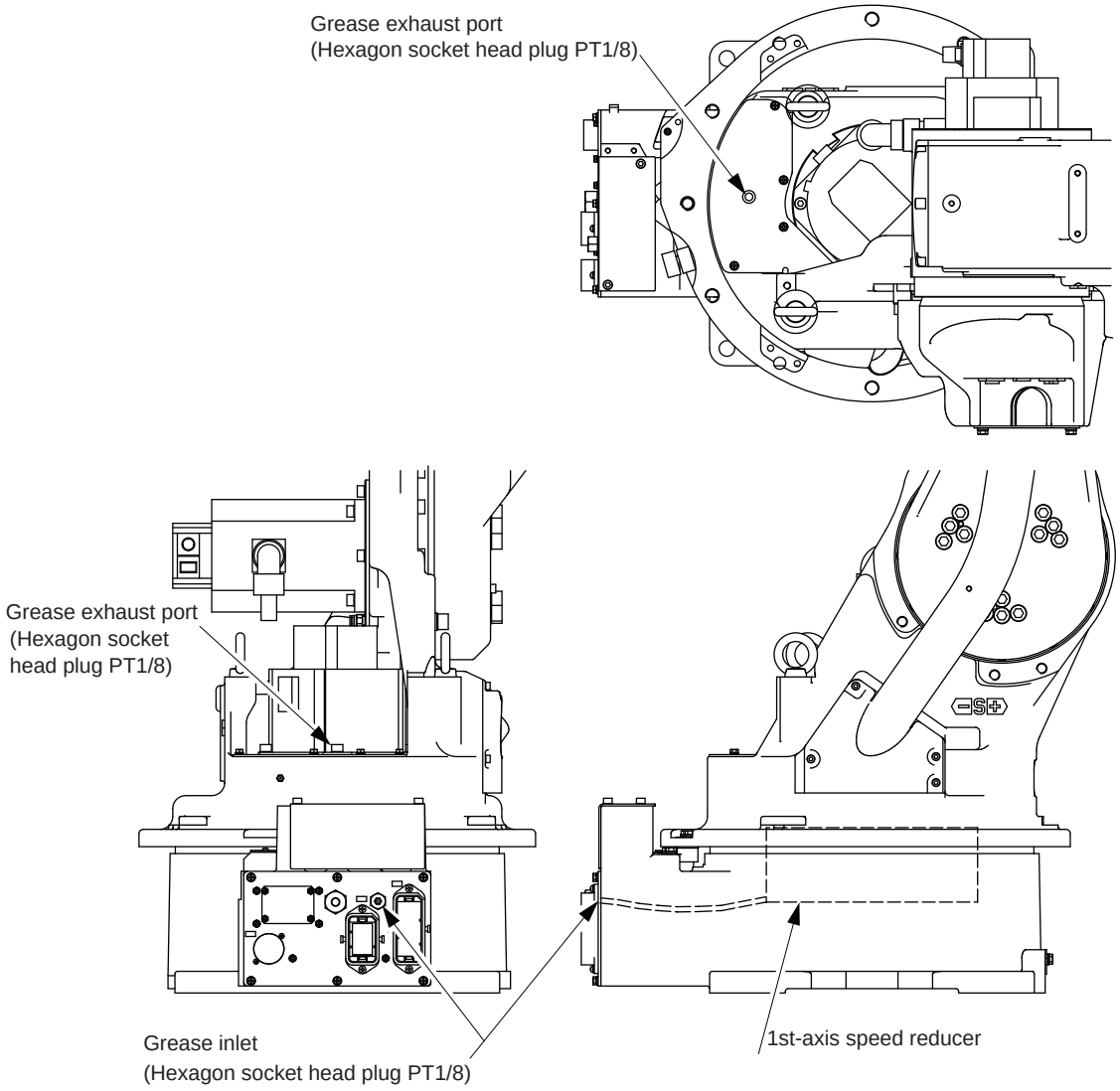


Figure 5-4. 1st-Axis Speed Reducer Diagram

CAUTION: For ceiling-mounted robots, the exhaust port and grease inlet are inverted.

1. Remove the hexagon socket head plug (PT1/8) on the grease exhaust port.

WARNING: If grease is added without removing the hexagon socket head plug (PT1/8,) the grease will go inside the motor and may damage it. It is absolutely necessary to remove the plug.

2. Remove the hexagon socket head plug (PT1/8) on the grease inlet and install the grease zerk (PT1/8). (The grease zerk (PT1/8) is delivered with the robot.)
3. Inject the grease (approximately 1800 cc, VIGO Grease RE No. 0) into the grease inlet using a grease gun. The grease exchange is complete when new grease appears in the grease exhaust port. The new grease can be distinguished from the old grease by color.
4. Move the 1st-axis for a few minutes to discharge the excess grease.
5. Remove the grease zerk on the grease inlet.
6. Wipe the grease exhaust port with a cloth and reinstall the plugs on the grease inlet and the grease exhaust port. Prior to installation, coat the screw threads with Three Bond 1206C.

5.3 Grease Exchange for 2nd-Axis Speed Reducer

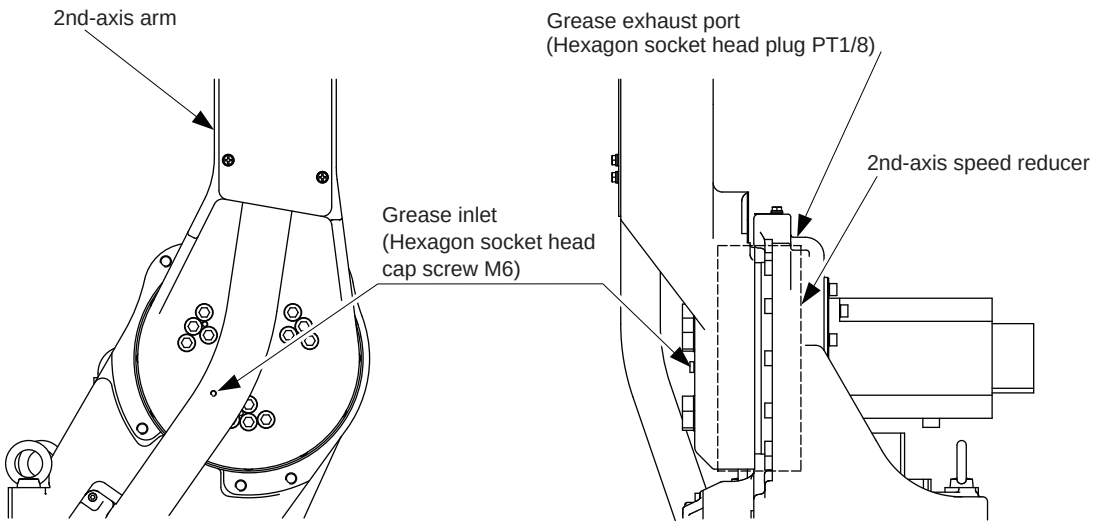


Figure 5-5. 2nd-Axis Speed Reducer Diagram

CAUTION: For ceiling-mounted robots, the exhaust port and grease inlet are inverted.

1. Position the 2nd-axis arm vertically to the ground.
2. Remove the hexagon socket head plug (PT1/8) on the grease exhaust port.

WARNING: If grease is added without removing the hexagon socket head plug (PT1/8), the grease will go inside the motor and may damage it. It is absolutely necessary to remove the plug.

3. Remove the hexagon socket head cap screw (M6) on the grease inlet and install the grease zerk (A-MT6X1).
4. Inject the grease (approximately 500 cc, VIGO Grease RE No. 0) into the grease inlet using a grease gun. The grease exchange is complete when new grease appears in the grease exhaust port. The new grease can be distinguished from the old grease by color.
5. Move the 2nd-axis for a few minutes to discharge the excess grease.
6. Remove the grease zerk on the grease inlet and reinstall the hexagon socket head cap screw (M6). Prior to installation, coat the screw threads with Three Bond 1206C.
7. Wipe the grease exhaust port with a cloth and reinstall the hexagon socket head plug on the grease exhaust port. Prior to installation, coat the screw threads with Three Bond 1206C.

5.4 Grease Exchange for 3rd-Axis Speed Reducer

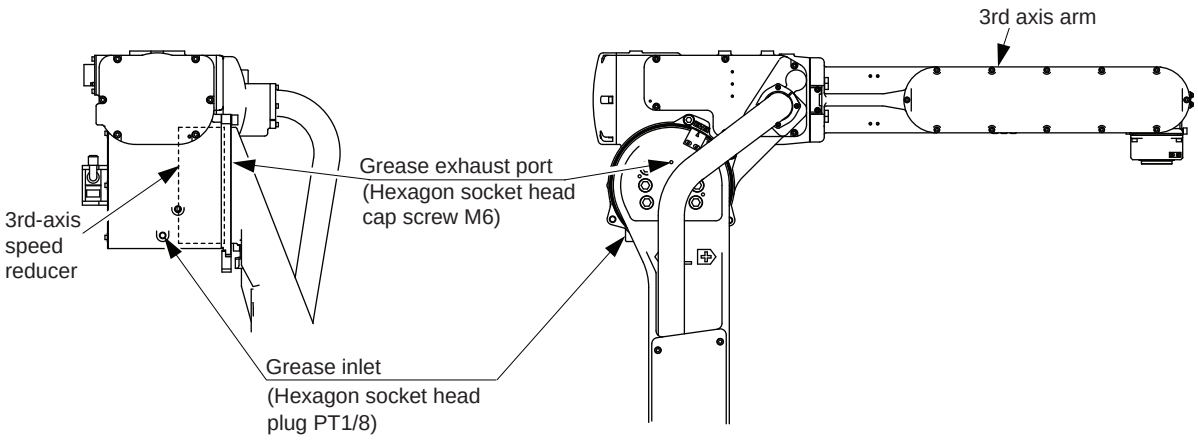


Figure 5-6. 3rd-Axis Speed Reducer Diagram

CAUTION: For ceiling-mounted robots, the exhaust port and grease inlet are inverted.

1. Position the 3rd-axis arm horizontally to the ground.
2. Remove the hexagon socket head cap screw on the grease exhaust port.

WARNING: If grease is added without removing the hexagon socket head cap screw, the grease will go inside the motor and may damage it. It is absolutely necessary to remove the plug.

3. Remove the hexagon socket head plug (PT 1/8) on the grease inlet and install the grease zerk (A-MT6X1).
4. Inject the grease (approximately 300 cc, VIGO Grease RE No. 0) into the grease inlet using a grease gun. The grease exchange is complete when new grease appears in the grease exhaust port. The new grease can be distinguished from the old grease by color.
5. Move the 3rd-axis for a few minutes to discharge the excess grease.
6. Remove the grease zerk on the grease inlet and reinstall the hexagon socket head cap plug (PT 1/8). Prior to installation, coat the screw threads with Three Bond 1206C.
7. Wipe the grease exhaust port with a cloth and reinstall the hexagon socket head cap screw on the grease exhaust port. Prior to installation, coat the screw threads with Three Bond 1206C.

5.5 Grease Replenishment for 4th-Axis Speed Reducer

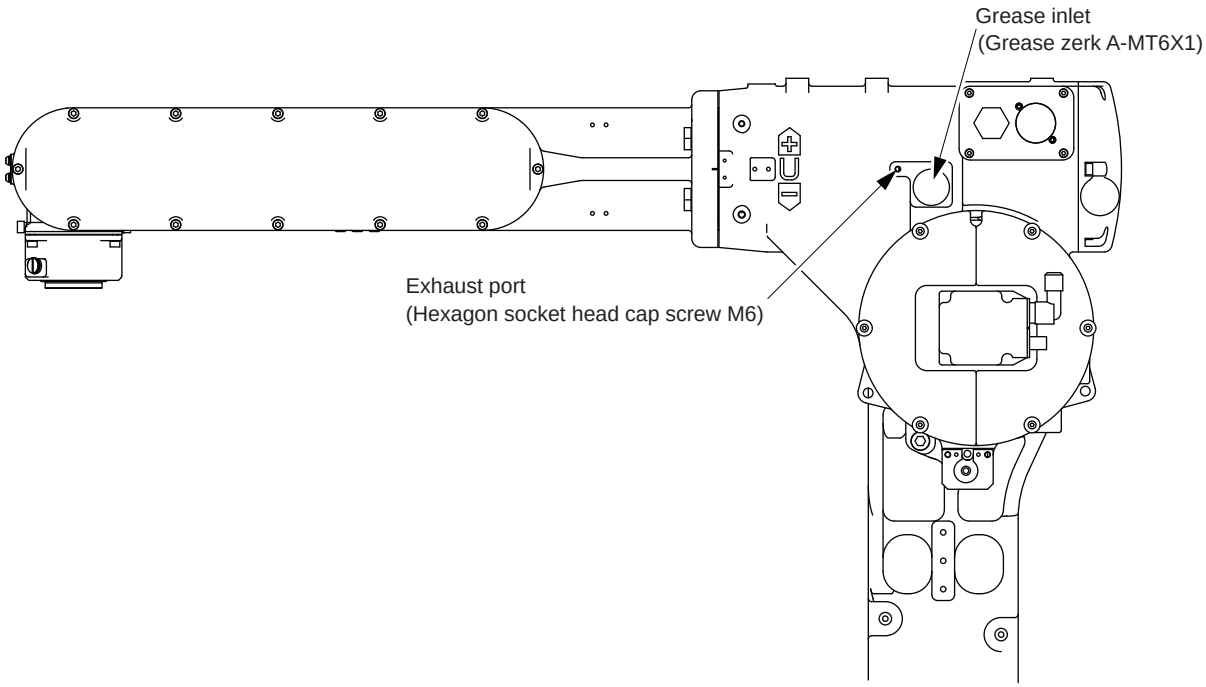


Figure 5-7. 4th-Axis Speed Reducer Diagram

1. Remove the hexagon socket head plug (PT1/8) on the grease exhaust port.
2. Inject the grease (8 cc (16 cc for the first supply), Harmonic grease SK-1A) into the grease inlet using a grease gun.

   NOTE: The exhaust port is used for air flow. Do no inject excessive grease into the grease inlet.

3. Reinstall the hexagon socket head plug (PT 1/8) on the grease exhaust port. Prior to installation, coat the screw threads with Three Bond 1206C.

5.6 Grease Replenishment for 5th- and 6th-Axes Speed Reducers

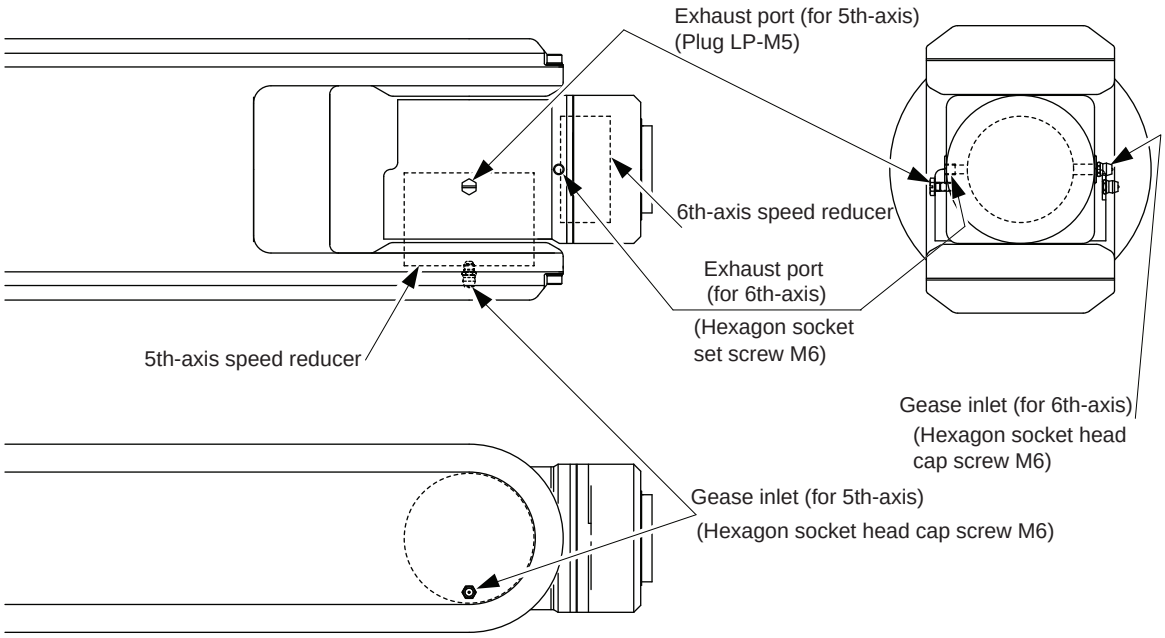


Figure 5-8. 5th- and 6th-Axes Speed Reducer Diagram

1. Remove the plug on the exhaust port for the 5th axis or the hexagon socket set screw on the grease exhaust port for the 6th axis.

   NOTE: Remove the cover for the 5th-axis speed reducer.

2. Remove the hexagon socket head cap screw on the grease inlet and install the grease zerk (A-MT6X1).
3. Inject the grease into the grease inlet using a grease gun. (For the 5th axis: use approximately 10 cc (20 cc for first supply); for the 6th axis: use 5 cc (10 cc for first supply); use Harmonic grease SK-1A for both axes.)

   NOTE: The exhaust port is used for air flow. Do no inject excessive grease into the grease inlet.

4. Reinstall the plug on the exhaust port for the 5th axis or the hexagon socket set screw on the grease exhaust port for the 6th axis. Prior to installation, coat the screw threads with Three Bond 1206C.
5. Remove the grease zerk on the grease inlet and reinstall the hexagon socket head cap screw. Prior to installation, coat the screw threads with Three Bond 1206C.
6. Mount the cover for the 5th-axis speed reducer. (Refer to **Section on page 61**.)

5.7 Grease Replenishment for 6th-Axis Gear

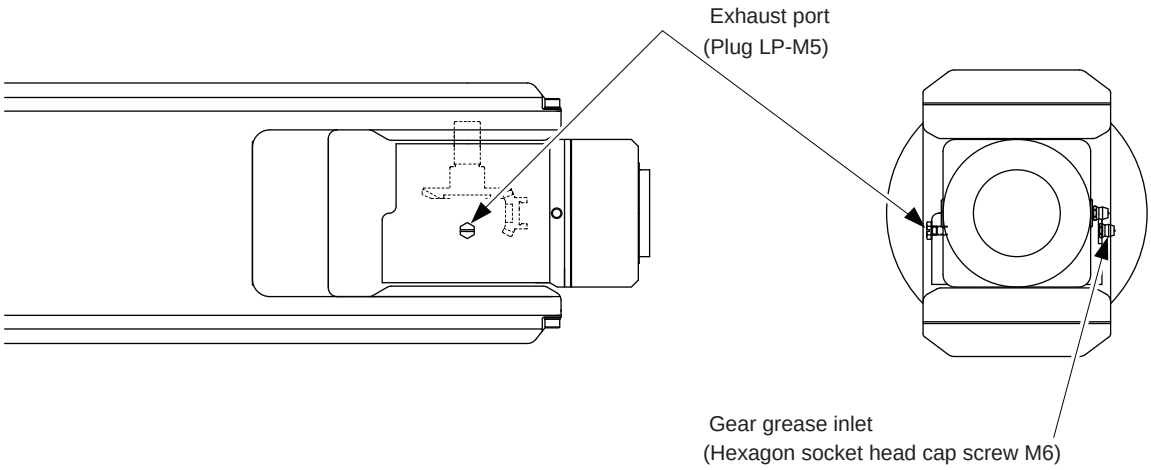


Figure 5-9. 6th-Axis Gear Diagram

1. Remove the plug on the grease exhaust port.
2. Remove the hexagon socket head cap screw on the grease inlet and install the grease zerk (A-MT6X1).
3. Inject 5 cc of grease (10 cc for first supply, Harmonic grease SK-1A) into the gear grease inlet using a grease gun.

   NOTE: The exhaust port is used for air flow. Do no inject excessive grease into the gear grease inlet.

4. Reinstall the plug on the exhaust port. Prior to installation, coat the screw threads with Three Bond 1206C.
5. Remove the grease zerk on the gear grease inlet and reinstall the hexagon socket head cap screw. Prior to installation, coat the screw threads with Three Bond 1206C.

5.8 Grease Replenishment for 4th-Axis Cross Roller Bearing

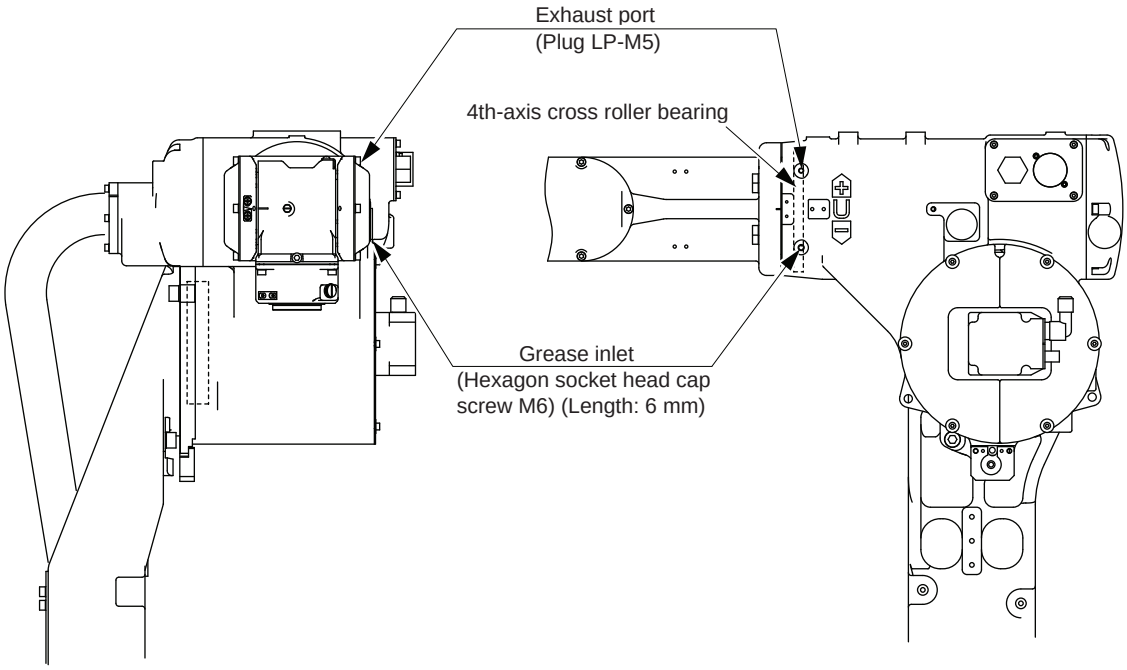


Figure 5-10. 4th-Axis Cross Roller Bearing Diagram

1. Remove the plug on the exhaust port.
2. Remove the hexagon socket head cap screw from the grease inlet and install the grease zerk (A-MT6X1).
3. Inject the grease (8 cc (16 cc for first supply, Alvania EP grease 2) into the grease inlet using a grease gun.

   NOTE: The exhaust port is used for air flow. Do no inject excessive grease into the grease inlet.

4. Reinstall the plug on the exhaust port. Prior to installation, coat the screw threads with Three Bond 1206C.
5. Remove the grease zerk on the grease inlet and reinstall the hexagon socket head cap screw. Prior to installation, coat the screw threads with Three Bond 1206C.

5.9 Removing the Encoder Connector

When performing maintenance, such as replacing a wire harness in the robot, it may be necessary to remove the encoder connector (note the CAUTION label). In this case, be sure to connect the battery pack to the battery backup connector before removing the encoder connector. If you remove the encoder connector without connecting the battery backup, the encoder absolute data might be lost. For instructions on making the battery pack connections, see **Figure 5-11 on page 70** and **Figure 5-12 on page 71**.

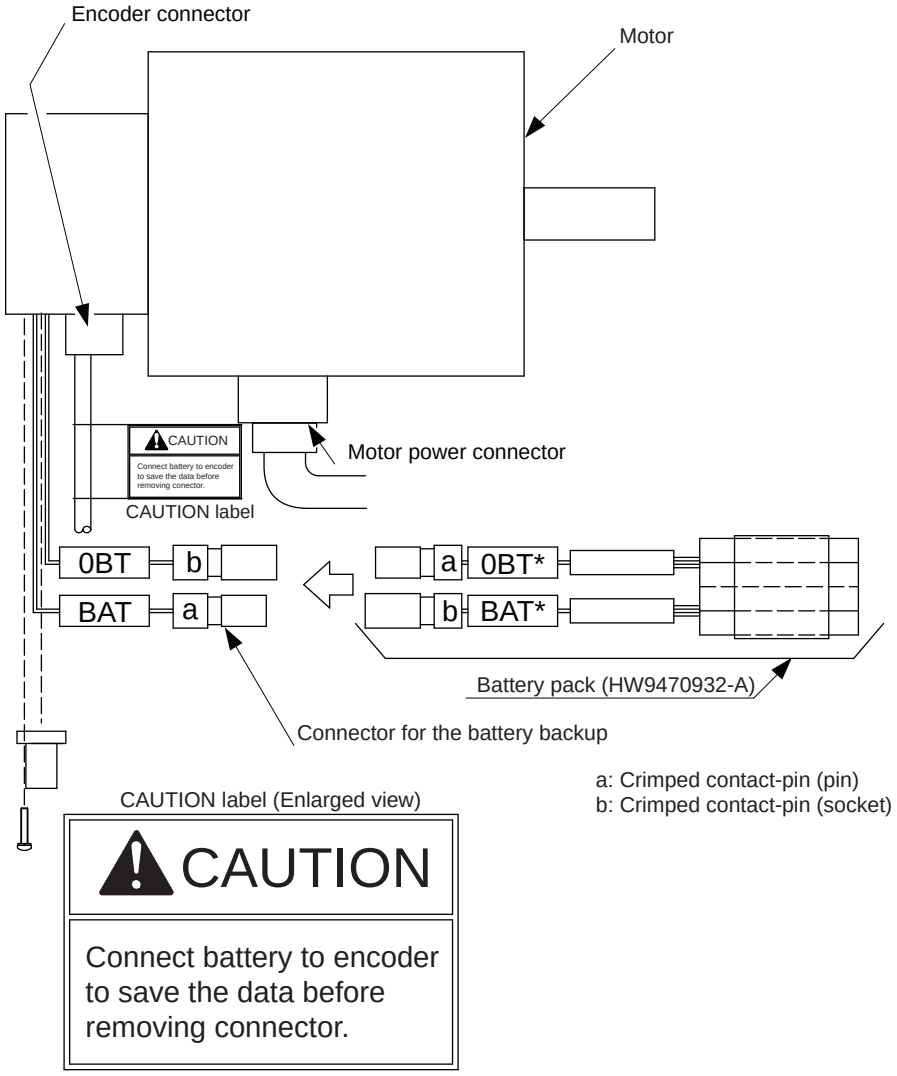


Figure 5-11. Encoder Connector for 1st, 2nd, and 3rd Axes

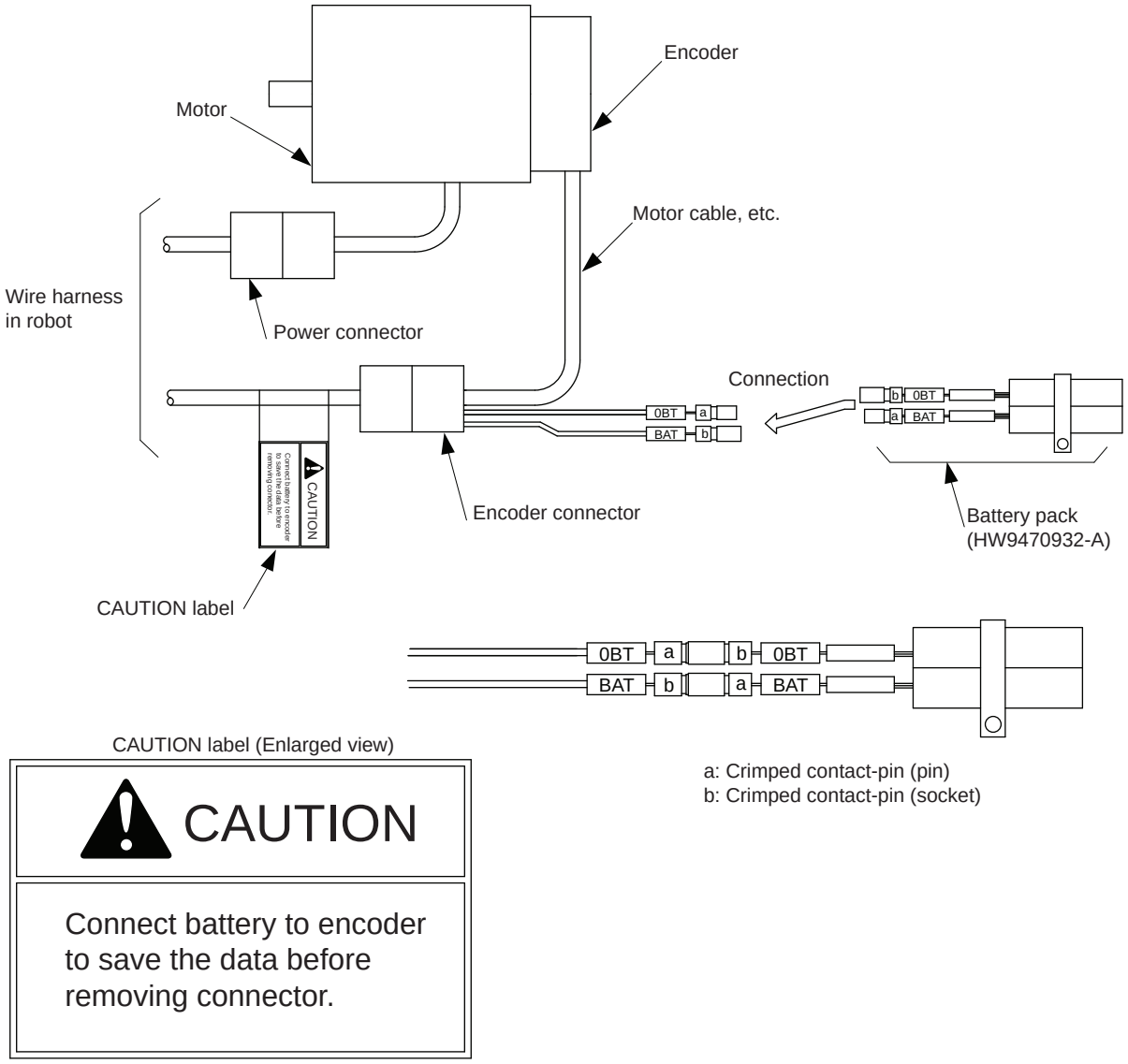


Figure 5-12. Encoder Connector for 4th, 5th, and 6th Axes

5.10 Replacing the Encoder Backup Battery

The encoder backup batteries should be replaced every two years. Replace the batteries according to the procedure below.

1. Prepare a new battery pack for replacement.
2. Turn off AC power to the PA-4 and DC power to the controller.
3. Remove the mounting screws for the battery pack on the support. See **Figure 5-13**.

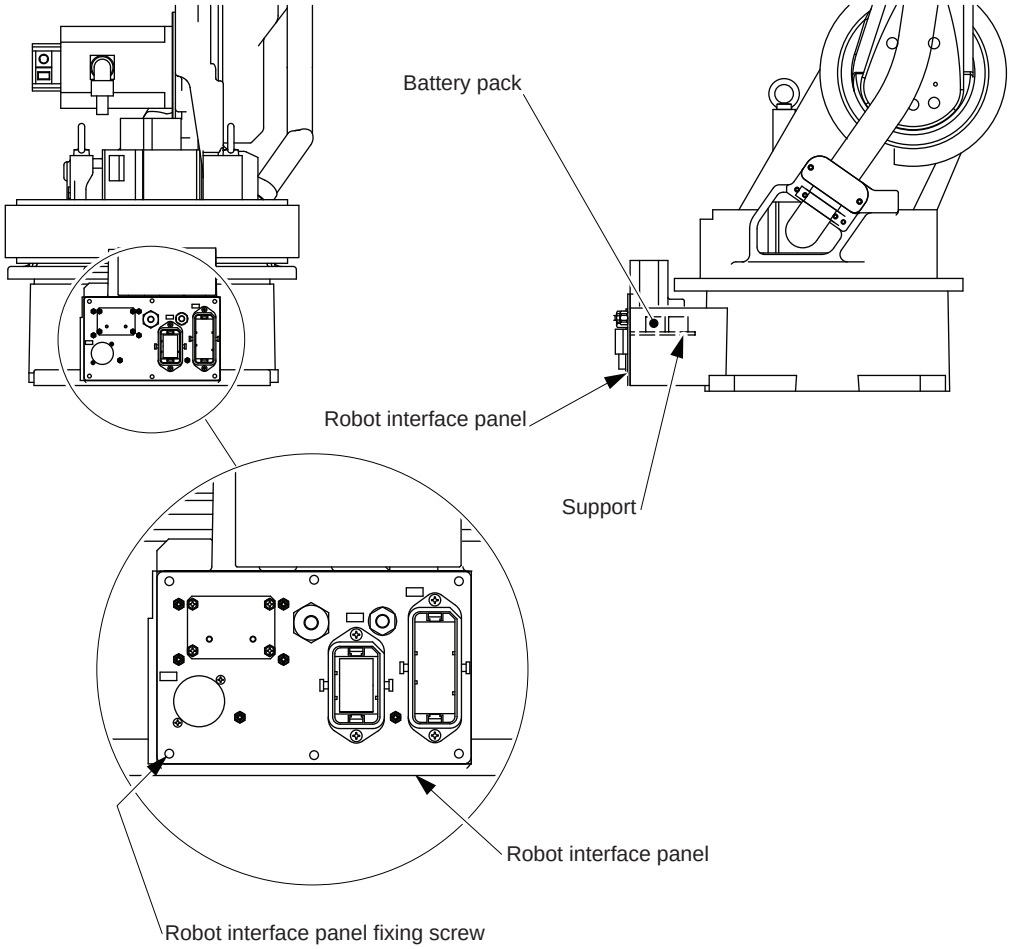


Figure 5-13. Removing Cover to Replace Encoder Batteries

4. Remove the battery pack from the holder.
5. Connect the new battery pack to an unconnected connector.

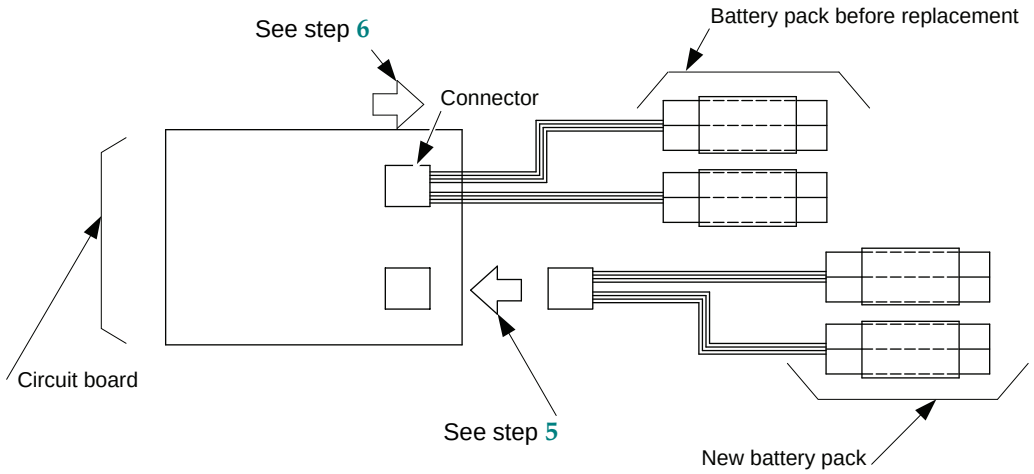


Figure 5-14. Battery Pack Connection

6. Remove the old battery pack from the circuit board.

   NOTE: Connect the new battery pack before removing the old one. If you remove the old battery pack first, the encoder positional data will be lost.

7. Mount the new battery pack on the holder.
8. Securely fix the battery pack on the support with the mounting screws.

5.11 Installing User-Supplied Hardstops

For the purpose of limiting the robot working envelope, the hardstops, or mechanical ends, for axes 1, 2, and 3 on the Adept Viper robots can be changed by installing user-supplied hardstop devices. In addition, the default softstops, or software limits, must be modified after the optional hardstop kit has been installed.

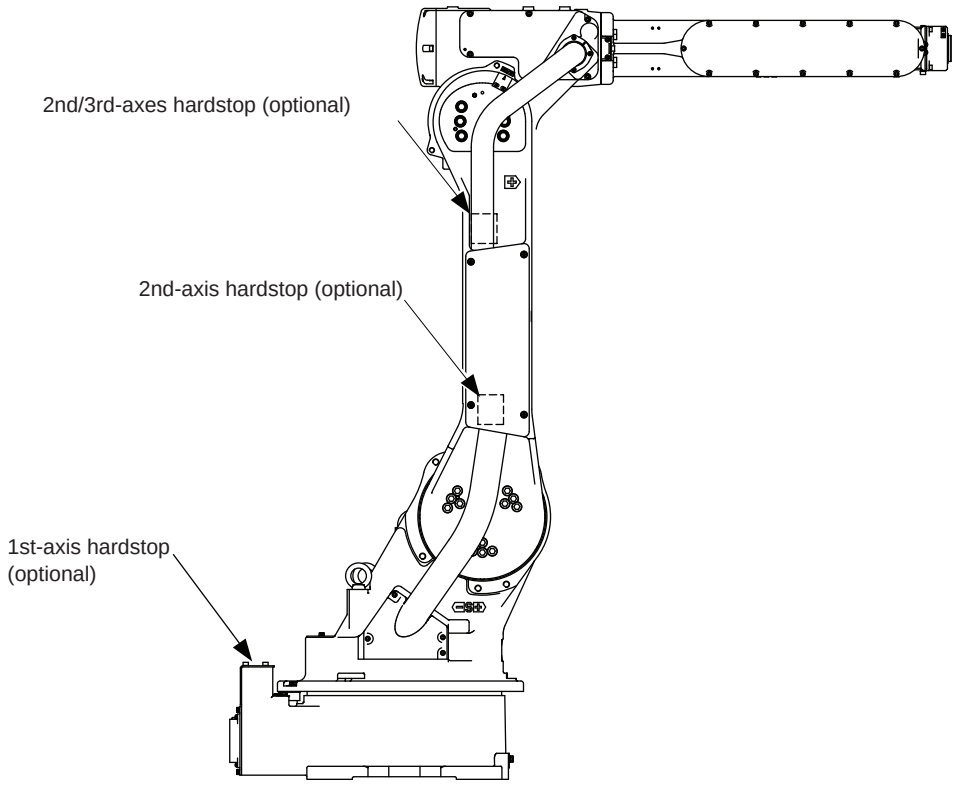


Figure 5-15. Hardstops (Optional) Locations

If you need information on modifying hardstops, please contact Adept.

CAUTION: Failures caused by user-supplied hardstops are not covered by the warranty, even if the robot is under warranty.

6 Technical Specifications

6.1 Robot Dimensions

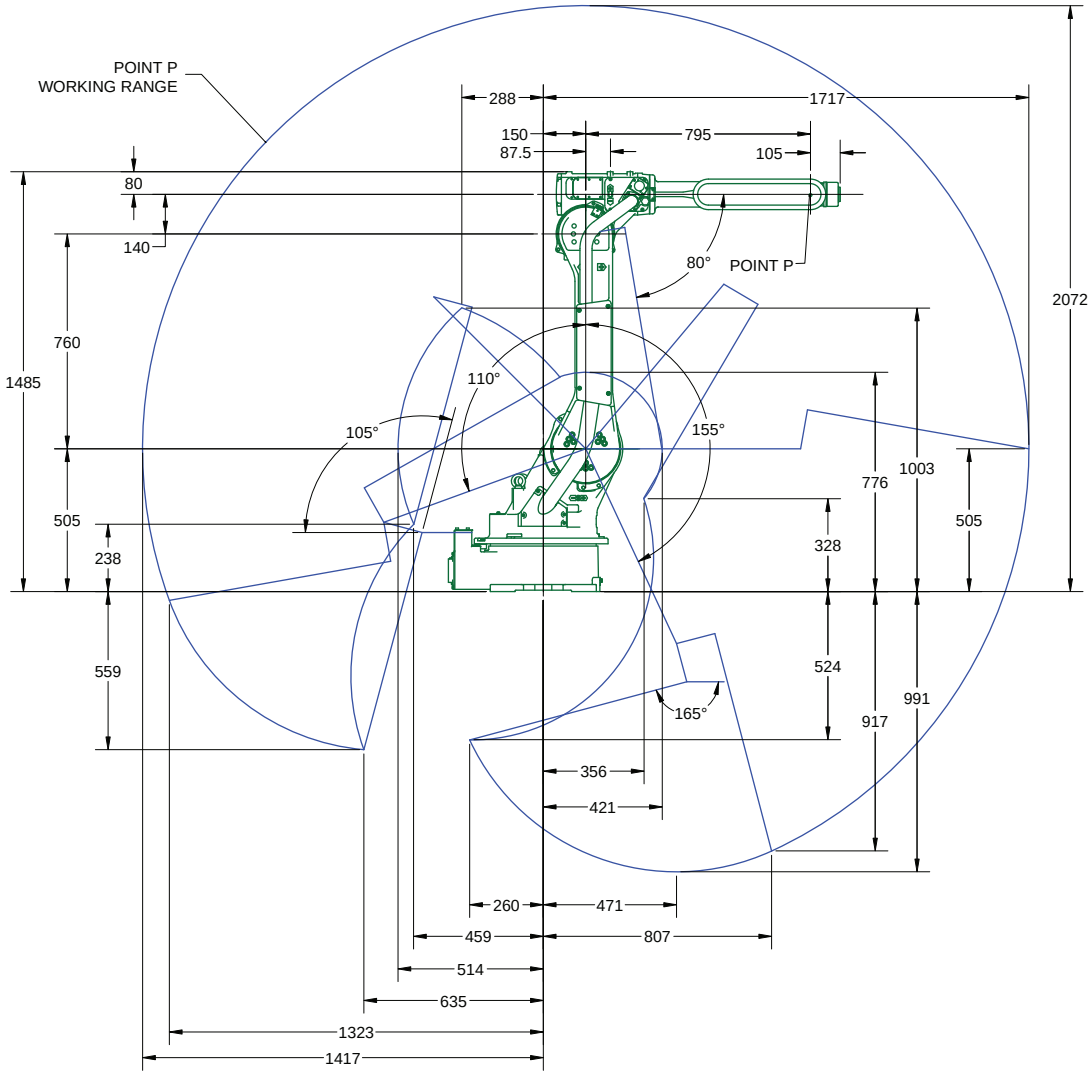


Figure 6-1. Adept Viper s1700D Side Dimensions and Work Envelope

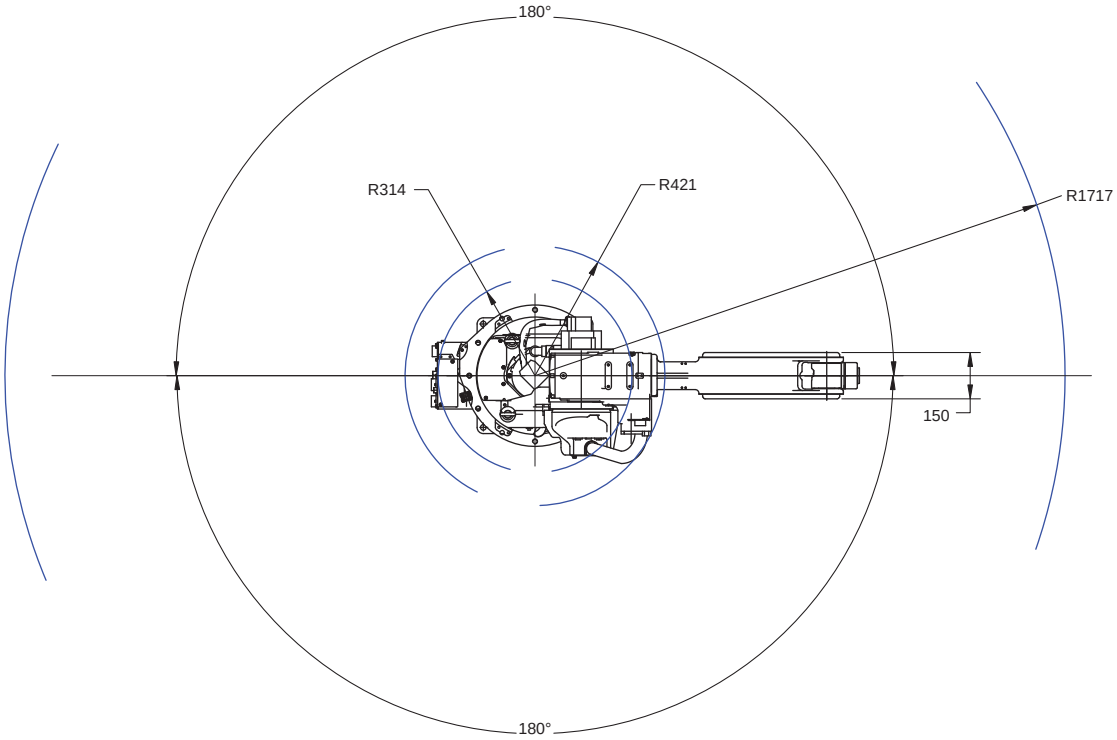


Figure 6-2. Adept Viper s1700D Top Dimensions and Work Envelope

6.2 Robot Flange Dimensions

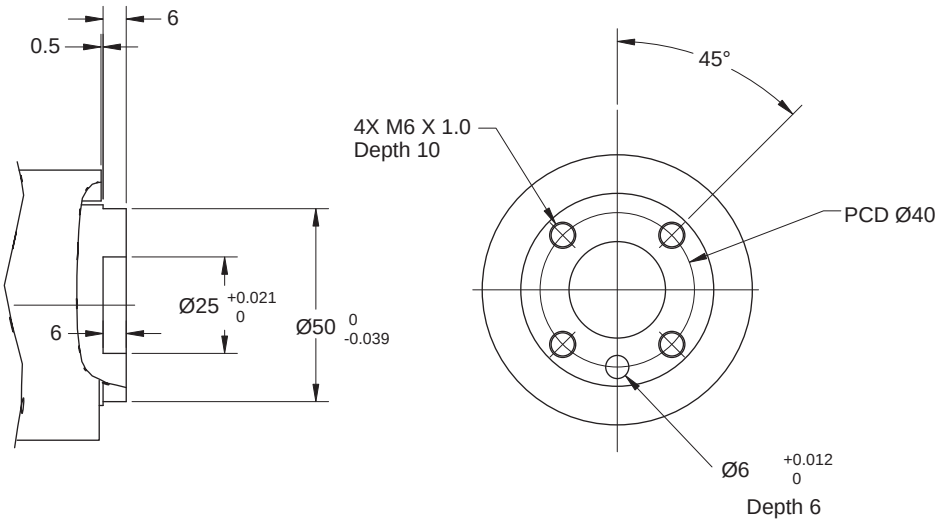


Figure 6-3. Robot Flange Dimensions

6.3 Specifications

Table 6-1. Robot Specifications

Specification	Value	
Configuration	Vertically articulated	
Degrees of freedom	6	
Payload	20 kg	
Reach	1717 mm	
Position repeatability[a]	±0.06 mm	
Motion range	J1: ±180° (turning) J2: -110°, +155° (lower arm) J3: -165°, +255° (upper arm) J4: ±200° (wrist roll) J5: -50, +230° (wrist pitch/yaw) J6: ±360° (wrist twist)	
Maximum speed	J1: 3.44 rad/s, 197°/s J2: 2.97 rad/s, 170°/s J3: 3.26 rad/s, 187°/s J4: 6.98 rad/s, 400°/s J5: 6.98 rad/s, 400°/s J6: 10.47 rad/s, 600°/s	
Allowable moment[b]	J4: 39.2 N•m (29 ft•lbf) J5: 39.2 N•m (29 ft•lbf) J6: 19.6 N•m (14.5 ft•lbf)	
Allowable inertia ($GD^2/_4$)[b]	J4: 1.05 kg•m^2 J5: 1.05 kg•m^2 J6: 0.75 kg•m^2	
Weight	Approx. 268 kg (590 lbs)	
	During Operation	During Shipment/Storage
Temperature	0° to 45° C (32° to 113° F)	-10° to 60° C (14° to 140° F)
Humidity	20 to 80% RH (at constant temperature)	less than 75% RH, non-condensing
Vibration acceleration	less than 4.9 m/s^2 (0.5 G)	less than 29.4 m/s^2 (3.0 G)
Other ambient conditions	Free from corrosive gasses or liquids, or explosive gasses Clean and dry Free from excessive electrical noise (plasma)	
Power requirements	2.0 kVA[c]	

[a] Position repeatability is the value at constant ambient temperature.
[b] Refer to **Section 2.9 on page 35** for details on allowable moment and inertia.
[c] For typical power consumption information, see **Table 3-2 on page 43**.

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