Adept Cobra s600/s800 Robot

User's Guide

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P/N: 03017-000, Rev L1

May, 2013

adept

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Table of Contents

Chapter 1: Introduction

1.1 Product Description

Adept Cobra s600/s800™ Robots

The Adept Cobra s600 and s800 robots are four-axis SCARA robots (Selective Compliance Assembly Robot Arm). See the following figure. Joints 1, 2, and 4 are rotational; Joint 3 is translational. For a description of the robot joint locations, see Robot Joint Motions on page 10.

The Adept Cobra s600 and s800 robots require an Adept SmartController™ motion controller. The robots are programmed and controlled using the SmartController, running on the Adept SmartServo distributed motion control platform. Mechanical specifications for the Adept Cobra s600 and s800 robots are provided in Robot Specifications on page 108.

> **NOTE:** The descriptions and instructions in this manual apply to both the Cobra s600 and the Cobra s800, except for instances where there is a difference, as in dimension and work envelope drawings. In those cases the information is presented for both robots.

Figure 1-1. Adept Cobra s800 Robot

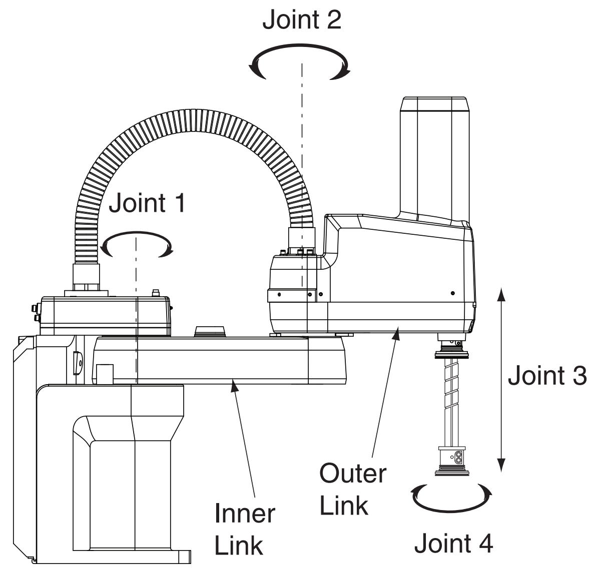


Figure 1-2. Robot Joint Motions

AIB™, eAIB™ (Amplifiers in Base)

The amplifiers for the Adept Cobra s600 and s800 robots are embedded in the base of the robot. There are two versions offered: the AIB and the eAIB. Both provide power amplifiers and full servo control.

Adept AIB and eAIB feature:

- On-board digital I/O
- Low EMI for use with noise sensitive equipment
- No external fan for quiet robot operation
- 8 kHz servo rate to deliver low positional errors and superior path following
- Sine wave commutation to lower cogging torque and improve path following
- Digital feed forward design to maximize efficiency, torque, and velocity
- Temperature sensors on all amplifiers and motors for maximum reliability and easy troubleshooting

Adept eAIB only:

- Hardware-based E-Stop and Teach Restrict controls

  For improved safety relative to European standards implemented in 2012

The two amplifiers look very similar, and both fit either Cobra model.

Figure 1-3. Amplifier on Robot, AIB, s600 Shown

Adept SmartController™

The SmartController is the foundation of Adept's family of high-performance distributed motion controllers. The SmartController is designed for use with:

- Adept Cobra s-Series robots
- Adept Quattro robots
- Adept Viper s-Series robots
- Adept Python linear modules
- Adept MotionBlox-10
- Adept sMI6 (SmartMotion)

The SmartController supports a conveyor tracking option, as well as other options. There are two models available: the SmartController CX, which uses the V+ Operating System, and the SmartController EX, which uses the eV+ Operating System. Both models offer 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 SmartController also includes Fast Ethernet and DeviceNet. See the following figure.

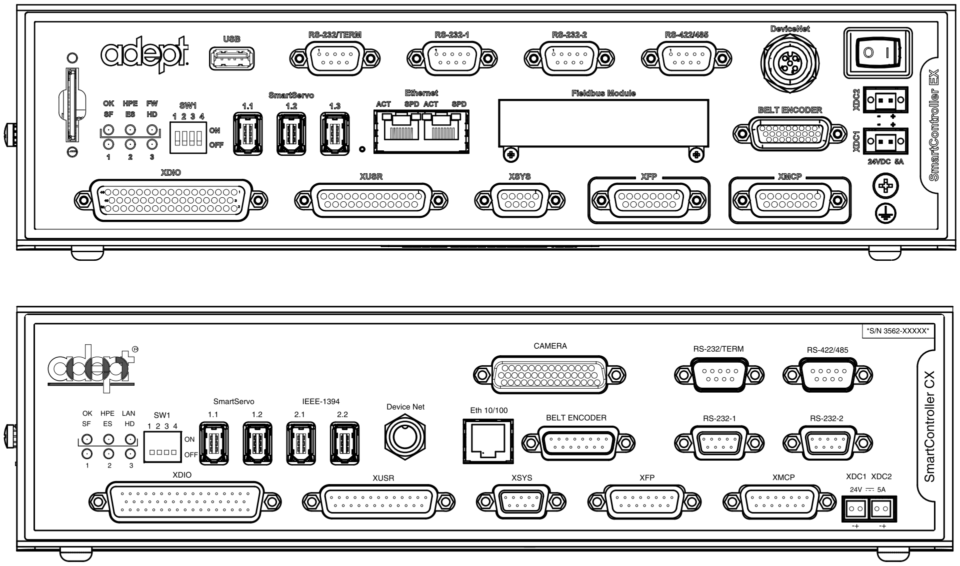


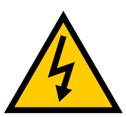
Figure 1-4. Adept SmartController EX, CX

sDIO™ Module

The sDIO module provides 32 optical isolated digital inputs and 32 optical isolated outputs and also includes an IEEE 1394 interface.

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.

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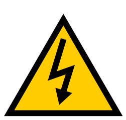


WARNING: This indicates a potentially hazardous electrical situation which, if not avoided, could result in injury or major damage to the equipment.

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: An Adept Cobra s600/s800 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 Intended Use of the Robots on page 14. 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 Conformity (MDOC)

This lists all standards with which each robot complies. For details, 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. For details, see Adept Document Library on page 16.

1.6 Intended Use of the Robots

The Adept Cobra s600 and s800 robots are intended for use in parts assembly and material handling for payloads less than 5.5 kg (12.1 lb). See Robot Specifications on page 108 for complete information on the robot specifications. Refer to the *Adept Robot Safety Guide* for details on the intended use of Adept robots.

1.7 Installation Overview

The system installation process is summarized in the following table. Also, refer to Robot Installation on page 17 and System Installation on page 25.

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

Table 1-1. Installation Overview

Task to be Performed	Reference Location
Mount the robot on a flat, secure mounting surface.	See Mounting the Robot on page 19.
Install the SmartController, Front Panel, pendant, and Adept ACE™ software.	See Installing the SmartController on page 26.
Install the IEEE 1394 and XSYS cables between the robot and SmartController.	See Cable Connections from Robot to SmartController on page 27.
Create a 24 VDC cable and connect it between the SmartController and the user-supplied 24 VDC power supply.	See Installing the SmartController on page 26.
Create a 24 VDC cable and connect it between the robot and the user-supplied 24 VDC power supply.	See Connecting 24 VDC Power to Robot on page 28.
Create a 200-240 VAC cable and connect it between the robot and the facility AC power source.	See Connecting 200-240 VAC Power to Robot on page 31.
Install user-supplied safety barriers in the workcell.	See Installing User-Supplied Safety Equipment on page 36.
Learn about connecting digital I/O through the XIO connector on the robot.	See Using Digital I/O on Robot XIO Connector on page 43.
Learn about starting the system for the first time.	See Starting the System for the First Time on page 50.
Learn about installing optional equipment,	See Installing End-Effectors on page 71.

Task to be Performed	Reference Location
including end-effectors, user air and electrical lines, external equipment, solenoids, etc.	

1.8 Manufacturer's Declaration

The Manufacturer's Declaration of Incorporation and Conformity for Adept robot systems can be found on the Adept website, in the Download Center of the Support section.

http://www.adept.com/support/downloads/file-search

NOTE: The Download Center requires that you are logged in for access. If you are not logged in, you will be redirected to the Adept website Login page, and then automatically returned to the Download Center when you have completed the login process.

1. From the Download Types drop-down list, select Manufacturer Declarations
2. From the Product drop-down list, select your Adept robot product category (such as Adept Cobra Robots, Adept Viper robots, etc.).
3. Click Begin Search. The list of available documents is shown in the Search Results area, which opens at the bottom of the page. You may need to scroll down to see it.
4. Use the Description column to locate the document for your Adept robot, and then click the corresponding Download ID number to access the Download Details page.
5. On the Download Details page, click Download to open or save the file.

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 website:

http://www.adept.com

- For Contact information:
  http://www.adept.com/contact/americas
- 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/

Related Manuals

This manual covers the installation, operation, and maintenance of an Adept Cobra s600/s800 robot system. For additional manuals covering programming the system, reconfiguring installed components, and adding optional components, see the following table.

Table 1-2. Related Manuals

Manual Title	Description
Adept Robot Safety Guide	Contains safety information for Adept robots.
Adept SmartController User's Guide	Contains information on the installation and operation of the Adept SmartController and the optional sDIO product.
Adept T2 Pendant User's Guide	Describes the use of the optional Adept manual control pendant.
Adept ACE User's Guide	Instruction for the use of the Adept ACE software.
Adept Dual-Robot Configuration Procedure	Contains cable diagrams and configuration procedures for a dual-robot system.
Adept IO Blox User's Guide	Describes the IO Blox product.

Adept Document Library

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

Support > 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, use the menu links located above the search field.

Chapter 2: Robot Installation

2.1 Transport and Storage

This equipment must be shipped and stored in a temperature-controlled environment, within the range –25 C to +55 C. The recommended humidity range is 5 to 90 percent, non-condensing. It should be shipped and stored in the Adept-supplied packaging, which is designed to prevent damage from normal shock and vibration. You should protect the package from excessive shock and vibration.

Use a forklift, pallet jack, or similar device to transport the packaged equipment (see the following figure).

The robots must always be stored and shipped in an upright position in a clean, dry area that is free from condensation. Do not lay the crate on its side or any other position: this could damage the robot.

The s600 robot weighs 41 kg (90 lb) and the s800 weighs 43 kg (95 lb) with no options installed.

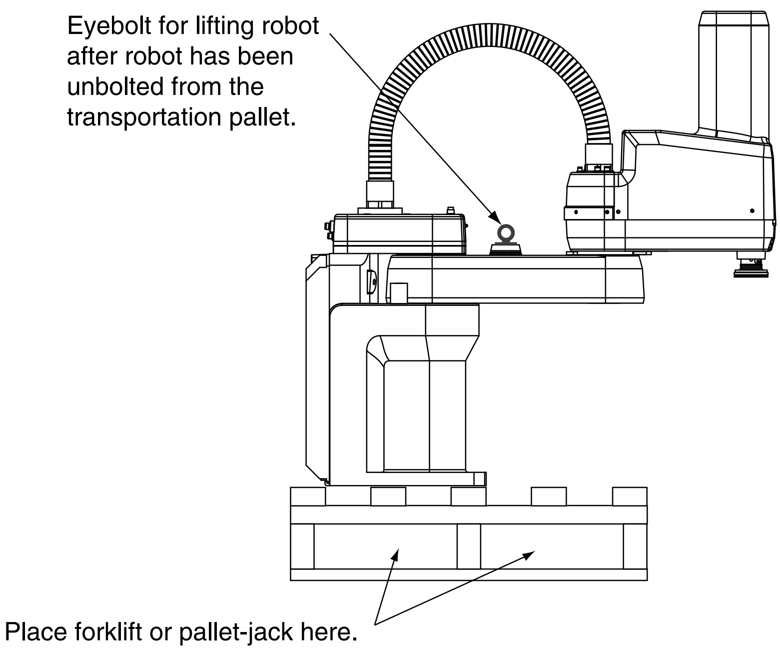


Figure 2-1. Cobra s600 Robot on a Transportation Pallet

2.2 Unpacking and Inspecting the Adept Equipment

Before Unpacking

Carefully inspect all shipping crates for evidence of damage during transit. Pay special attention to any tilt and shock indication labels on the exteriors of the containers. 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 How Can I Get Help? on page 15.

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

2.3 Repacking for Relocation

If the robot or other equipment needs to be relocated, reverse the steps in the installation procedures that follow this chapter. Reuse all original packing containers and materials and follow all safety notes used for installation. Improper packaging for shipment will void your warranty. Specify this to the carrier if the robot is to be shipped.

CAUTION: Before unbolting the robot from the mounting surface, fold the outer arm against the Joint 2 hardstops to help centralize the center of gravity. The robot must always be shipped in an upright orientation.

2.4 Environmental and Facility Requirements

The Adept robot system installation must meet the operating environment requirements shown in the following table.

Table 2-1. Robot System Operating Environment Requirements

Ambient temperature	5 to 40° C (41 to 104° F)
Humidity	5 to 90%, non-condensing

Altitude	up to 2000 m (6500 ft)
Pollution degree	2
Robot protection class	IP 20 (NEMA Type 1)
NOTE: For robot dimensions, see Dimension Drawings on page 101.	

2.5 Mounting the Robot

WARNING: Only qualified service personnel may install or service the robot system.

Mounting Surface

The Adept Cobra s600 and s800 robots are designed to be mounted on a smooth, flat, level tabletop. The mounting structure must be rigid enough to prevent vibration and flexing during robot operation. Adept recommends a 25 mm (1 in.) thick steel plate mounted to a rigid tube frame. Excessive vibration or mounting flexure will degrade robot performance. The following figure shows the mounting hole pattern for the Adept Cobra s600 and s800 robots.

NOTE: On the under side of the base there is a hole and a slot that can be used as locating points for user-installed dowel pins in the mounting surface; see the following figure. Using locating pins could improve the ability to remove and reinstall the robot in the same position.

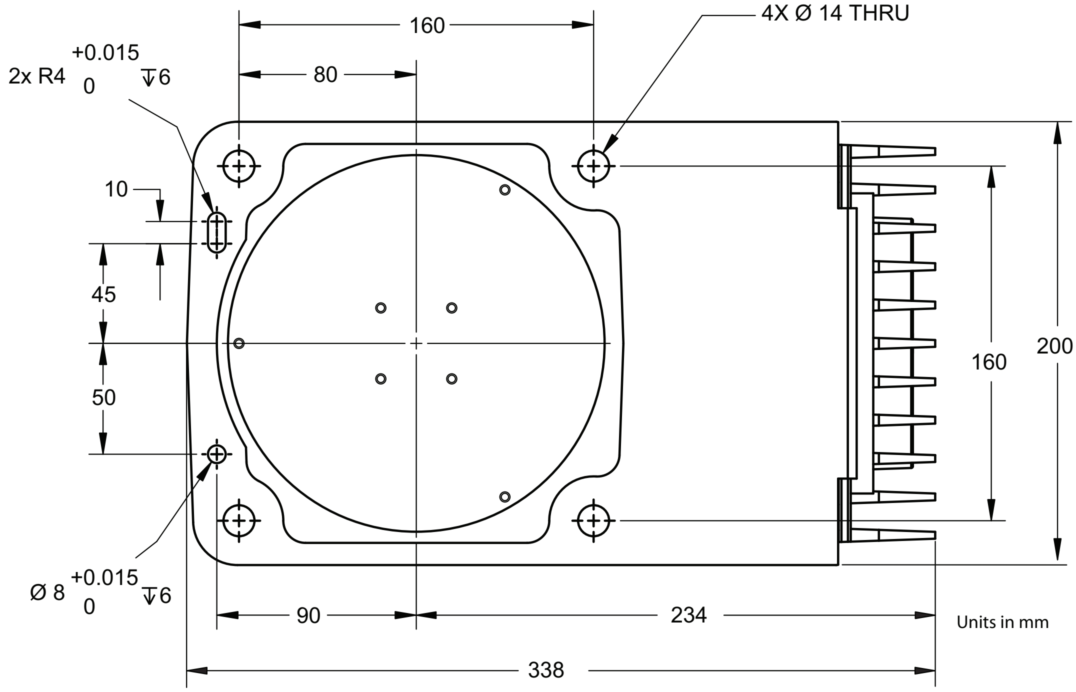


Figure 2-2. Mounting Hole Pattern for Robot

Robot Mounting Procedure

1. Using the dimensions shown in the previous figure, drill and tap the mounting surface for four M12 - 1.75 x 36 mm (or 7/16 - 14 UNC x 1.50 in.) machine bolts (bolts are user-supplied).
2. While the robot is still bolted to the transportation pallet, connect the hydraulic lift to the eyebolt at the top of the inner link (see Figure 2-1). Take up any slack, but do not lift the robot at this time.

WARNING: Do not attempt to lift the robot at any points other than the eyebolt provided. Do not attempt to extend the inner or outer links of the robot until the robot has been secured in position. Failure to comply could result in the robot falling and causing either personnel injury or equipment damage.

3. Remove the four bolts securing the robot base to the pallet.

   Retain these bolts for possible later relocation of the equipment.
4. Lift the robot and position it directly over the mounting surface.
5. Slowly lower the robot while aligning the base and the tapped mounting holes in the mounting surface.

NOTE: The base casting of the robot is aluminum and can easily be dented if bumped against a harder surface.

6. Verify that the robot is mounted squarely (can not rock back and forth) before tightening the mounting bolts.
7. Install the user-supplied mounting bolts and washers. Tighten bolts to the torque specified in the following table.

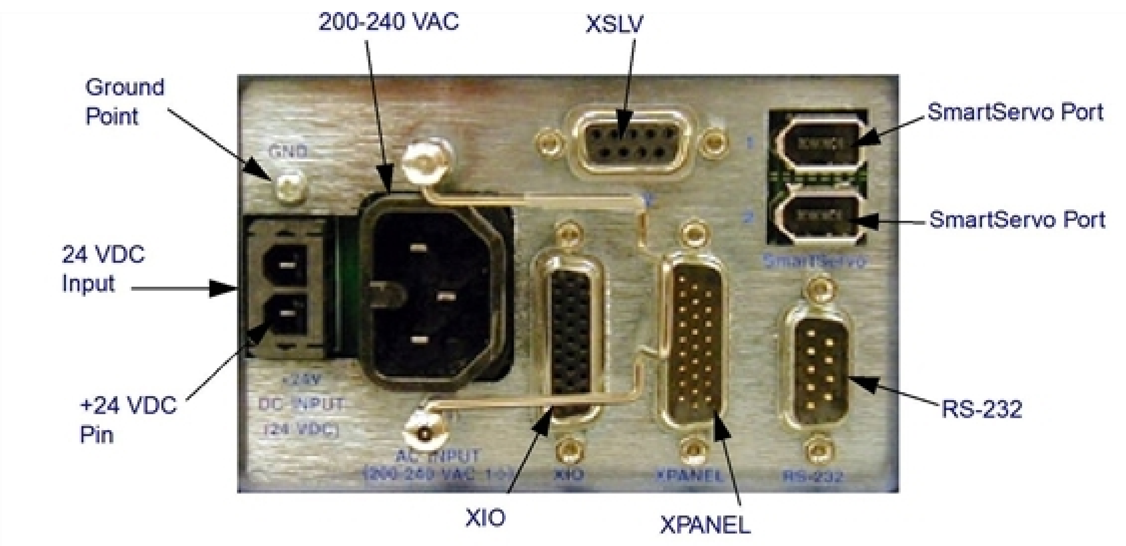
WARNING: The center of mass of the robot may cause the robot to fall over if the robot is not secured with the mounting bolts.

NOTE: Check the tightness of the mounting bolts one week after initial installation, and then recheck every 6 months. See Maintenance on page 55 for periodic maintenance.

Table 2-2. Mounting Bolt Torque Specifications

Standard	Size	Specification	Torque
Metric	M12 x P1.75	ISO Property Class 8.8	85 N·m
SAE	7/16-14 UNC	SAE J429 Grade 5 or ASTM A449	65 ft-lb

2.6 Description of Connectors on Robot Interface Panel



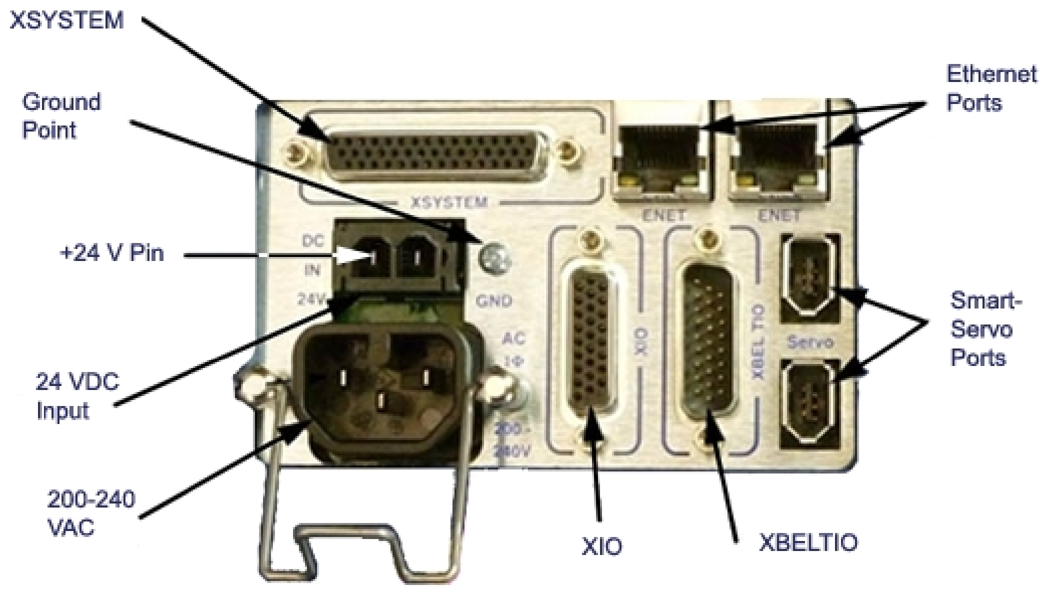


Figure 2-3. Robot Interface Panels - AIB and eAIB

The following connections are the same for both the AIB and the eAIB:

24 VDC—for connecting user-supplied 24 VDC power to the robot. The mating connector is provided.

Ground Point—for connecting cable shield from user-supplied 24 VDC cable.

200/240 VAC—for connecting 200-240 VAC, single-phase, input power to the robot. The mating connector is provided.

SmartServo x2 (IEEE 1394) — for connecting the IEEE 1394 cable from the controller (SmartServo 1.1) to the robot. The other robot connector can be used to connect to a second robot or another 1394-based motion axis.

XIO (DB26, high density, female) — for user I/O signals for peripheral devices. This connector provides 8 outputs and 12 inputs. For connector pin allocations for inputs and outputs, see Using Digital I/O on Robot XIO Connector on page 43. That section also contains signal nubmer to access these I/O signals via V+/eV+.

The following connections are different on the AIB and the eAIB:

XSYSTEM (eAIB only) — includes the functions of the XPANEL and XSLV on the AIB. This requires either the eAIB XSLV Adapter cable, to connect to the XSYS cable, or an eAIB XSYS cable, which replaces the XSYS cable. See Cable Connections from Robot to SmartController on page 27.

XPANEL (DB26, high density, male; AIB only) — used only with Cobra i-series robots, for connecting the front panel and MCP circuit.

XSLV (DB-9, female; AIB only) — for connecting the supplied XSYS cable from the controller XSYS connector.

XBELTIO (eAIB only) — adds two belt encoders, EXPIO at the back of the robot (which is not available on an AIB), and an RS-232 interface.

RS-232 (DB-9, male; AIB only) — used only with Cobra i-series robots, for connecting a system terminal.

Ethernet x2 (eAIB only) — these are not used with the SmartController CX, and are not currently used with the SmartController EX.

Chapter 3: System Installation

3.1 System Cable Diagram

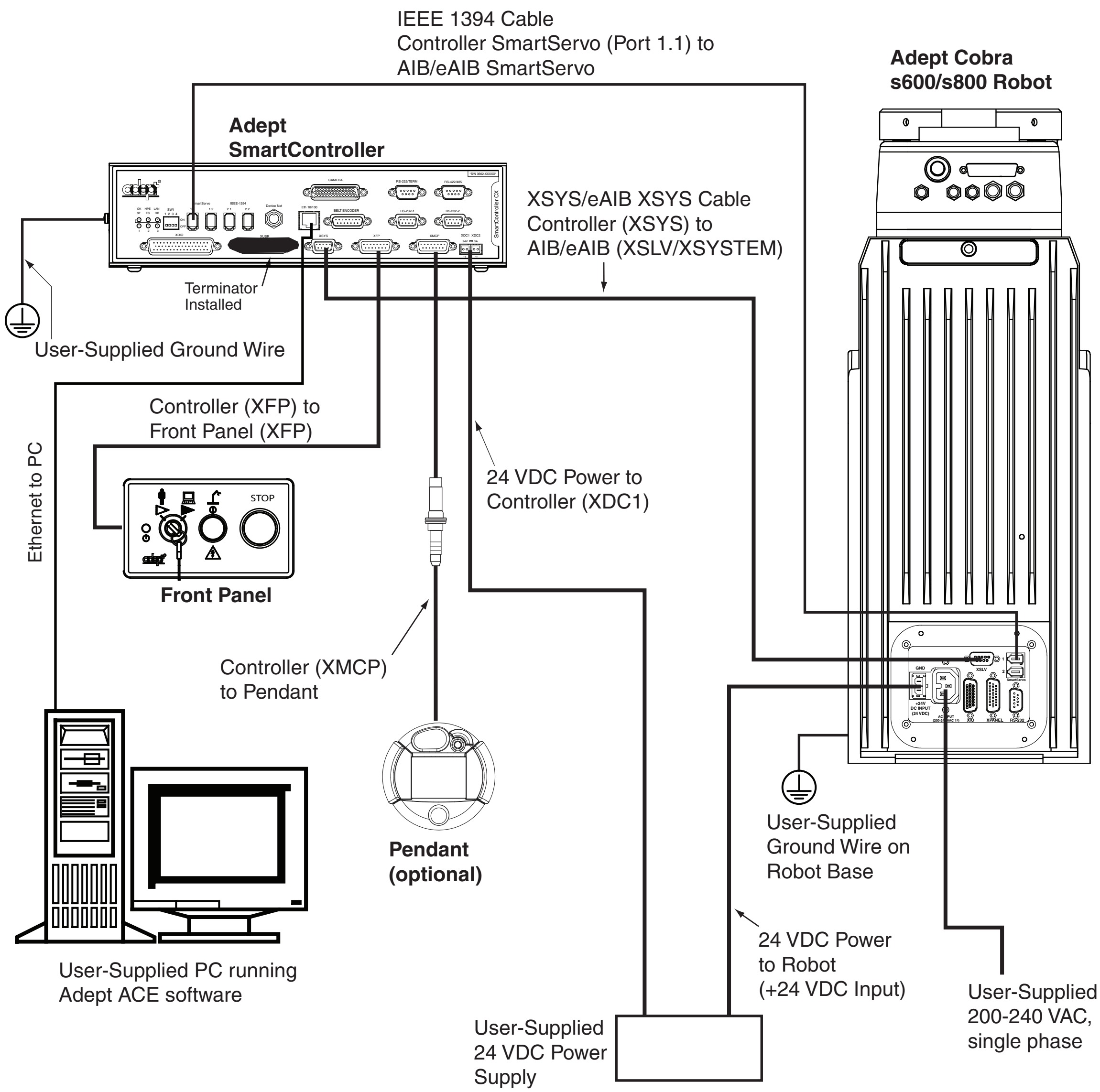


Figure 3-1. System Cable Diagram for Adept Cobra s600/s800 Robots - AIB Shown

NOTE: For additional system grounding information, see Installing 24 VDC Robot Cable on page 30.

3.2 Cable and Parts List

Table 3-1. Cable and Parts List

Part Description	Notes
IEEE 1394 Cable, 4.5 M	Standard cable—supplied with system
XSYS Cable, AIB only, 4.5 M	Standard cable—supplied with AIB system
eAIB XSYS Cable, 4.5 M	Standard cable--supplied with eAIB system
eAIB XSLV Adapter Cable, 250 mm	Standard for AIB-eAIB upgrade
Front Panel Cable	Supplied with Front Panel
T1/T2 Pendant Adapter Cable, 2 M	Supplied with Adept T2™ pendant option
Power Cable Kit, contains 24 VDC and AC power cables	Available as option
XIO Breakout Cable, 12 inputs/ 8 outputs, 5 M	Available as option—see XIO Breakout Cable on page 48.
Y Cable, for XSYS cable connections to dual robots - attaches at the controller only for an eAIB system	Available as option -- see the *Dual Robot Configuration Guide*.

3.3 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.

   WARNING: Ensure that the front panel is located outside of the workcell and outside of the work envelope.

2. Connect the Front Panel to the SmartController.
3. Connect the optional pendant to the SmartController.
4. Connect user-supplied 24 VDC power to the SmartController.

   Instructions for creating the 24 VDC cable, and power specification, are covered in the *Adept SmartController User's Guide.*

5. Install a user-supplied ground wire between the SmartController and ground.

3.4 Connecting User-Supplied PC to SmartController

The SmartController for Adept Cobra s600/s800 robots must be connected to a user-supplied PC for setup, control, and programming. The user loads the Adept ACE software onto the PC and connects it to the SmartController via an Ethernet cable.

PC Requirements

The Adept ACE CD-ROM will display a ReadMe file when inserted in your PC. This contains hardware and software requirements for running Adept ACE software.

> **NOTE:** The specifications are also listed in the ACE PackXpert Datasheet, available on the Adept corporate website.

3.5 Installing Adept ACE Software

You install Adept ACE from the Adept Software CD-ROM. Adept ACE needs Microsoft .NET Framework. The Adept ACE Setup Wizard scans your PC for .NET, and installs it automatically if it is not already installed.

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.

   > **NOTE:** The online document that describes the installation process opens in the background when you select one of software installation steps below.

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 Adept ACE software.

3.6 Cable Connections from Robot to SmartController

The following cables are shipped in the cable/accessories box.

- Locate the IEEE 1394 cable (length 4.5 M).
- For an AIB system, locate the XSYS cable.

- For an eAIB system, locate the eAIB XSYS cable or eAIB XSLV Adapter cable, which can be used with an existing XSYS cable.

Install one end of the IEEE 1394 cable into the SmartServo port 1.1 connector on the SmartController, and the other end into a SmartServo connector on the AIB or eAIB interface panel. See Figure 3-1.

AIB only:

- Install the XSYS cable between the robot interface panel XSLV safety interlock connector and XSYS connector on the SmartController, and tighten the latching screws.

eAIB only:

- For a new SmartController system with an eAIB, the system will be supplied with a 15 ft (4.5 m) cable with connectors for XSYS (DB9) on one end and XSYSTEM (DB44) on the other. Connect the XSYSTEM end to the eAIB, and the XSYS end to the SmartController.
- For a field upgrade from an old AIB, if you already have the old XSYS (DB9-DB9) cable routed and all you want to do is adapt your new eAIB to plug into the old cable, use the eAIB XSLV Adapter cable. This is a 1 ft (250 mm) long adapter that essentially turns the XSYSTEM into the old XSLV connector. Connect the XSYSTEM end to the eAIB, and the XSLV end to the old XSYS cable.

3.7 Connecting 24 VDC Power to Robot

Specifications for 24 VDC Power

Table 3-2. Specifications for 24 VDC User-Supplied Power Supply

Customer-Supplied Power Supply	24 VDC (± 10%), 150 W (6 A) (21.6 V < V_{in} < 26.4 V)
Circuit Protection[a]	Output must be less than 300 W peak or 8 Amp in-line fuse
Power Cabling	1.5 – 1.85 mm² (16-14 AWG)
Shield Termination	Braided shield connected to frame ground terminal at both ends of cable. See Figure 3-2.

[a]User-supplied 24 V power supply must incorporate overload protection to limit peak power to less than 300 W, or 8 A in-line fuse protection must be added to the 24 V power source. (In case of multiple robots on a common 24 V supply, each robot must be fused individually.)

NOTE: Fuse information is located on the AIB/eAIB electronics.

The power requirements for the user-supplied power supply will vary depending on the configuration of the robot and connected devices. Adept recommends a 24 V, 6 A power supply to allow for startup current draw and load from connected user devices, such as solenoids and digital I/O loads. If multiple robots are sharing a 24 V power supply, increase the supply capacity by 3 A for each additional robot.

CAUTION: Make sure you select a 24 VDC power supply that meets the specifications in the previous table. Using an under-rated supply can cause system problems and prevent your equipment from operating correctly. See the following table for recommended power supplies.

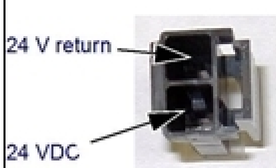
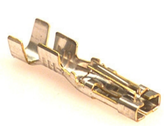
Table 3-3. Recommended 24 VDC Power Supplies

Vendor Name	Model	Ratings
XP Power	JPM160PS24	24 VDC, 6.7 A, 160 W
Astrodyne	SP-150-24	24 VDC, 6.3 A, 150 W
Mean Well	SP-150-24	24 VDC, 6.3 A, 150 W

Details for 24 VDC Mating Connector

The 24 VDC mating connector and two pins are supplied with each system. They are shipped in the cable/accessories box.

Table 3-4. 24 VDC Mating Connector Specs

Connector Details  	Connector receptacle, 2 position, type: Molex Saber, 18 A, 2-Pin
	Molex P/N 44441-2002
	Digi-Key P/N WM18463-ND
Pin Details 	Molex connector crimp terminal, female, 14-18 AWG
	Molex P/N 43375-0001
	Digi-Key P/N WM18493-ND
Recommended crimping tool, Molex Hand Crimpers	Molex P/N 63811-0400
	Digi-Key P/N WM9907-ND

NOTE: The 24 VDC cable is not supplied with the system, but is available in the optional Power Cable kit. See Table 3-1.

Procedure for Creating 24 VDC Cable

1. Locate the connector and pins shown in Table 3-4.
2. Use 14-16 AWG wire to create the 24 VDC cable. Select the wire length to safely reach from the user-supplied 24 VDC power supply to the robot base.

NOTE: You also must create a separate 24 VDC cable for the SmartController. That cable uses a different style of connector. See the *Adept SmartController User's Guide*.

3. Crimp the pins onto the wires using the crimping tool.
4. Insert the pins into the connector. Confirm that the 24 V and 24 V return wires are in the correct terminals in the plug.
5. Prepare the opposite end of the cable for connection to the user-supplied 24 VDC power supply.

Installing 24 VDC Robot Cable

1. Connect one end of the shielded 24 VDC cable to your user-supplied 24 VDC power supply. The cable shield should be connected to frame ground on the power supply. Do not turn on the 24 VDC power until instructed to do so in Turning on Power on page 51. See the following figure.
2. Plug the mating connector end of the 24 VDC cable into the 24 VDC connector on the interface panel on the back of the robot. The cable shield should be connected to the ground point on the interface panel.

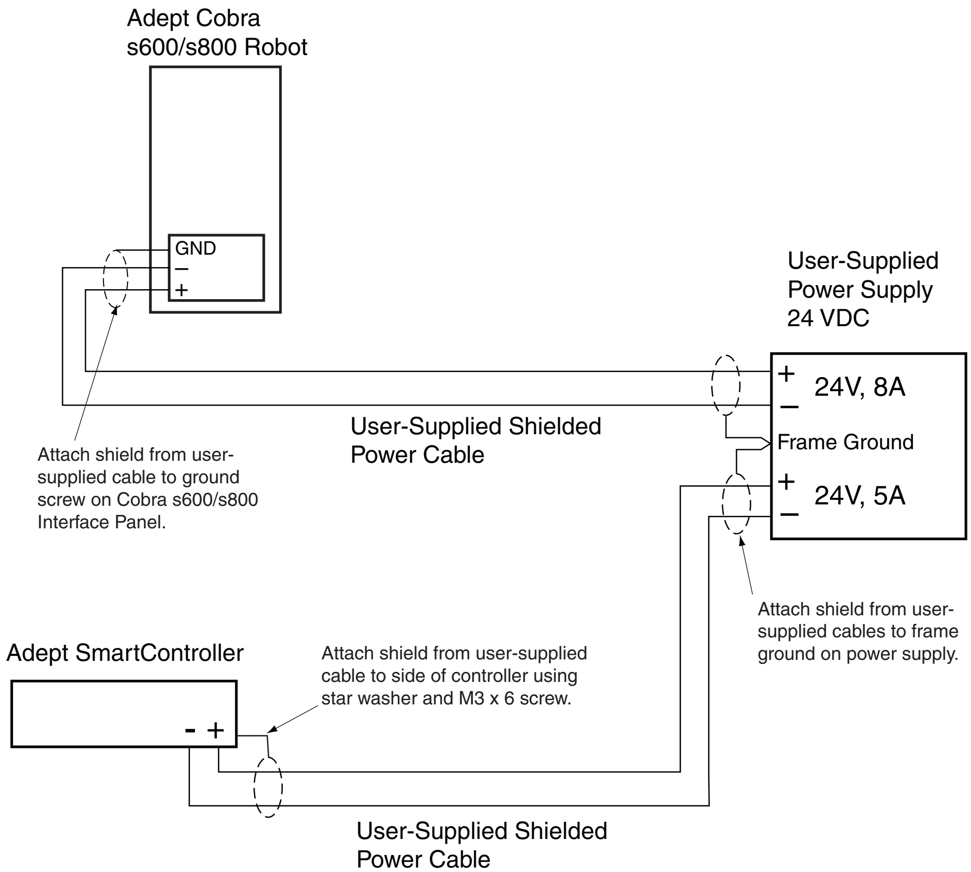
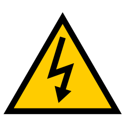


Figure 3-2. User-Supplied 24 VDC Cable

NOTE: In order to maintain compliance with standards, Adept recommends that DC power be delivered over a shielded cable, with the shield connected to frame ground at both ends of the cable.

3.8 Connecting 200-240 VAC Power to Robot



WARNING: Appropriately sized Branch Circuit Protection and Lockout / Tagout Capability must be provided in accordance with the National Electrical Code and any local codes.Ensure compliance with all local and national safety and electrical codes for the installation and operation of the robot system.

Specifications for AC Power

Table 3-5. Specifications for 200/240 VAC User-Supplied Power Supply

Auto-Ranging Nominal Voltage Ranges	Minimum Operating Voltage[a]	Maximum Operating Voltage	Frequency/ Phasing	Recommended External Circuit Breaker, User-Supplied
200 V to 240 V	180 V	264 V	50/60 Hz 1-phase	10 Amps

[a]Specifications are established at nominal line voltage. Low line voltage can affect robot performance.

Table 3-6. Typical Robot Power Consumption

Cobra Robot	Move	Average Power (W)	RMS Current (A)	Peak Power (W)[a]
s600	No load—Adept cycle[b]	344	1.56	1559
	5.5 kg—Adept cycle[b]	494	2.25	2061
	5.5 kg—all joints move	880	4.00	2667
s800	No load—Adept cycle[b]	377	1.71	1406
	5.5 kg—Adept cycle[b]	531	2.41	1955
	5.5 kg—all joints move	794	3.61	2110

[a]For short durations (100 ms).
[b]For details on Adept cycle, see Robot Specifications on page 108.

NOTE: The Adept robot system is intended to be installed as a piece of equipment in a permanently-installed system.

WARNING: Adept systems require an isolating transformer for connection to mains systems that are asymmetrical or use an isolated (impedant) neutral. Many parts of Europe use an impedant neutral.

DANGER: AC power installation must be performed by a skilled and instructed person—refer to the *Adept Robot Safety Guide*. During installation, unauthorized third parties must be prevented from turning on power through the use of fail-safe lockout measures.

Facility overvoltages Protection

The user must protect the robot from excessive overvoltages and voltage spikes. If the country of installation requires a CE-certified installation, or compliance with IEC 1131-2, the following information may be helpful: IEC 1131-2 requires that the installation must ensure that Category II overvoltages (i.e., line spikes not directly due to lightning strikes) are not exceeded. Transient overvoltages at the point of connection to the power source shall be controlled not to exceed overvoltages Category II, i.e., not higher than the impulse voltage corresponding to the rated voltage for the basic insulation. The user-supplied equipment or transient suppressor shall be capable of absorbing the energy in the transient.

In the industrial environment, nonperiodic overvoltage peaks may appear on mains power supply lines as a result of power interruptions to high-energy equipment (such as a blown fuse on one branch in a 3-phase system). This will cause high current pulses at relatively low voltage levels. The user shall take the necessary steps to prevent damage to the robot system (such as by interposing a transformer). See IEC 1131-4 for additional information.

AC Power Diagrams

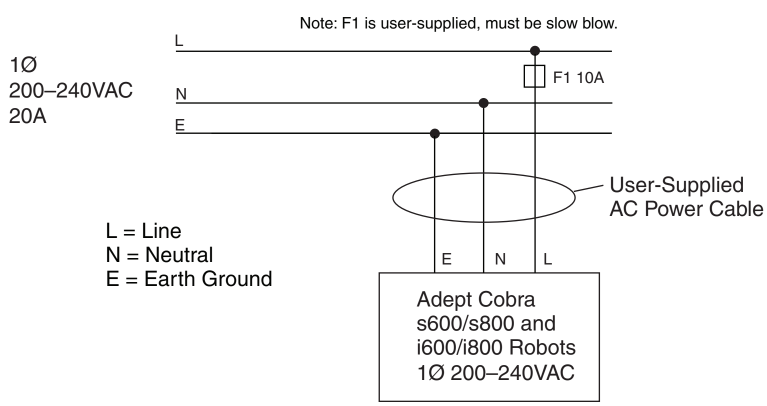


Figure 3-3. Typical AC Power Installation with Single-Phase Supply

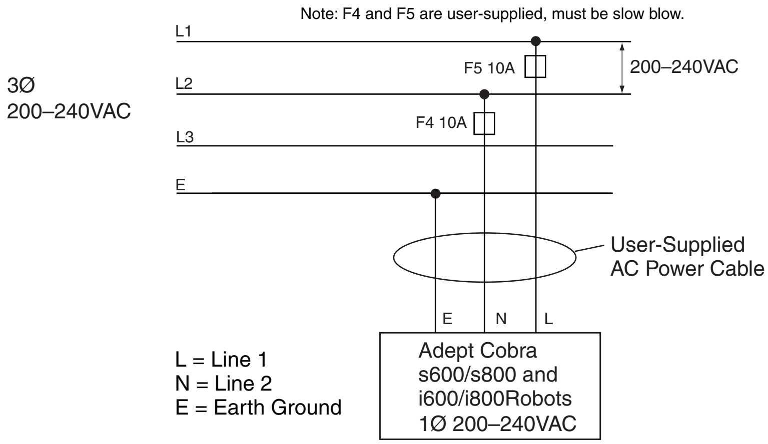


Figure 3-4. Single-Phase Load across L1 and L2 of a Three-Phase Supply

NOTE: If a three-phase power source is used, it must be symmetrically-earthed (with grounded neutral). Connections called out as single-phase can be wired Line-to-Neutral or Line-to-Line.

Details for AC Mating Connector

The AC mating connector is supplied with each system. It is typically shipped in the cable/accessories box. The supplied plug is internally labeled for the AC power connections (L, E, N).

Table 3-7. AC Mating Connector Details

AC Connector details 	AC in-line power plug, straight, female, screw terminal, 10 A, 250 VAC
	Qualtek P/N 709-00/00
	Digi-Key P/N Q217-ND

The AC power cable is not supplied with the system, but is available in the optional Power Cable kit; see Table 3-1.

Creating the 200-240 VAC Cable

1. Locate the AC mating connector shown in the previous table.
2. Open the connector by unscrewing the screw on the shell and removing the cover.
3. Loosen the two screws on the cable clamp. See Figure 3-5.
4. Use 18 AWG wire to create the AC power cable. Select the wire length to safely reach

from the user-supplied AC power source to the robot base.

5. Strip approximately 18 to 24 mm insulation from each of the three wires.
6. Insert the wires into the connector through the removable bushing.
7. Connect each wire to the correct terminal screw, and tighten the screw firmly.
8. Tighten the screws on the cable clamp.
9. Reinstall the cover and tighten the screw to seal the connector.
10. Prepare the opposite end of the cable for connection to the facility AC power source.

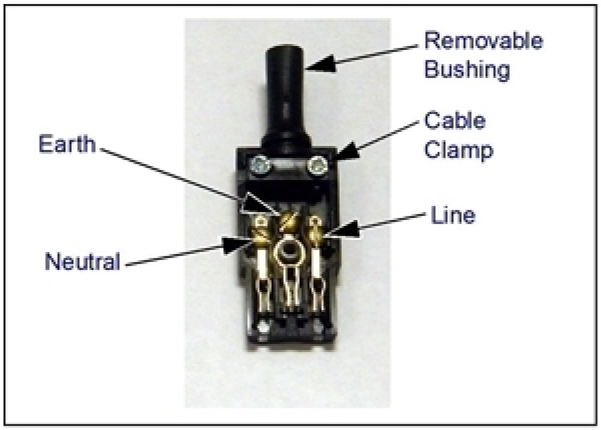


Figure 3-5. AC Power Mating Connector

Installing AC Power Cable to Robot

1. Connect the unterminated end of the AC power cable to your facility AC power source. See AC Power Diagrams on page 33. Do not turn on AC power at this time.
2. Plug the AC connector into the AC power connector on the interface panel on the robot.
3. Secure the AC connector with the locking latch.

3.9 Grounding the Adept Robot System

Proper grounding is essential for safe and reliable robot operation. Follow these recommendations to properly ground your robot system.

Grounding the Robot Base

The user can install a ground wire at the robot base to ground the robot. See Figure 3-6. The robot ships with an M8 x 12 stainless steel, hex-head screw, and M8 split and flat washers installed in the grounding hole. The user is responsible for supplying the ground wire to connect to earth ground.

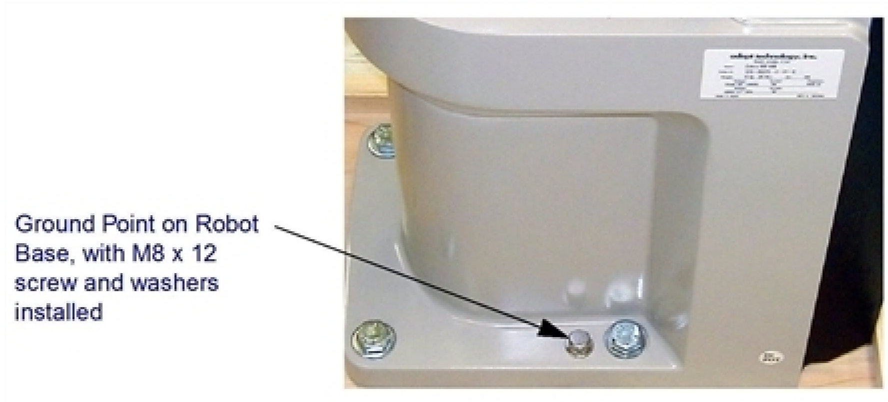


Figure 3-6. Ground Point on Robot Base

Grounding Robot-Mounted Equipment

The following parts of an Adept Cobra s600/s800 robot are not grounded to protective earth: the Joint 3 quill and the tool flange. If hazardous voltages are present at any user-supplied robot-mounted equipment or tooling, you must install a ground connection from that equipment/tooling to the ground point on the robot base. Hazardous voltages can be considered anything in excess of 30 VAC (42.4 VAC peak) or 60 VDC.

Also, for the grounding point on the tool flange, see Figure 7-4.

DANGER: Failing to ground robot-mounted equipment or tooling that uses hazardous voltages could lead to injury or death of a person touching the end-effector when an electrical fault condition exists.

3.10 Installing User-Supplied Safety Equipment

The user is responsible for installing safety barriers to protect personnel from coming in contact with the robot unintentionally. Depending on the design of the workcell, safety gates, light curtains, and emergency stop devices can be used to create a safe environment. Read the *Adept Robot Safety Guide* for a discussion of safety issues.

Refer to the *Adept SmartController User's Guide* for information on connecting safety equipment into the system through the XUSR connector on the SmartController. There is a detailed section on Emergency Stop Circuits and diagrams on recommended E-Stop configurations.

Chapter 4: System Operation

4.1 Robot Status LED Description

The robot Status LED indicator is located on the top of the robot. The blinking pattern indicates the status of the robot.

The current robot models support the UL standard. The LED on these robots is amber. See the following figure and table.

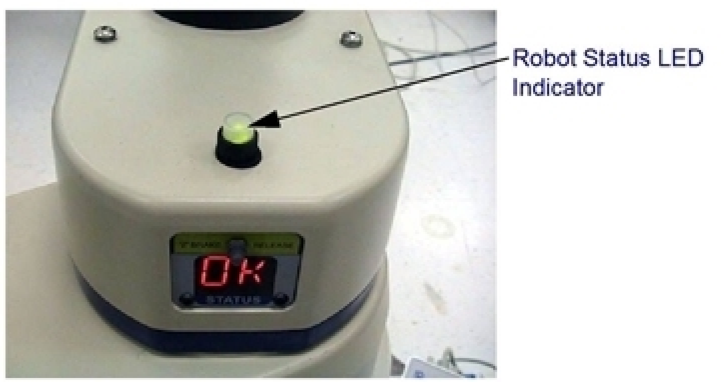


Figure 4-1. Robot Status LED Indicator Location

Table 4-1. Status LED Definitions on UL-Certified Robots

LED Status	2-Digit Status Panel Display	Description
Off	Off	24 VDC not present
Off	OK	High Power Disabled
Amber, Solid	ON	High Power Enabled
Amber, Slow Blink	N/A	Selected Configuration Node
Amber, Fast Blink	Fault Code(s)	Fault, see the next section
Amber, Solid	Fault Code(s)	Fault, see the next section

4.2 Status Panel Fault Codes

The status panel, shown in the following figure, displays alpha-numeric codes that indicate the operating status of the robot, including detailed fault codes. The following table gives meanings of the fault codes. These codes provide information for quickly isolating problems during troubleshooting.

The displayed fault code will continue to be displayed even after the fault is corrected or additional faults are recorded. All displayed faults will be cleared from the display, and reset to a no-fault condition, upon successfully enabling high power to the robot, or power cycling the 24 V supply to the robot.

Figure 4-2. Status Panel

Table 4-2. Status Panel Codes

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

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

4.3 Brakes

The robot has a braking system that decelerates the robot in an emergency condition, such as when the emergency stop circuit is open or a robot joint passes its softstop.

The E-Stop is a dual-channel, passive E-Stop that supports Category 3 CE safety requirements. It supports a customer-programmable E-Stop delay that maintains motor power for a programmed time after the E-Stop is activated. This customizable feature allows the motors to decelerate under servo control to a stop. This can aid in eliminating coasting or overshooting on low friction mechanisms. It can also aid in the reduction of wear on highly-geared, high-inertia mechanisms, while maintaining safety compliance per all standards.

The Programmable E-Stop delay can be set up in Adept ACE, in the robot editor. The default setting is appropriate for most applications. See Programmable E-Stop Delay, in the next section.

The braking system will not prevent you from moving the robot manually once the robot has stopped (and high power has been removed).

In addition, Joint 3 has an electromechanical brake. The brake is released when high power is enabled. When high power is turned off, the brake engages and holds the position of Joint 3.

Programmable E-Stop Delay

To set the programmable E-Stop delay from the ACE software, go to the object editor for the robot, and enable Expert Access:

Object > Expert Access

NOTE: This requires a password to enable.

Once enabled, you will be able to see and modify the following three parameters (among others):

- Auto Mode E-Stop Shutdown Timeout
- Hold-to-Run E-Stop Shutdown Timeout
- Manual Mode E-Stop Shutdown Timeout

Each of these is the time, in seconds, after that mode E-Stop is asserted, in which V+/eV+ is allowed to decelerate the robot, engage the brakes, and shut down power before the servo nodes automatically shut down power. The value can be set from 0 (immediate power-off) to 0.512 seconds. If the deceleration is too slow, or the brake-on delay too long, the servo will automatically cut power.

Brake Release Button

Under some circumstances you may want to manually position Joint 3 on the Z-Axis without turning on high power. For such instances, a “Z” Brake Release button is located above the robot status panel, as shown in Figure 4-2. When system power is on, pressing this button releases the brake, which allows movement of Joint 3.

NOTE: 24 Volt robot power must be ON to release the brakes.

If this button is pressed while high power is on, high power will automatically shut down.

WARNING: Due to the effect of gravity, pressing the Brake Release button may cause the quill and tool flange to fall.

When the Brake Release button is pressed, Joint 3 may drop to the bottom of its travel. To prevent possible damage to the equipment, make sure that Joint 3 is supported while releasing the brake and verify that the end-effector or other installed tooling is clear of all obstructions.

4.4 Front Panel

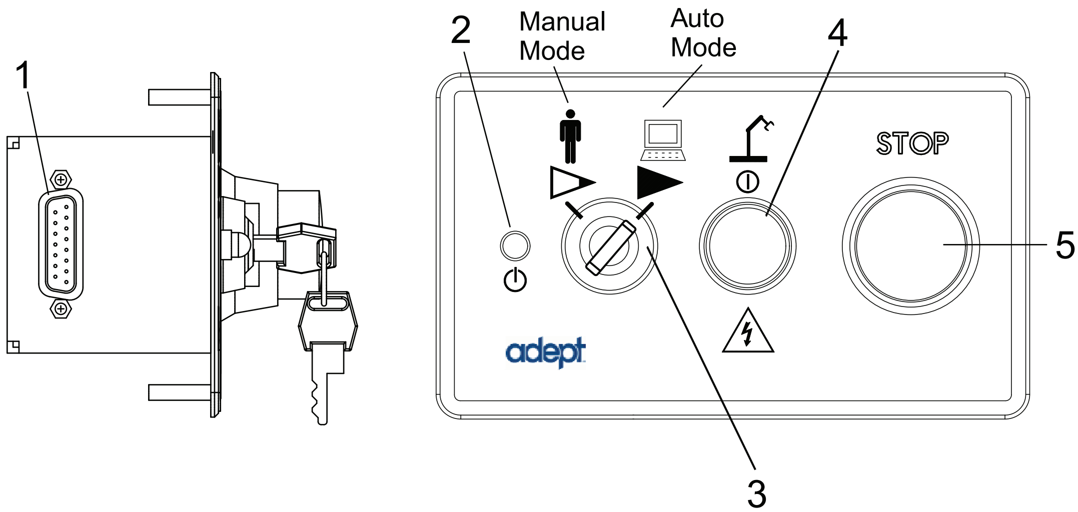


Figure 4-3. Front Panel

1. **XFP connector**
   Connects to the XFP connector on the SmartController.
2. **System 5 V Power-On LED**
   Indicates whether or not power is connected to the robot.
3. **Manual/Automatic Mode Switch**
   Switches between Manual and Automatic mode. In Automatic mode, executing programs control the robot, and the robot can run at full speed. In Manual mode, the system limits robot speed and torque so that an operator can safely work in the cell. Manual mode initiates software restrictions on robot speed, commanding no more than 250 mm/sec.
4. **High Power On/Off Switch and Lamp**
   Controls high power, which is the flow of current to the robot motors. Enabling high

power is a two-step process. An “Enable Power” request must be sent from the user-supplied PC, an executing program, or the Adept pendant. Once this request has been made and the High Power On/Off lamp/button is blinking, the operator must press and release this button, and high power will be enabled.

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

> **NOTE:** If enabled, the Front Panel button must be pressed while blinking (default time-out is 10 seconds). If the button stops blinking, you must enable power again.

5. **Emergency Stop Switch**
   The E-Stop is a dual-channel, passive E-Stop that supports Category 3 CE safety requirements. Pressing this button turns off high power to the robot motors.

NOTE: The Front Panel must be installed to be able to Enable Power to the robot. To operate without a Front Panel, the user must supply the equivalent circuits.

4.5 Connecting Digital I/O to the System

You can connect digital I/O to the system in several different ways. See the following table and figure.

Table 4-3. Digital I/O Connection Options

Product	I/O Capacity	For more details
XIO Connector on Robot	12 inputs 8 outputs	see Using Digital I/O on Robot XIO Connector on page 43
XDIO Connector on SmartController	12 inputs 8 outputs	see *Adept SmartController User’s Guide*
Optional IO Blox Device, connects to robot	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 eight sDIO per system	see *Adept SmartController User’s Guide*

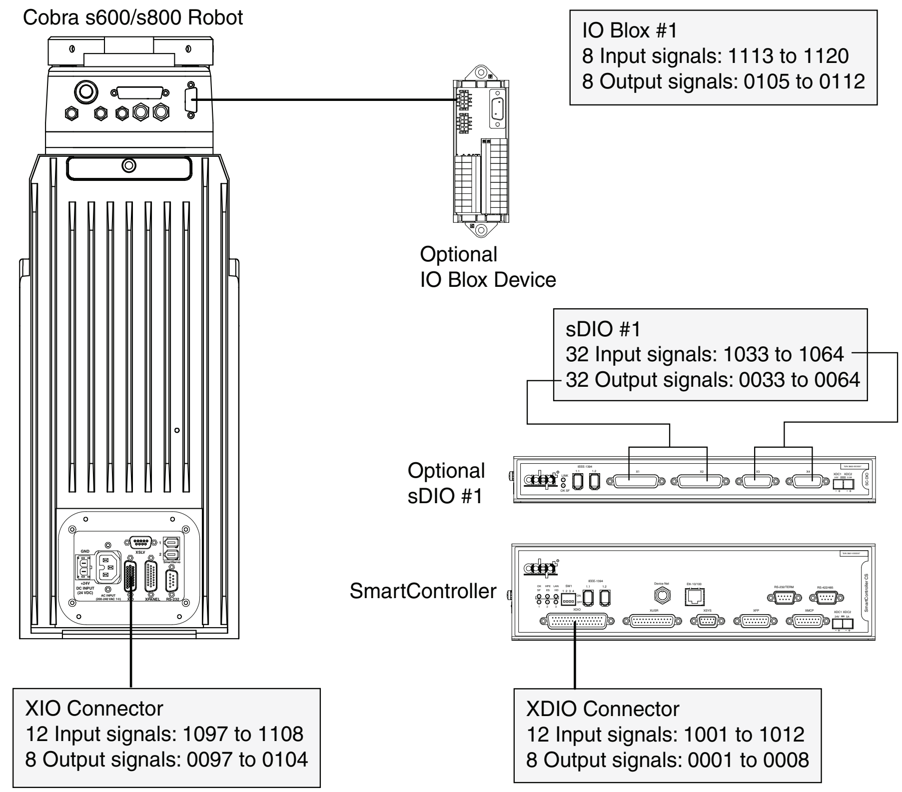


Figure 4-4. Connecting Digital I/O to the System, AIB shown

Table 4-4. 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
Robot 1 XIO connector[a]	Inputs	1097–1108
	Outputs	0097–0104
IO Blox 1	Inputs	1113–1120
	Outputs	0105–0112
IO Blox 2	Inputs	1121–1128
	Outputs	0113–0120

Location	Type	Signal Range
IO Blox 3	Inputs	1129–1136
	Outputs	0121–0128
IO Blox 4	Inputs	1137–1144
	Outputs	0129–0136
[a]For Dual Robot systems, see *Adept Dual-Robot Configuration Procedure*.		

Using Digital I/O on Robot XIO Connector

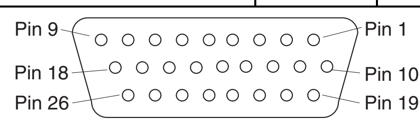
The XIO connector on the robot interface panel offers access to digital I/O, 12 inputs and 8 outputs. These signals can be used by V+ or eV+ to perform various functions in the workcell. See the following table for the XIO signal designations.

- 12 Inputs, signals 1097 to 1108
- 8 Outputs, signals 0097 to 0104

Table 4-5. XIO Signal Designations

Pin No.	Designation	Signal Bank	V+/eV+ Signal Number
1	GND		
2	24 VDC		
3	Common 1	1	
4	Input 1.1	1	1097
5	Input 2.1	1	1098
6	Input 3.1	1	1099
7	Input 4.1	1	1100
8	Input 5.1	1	1101
9	Input 6.1	1	1102
10	GND		
11	24 VDC		
12	Common 2	2	
13	Input 1.2	2	1103
14	Input 2.2	2	1104
15	Input 3.2	2	1105
16	Input 4.2	2	1106

Pin No.	Designation	Signal Bank	V+/eV+ Signal Number
17	Input 5.2	2	1107
18	Input 6.2	2	1108
19	Output 1		0097
20	Output 2		0098
21	Output 3		0099
22	Output 4		0100
23	Output 5		0101
24	Output 6		0102
25	Output 7		0103
26	Output 8		0104



Optional I/O Products

These optional products are also available for use with digital I/O:

- **XIO Breakout Cable** For information, see XIO Breakout Cable on page 48. This cable is not compatible with the XIO Termination Block.
- **XIO Termination Block**, with terminals for user wiring, plus input and output status LEDs. Connects to the XIO connector with 6 foot cable. See the *Adept XIO Termination Block Installation Guide* for details.

XIO Input Signals

The 12 input channels are arranged in two banks of six. Each bank is electrically isolated from the other bank and is optically isolated from the robot’s ground. The six inputs within each bank share a common source/sink line.

The inputs are accessed through direct connection to the XIO connector (see the previous table), or through the optional XIO Termination Block. See the documentation supplied with the termination block for details.

The XIO inputs cannot be used for REACTI programming, high-speed interrupts, or vision triggers.

XIO Input Specifications

Table 4-6. XIO Input Specifications

Operational voltage range	0 to 30 VDC
"Off" state voltage range	0 to 3 VDC
"On" state voltage range	10 to 30 VDC
Typical threshold voltage	V_{in} = 8 VDC
Operational current range	0 to 7.5 mA
"Off" state current range	0 to 0.5 mA
"On" state current range	2.5 to 7.5 mA
Typical threshold current	2.0 mA
Impedance (V_{in}/I_{in})	3.9 K Ω minimum
Current at V_{in} = +24 VDC	$I_{in} \leq 6$ mA
Turn on response time (hardware) Software scan rate/response time	5 µsec maximum 16 ms scan cycle/ 32 ms max response time
Turn off response time (hardware) Software scan rate/response time	5 µsec maximum 16 ms scan cycle/ 32 ms max response time

NOTE: The input current specifications are provided for reference. Voltage sources are typically used to drive the inputs.

Typical Input Wiring Example

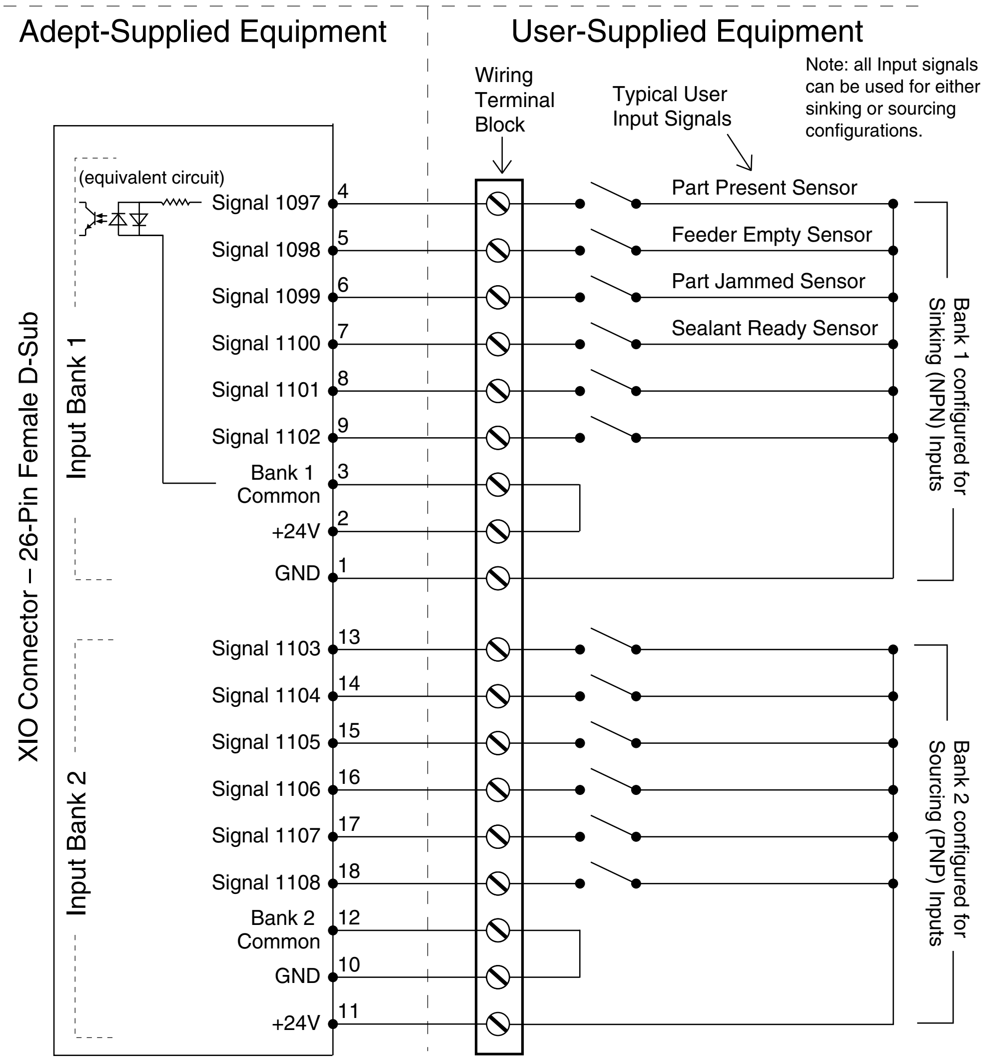


Figure 4-5. Typical User Wiring for XIO Input Signals

NOTE: The OFF state current range exceeds the leakage current of XIO outputs. This guarantees that the inputs will not be turned on by the leakage current from the outputs. This is useful in situations where the outputs are looped-back to the inputs for monitoring purposes.

XIO Output Signals

The eight digital outputs share a common, high side (sourcing) driver IC. The driver is designed to supply any kind of load with one side connected to ground. It is designed for a range of user-provided voltages from 10 to 24 VDC and each channel is capable of up to 0.7 A of current. This driver has overtemperature protection, shorted load protection, and is current limiting. In the event of an output short or other overcurrent situation, the affected output of the driver IC turns off and back on automatically to reduce the temperature of the IC. The driver draws power from the primary 24 VDC input to the robot through a self-resetting polyfuse.

The outputs are accessed through direct connection to the XIO connector (see Table 4-5). Optionally, use the XIO Termination Block. See the documentation supplied with the termination block for details.

XIO Output Specifications

Table 4-7. XIO Output Circuit Specifications

Parameter	Value
Power supply voltage range	See Specifications for 24 VDC Power on page 28.
Operational current range, per channel	$I_{out} \leq$ 700 mA
Total Current Limitation, all channels on.	$I_{total} \leq$ 1.0 A @ 50° C ambient $I_{total} \leq$ 1.5 A @ 25° C ambient
On state resistance (I_{out} = 0.5 A)	$R_{on} \leq$ 0.32 Ω @ 85° C
Output leakage current	$I_{out} \leq$ 25 µA
Turn on response time	125 µsec max., 80 µsec typical (hardware only)
Turn off response time	60 µsec. max., 28 µsec typical (hardware only)
Output voltage at inductive load turnoff (I_{out} = 0.5A, Load = 1 mH)	$(+V - 65) \leq V_{demag} \leq (+V - 45)$
DC short circuit current limit	$0.7A \leq I_{LIM} \leq 2.5$ A
Peak short circuit current	$I_{ovpk} \leq$ 4 A

Typical Output Wiring Example

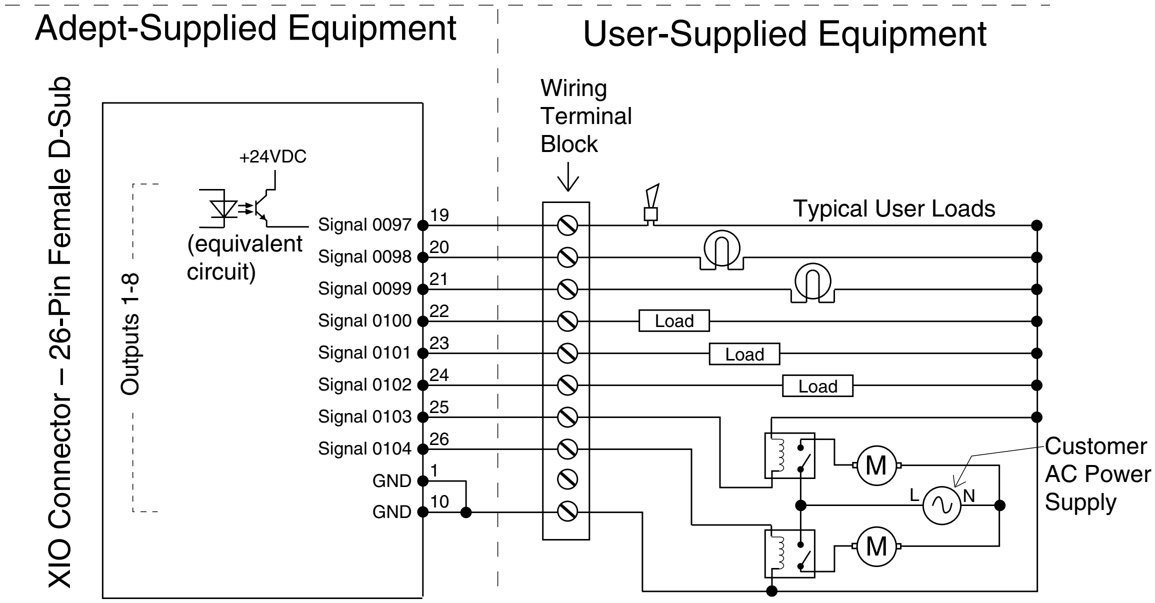


Figure 4-6. Typical User Wiring for XIO Output Signals

XIO Breakout Cable

The XIO Breakout cable is available as an option—see the following figure. This cable connects to the XIO connector on the AIB/eAIB, and provides flying leads on the user's end, for connecting input and output signals in the workcell. The cable length is 5 M (16.4 ft).

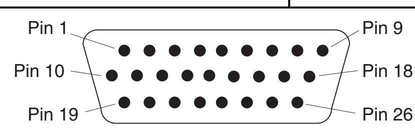
For the wire chart on the cable, see the following table.

NOTE: This cable is not compatible with the XIO Termination Block.

Figure 4-7. Optional XIO Breakout Cable

Table 4-8. XIO Breakout Cable Wire Chart

Pin No.	Signal Designation	Wire Color
1	GND	White
2	24 VDC	White/Black
3	Common 1	Red
4	Input 1.1	Red/Black
5	Input 2.1	Yellow
6	Input 3.1	Yellow/Black
7	Input 4.1	Green
8	Input 5.1	Green/Black
9	Input 6.1	Blue
10	GND	Blue/White
11	24 VDC	Brown
12	Common 2	Brown/White
13	Input 1.2	Orange
14	Input 2.2	Orange/Black
15	Input 3.2	Gray
16	Input 4.2	Gray/Black
17	Input 5.2	Violet
18	Input 6.2	Violet/White
19	Output 1	Pink
20	Output 2	Pink/Black
21	Output 3	Light Blue
22	Output 4	Light Blue/Black
23	Output 5	Light Green
24	Output 6	Light Green/Black
25	Output 7	White/Red
26	Output 8	White/Blue
Shell		Shield



4.6 Starting the System for the First Time

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
- Move each axis of the robot (generally with the pendant) 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.
- Any end-of-arm tooling is properly installed.
- 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 a SmartServo connector on the robot interface panel.

- XSYS cable between the XSYS connector on the SmartController and the robot interface panel XSLV connector (AIB) or eAIB XSLV adapter and XSYSTEM connector (eAIB), with the latching screws tightened.

  or

  eAIB XSYS (eAIB) cable between the robot interface panel XSYSTEM connector and XSYS connector on the SmartController, and the latching screws tightened.

  See Cable Connections from Robot to SmartController on page 27.

- User-supplied 24 VDC power to the robot 24 VDC connector.

- User-supplied 200/240 VAC power to the robot 200/240 VAC connector.

User-Supplied Safety Equipment Checks

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

Turning on Power

After the system installation has been verified, you are ready to turn on AC and DC power to the system and start up Adept ACE.

1. Manually move the robot joints away from the folded shipping position, see Transport and Storage on page 17.
2. Turn on the 200/240 VAC power.

   DANGER: Make sure personnel are skilled and instructed—refer to the *Adept Robot Safety Guide*.

3. Turn on the 24 VDC power to the robot. The Status Panel displays OK. The Robot Status LED will be off.
4. Verify the Auto/Manual switch on the Front Panel is set to Auto Mode.
5. Turn on the user-supplied PC and start Adept ACE.
   - 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.
6. On the Adept ACE Startup menu
   - Check Create New Workspace for Controller at Address:
     to make the connection to the controller.
   - Select the IP address to match the setting being used by your PC.

Starting Adept ACE

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

1. Turn on the user-supplied PC and start Adept ACE.
   - 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 Getting Started screen:
   - Select New SmartController Workspace.
   - Select Create New Workspace for Selected Controller to make the connection to the controller.
   - Select the IP address of the controller you wish to connect to, or manually type in the IP address.
3. Click OK. You will see the message "Working ... please wait".

Enabling High Power

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

Using Adept ACE to Enable High Power

1. From the Adept ACE main menu, click the Enable High Power icon.
2. Press and release the blinking High Power button on the Front Panel within 10 seconds.

   The Front Panel is shown in Figure 4-3. (If the button stops blinking, you must Enable Power again.)

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

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

- The Robot Status LED glows amber.
- The code on the Robot Status Panel displays ON. See Status Panel Fault Codes on page 37.

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 for each.

Verify Robot Motions

Use the pendant (if purchased) to verify that the robot moves correctly. Refer to your Adept pendant user's guide for complete instructions on using the pendant.

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*.

4.7 Learning to Program the Adept Cobra s-Series 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+/eV+ programming information, refer to the V+/eV+ user and reference guides in the Adept Document Library (ADL) on the Adept website. For more details on the ADL, see Adept Document Library on page 16.

Chapter 5: Maintenance

5.1 Field-replaceable Parts

WARNING: Only qualified service personnel may install or service the robot system.

The following parts are the only field-replaceable parts:

Table 5-1. Field-replaceable Parts

<table>
<tr><th>Part</th><th colspan="2">Adept Part Number</th></tr>
<tr><td>Encoder battery</td><td colspan="2">09977-000 (3.6 V, 6.8 Ah)
(This has replaced part number 02704-000)</td></tr>
<tr><td>AIB (Amp-In-Base)</td><td colspan="2">04900-000</td></tr>
<tr><td rowspan="2">eAIB (Amp-In-Base)</td><td>s600</td><td>s800</td></tr>
<tr><td>19800-600</td><td>19800-800</td></tr>
</table>

These parts must only be replaced with the Adept part numbers in the preceding table.

5.2 Periodic Maintenance Schedule

The following table gives a summary of the preventive maintenance procedures and guidelines on frequency.

Also, for cleanroom robots, see Cleanroom Maintenance on page 125; for IP-65 robots, see Customer Requirements on page 116.

Table 5-2. Inspection and Maintenance

Item	Period	Reference
Check E-Stop, enable and key switches, and barrier interlocks	6 months	Checking Safety Systems on page 56
Check robot mounting bolts	6 months	Checking Robot Mounting Bolts on page 56
Check for signs of oil around of harmonic drive area.	3 months	Checking for Oil Leakage on page 56.
Lubricate Joint 3 (Z-axis) ball screw	3 months	Lubricating Joint 3 on page 57
Replace encoder battery	5 to 10 years	Replacing the Encoder Battery Pack on page 68

NOTE: The frequency of these procedures will depend on the particular system, its operating environment, and amount of usage. Use the times in this table as guidelines and modify the schedule as needed.

WARNING: Lockout and tagout power before servicing.

WARNING: The procedures and replacement of parts mentioned in this section should be performed only by skilled or instructed persons, as defined in the *Adept Robot Safety Guide*. The access covers on the robot are not interlocked – turn off and disconnect power if covers or the AIB/eAIB will be removed.

5.3 Checking Safety Systems

These tests should be done every six months.

1. Test operation of:
    - E-Stop button on Front Panel
    - E-Stop button on pendant
    - Enabling switch on pendant
    - Auto/Manual switch on Front Panel

    NOTE: Operating **any** of the above switches should disable high power.

2. Test operation of any external (user-supplied) E-Stop buttons.
3. Test operation of barrier interlocks, etc.

5.4 Checking Robot Mounting Bolts

Check the tightness of the base mounting bolts after one week, and then every 6 months. Tighten to 85 N·m (63 ft-lb). Also check the tightness of all cover plate screws.

5.5 Checking for Oil Leakage

The Adept Cobra s600 and s800 robots use oil in the harmonic drive components for lubrication. Periodically inspect the robot for any signs of oil in areas immediately outside of the harmonic drive. Check these locations:

- the area around Joint 1
- the area around Joint 2

- inside the base of the robot, by opening the AIB/eAIB chassis and inspecting internally.

WARNING: Remove all power to the robot before opening the AIB/eAIB chassis.

Contact Adept if you find any signs of oil in these areas.

5.6 Lubricating Joint 3

Use LG-2 Grease
(Lithium Soap/Synthetic Hydrocarbon),
Adept part number: 90401-04029.

CAUTION: Using improper lubrication products on the Adept Cobra s600 or s800 robot may cause damage to the robot.

Lubrication Procedure

1. Turn off main power to the controller and robot.
2. Remove the outer link cover by removing screws located on the sides and top of the cover. Carefully remove the cover.

   WARNING: When the outer link cover is removed, you see the label shown in Figure 6-4. Do not remove the J3-ENC or J4-ENC encoder cable connectors from their sockets. If they are removed, the calibration data will be lost and the robot must be run through a factory recalibration process, which requires special software and tools.

   For the IP-65 version, refer to Robot Outer Link Cover Removal and Reinstallation on page 113 for instructions on removing the link cover, and IP-65 Bellows Replacement on page 119 for instructions on removing the bellows.

   For the Cleanroom version, refer to Bellows Replacement on page 125 for instructions on removing the bellows. The outer link cover is standard.
3. Switch on 24 VDC power to the robot.
4. Press the brake button and move Joint 3 to the top of its travel.

   Remove any existing grease with a clean, lint-free, soft cloth.
5. Using a syringe, apply a small bead of grease to the Joint 3 ball screw grooves, see Figure 5-1.

Apply grease to the three vertical grooves and the spiral groove.

6. Press the brake button and move Joint 3 to the bottom of its travel.

   Remove any existing grease with a clean, lint-free, soft cloth.

7. Apply a small bead of grease to any grooves of the ball screw that are now exposed.
8. Move Joint 3 up and down several times to spread the grease evenly.
9. Remove 24 VDC power from the robot.
10. Reinstall the outer link cover.

    For the Cleanroom version, replace the bellows.

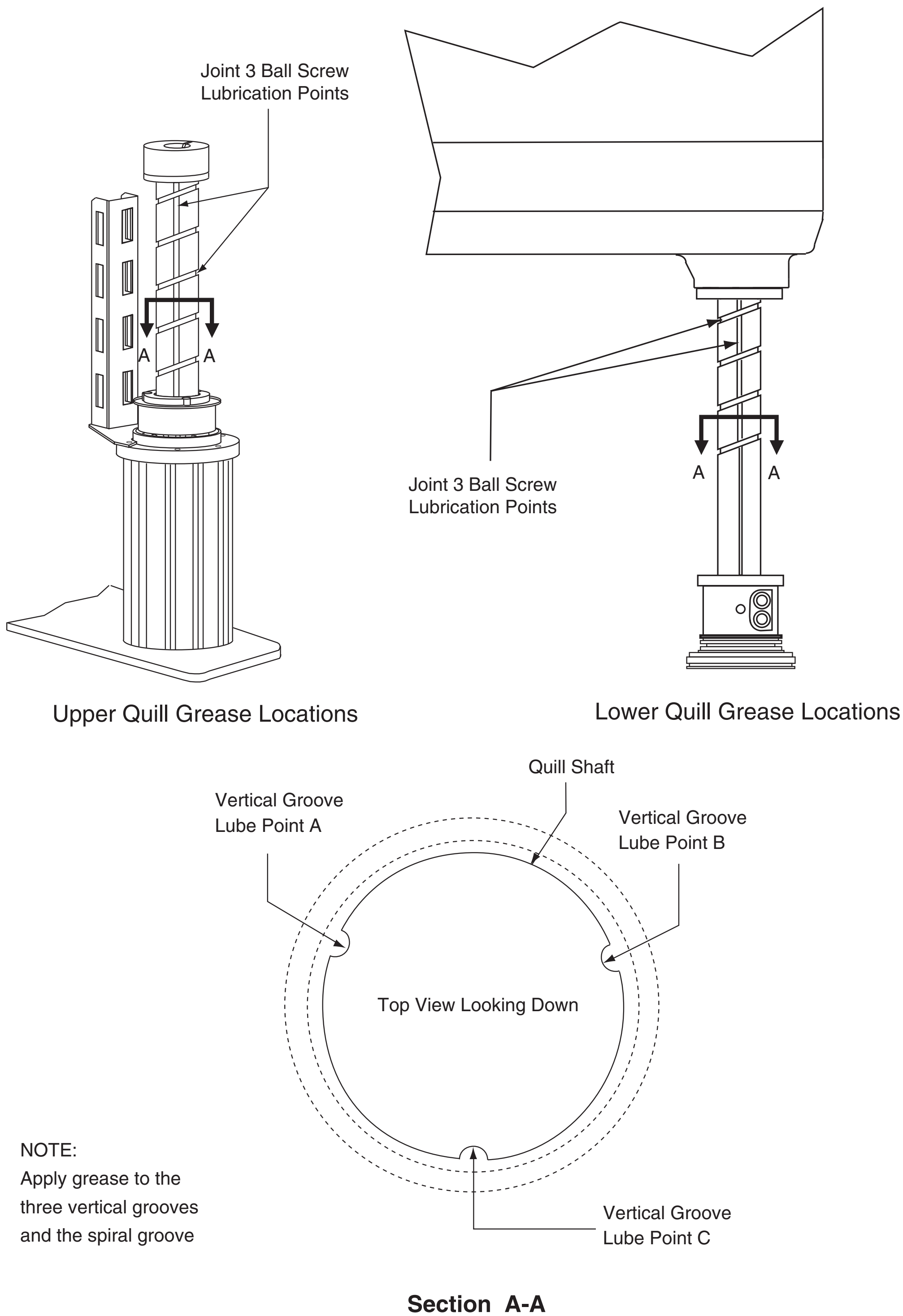


Figure 5-1. Lubrication of Joint 3 Quill

5.7 Replacing the AIB or eAIB Chassis

CAUTION: Follow appropriate ESD procedures during the removal/replacement phases.

Removing the AIB or eAIB Chassis

1. Switch off the SmartController.
2. Switch off the 24 VDC input supply to the chassis.
3. Switch off the 200/240 VAC input supply to the chassis.
4. Disconnect the 24 VDC supply cable from the chassis +24 VDC input connector. For the connector location, see Figure 2-3.
5. Disconnect the 200/240 VAC supply cable from the chassis AC Input connector.
6. Disconnect the XSYS cable from the chassis XSLV connector (AIB) or

   Disconnect the eAIB XSYS cable or XSYS cable with eAIB XSLV Adapter from the chassis XSYSTEM connector (eAIB).
7. Disconnect the 1394 cable from the chassis SmartServo connector.
8. Disconnect any other cables, which may be connected to the chassis, such as XIO, RS-232, or any others.
9. Using a 5 mm hex wrench, carefully unscrew the chassis securing screw, which is shown in the following figure. Note that the screw does not need to be completely removed in order to remove the chassis, as this screw is captured on the chassis heat sink.

Figure 5-2. Securing Screw on AIB/eAIB Chassis

10. While holding the chassis heat sink, carefully and slowly lower the chassis down (see the following figure), so that enough access is available to remove the internal cables. The chassis can be laid flat or placed to the right side of the robot for better access.

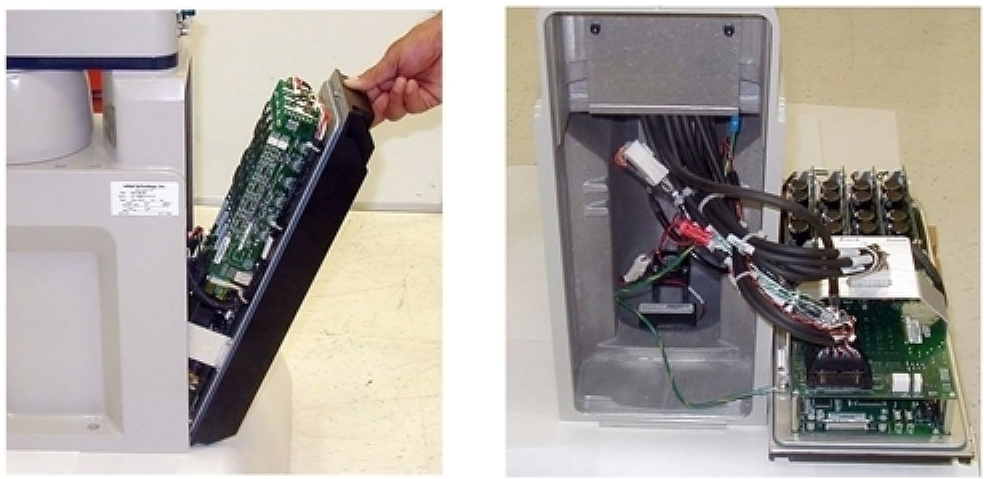


Figure 5-3. Opening and Removing Chassis

11. Disconnect the “white” amplifier cable from the amplifier connector located on the chassis bracket. See the following figure.

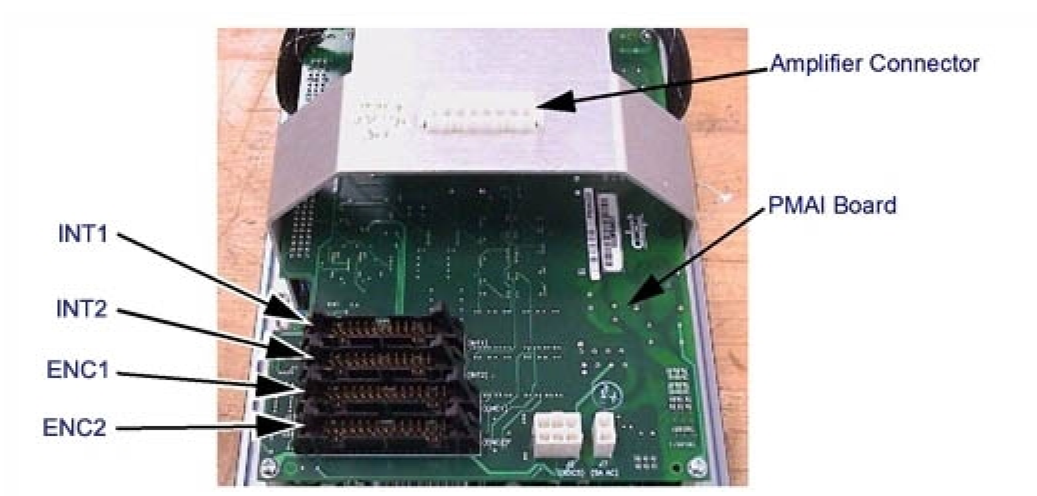


Figure 5-4. Connectors on Chassis and PMAI/ePMAI Board - AIB Shown

12. Carefully disconnect the INT1, INT2, ENC1, and ENC2 cables from their connectors on the PMAI/ePMAI board, by disengaging the securing latches:

    NOTE: The inside of the eAIB chassis looks slightly different from the AIB shown, but the connectors listed are the same.

13. Using a 5 mm hex wrench, disconnect and remove the ground wire from the chassis. Keep the screw for reassembly later. See the following figures.

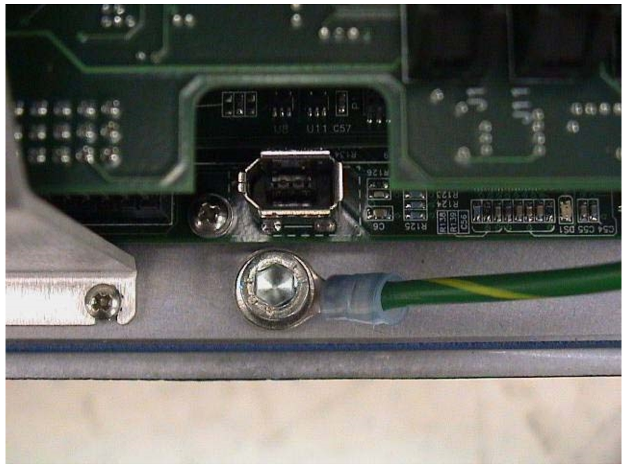


Figure 5-5. Ground Screw on AIB Chassis

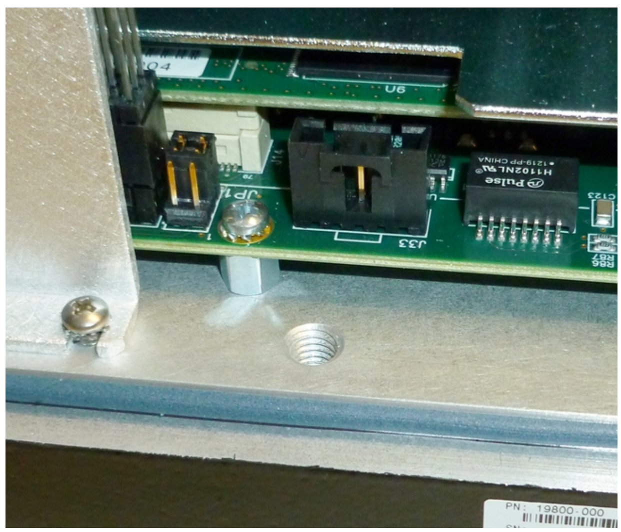


Figure 5-6. Ground Screw Hole on eAIB Chassis

14. Carefully remove the chassis from the robot, and place it aside. Tag it with the appropriate fault diagnosis faults/errors and robot serial number information.

Installing a New AIB or eAIB Chassis

1. Carefully remove the new chassis from its packaging, check it for any signs of damage, and remove any foreign packing materials or debris from inside the chassis.
2. Carefully place the chassis next to the robot.
3. Using a 5 mm hex wrench, carefully connect the ground wire to the chassis.
4. Carefully reconnect the cables you removed from their connectors on the PMAI/ePMAI board, and engage the securing latches.

5. Carefully connect the "white" amplifier cable to the amplifier connector located on the chassis bracket.

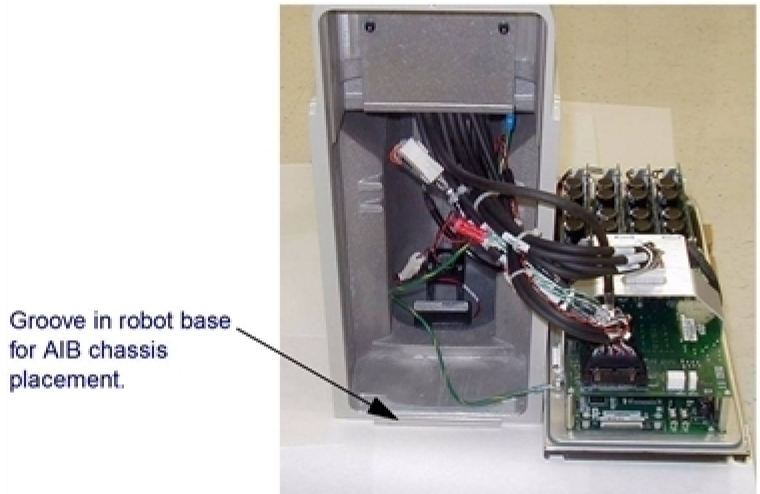


Figure 5-7. Installing AIB Chassis in Robot Base

6. Carefully insert the chassis into the robot base in the groove at the bottom of the base—see Figure 5-7. Tilt the chassis up and into place against the robot, making sure that none of the cables get trapped or pinched and that the chassis O-ring is not damaged during installation.
7. Once the chassis is in place, use a 5 mm hex wrench to tighten the chassis securing screw. See Figure 5-2 for details.
8. Connect the 200/240 VAC supply cable to the chassis AC input connector.
9. Connect the XSYS cable to the chassis XSLV connector (AIB).

   or

   Connect the eAIB XSYS cable or XSYS cable with eAIB XSLV Adapter to the chassis XSYSTEM connector (eAIB).
10. Connect the 1394 cable to the chassis SmartServo connector.
11. Connect any other cables that were connected to the chassis, such as XIO, RS-232, or any others.
12. Connect the 24 VDC supply cable to the chassis +24 VDC input connector.
13. Switch on the 200/240 VAC input supply to the chassis.
14. Switch on the 24 VDC input supply to the chassis.
15. Switch on the SmartController.
16. Once the system has completed booting, test the system for proper operation.

5.8 Commissioning a System with an eAIB

Commissioning a system involves synchronizing the robot with the eAIB.

> **NOTE**: This section only applies to robots that have an eAIB amplifier. A robot with an AIB amplifier does not need the Adept ACE commissioning.

For a new system with an eAIB, the robot and the eAIB will have been commissioned at the factory and should not need commissioning.

If you are replacing an AIB with an eAIB, you will need to commission the system.

In rare cases with a new robot with an eAIB, you may need to commission the system.

- If the system will not power up, and the robot status display shows SE, you need to commission the system.
- If the system will not power up in Manual mode, and the robot status display shows TR, you need to commission the system.

Safety Commissioning Utilities

The Adept eAIB adds two functions that implement safety in hardware:

- E-Stop

  This serves as a backup to the standard software E-Stop process. The system will always try to stop the robot using the software E-Stop first. The hardware E-Stop will take over in the event of a failure of the software E-Stop.
- Teach Restrict

  This limits the maximum speed of the robot when it is operated in Manual mode. As with the E-Stop, this is a hardware backup to software limits on robot speed. If the software fails to limit the robot speed during manual operation, the hardware Teach Restrict will disable power to the system.

These two functions are only in the eAIB amplifiers. They were not implemented in hardware in the AIB amplifiers, so these utilities do not apply to those amplifiers.

These two functions are supported by four wizards:

- E-Stop Configuration

  This sets the E-Stop hardware delay to factory specifications.
- E-Stop Verification

  This verifies that the hardware E-Stop is functioning correctly.
- Teach Restrict Configuration

  This sets the hardware Teach Restrict maximum speed to factory specifications.
- Teach Restrict Verification

  This verifies that the hardware Teach Restrict is functioning correctly.

The initial utility screen will tell you which functions are commissioned. If a function is not commissioned, its verification wizard will not be displayed. Any displayed verification wizard can be run at any time, to ensure that its function is working properly.

Prerequisites

- The robot must be set up and functional.
- The robot must use eAIB amplifiers.

  The AIB amplifiers do not support these hardware functions, and these wizards will not run.
- Adept ACE software must be installed.
- The Front Panel keyswitch must be in Auto mode.

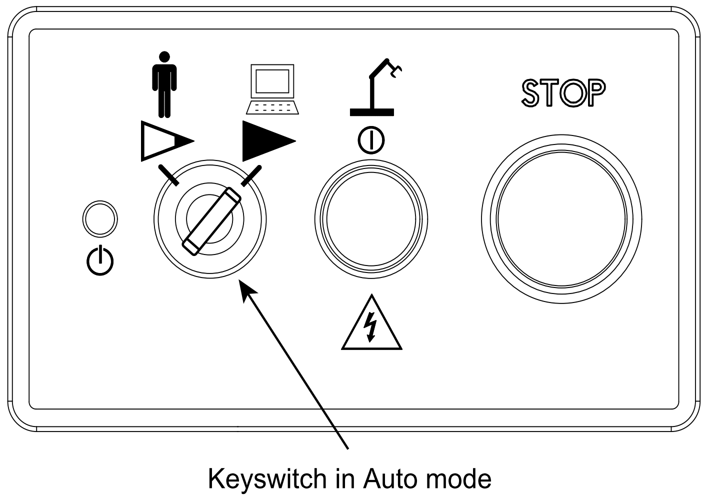


Figure 5-8. Adept Front Panel

- No E-Stops can be activated.
- For Configuration (E-Stop and Teach Restrict), the eAIB Commissioning Jumper must be plugged into the XBELTIO jack on the eAIB.

  NOTE: This is the only time that this jumper will be used. It is part number 11901-000, and must be removed for Verification and normal operation.

Figure 5-9. eAIB Commissioning Jumper

- An Adept pendant is required for the Teach Restrict verification.

E-Stop Configuration Utility

This utility sets the E-Stop hardware delay to factory specifications.

> **NOTE**: Ensure that the commissioning jumper is plugged into the XBELTIO jack on the eAIB before you start this procedure.

Procedure

From within the Adept ACE software:

1. Open the robot object editor.
2. Select **Configure > Safety Settings > Configure ESTOP Hardware Delay**, then click Next.

   This procedure will configure Channel A and then Channel B.
   It will then report the delay that it set for each.
3. Reboot the SmartController.

   On some systems, the SmartController will reboot automatically.
4. Reboot the eAIB.

E-Stop Verification Utility

This utility verifies that the hardware E-Stop parameters are set correctly and that the hardware E-Stop is working.

The hardware E-Stop must have already been configured for this wizard to run.

> **NOTE**: If the commissioning jumper is plugged into the XBELTIO jack on the eAIB, remove it before you start this procedure.

Procedure

From within the Adept ACE software:

1. Open the robot object editor.
2. Select **Configure > Safety Settings > Verify ESTOP Hardware Delay**, then click Next.
3. Enable high power, if not already enabled, then click Next.
4. Press an E-Stop button (on the Front Panel), then click Next.

   The utility will confirm that the hardware delay has been verified for this robot, and display the delay times for channels A and B.
5. Reboot the SmartController.

   On some systems, the SmartController will reboot automatically.

Teach Restrict Configuration Utility

This utility sets the hardware Teach Restrict maximum speed parameter to factory specifications.

> **NOTE**: Ensure that the commissioning jumper is plugged into the XBELTIO jack on the eAIB before you start this procedure.

Procedure

> **NOTE**: This procedure takes 2 or 3 minutes to complete.

From within the Adept ACE software:

1. Open the robot object editor.
2. Select **Configure > Safety Settings > Configure Teach Restrict**, then click Next.
3. From the Prerequisite screen, click Next.

   The wizard will go through all of the robot's motors, and display messages that it is configuring Channel A and B for each.

   It will then record the configuration, and display the target times that it set.
4. Click Finish.
5. Reboot the SmartController.

   On some systems, the SmartController will reboot automatically.

Teach Restrict Verification Utility

This utility verifies that the Teach Restrict parameters are set correctly and that the hardware Teach Restrict maximum speed control is working.

This is a two-part wizard. The first is run in Auto mode. The second is run in Manual mode.

Before running this verification utility, the Teach Restrict must be configured.

> **NOTE**: If the commissioning jumper is plugged into the XBELTIO jack on the eAIB, remove it before you start this procedure.

Automatic Mode Procedure

WARNING: The robot will move during this wizard. Ensure that personnel stay clear of the robot work area.

From within the Adept ACE software:

1. Open the robot object editor.
2. Select **Configure > Safety Settings > Verify Teach Restrict**, then click Next.

3. Teach a Start Position.

   This can be any position that does not conflict with obstacles or the limits of joint movements.

   - If the robot is already in such a position, you can just click Next.
   - Otherwise, move the robot to such a position, then click Next.
   - The screen will display the number of degrees that each joint is expected to move during the verification process.
   - You can click Preview Motions on this screen to view the motions at slow speed. The default speed is 10, but you can change that speed with this screen's speed control.
   - You can click Move to Ready, to move the robot to the Ready position.

     The robot will move each joint, in succession. It will generate an over-speed condition for each, and verify that the hardware detected the over-speed condition.

4. Click Next, to proceed to the Manual Mode Procedure.

   If the Automatic Mode Procedure fails, you will not be allowed to proceed with the Manual Mode.

Manual Mode Procedure

The manual mode of this verification requires the use of an Adept pendant.

For this verification, the Front Panel keyswitch must be in Manual mode.

1. From the Introduction screen, click Next.
   - Set the pendant to Joint mode.
   - Set the pendant manual control speed to 100.
2. Click Next.
3. Using the pendant, jog any of the robot's joints until power is disabled.

   This indicates that the Teach Restrict function is working.
4. Click Next.

   The results of the verification will be displayed.
5. Click Finish.
6. Reboot the SmartController.

   On some systems, the SmartController will reboot automatically.
7. Reset the Front Panel keyswitch to Auto mode.

5.9 Replacing the Encoder Battery Pack

The data stored by the encoders is protected by a 3.6 V lithium backup battery pack located in the base of the robot.

CAUTION: Replace the battery pack only with a 3.6 V, 6.8 Ah lithium battery pack, Adept P/N 09977-000.

NOTE: The previous battery, P/N 02704-000, has been superseded by this battery pack. The battery replacement interval and procedure have not changed.

Battery Replacement Time Periods

If the robot is kept in storage and not in production, or the robot is turned off (no 24 VDC supply) most of the time, then the battery should be replaced every 5 years.

If the robot is turned on with 24 VDC supplied to the robot more than half the time, then you can increase the replacement interval to a maximum of 10 years.

NOTE: Dispose of the battery according to all local and national environmental regulations regarding electronic components.

Battery Replacement Procedure

1. Obtain the replacement battery pack.
2. Switch off the SmartController.
3. Switch off the 24 VDC input supply to the robot.
4. Switch off the 200/240 VAC input supply to the robot.
5. Disconnect the 24 VDC supply cable from the robot +24 VDC input connector. For the connector location, see Figure 2-3.
6. Disconnect the 200/240 VAC supply cable from the robot AC input connector.
7. Using a 5 mm hex wrench, carefully unscrew the AIB or eAIB chassis securing screw. See Figure 5-2. Note that the screw does not need to be completely removed in order to remove the chassis, as this screw is captured on the chassis heat sink.
8. While holding the chassis heat sink, carefully and slowly lower the chassis down, see Figure 5-3. This provides access to the battery pack, as shown in the following figure.

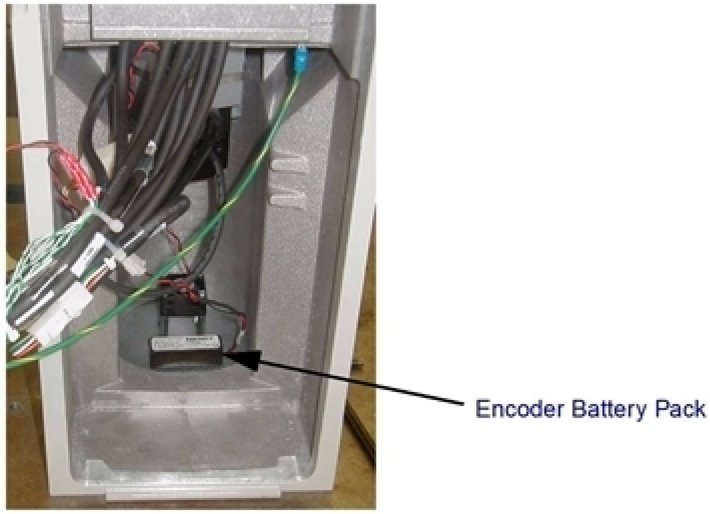


Figure 5-10. Location of Encoder Battery Pack

9. The battery cable assembly has two sets of connectors. Locate the secondary (unused) battery cable in the wire bundle in the base area.
10. Place the new battery pack next to the original one, but do not disconnect the original one.
11. Connect the new battery pack to the connectors on the secondary battery cable. Make sure to verify the positive and negative connections are correct.
12. Once the new battery pack is connected, disconnect and remove the original battery pack.

    NOTE: Dispose of the battery pack in accordance with all local and national environmental regulations regarding electronic components.

13. Place the new battery pack in the original location on the base of the robot.
14. Close the robot by reversing the steps in the beginning of this procedure.
15. Reconnect the 200/240 VAC supply cable to the robot AC input connector.
16. Reconnect the 24 VDC supply cable to the robot +24 VDC input connector. For the connector location, see Figure 2-3.

Chapter 6: Optional Equipment Installation

6.1 Installing End-Effectors

The user is responsible for providing and installing any end-effector or other end-of-arm tooling. End-effectors can be attached to the tool flange using four M6 screws. See Figure 7-4. for a detailed dimension drawing of the tool flange.

A 6 mm diameter x 12 mm dowel pin (user-supplied) fits in the through hole in the tool flange and can be used as a keying or anti-rotation device in a user-designed end-effector.

If hazardous voltages are present at the end-effector, you must install a ground connection from the base of the robot or the outer link to the end-effector. See Grounding Robot-Mounted Equipment on page 36.

> **NOTE:** A threaded hole is provided on the tool flange. See Figure 7-4. The user may attach a ground wire through the quill connecting the outer link and the tool flange.

6.2 Removing and Installing the Tool Flange

The tool flange can be removed and reinstalled. If the flange is removed, it must be reinstalled in exactly the same position to avoid losing the calibration for the system.

There is a setscrew on the flange that holds the rotational position of the flange on the quill shaft. A steel ball behind the setscrew contacts the shaft in one of the vertical-spline grooves in the shaft. Follow the procedures below to remove and reinstall the flange assembly.

Removing the Flange

1. Turn off high power and system power to the robot.
2. Remove any attached end-effectors or other tooling from the flange.
3. Use a 2.5 mm hex wrench to loosen the setscrew. See Figure 6-1. Note the vertical-spline groove that is in line with the setscrew. You must reinstall the flange in the same position.
4. Use a socket driver to loosen the two M4 socket-head screws.
5. Slide the flange down slowly until it is off the shaft. *Be careful* not to lose the steel ball (3.5 mm) that is inside the flange behind the setscrew.

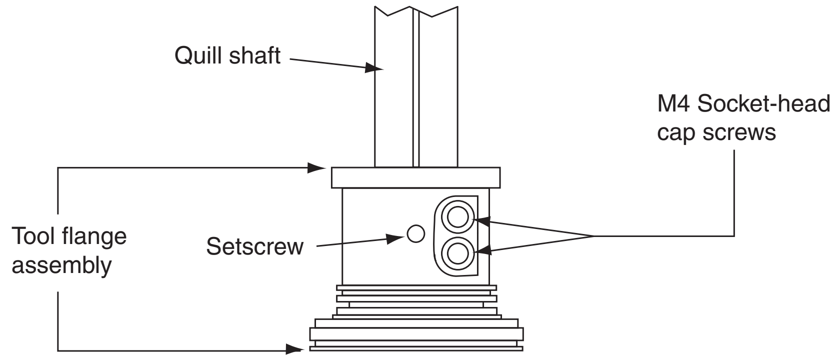


Figure 6-1. Tool Flange Removal Details

Installing the Flange

1. Make sure the steel ball is in the setscrew hole inside the flange. Hold it in place with your finger as you get ready to install the flange.
2. Slide the flange up on the quill shaft as far as it will go, and rotate until the setscrew is lined up with the original vertical groove.
3. Support the flange while using a 2.5 mm hex wrench to tighten the setscrew to finger tight. Do not over-tighten the setscrew because this will cause the flange to be off-center from the quill shaft.
4. Use a socket driver to tighten one of the socket-head screws part of the way, then tighten the other one the same amount. Alternate between the two screws so there is even pressure on both once they are tight. The torque specification for each screw is 8 N·m (70 in-lb).

6.3 User Connections on Robot

User Air Lines

There are five user air line connectors on the robot user panel on the back of Joint 1 (see Figure 6-2). The five air lines run through the robot up to another set of five matching connectors on the top of the outer link. See Figure 6-3.

- The two larger connectors are 6 mm diameter.
- The three smaller connectors are 4 mm diameter.

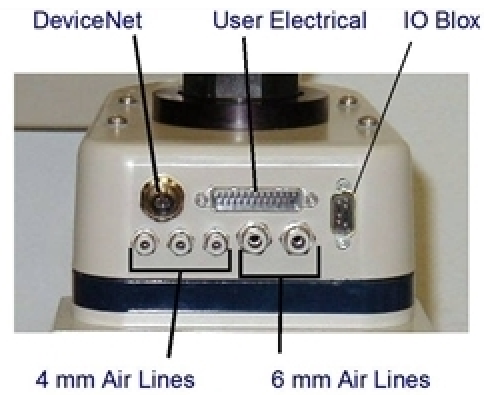


Figure 6-2. User Connectors on Joint 1

Figure 6-3. User Connectors on Joint 2

For information on the IO Blox connector, see Connecting Digital I/O to the System on page 41. Also, refer to the *Adept IO Blox User's Guide* for details.

User Electrical Lines

There is a 25-pin male connector (24 conductor) on the robot user panel on the back of Joint 1 for user electrical lines, see Figure 6-2. This connector is wired directly to a 25-pin female connector on the top of the outer link, see Figure 6-3. These connectors can be used to run user electrical signals from the user panel, through the robot, and up to the outer link.

Wire Specifications: Wire size: 0.1 mm^2, Pin Numbers 1-24, 12 pairs, twisted in pairs as 1&2, 3&4, 5&6, . . . 23&24. Maximum current per line: 1 Amp.

6.4 Internal User Connectors

The internal user connectors, OP3/4, EOAPWR, and ESTOP, can be accessed with the Outer Link cover removed—see Figure 6-4. The SOLND connector is located on the opposite of the bulkhead area—see Figure 6-5.

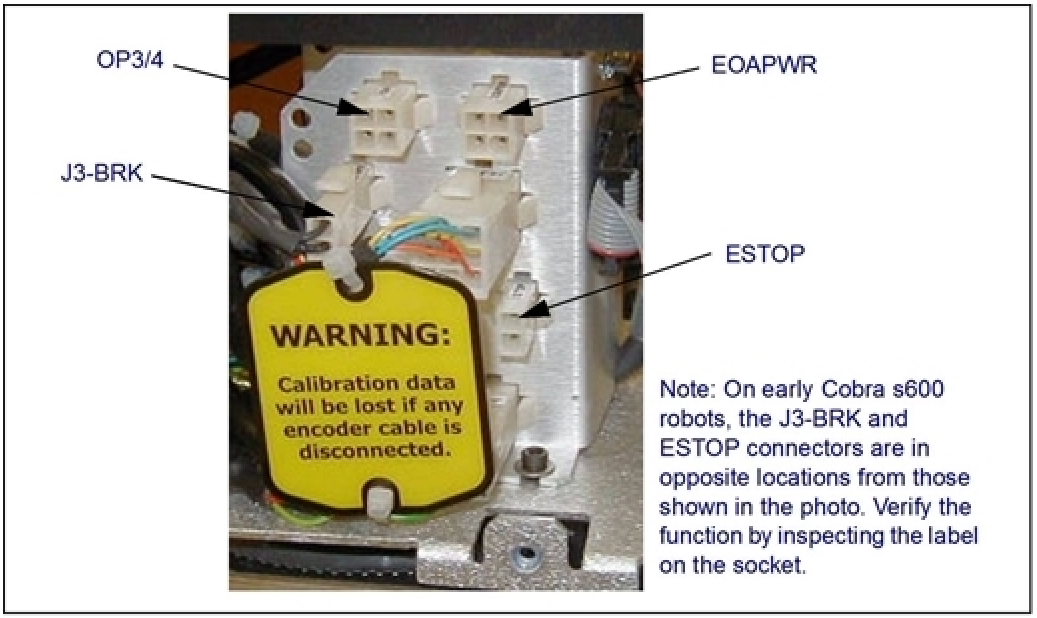


Figure 6-4. Internal User Connectors—OP3/4, EOAPWR, ESTOP

WARNING: When the Outer link cover is removed, you see the label shown above. Do not remove the J3-ENC or J4-ENC encoder cable connectors from their sockets. If they are removed, the calibration data will be lost and the robot must be run through a factory recalibration process, which requires special software and tools.

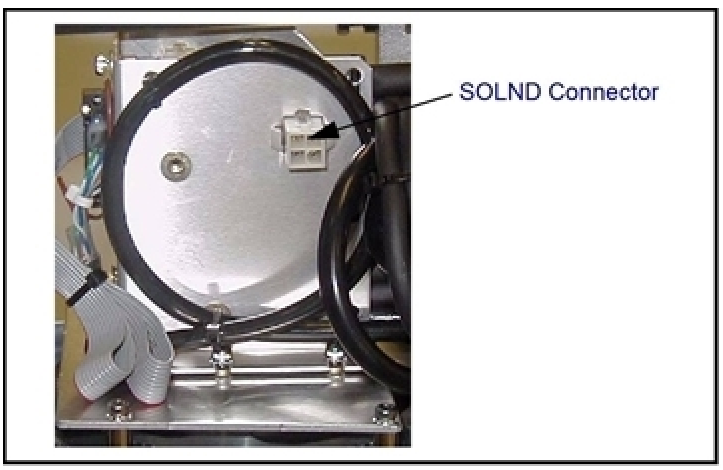
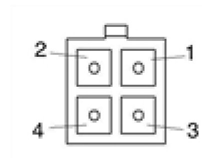


Figure 6-5. SOLND Connector

SOLND Connector

This 4-pin connector provides the output signals for the optional Robot Solenoid Kit. See the previous figure and following table. For installation details, see Installing the Robot Solenoid Kit on page 79.

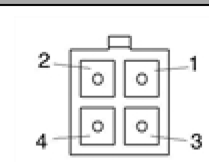
Table 6-1. SOLND Connector Pinout

<table>
<tr><th>Pin #</th><th>Description</th><th>Pin Location</th></tr>
<tr><td>1</td><td>Output 3001</td><td rowspan="5">
SOLND Connector
as viewed on robot</td></tr>
<tr><td>2</td><td>Ground</td></tr>
<tr><td>3</td><td>Output 3002</td></tr>
<tr><td>4</td><td>Ground</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="3">Mating Connector:
AMP/Tyco #172167-1, 4-pin Mini-Universal Mate-N-Lok
AMP/Tyco #770985-1, Pin Contact, Mini-Univ. Mate-N-Lok</td></tr>
</table>

OP3/4 Connector

This 4-pin connector provides the output signals for a second set of optional robot hand valve solenoids, or other user-supplied devices. See the following table and figure. For the connector location, see Figure 6-4.

Table 6-2. OP3/4 Connector Pinout

<table>
<tr><th>Pin #</th><th>Description</th><th>Pin Location</th></tr>
<tr><td>1</td><td>Output 3003</td><td rowspan="5">
OP3/4 Connector
as viewed on robot</td></tr>
<tr><td>2</td><td>Ground</td></tr>
<tr><td>3</td><td>Output 3004</td></tr>
<tr><td>4</td><td>Ground</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="3">Mating Connector:
AMP/Tyco #172167-1, 4-pin Mini-Universal Mate-N-Lok
AMP/Tyco #770985-1, Pin Contact, Mini-Univ. Mate-N-Lok</td></tr>
</table>

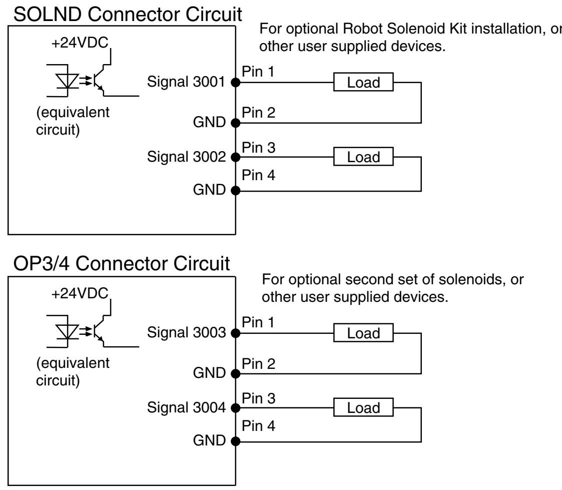
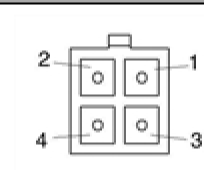


Figure 6-6. OP3/4 and SOLND Circuits

EOAPWR Connector

This 4-pin connector provides 24 VDC power and ground for user applications. See the following table for the pinouts and the following section for the output specifications. For the connector location, see Figure 6-4.

Table 6-3. EOAPWR Connector Pinout

Pin #	Description	Pin Location
1	24 VDC (see the next table for current specs)	 EOAPWR Connector as viewed on robot
2	Ground	
3	24 VDC (see the next table for current specs)	
4	Ground	
Mating Connector: AMP/Tyco #172167-1, 4-pin Mini-Universal Mate-N-Lok AMP/Tyco #770985-1, Pin Contact, Mini-Univ. Mate-N-Lok		

Internal User Connector Output Specifications

The output specifications in the following table apply to the EOAPWR, OP3/4, and SOLND internal user connectors.

Table 6-4. Internal User Connector Output Circuit Specifications

Parameter	Value
Power supply voltage range	24 VDC ± 10% See Specifications for 24 VDC Power on page 28.
Operational current range, per channel	$I_{out} \leq$ 700 mA
Total Current Limitation, all channels on[a]	$I_{total} \leq$ 1.0 A @ 50° C ambient $I_{total} \leq$ 1.5 A @ 25° C ambient
On-state resistance (I_{out} = 0.5 A)	$R_{on} \leq$ 0.32 Ω @ 85° C
Output leakage current	$I_{out} \leq$ 25 µA
Turn-on response time	125 µsec. max., 80 µsec typical (hardware only)
Turn-off response time	60 µsec. max., 28 µsec typical (hardware only)
Output voltage at inductive load turnoff (I_{out} = 0.5 A, Load = 1 mH)	$(+V - 65) \leq V_{demag} \leq (+V - 45)$
DC short circuit current limit	$0.7A \leq I_{LIM} \leq 2.5$ A
Peak short circuit current	$I_{ovpk} \leq$ 4 A

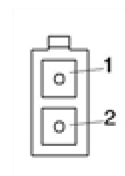
[a]**NOTE:** Total current is the sum of the output current used by output signals 3001-3004 (SOLND and OP3/4) and any user current drawn from EOAPWR.

ESTOP Connector

The Break-away E-STOP function is provided to enable a high power shutdown from the outer link area. For example, it would be used if you want a break-away gripper to shut down robot high power. It lets you disable high power through a user relay circuit inside the robot.

The 2-pin ESTOP connector provides a pair of contacts that can be used for a Break-away E-Stop function at the end of the arm. See the following table. The function is disabled by default when the system is shipped. The user must enable this function using the Adept ACE software (see below), and connect a normally-closed circuit to Pins 1 and 2. When the circuit is opened, the system will stop in an E-Stop condition. See the following table and figure.

Table 6-5. ESTOP Connector

Pin #	Description	Pin Location
1	ESTOP_INPUT	
2	24 V	
		ESTOP Connector as viewed on robot
Mating Connector: AMP/Tyco #172165-1, 2-pin Mini-Universal Mate-N-Lock AMP/Tyco #770985-1, Pin Contact, Mini-Univ. Mate-N-Lok		

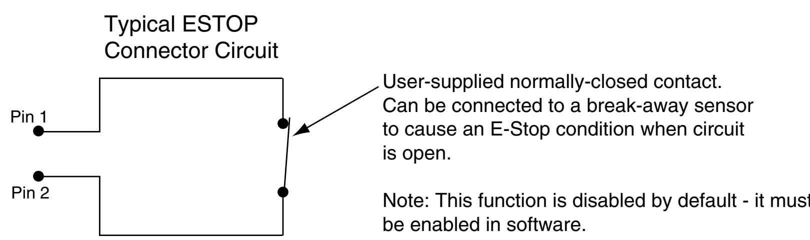


Figure 6-7. Internal E-Stop Connector Circuit

> **NOTE:** This circuit will trigger an emergency stop of the local robot only. It does not link to the E-Stop chain of the host SmartController.

Procedure to Enable the Break-away E-Stop Function

To enable the Break-away E-Stop function, you have to use the Adept ACE software to change the default configuration:

> **NOTE**: This requires that you have Expert access.

From the Adept ACE software:

To get into Expert mode:

1. Click on Object.
2. Click Expert Access.

   You will be asked for a password, to enter Expert Access.
3. Enter the Expert Access password.

To change the Break-away E-Stop parameter:

1. Double-click the robot in the structure pane.

   This will open up the object editor for the robot.

2. Select Break-away E-Stop Enable.

3. Change the value of this field to True.

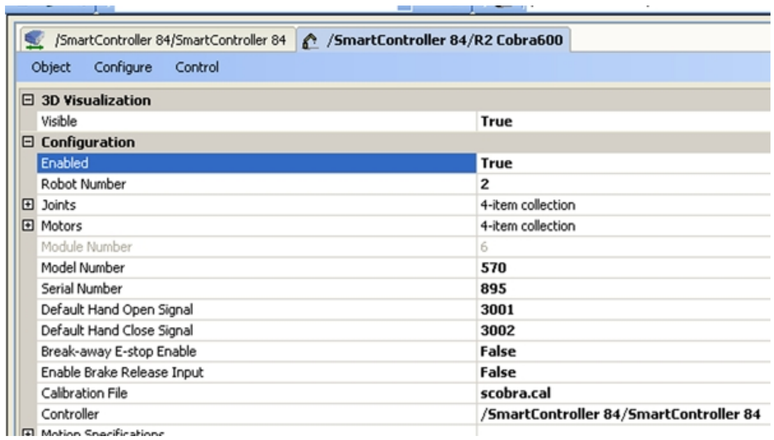


Figure 6-8. Screen Shot with Break-away E-Stop Parameter Field

NOTE: When the Break-away E-Stop function has been enabled, you must connect a normally-closed circuit to pins 1 and 2 of the ESTOP connector, as described above. If this is not done, the system will be in an E-Stop condition and you will not be able to enable power.

6.5 Mounting Locations for External Equipment

Three locations are provided for mounting user's external equipment on the robot arm. The first location is on the J1 Harness Support (top side of the inner link), a second is on the top side of the outer link, and a third is on the bottom side of the outer link. Each location has a set of four tapped holes. See Figure 7-5 and Figure 7-6 for the dimensions.

NOTE: The cover on the outer link must be removed for maintenance (lubrication), so keep this in mind when mounting any external equipment to the outer link cover.

For information on mounting cameras on the robot, see Installing the Camera Bracket Kit on page 85.

6.6 Installing the Robot Solenoid Kit

This procedure describes how to mount the 24 V Robot Solenoid option on Adept Cobra s600 and s800 robots. The kit is available as Adept P/N 02853-000.

The robot has been pre-wired to accommodate a bank of two 24 VDC solenoid valves. Power for the internal mounting is accessible via a connector mounted inside the outer link cover (see

Figure 6-10). The signals actuating the valves are directly switchable from the Adept ACE software using software signals 3001 and 3002.

1. Open the gripper object editor.
2. Select the Open/Close tab.
3. Set the signal values for Open, Close, and Release.

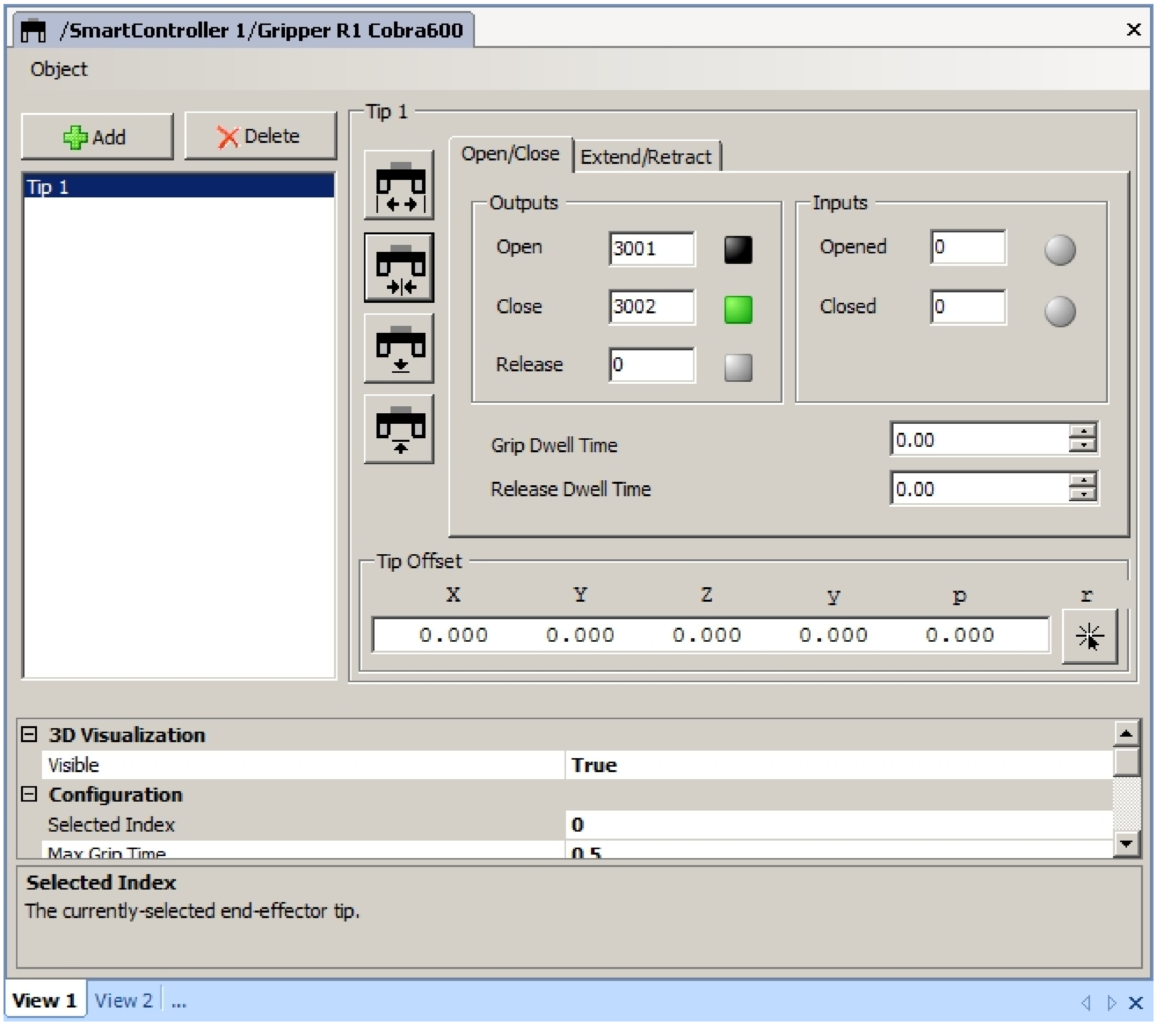


Figure 6-9. Setting Solenoid Signal Values

The Adept-supplied solenoids each draw a nominal 75 mA from 24 VDC.

The solenoid valve assembly consists of two independent valves (Valve #1 and Valve #2) on a common manifold. The manifold supplies air at the user's line pressure: minimum 28 psi (0.19 MPa), to maximum 114 psi (0.786 MPa). Each valve has two output ports, A and B. The output ports are arranged so that when Port A is pressurized, Port B is not pressurized. Conversely, when Port B is pressurized, Port A is not. In the Adept Cobra s600 and s800 robots, the air lines from Port A on each valve are plugged at the factory (at the solenoid assembly).

The Solenoid Kit for the Adept Cobra s600 and s800 robots is available through Adept. Contact your Adept Sales Representative for current price and availability.

Table 6-6. Air Pressure

Air Pressure (Psi)	Air Pressure (MPa)
28 - 114	0.19 - 0.786

Tools Required

- Hex drivers
- Cable ties
- Diagonal wire cutters
- Solenoid Valve upgrade Kit (Adept P/N 02853-000)

Procedure

1. Turn off all power to the robot.
2. Remove two screws on s600 (three screws on s800) on each side of the outer link cover. Remove two screws on top and remove the cover.
3. Connect the Internal Solenoid Valve Cable assembly to the Solenoid Manifold assembly, by plugging the SOL 1 connector into Valve 1 and SOL 2 into Valve 2.

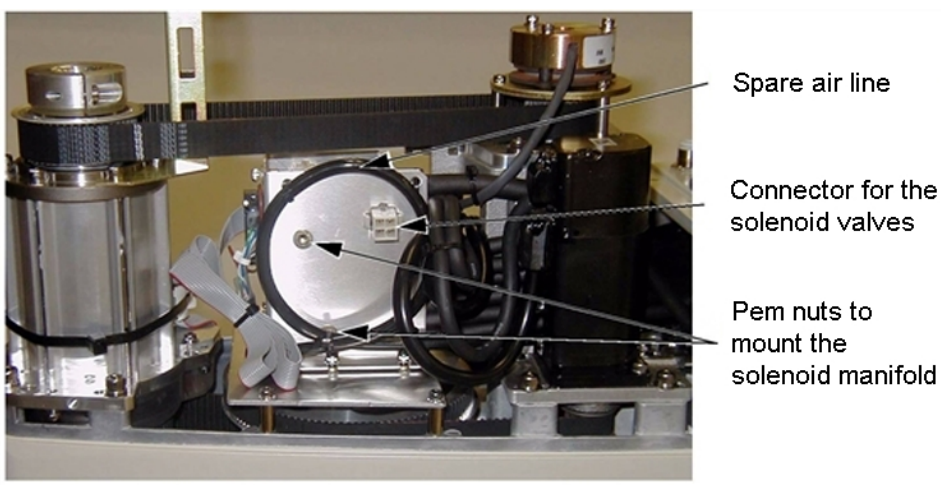


Figure 6-10. Solenoid Mounting Bracket with Connector and Spare Air Line

4. Cut and discard the cable ties holding the spare air line at the top of the mounting bracket. Move the air line away to facilitate the mounting of the solenoid manifold. See Figure 6-10.
5. Mount the solenoid manifold onto the bracket using the supplied M3 x 25 mm screws

and washers. See Figure 6-11.

6. Insert the spare air line into the air intake coupling of the solenoid manifold. Make sure the air line is pushed in all the way and secured in place by the intake coupling. Confirm by gently pulling the air line.

NOTE: If you are installing on a Cleanroom or IP-65 robot, the spare air line is used for a different purpose in those robots. You will have to provide a piece of 6 mm tubing to run from one of the 6 mm user air lines at the Joint 2 cover to the air intake coupling mentioned above.

7. Plug the connector plug into the female connector jack (marked SOLND) on the bracket.
8. Use cable ties to secure air line to the bracket as needed.

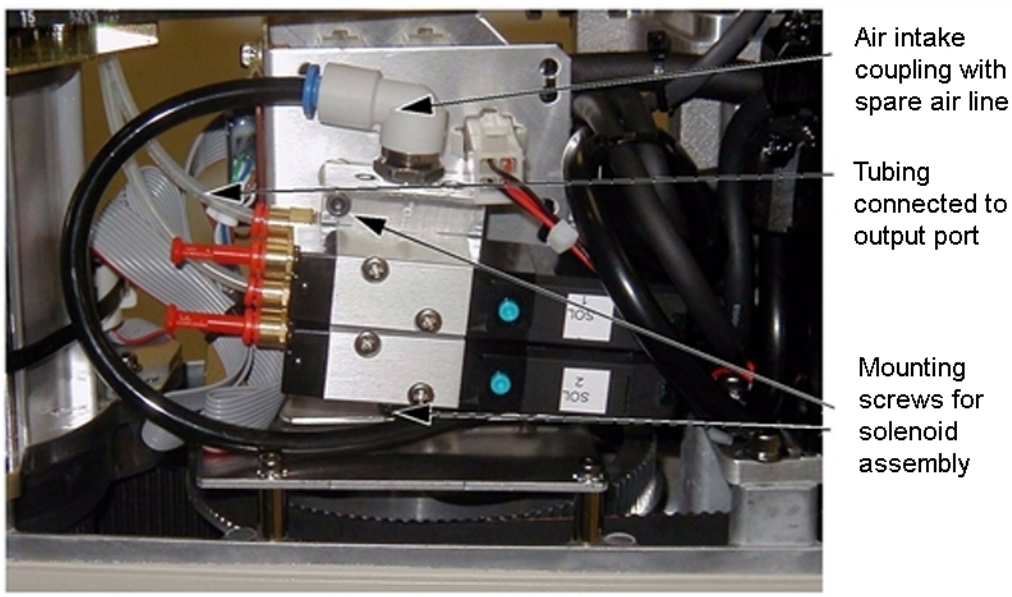


Figure 6-11. Solenoid Placement Using Mounting Hardware

9. Install the appropriate lengths of 5/32 inch plastic tubing (supplied) into the two output ports on the manifold.
   - Route the tubing up along the tower bracket next to the quill and down through the center of the quill.
   - Use cable ties as needed to secure the tubing.
10. Loosen the securing screw on the AIB/eAIB chassis, and lower the chassis down flat. See Figure 5-2 for the location of the securing screw.
11. Remove the cable strap plate by removing two screws and split washers. See Figure 6-12. This allows the harness to move when you lift the J1 cover in the next step.

Figure 6-12. Removing the Cable Strap Plate

12. Remove the four screws for the Joint 1 cover and lift the cover up so you have access to the tubing under the cover. See Figure 6-13.

Figure 6-13. Connecting Spare Air Line to User Connector

13. Disconnect the tubing from the 6 mm User Air fitting shown in Figure 6-13. Fold the tubing out of the way and restrain using tie-wraps.
14. Locate the spare air line contained in the tubing bundle inside the front end of the cover. Remove the spare air line from the bundle.
15. Insert the spare air line into the back of the empty 6 mm User Air fitting.

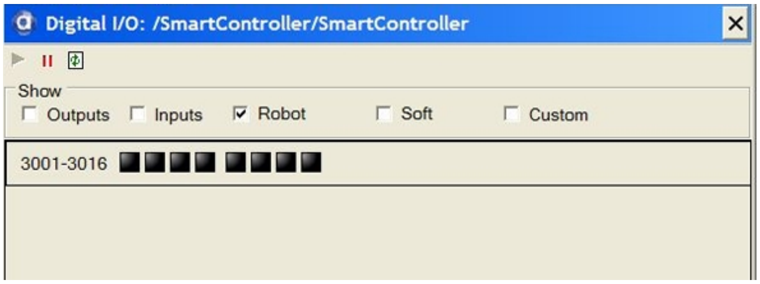
NOTE: This 6 mm User Air connector and the 6 mm User Air connector at the top of Figure 6-2 are not available for other uses after this modification.

16. Reinstall the Joint 1 cover, taking care to ensure that all tubing is inside the cover and nothing gets crimped or pinched while pushing the cover into position. Reinstall four screws to secure the cover. Tighten the screws to 1.6 N·m (14 in-lb) of torque.
17. Reinstall the cable strap plate that you removed earlier in the procedure.
18. Raise the AIB/eAIB chassis to the closed position and tighten the securing screw.
19. Reinstall the outer link cover and tighten the screws to 1.6 N·m (14 in-lb) of torque.
20. Connect the factory air supply to the 6 mm User Air connector.

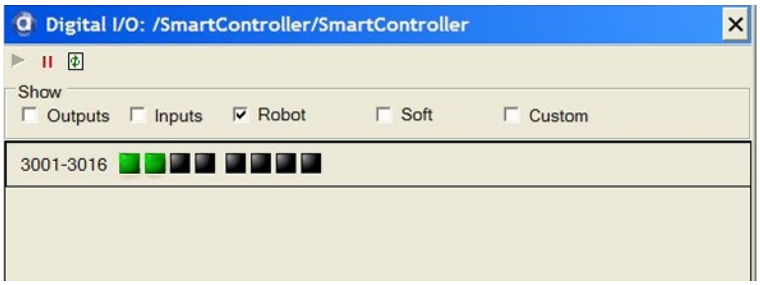
    For the non-IP-65 robot, this is the air connector just modified.
21. From the Adept ACE software:
    a. Click the Digital I/O button in the controller toolbar:

    b. The Digital I/O window will open.

    c. Check Robot.
    d. Select Signal 3001 and Signal 3002 (the first two blocks) to activate the solenoids one at a time.
    e. The selected blocks will turn green, to indicate they are active.

WARNING: Disconnect robot air pressure until this test has been done to prevent unsecured pneumatic lines from accidentally injuring personnel.

6.7 Installing the Camera Bracket Kit

The Adept Cobra Robot Camera Bracket Kit provides a convenient way of mounting cameras to the outer link of the robot. The kit consists of the following:

- One camera plate
- Two camera brackets
- One camera mount slide bracket
- One camera mount channel
- M4 X 12 mm screws
- M4 stainless steel flat washers
- M5 X 12 mm screws

Tools Required

- M4 hex wrench
- M3 hex wrench

Procedure

1. Install the camera plate to the outer link with four M5 X 12 mm screws. See Figure 6-14 as you perform this procedure.
2. Install the two camera brackets to the camera plate with two stainless steel washers and two M4 X 12 mm screws for each bracket. (The camera brackets are not required unless you are mounting more than one camera.)
3. Mount the camera channel to the camera brackets or camera plate with M4 x 12 mm screws.
4. Mount the camera to the camera mount.
5. Mount the camera and camera mount to the camera channel using M5 x 12 mm screws.

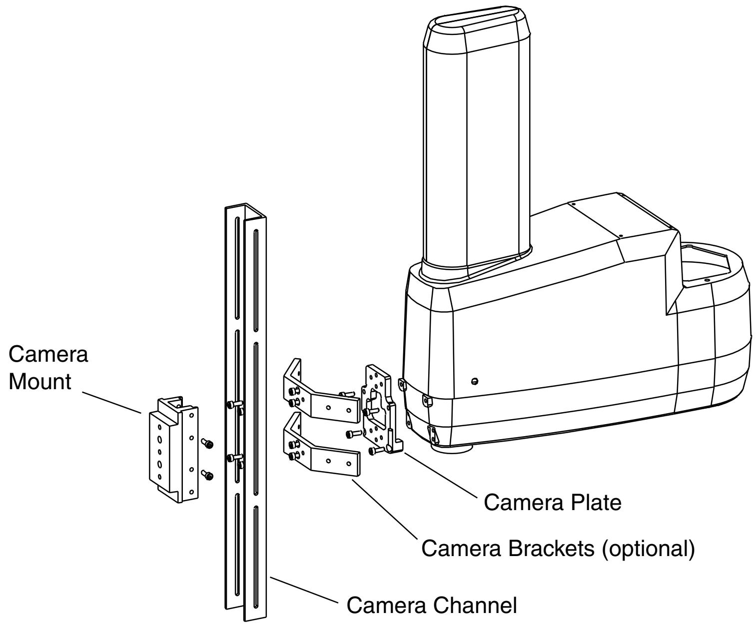


Figure 6-14. Mounting a Camera on the Robot

6.8 DeviceNet Communication Link

DeviceNet is a communications link that connects industrial I/O devices to a message-packeting network. All nodes connect to the same backbone cable, eliminating the need for individual wiring for each I/O point.

Adept incorporates the following DeviceNet-ready hardware in the Adept Cobra s600 and s800 robots:

- Male micro-style 12 mm thread DIN connector at the robot base. See Figure 6-2.
- Female micro-style 12 mm thread DIN connector for joint 2 of the robot. See Figure 6-3 and Figure 6-15. .
- A non-standard DeviceNet cable, consisting of two shielded twisted pairs that connect the base and joint 2 connectors. Adept considers this cabling to be a drop line with a maximum total length of 6 meters (20 feet) and therefore uses the following wire sizes:

Cable Type	Adept Wire Size	DeviceNet “thin cable”
Power pairs	24 AWG	22 AWG
Signal pairs	28 AWG	24 AWG

This means that total current on the power pairs must be limited to 2 A instead of the standard 3 A in a DeviceNet trunk line. Because this is intended to be a DeviceNet drop line with a maximum of 6 meters (20 feet), the full data rate should be achievable. However, Adept has tested the internal cable only at 125k baud.

See the *Adept SmartController User’s Guide* for physical installation.

Use Adept ACE, controller configuration, for software setup. This assigns the controller signals to the physical ports of the DeviceNet nodes.

NOTE: The local setting baud rate must match the DeviceNet node's setting.

From the Adept ACE software:

1. Double-click on the controller in the tree structure pane.
   This opens the object editor for the controller.
2. Select **Configure > Configure V+** (or eV+).
3. Select DEVICENET.
4. If there is no LOCAL statement, you are prompted to add one before scanning.

   The LOCAL statement in the DeviceNet configuration specifies the MAC ID of the Adept controller on the DeviceNet bus. The default setting is 0. Set the MAC ID so that all the nodes on the bus have different MAC IDs.

   ```
   LOCAL = "/MACID n /BAUD n".
   ```

   This statement also defines the baud rate of the DeviceNet scanner. The baud rate depends on multiple factors, such as the length of the DeviceNet cable, the DeviceNet components on the bus, etc.

   Syntax of the LOCAL statement:

   ```
   LOCAL = "/MACID local_id
   /BAUD baud_rate"
   ```

Parameter	Description	Range
local_id	MACID for the Adept controller on the bus	0 - 63
baud_rate	Baud rate to be used on the DeviceNet	125K, 250K, or 500K

5. Click Scan.

   This scans for your physical DeviceNet nodes, and return the MACIDs for them.
6. Use Add or Edit to set the values for DeviceNet.
7. The fields that need to be entered are:
   - Index - a unique number for this mapping
   - Byte - usually starts at 1

     This is the input or output block where mapping starts.
     A byte refers to 8 inputs or outputs, so if you are using two 8-channel input blocks, byte 1 would be the first input block, and byte 2 the second.
   - Bit - usually starts at 1

     This is the bit within the byte where mapping starts.
     To map the first input of an 8-channel input block, this would be 1.

- Signal - the input or output signal number (e.g. 1013 or 013) where mapping starts.
- Bit_length - the number of input or output signals to map.
- MACID - the MACID returned by the Scan.

8. When you are finished, click Done.
9. Check that the assignments worked correctly by opening the Digital I/O tab.

   The new signals should show up as being mapped now.

Recommended Vendors for Mating Cables and Connectors

A variety of vendors have molded cable assemblies for the Micro-style connector including Brad Harrison, Crouse Hinds, Lumberg, Turk, and others. In addition, Hirshmann, Phoenix Contact, and Beckhoff have mating micro connectors that have screw terminals in the plug to allow the user to make custom cables.

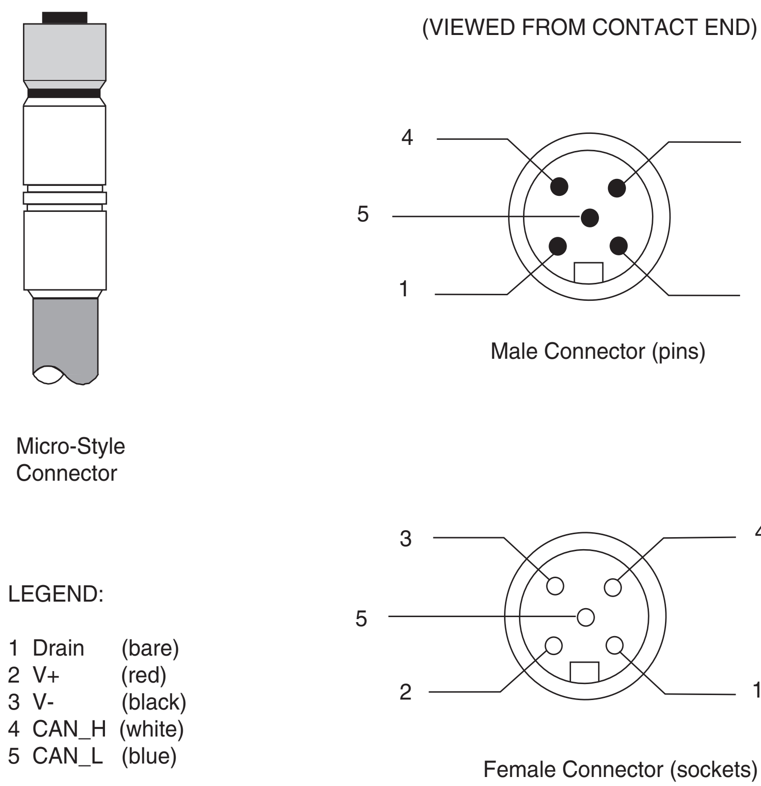


Figure 6-15. Micro-Style Connector Pinouts for DeviceNet

6.9 Installing Adjustable Hardstops

Adept offers an adjustable hardstop kit for Joint 1 and Joint 2 on the Adept Cobra s600/s800 robots. These are user-installed options that can be used to limit the work envelope of the robot. The Adept part number for the kit is 02592-000.

Joint 1 Adjustable Hardstops

The Joint 1 Adjustable Hardstops consist of two black rubber stop cylinders, and the required screws to install them. There are two locations for the hardstops on each side of the robot, Position 1 and Position 2. See the following figure.

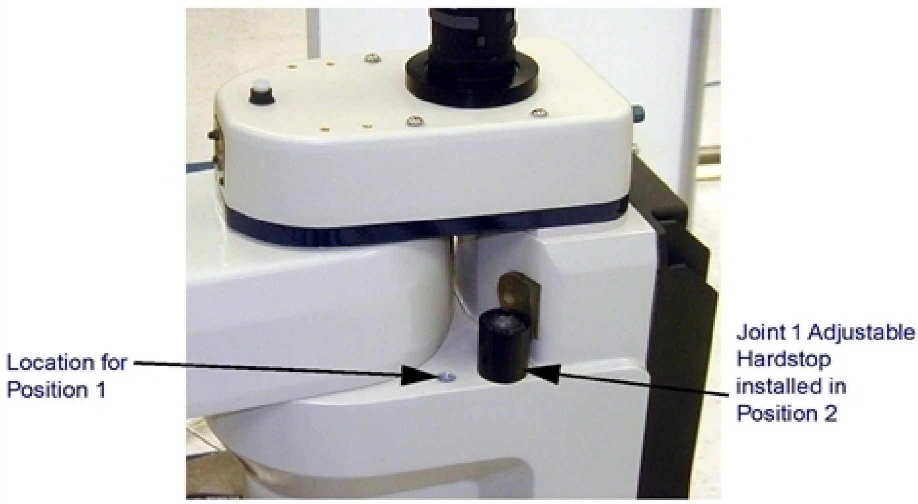


Figure 6-16. Joint 1 Adjustable Hardstops

Installation Procedure

1. Remove the plug from desired threaded hole, Position 1 or 2, on each side of the robot.
2. Install the adjustable hardstop into the threaded hole using an 8 mm hex wrench. Tighten to a torque of 5.1 N·m (45 in-lbf).
3. Repeat the process on the other side of the robot.

NOTE: The two sides do not have to have a hardstop in the same position, i.e., you can use Position 1 on one side, and Position 2 (or none) on the other, if you choose.

Modifying Joint Limit Softstop Locations for Joint 1

After installing the adjustable hardstops, you must modify the softstop locations using the Adept ACE software.

1. From Adept ACE, select the robot in the tree structure pane.
2. Open the robot editor.

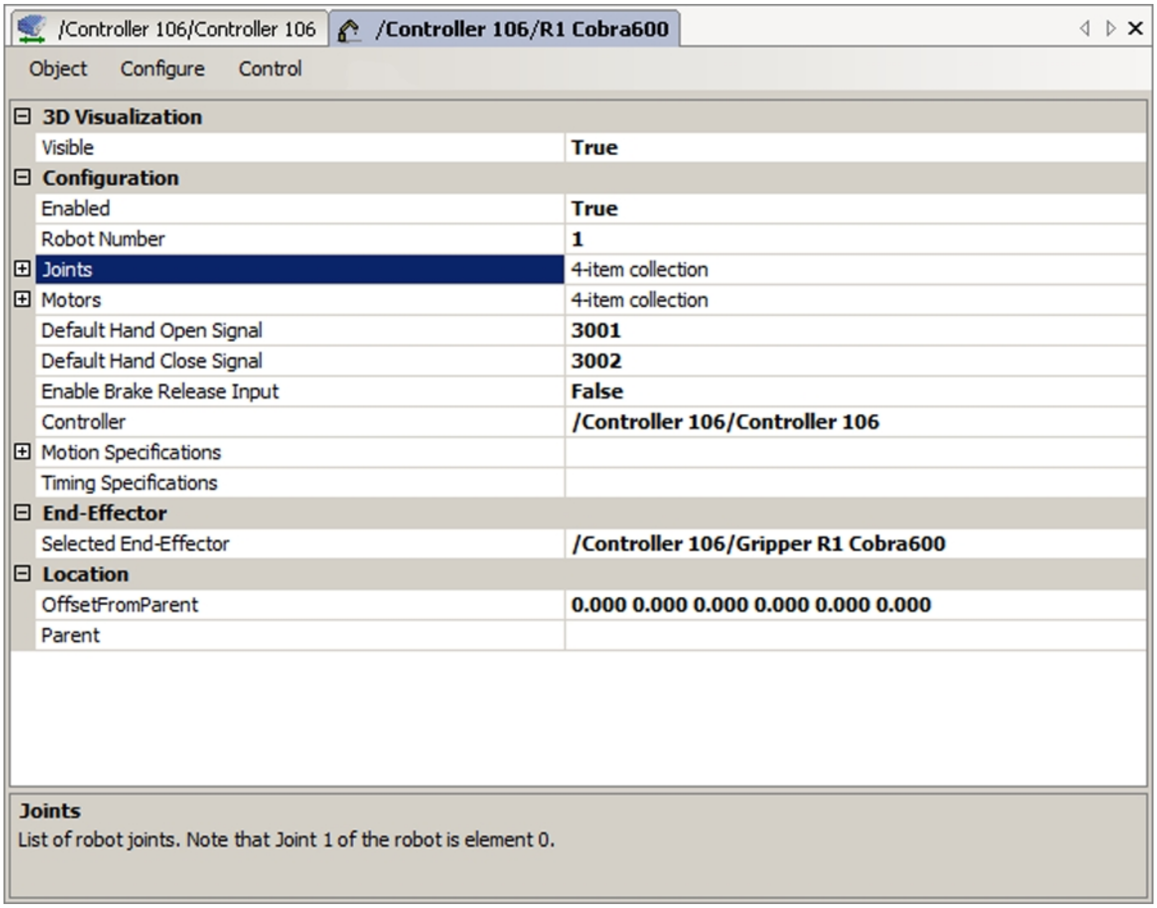


Figure 6-17. Robot Editor, with Joints Collapsed

3. Click the '+' in front of Joints, to display all of the joints.

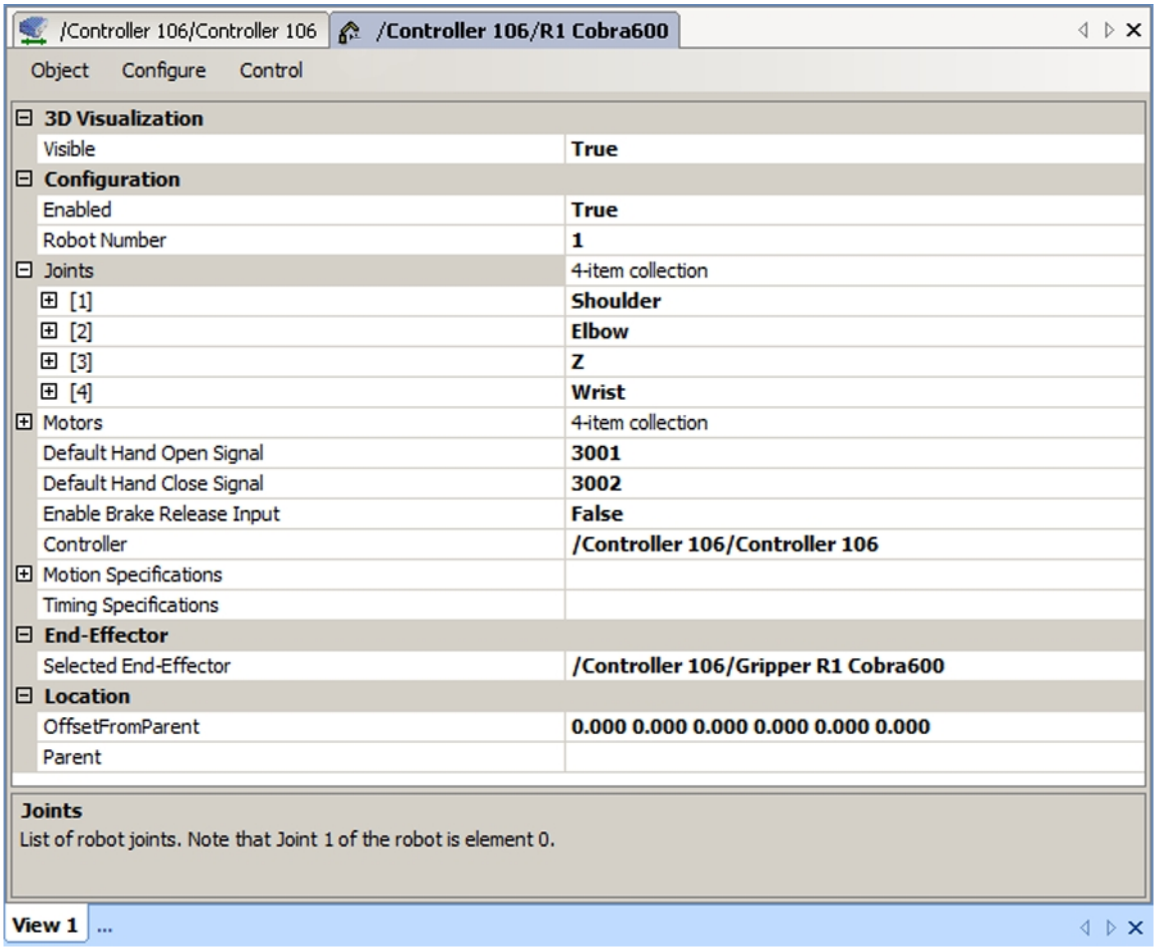


Figure 6-18. Robot Editor, with Joints Expanded

4. Click the '+' in front of [1], to open the values for joint 1.

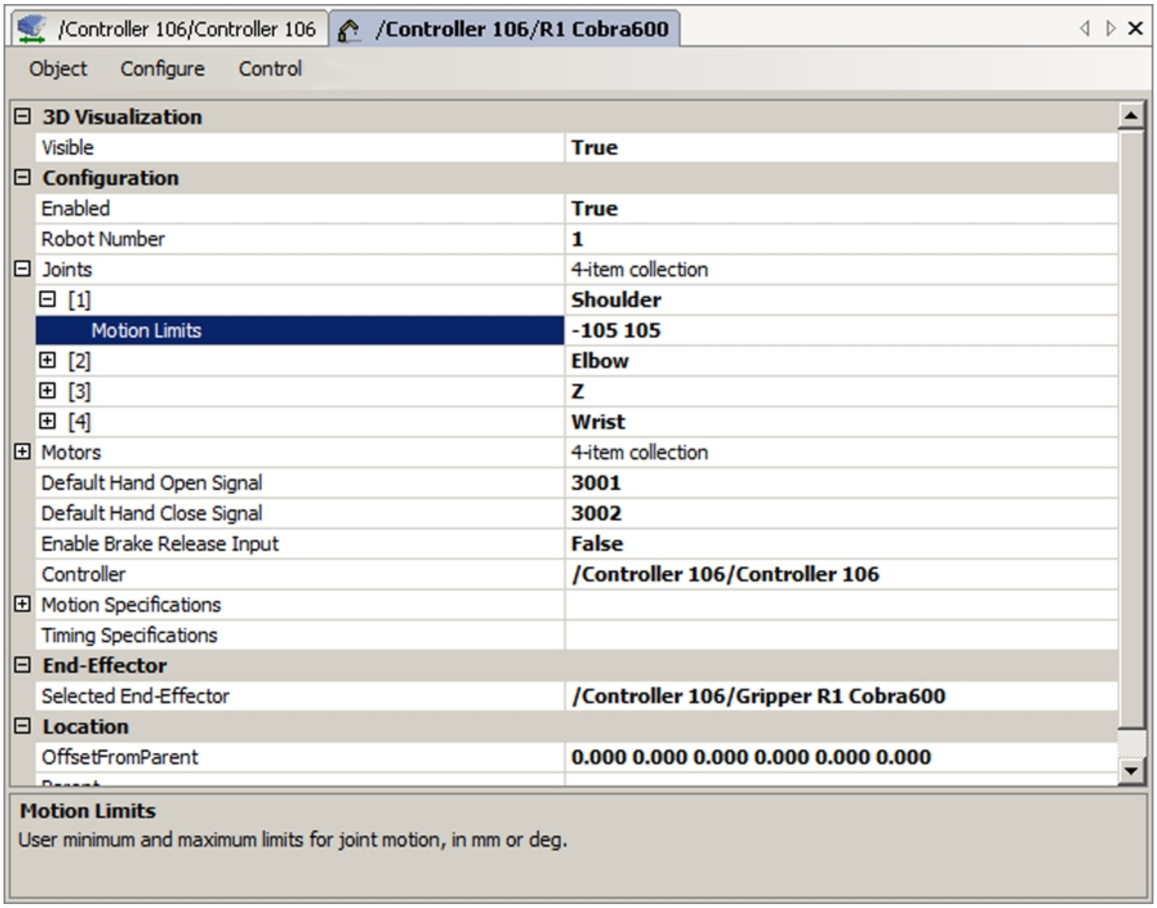


Figure 6-19. Robot Editor, with Joint 1 Expanded

5. Highlight the current values for joint 1, and replace them with the new values. See the following table for recommended softstop values for Position 1 or Position 2.

Table 6-7. Joint 1 Ranges for Adjustable Hardstops

	Hardstop Value	**Recommended Joint Limit Softstop**
J1 Hardstop Position 1	± 50°	Lower limit: – 49° Upper limit: + 49°
J1 Hardstop Position 2	± 88°	Lower limit: – 87° Upper limit: + 87°

6. Once you have modified the upper and lower joint limit softstops, you must reboot the system by cycling 24 VDC power to the SmartController. The new joint limits will be in affect when the system reboot is done.

Joint 2 Adjustable Hardstops

The Joint 2 Adjustable Hardstop kit (Figure 6-20) consists of two curved plates that are the adjustable hardstops, a small, black rectangular device that is the fixed hardstop, and the required screws to install them. The adjustable hardstop plates can be installed in different locations, depending on how much you need to limit the Joint 2 range of motion.

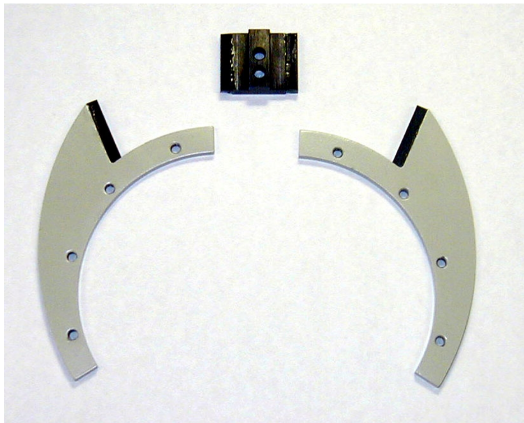


Figure 6-20. Joint 2 Hardstop Kit

Installation Procedure

1. Slide the two adjustable hardstop plates into the space between inner and outer links. See Figure 6-21. Looking up at the inner link from underneath, align the holes in the plates with the holes in the inner link. See Figure 6-22.

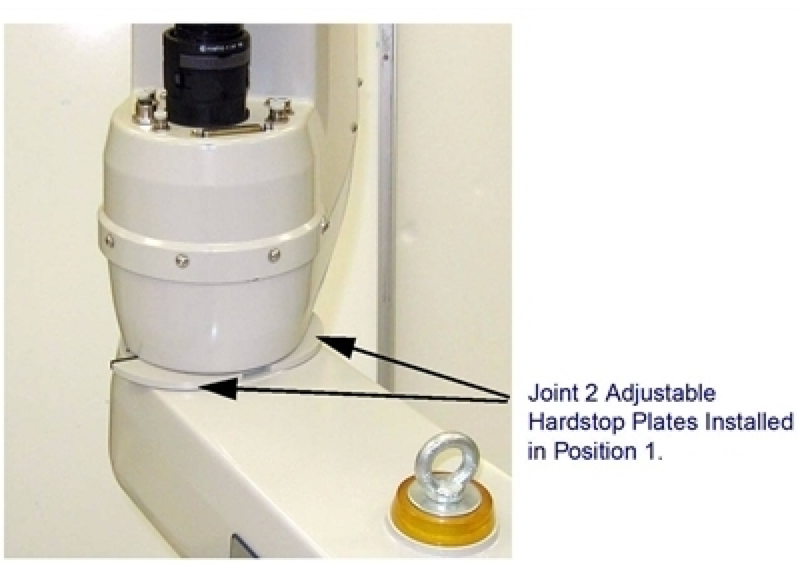


Figure 6-21. Joint 2 Adjustable Hardstop Locations

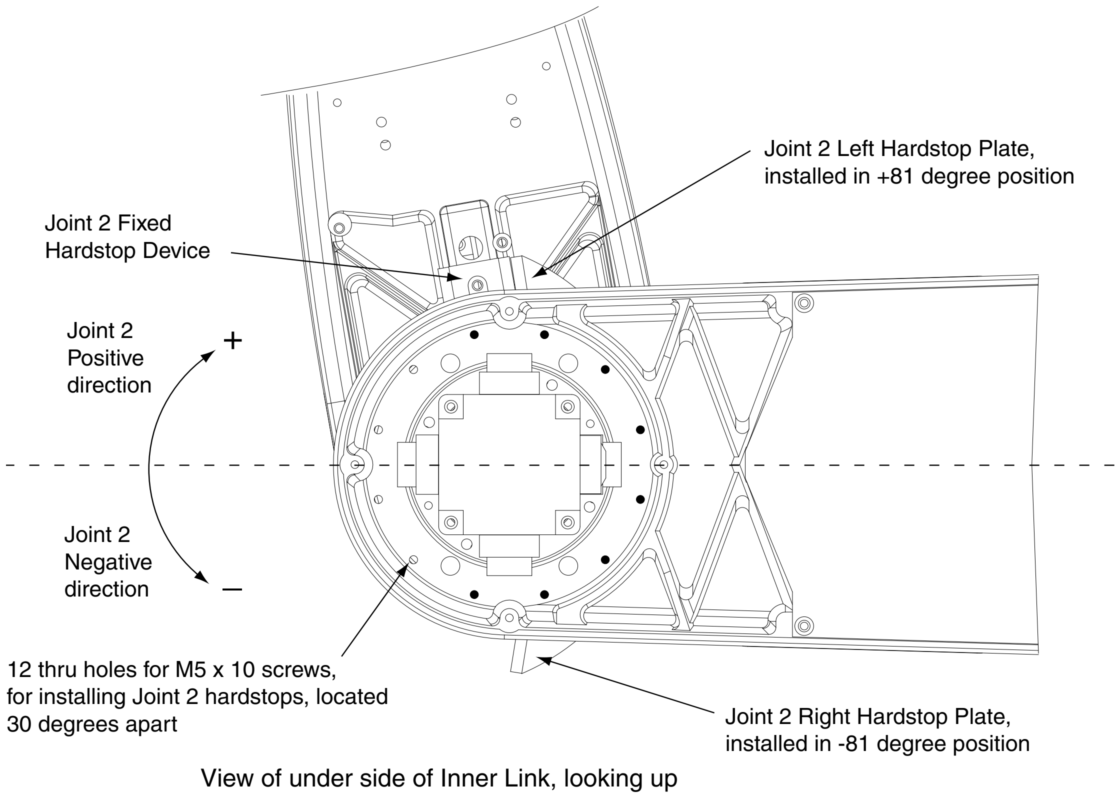


Figure 6-22. Screw Locations for Joint 2 Adjustable Hardstops

2. Use a 4 mm hex wrench to install three supplied M5 x 10 screws to secure the plate. Tighten the screws to a torque of 4.5 N·m (40 in-lb). Repeat the process for the second plate. Note that the plates can be installed in a number of different positions, depending on how much you need to limit the range of Joint 2.

NOTE: The two sides do not have to have the hardstop in the same position, so the workspace does not have to be symmetrical.

3. Slide the fixed hardstop device into the slot on the underside of the outer link. See Figure 6-23.

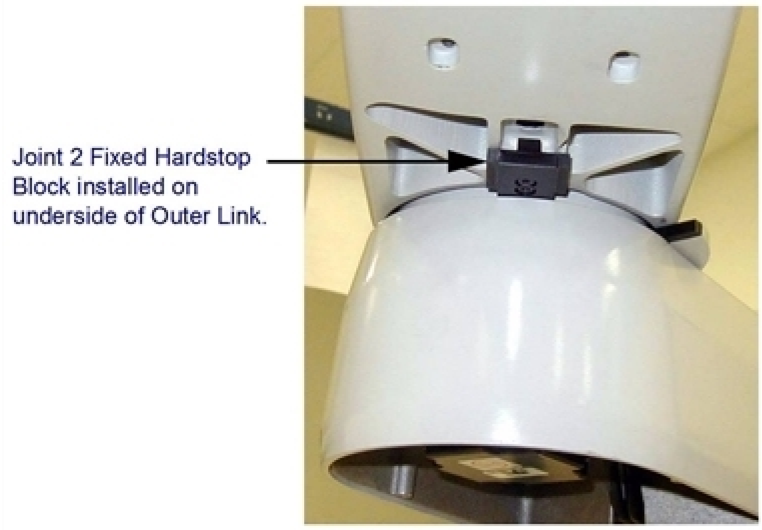


Figure 6-23. Fixed Hardstop Block for Joint 2

4. Use a 3 mm hex wrench to install two supplied M4 x 10 screws to secure the hardstop device. Tighten the screws to a torque of 2.5 N·m (22 in-lb).

Modifying Joint Limit Softstop Locations for Joint 2

After installing the adjustable hardstops, you must modify the softstop locations using the Adept ACE software.

1. From the Adept ACE software, select the robot in the tree structure pane.
2. Open the robot editor.

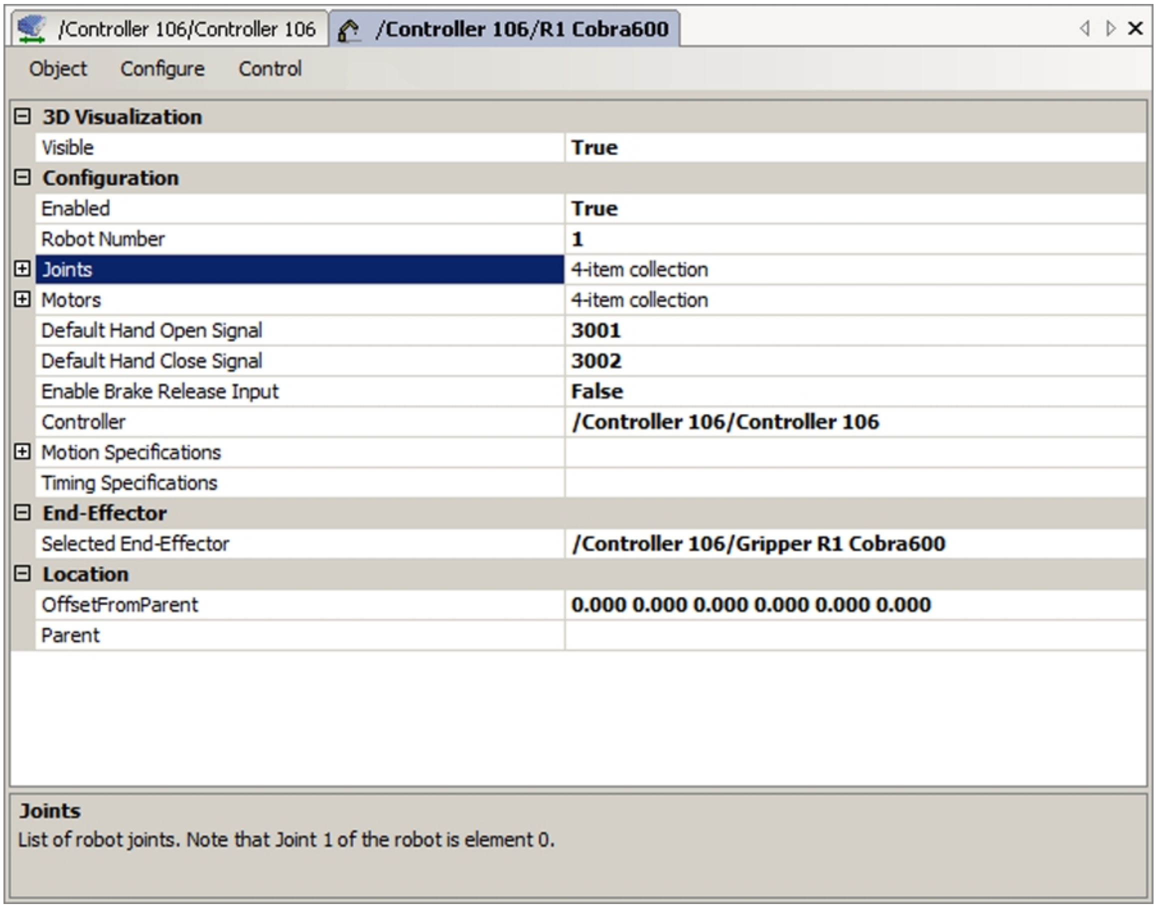


Figure 6-24. Robot Editor, with Joints Closed

3. Click the '+' in front of Joints, to display all of the joints.

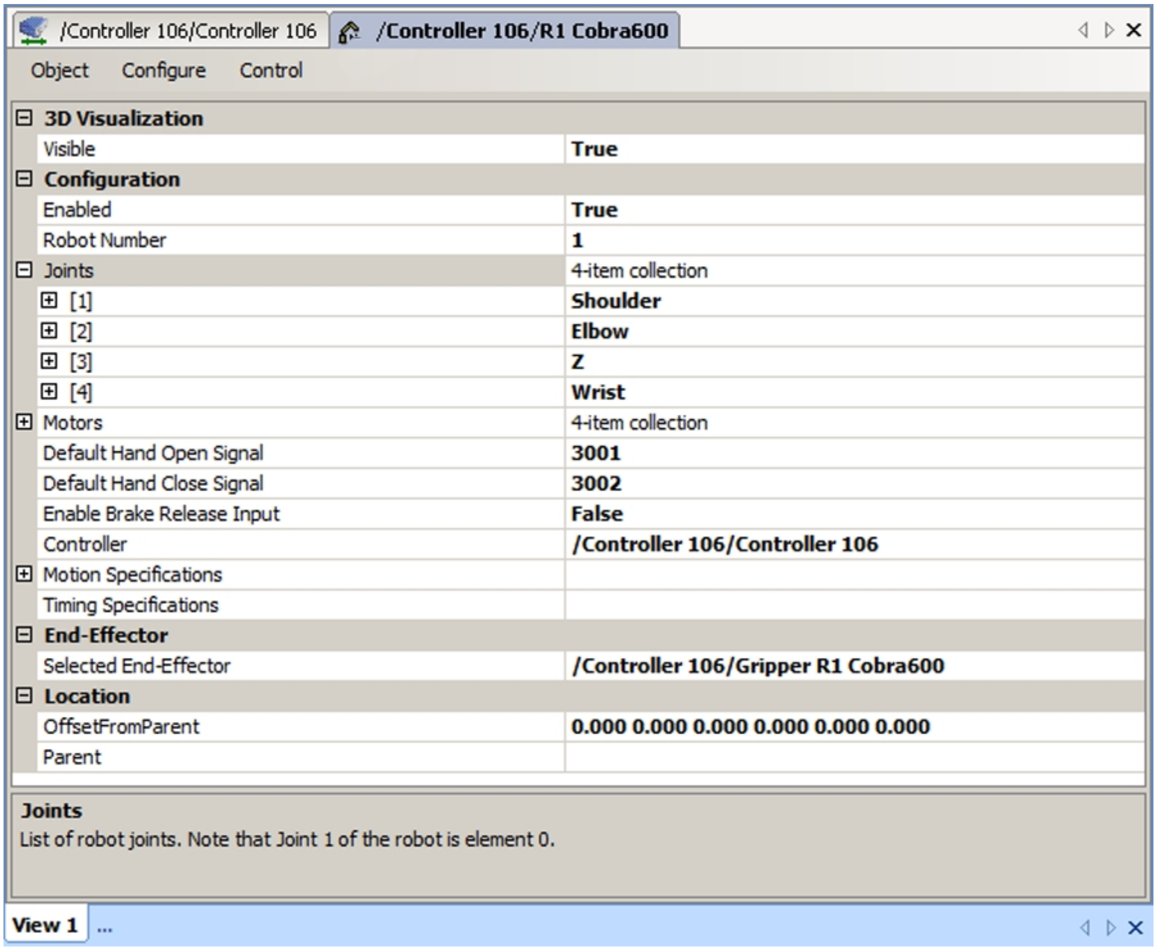


Figure 6-25. Robot Editor, with Joints Expanded

4. Click the '+' in front of [2], to open the values for joint 2.

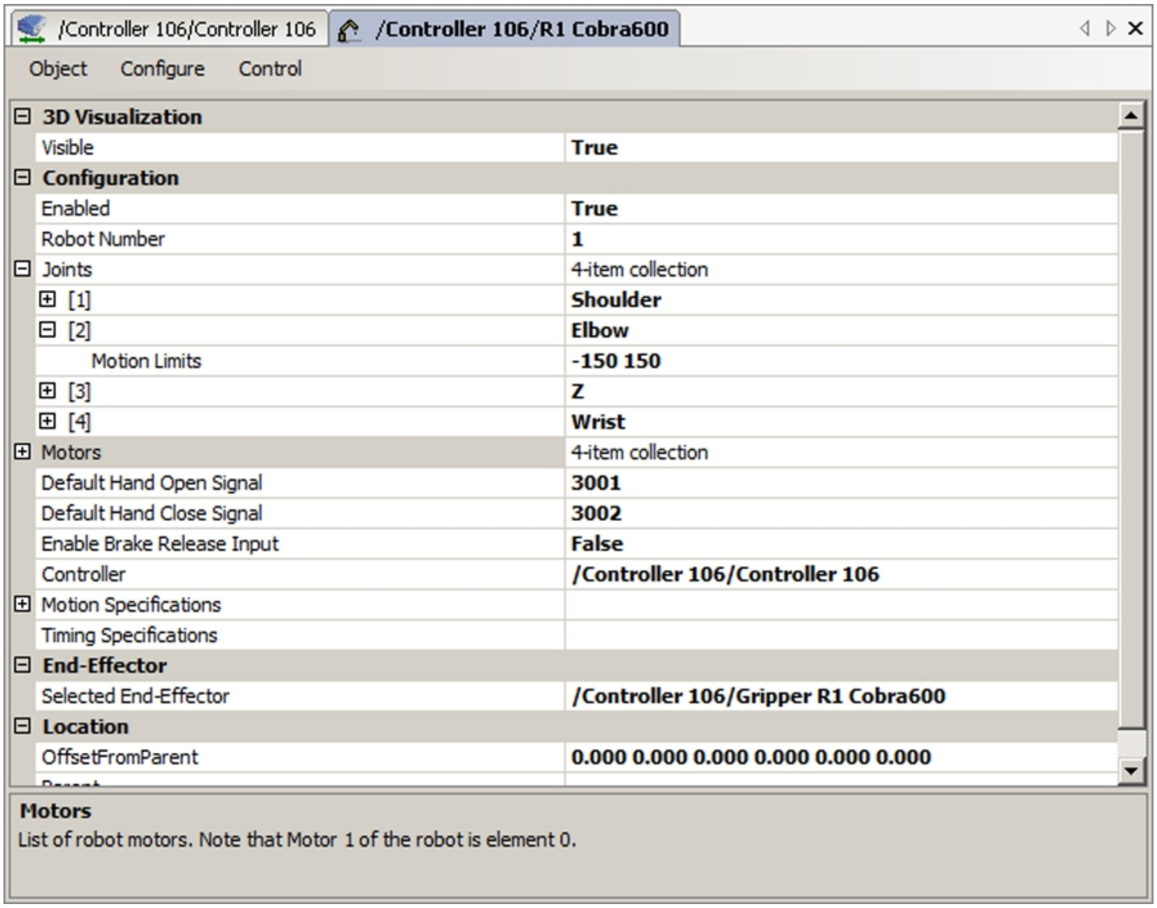


Figure 6-26. Robot Editor, with Joint 2 Expanded

5. Highlight the current values for joint 2, and replace them with the new values. See the following table for recommended softstop values.

Table 6-8. Joint 2 Ranges for Adjustable Hardstops

	Hardstop Value	**Recommended Joint Limit Softstop**
J2 Hardstop Position 1	± 81°	Lower limit: – 80° Upper limit: + 80°
J2 Hardstop Position 2	± 51°	Lower limit: – 50° Upper limit: + 50°
J2 Hardstop Position 3	± 21°	Lower limit: – 20° Upper limit: + 20°
Note: J2 Hardstops can be installed in a number of positions, depending on how the robot workcell needs to be configured. The positions are spaced 30° apart.		

6. Once you have modified the upper and lower joint limit softstops, you must reboot the system by cycling 24 VDC power to the SmartController. The new joint limits will be in affect when the system reboot is done.

Chapter 7: Technical Specifications

7.1 Dimension Drawings

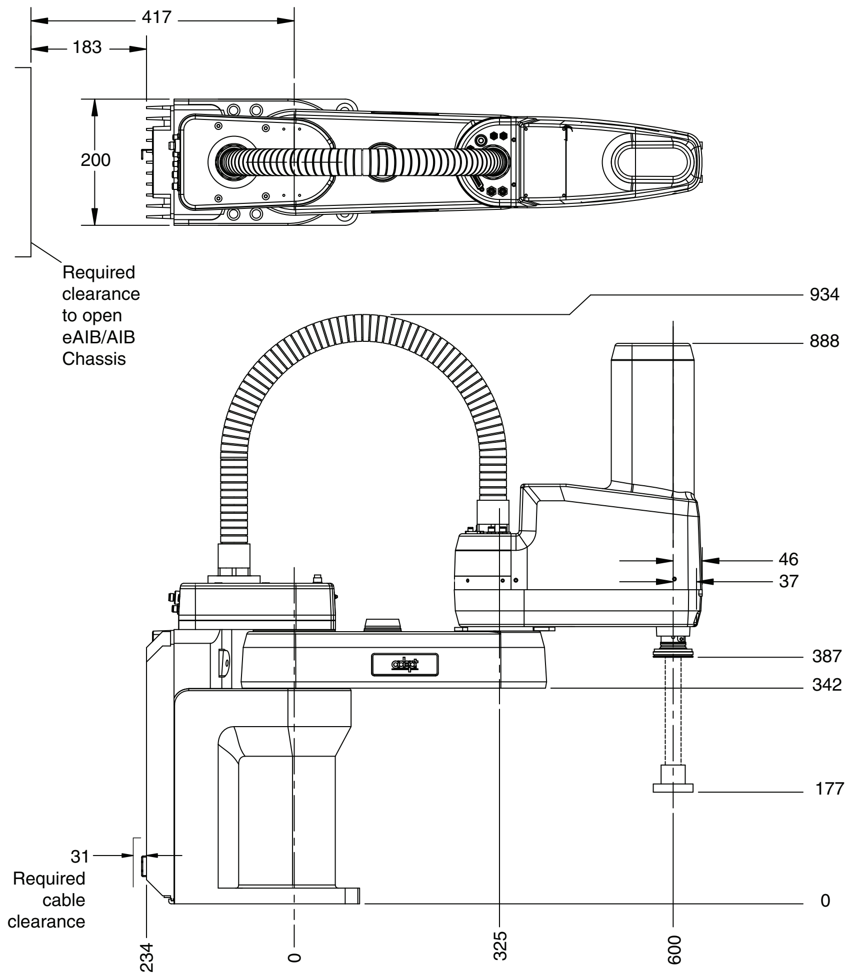


Figure 7-1. Adept Cobra s600 Robot Top and Side Dimensions

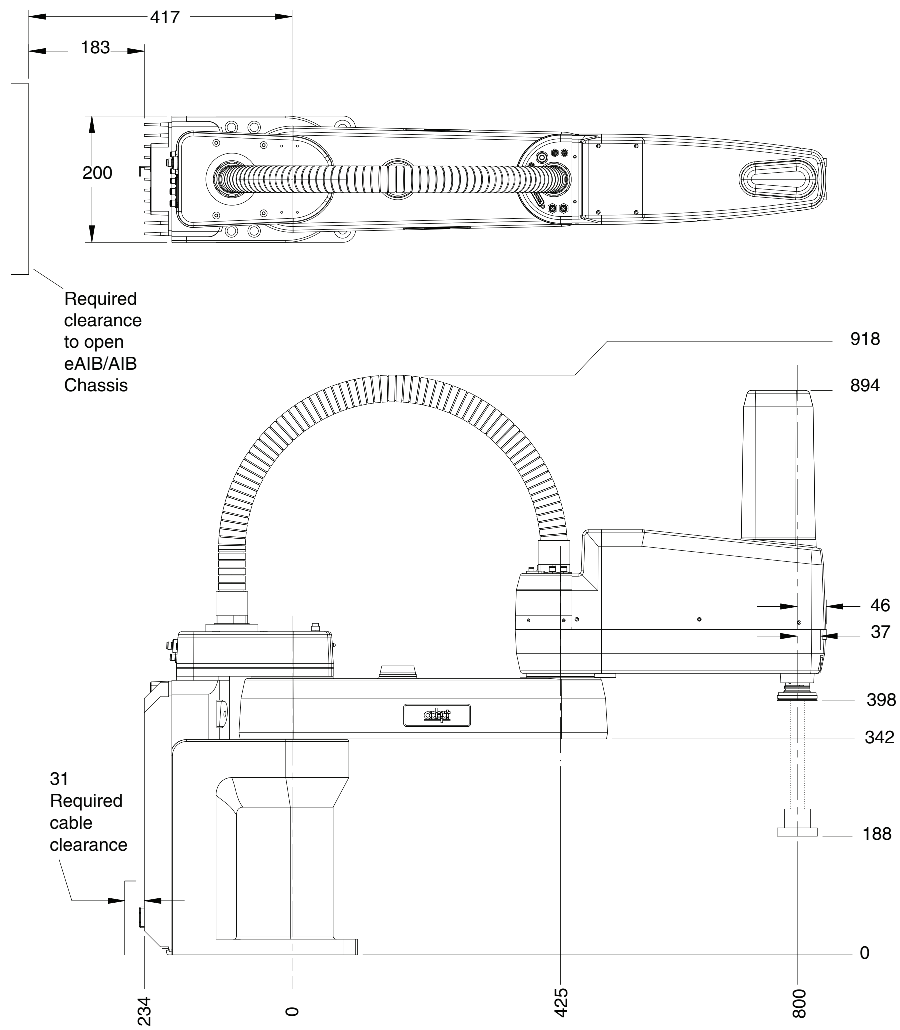


Figure 7-2. Adept Cobra s800 Robot Top and Side Dimensions

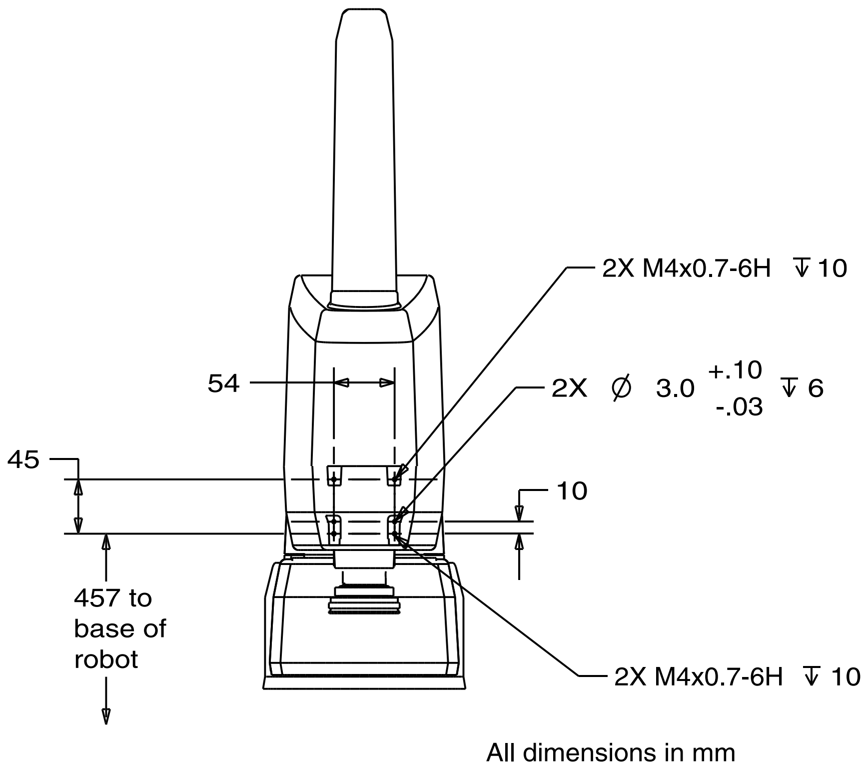


Figure 7-3. Dimensions of the Camera Bracket Mounting Pattern

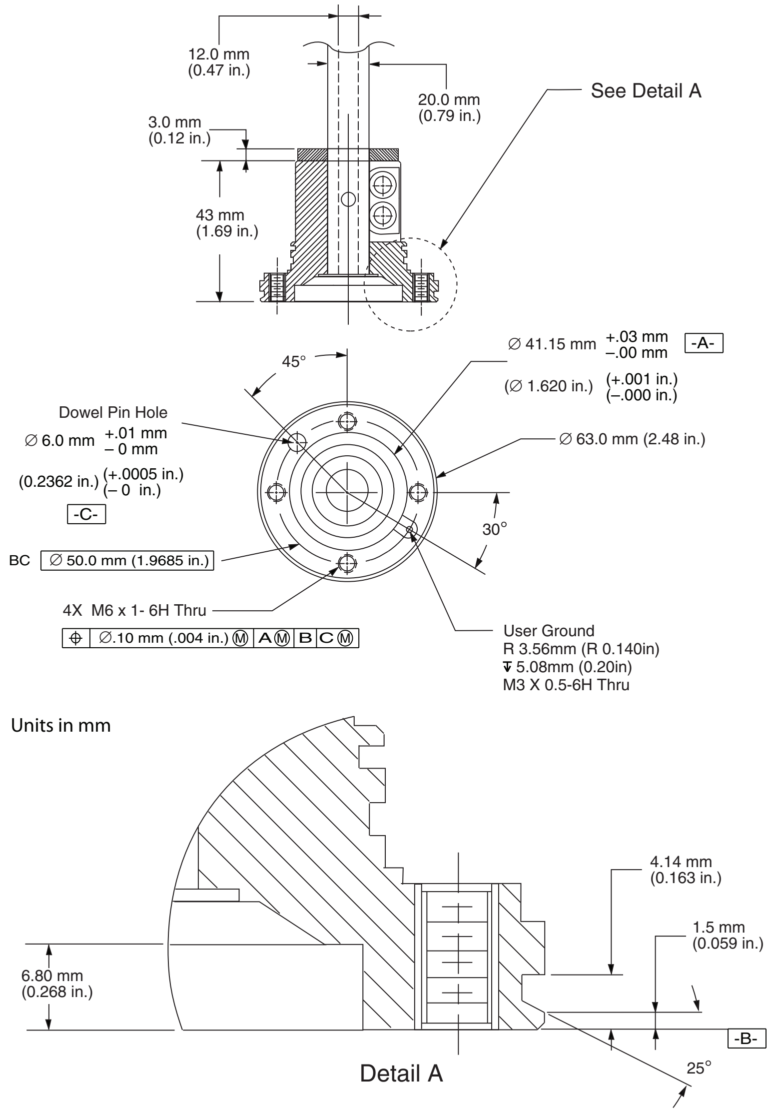


Figure 7-4. Tool Flange Dimensions for Both Robots

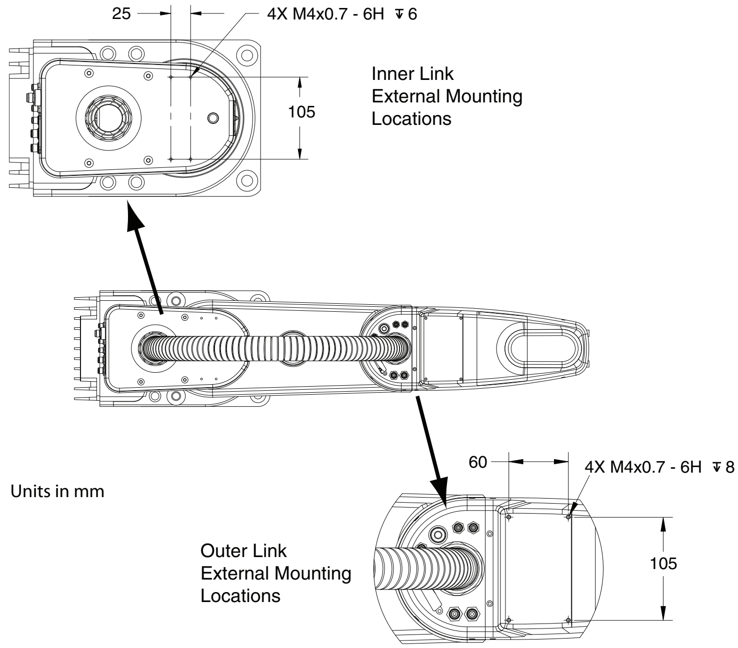


Figure 7-5. External Tooling on Top of Robot Arm

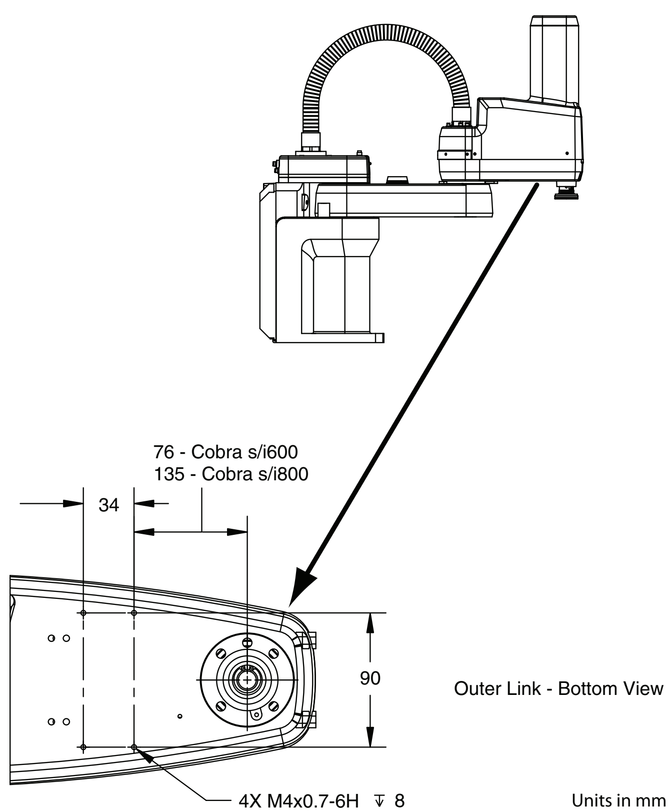


Figure 7-6. External Tooling on Underside of Outer Link

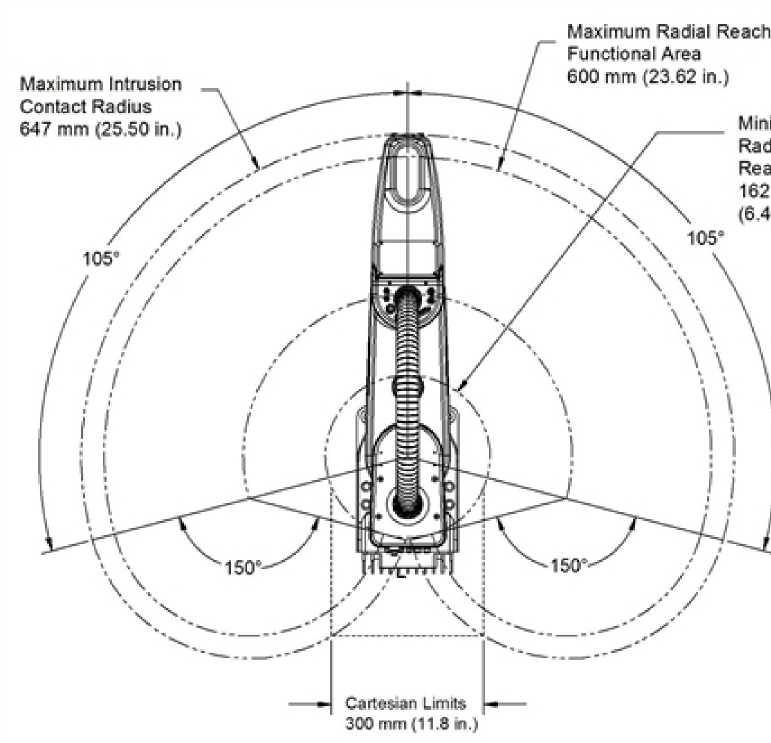


Figure 7-7. Adept Cobra s600 Robot Working Envelope

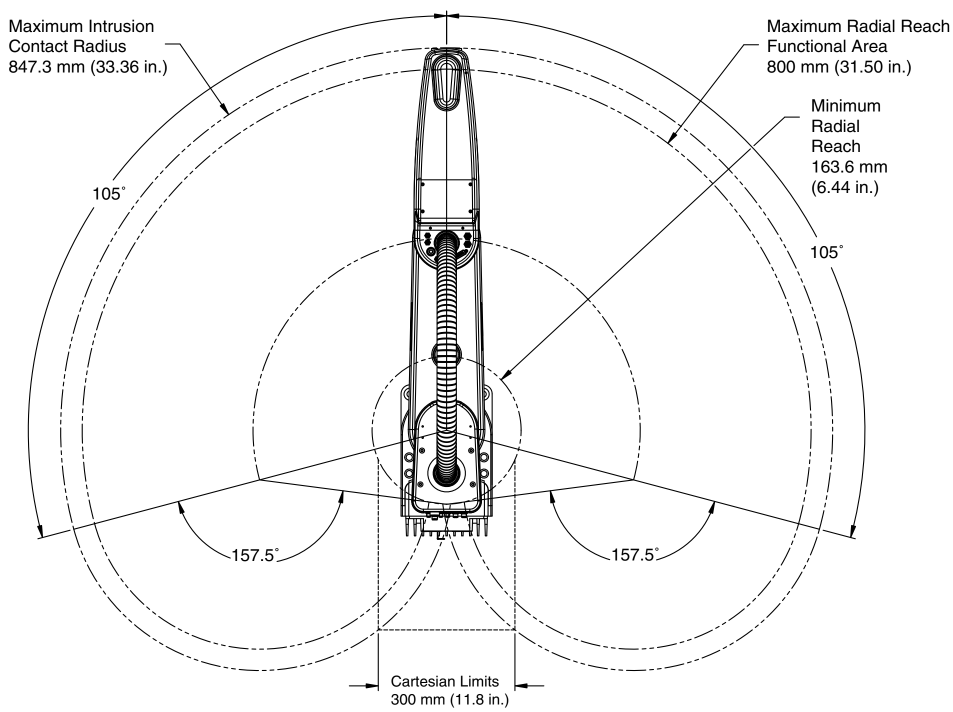


Figure 7-8. Adept Cobra s800 Robot Working Envelope

7.2 Cobra s600/s800 Robot Internal E-STOP Connections

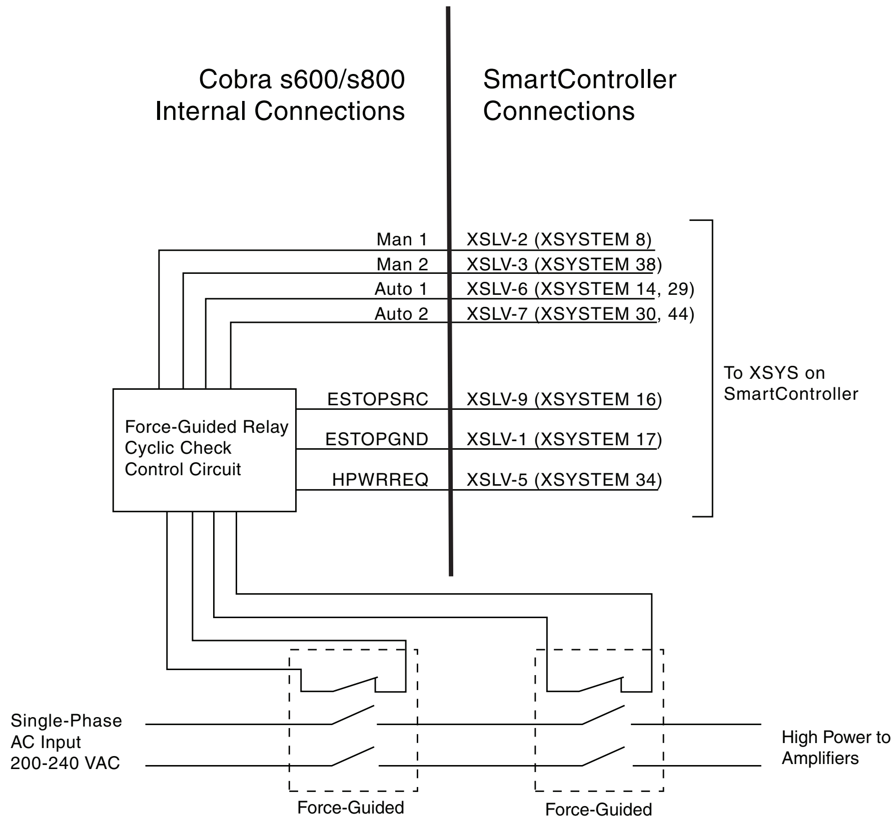


Figure 7-9. Internal E_STOP Connections Diagram

7.3 XSYS/XSYSTEM Connector

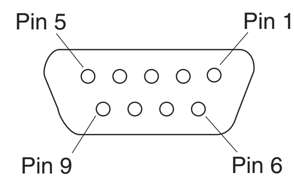
Table 7-1. XSYS to XSYSTEM Connector Pinout (eAIB only)

XSYS Pin #	XSYSTEM Pin #	Description	Comment	Pin Location
1	17	ESTOP_GND	E-Stop system Ground	
2	8	ENABLE_SW_1-		
3	38	ENABLE_SW_2-		
4	15	HPWR_DIS	High Power Disable	
5	34	HPWR_REQ		
6	14 & 29	MUTE_GATE_1-		
7	30 & 44	MUTE_GATE_2-		

XSYS Pin #	XSYSTEM Pin #	Description	Comment	Pin Location
8	N/C			
9	16	ESTOP_SRC	E-Stop System +24 V	
Shell	Shell	SHIELD		

7.4 XSLV Connector

Table 7-2. XSLV Connector Pinout (AIB only)

Pin #	Description	Comment	Pin Location
1	ESTOPGND	ESTOP System Ground	 XSLV1/2 Connector as viewed on Cobra
2	MAN1	ESTOP Manual Input Ch 1	
3	MAN2	ESTOP Manual Input Ch 2	
4	HIPWRDIS	High Power Disable	
5	ESTOP_RESET	Normally Closed Check Contacts	
6	AUTO1	ESTOP Auto Input Ch 1	
7	AUTO2	ESTOP Auto Input Ch 2	
8	N/C		
9	ESTOP_SRC	ESTOP System +24 V	
Mating Connector: AMP/Tyco #747904-2, 9-pin D-Sub AMP/Tyco #748676-1, D-Sub Cable Clamp			

7.5 Robot Specifications

Table 7-3. Adept Cobra s600/s800 Robot Specifications[a]

Description	s600 Robot	s800 Robot
Reach	600 mm (23.6 in)	800 mm (31.5 in)
Payload—rated	2.0 kg (4.4 lb)	2.0 kg (4.4 lb)
Payload—maximum	5.5 kg (12.1 lb)	5.5 kg (12.1 lb)
Moment of Inertia	Joint 4 - 450 kg-cm^2 (150 lb-in^2) - max	Joint 4 - 450 kg-cm^2 (150 lb-in^2) - max
Downward Push Force—Burst, (no load)	343 N (77 lb) - maximum	298 N (67 lb) - maximum
Lateral/Side Push Force—Burst	178 N (40 lb) - maximum	133 N (30 lb) - maximum

Description	s600 Robot	s800 Robot
Adept Cycle—Sustained (no J4 rotation)		
0 kg	0.42 sec at 20° C 0.48 sec at 40° C	0.48 sec at 20° C 0.51 sec at 40° C
2 kg	0.45 sec at 20° C 0.51 sec at 40° C	0.54 sec at 20° C 0.54 sec at 40° C
5.5 kg	0.58 sec at 20° C 0.64 sec at 40° C	0.70 sec at 20° C 0.70 sec at 40° C
Adept Cycle—Sustained (180° J4 rotation)		
0 kg	0.42 sec at 20° C 0.48 sec at 40° C	0.48 sec at 20° C 0.48 sec at 40° C
2 kg	0.45 sec at 20° C 0.51 sec at 40° C	0.54 sec at 20° C 0.61 sec at 40° C
5.5 kg	0.80 sec at 20° C 0.86 sec at 40° C	0.77 sec at 20° C 0.91 sec at 40° C
Repeatability		
X, Y	±0.017 mm (±0.00067 in.)	±0.017 mm (±0.00067 in.)
Z	±0.003 mm (±0.00012 in.)	±0.003 mm (±0.00012 in.)
Theta	±0.019°	±0.019°
Joint Range		
Joint 1	±105°	±105°
Joint 2	±150°	±157.5°
Joint 3	210 mm (8.3 in.)	210 mm (8.3 in.)
Joint 4	±360°	±360°
Joint Speed (maximum)		
Joint 1	386°/sec	386°/sec
Joint 2	720°/sec	720°/sec
Joint 3	1,100 mm/sec (43 in/sec)	1,100 mm/sec (43 in/sec)
Joint 4	1200°/sec	1200°/sec
Encoder type	Absolute	
Robot Brakes	Joints 1, 2, and 4: Dynamic	
	Joint 3: Electric	
Airline pass-through (quantity)	6 mm diameter (2), 4 mm diameter (3)	
Electrical pass-through	24 conductors (12 twisted pair)	

Description	s600 Robot	s800 Robot
DeviceNet pass-through	One available	
Weight (without options)	41 kg (90 lb)	43 kg (95 lb)
[a] Specifications subject to change without notice.		

Table 7-4. Softstop and Hardstop Specifications

Joint	Cobra s600		Cobra s800	
	Softstop	Hardstop – Approximate	Softstop	Hardstop – Approximate
Joint 1	± 105	± 108	± 105	± 108
Joint 2	± 150	± 151	± 157.5	± 160
Joint 3	0 to 210 mm	-5 to 215 mm	0 to 210 mm	-5 to 215 mm
Joint 4	± 360	not applicable	± 360	not applicable

Chapter 8: IP-65 Option

8.1 Cobra s800 IP-65 Classification

The factory installed IP-65 option kit provides an improved level of dust and water protection. IP-65 means "dust-tight and protection against water jetting."

- Dust Resistance—protection of the equipment inside the robot shell against ingress of solid foreign objects
- Specifically for IP-65 Dust Protection—"No ingress of dust is allowed."
- Water Resistance—protection of the equipment inside the robot shell against harmful effects due to the ingress of water
- Specifically for IP-65 Water Protection—"Water projected in jets against the robot enclosure from any direction shall have no harmful effects"

NOTE: The IP-65 Option is available only for the Cobra s800 robot.

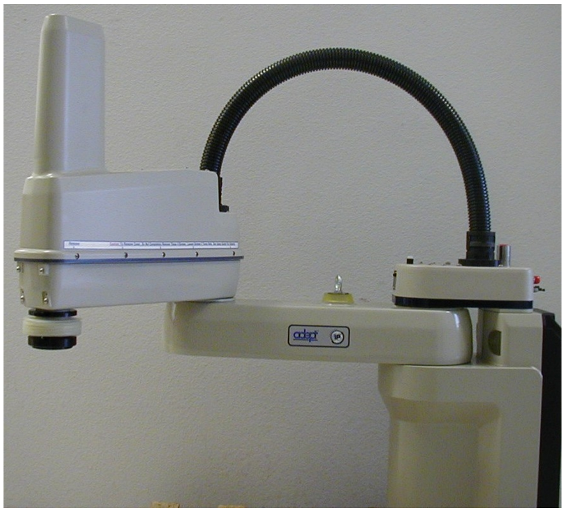


Figure 8-1. Adept Cobra s800 Robot—IP-65 Version

8.2 Installing Cable Seal Assembly

Cable Seal Identification

The cable seal assembly (04813-000) must be mounted on the back of the robot during the robot installation process. The cable seal assembly is shipped separately from the robot. See the following figure to identify the cable seal parts.

 Cable Seal Housing	

Figure 8-2. Cable Seal Parts

Installation Procedure

1. Disassemble the cable seal assembly into separate pieces by removing all screws.
2. Install the cable seal housing on the back of the robot using four M4x50 screws, four M4 lock washers, and four M4 flat washers. Note that the centered M6 threaded hole must be at the top. See the following figure.

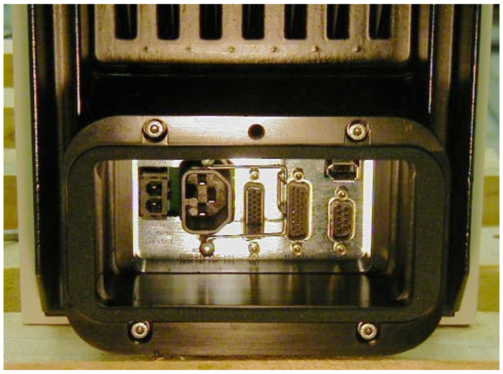


Figure 8-3. Cable Seal Housing Installed

3. Attach all system cables to the robot. See Figure 3-1.
4. Install the lower cable seal flange onto the housing. The lower flange fits into the groove at the bottom of the housing.
   a. Tilt the flange away from the robot as you install it—see Figure 8-4.
   b. Then pull up on the flange and push it toward the robot.

c. Finally push down on the flange to secure it against the housing. See Figure 8-5 for the lower flange in the installed position.

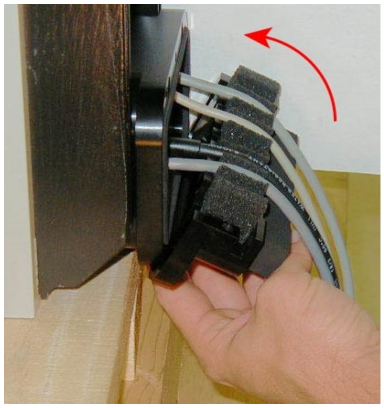


Figure 8-4. Installing Lower Flange

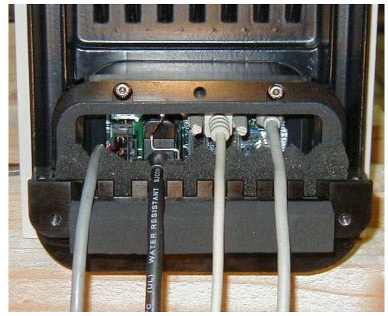


Figure 8-5. Lower Flange in Position

5. Seat all of the cables by pushing down into the foam on the lower flange.
6. Attach the upper flange to the lower flange using two M6 x 20 screws, two M6 lock washers, and two M6 flat washers. Make sure none of the cable are pinched or crimped when installing the upper flange.
7. Attach the flange assembly using one M6 x 20 screw, one M6 lock washer, and one M6 flat washer. See Figure 8-6.

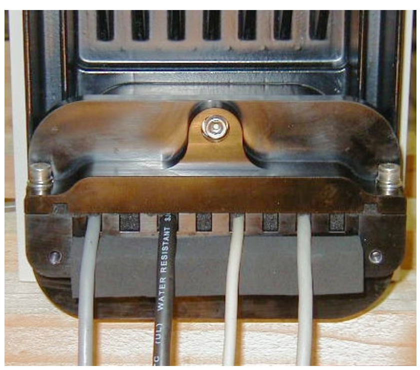


Figure 8-6. Upper Flange Installed

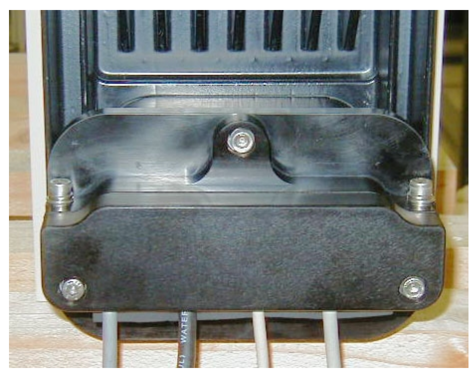


Figure 8-7. Splash Guard Installed

8. Install the splash guard using two M6 x 20 screws, two M6 lock washers, and two M6 flat washers. See Figure 8-7.

8.3 Robot Outer Link Cover Removal and Reinstallation

The robot outer link cover has special sealing hardware to ensure nothing can enter the inside of the robot. If you need to remove the outer link cover from the robot for any reason, please follow the procedures below.

Cover Removal Procedure

1. Turn off main power to the controller and power chassis.
2. Turn off the air supply to the robot. Clean the exterior of the outer link thoroughly to remove any dust or particles that might fall inside the robot when the cover is removed.
3. Unscrew the collar nut on the top of the outer link. See Figure 8-8.
4. Remove 2 screws and nylon washers on the top of the outer link.
5. Remove 2 screws (one on each side) at the front of the outer link. Make sure the O-ring on each screw stays in place and is not lost.
6. For the 8 screws along the side of the cover (4 on each side; see Figure 8-8), loosen only 1 to 2 turns, just enough to loosen the inside clamp nuts. You do not want to completely remove the screws. See the label on the side of the outer link cover.

CAUTION: Do not loosen these screws any more than 2 turns, because the special clamp nut on the inside of the cover might come loose and fall inside the robot.

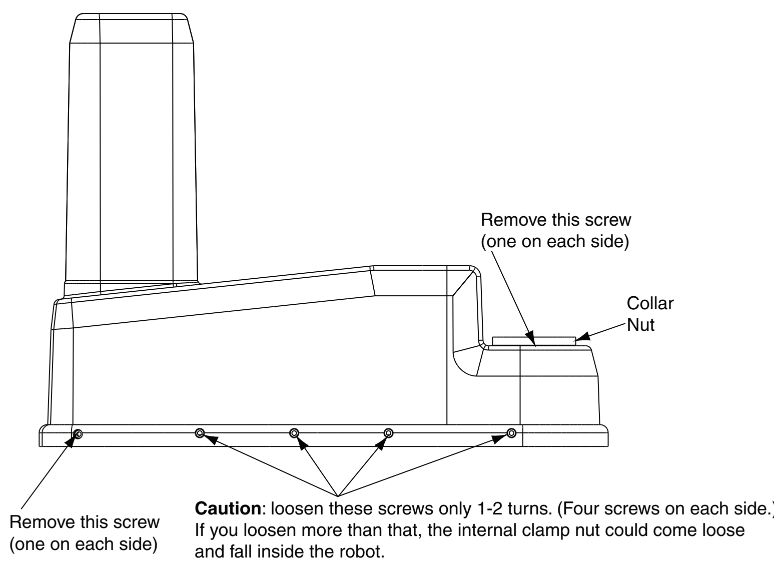


Figure 8-8. Cover Removal Instructions

7. When all 8 screws are loose (but not removed), lift the cover up and slide it back along the cable track and out of the way. Protect the cover with a soft cloth or other padding material so the cover does not get scratched. See Figure 8-9.

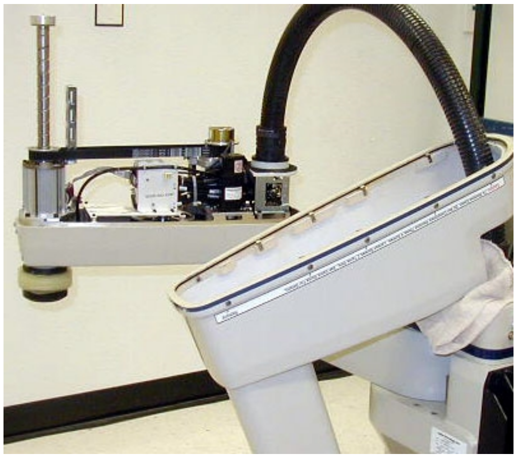


Figure 8-9. IP-65 Robot with Outer Link Cover Removed

Cover Reinstallation Procedure

1. Check the cover O-ring around the inner groove of the cover to make sure it is in place and not crimped when installing cover.
2. Hold the cover over the outer link and check to see that the clamp nuts attached to the 8 side screws are positioned so they will slip into place when the cover is lowered down onto the outer link.
3. Slowly lower the cover down onto the outer link, making sure the O-ring does not fall out or get pinched as the cover presses down to make the seal.

   NOTE: As you lower the cover down onto the outer link, make sure the 8 side screws are pushed all the way in, so the clamp nuts will slide into the correct position.

4. Reinstall the two screws and nylon washers at the top of the outer link and tighten to 5 in-lb (0.56 N-m).
5. Reinstall the 2 screws (check for O-ring on screw) near the front of the outer link and tighten to 10 in-lb (1.1 N-m).
6. Tighten the 8 side screws to 10 in-lb (1.1 N-m). Be careful to not over-tighten. Begin with the two screws (one on each side) at the back of the outer link, then move forward to the next two, and so on, until all eight are tightened. This pattern is recommended to achieve a balanced secure fit around the cover.
7. Reinstall the collar nut and tighten until secure.
8. Remember to turn on the compressed air supply to the system before restarting the robot.

8.4 Customer Requirements

The IP-65 robot provides most of the hardware needed to achieve an IP-65 protection level, but customers must provide a way of sealing the tool flange and pressurizing the robot through the compressed air attachment fitting (located at the top of the robot). These two requirements, sealing the tool flange and pressurizing the robot, are critical to achieving the IP-65 level of protection.

In addition, the robot must be inspected periodically to make sure these requirements are being met, as part of a periodic maintenance program.

Sealing the Tool Flange

The tool flange must be sealed so that the robot shell can be positively pressurized. The positive pressure reinforces the sealing properties of the gaskets and seals provided in the IP-65 robot.

The tool flange for the IP-65 robot has an additional protective shield on the outer edge that is not present on the standard robot tool flange. See Figure 8-10 for the side view dimensions. The bottom face of the flange (mounting surface) is the same as the standard flange, so the dimensions in Figure 7-4 are correct.

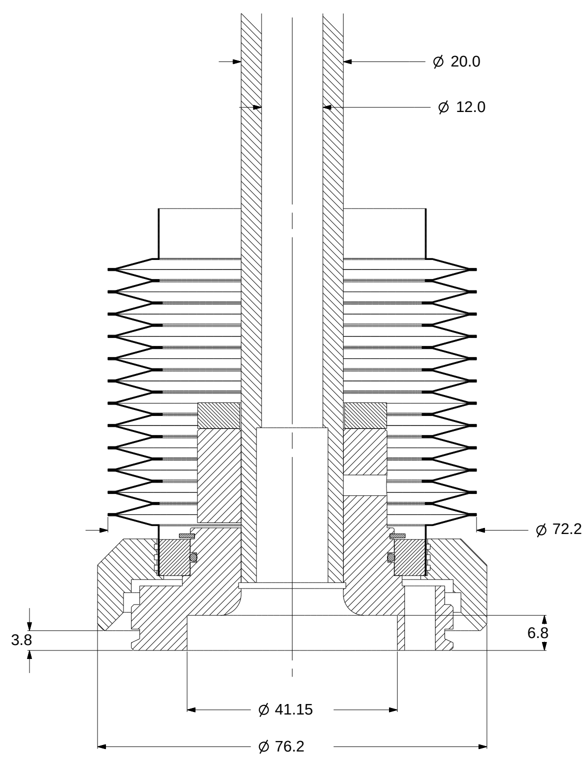


Figure 8-10. Cobra IP-65 Tool Flange

Pressurizing the Robot

The user must supply compressed air to keep a positive airflow pressure in the robot cavity.

1. Remove the red shipping plug from the compressed air fitting on the top of the robot. See the following figure.

Figure 8-11. Compressed Air Fitting on Robot

2. Connect a compressed air source to the air fitting. The specification for the regulated air supply is shown in the following table.

Table 8-1. Compressed Air Specifications

Required Air Pressure	Required Air Flow, Minimum
3 bar, ± 10% (44 PSI, ± 10%)	57 liters per minute (2 cubic feet per minute)

CAUTION: The compressed air supply must be **clean** and **dry** and it must be turned on continuously to maintain a positive air pressure inside the robot. Failure to do this could result in moisture or particle buildup inside the robot and lead to reduced performance or damage to the robot. This will also void your warranty.

8.5 User Connectors

User Electrical and DeviceNet

On the back of the Joint 1 cover, the user electrical, IO Blox, and DeviceNet connectors are filled with removable plugs at the factory. See Figure 1-12. If you use any of these connectors, you must provide a seal (see note below) at the connection to prevent moisture from entering the robot.

NOTE: The user electrical connector (DB-25) and the IO Blox connector (DB-9) on the back of the Joint 1 cover require a gel seal gasket to maintain an adequate seal. The gaskets are supplied in the accessory kit.

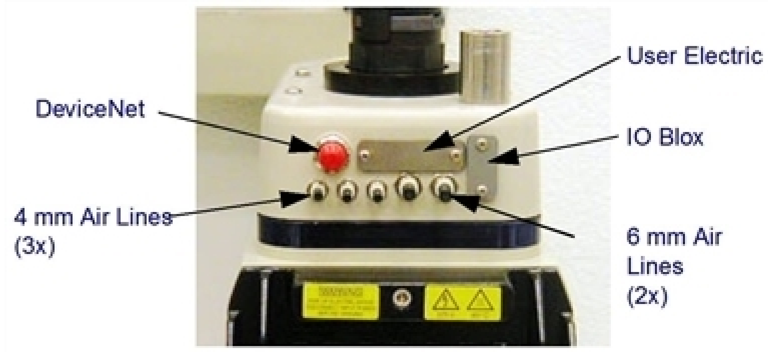


Figure 8-12. User Connectors on Joint 1 Cover

The user electrical and DeviceNet connectors on the outer link are accessible with the cover removed. See the following figure for locations of the internal connectors.

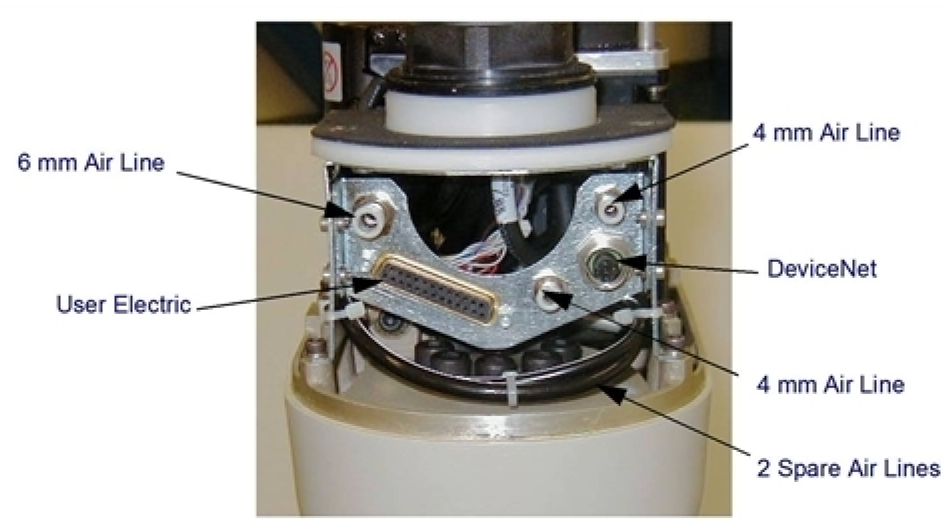


Figure 8-13. IP-65 Internal Connectors with Outer Link Cover Removed

User Air Lines

On the back of the Joint 1 cover, the user air line connectors are fitted with removable plugs at the factory. See Figure 8-12.

The user air line connectors on the outer link are accessible with the cover removed. See Figure 8-13 for locations of the internal connectors.

When routing air lines outside of the robot, any fittings you use must maintain an adequate seal in the cover to prevent moisture from entering the outer link.

CAUTION: Failure to prevent water intrusion through improperly-sealed external fittings could void your warranty.

Robot Solenoid Option

In an IP-65 robot, if you are installing the internally-mounted solenoid hand valves (Adept Option Kit P/N 02853-000), you must use a different air line than described in Installing the Robot Solenoid Kit on page 79.

The internal air line normally used to supply the solenoid manifold is instead used to provide positive airflow pressure to the bellows/outer link. You can use one of the passive 6 mm user air lines shown in Figure 8-12 and Figure 8-13.

8.6 Maintenance

IP-65 Bellows Replacement

Check the bellows, Adept P/N 04625-000, periodically for cracks, wear, or damage. Replace bellows, if necessary, using the procedure below.

1. Remove the lower bellows clamp by removing two M3 screws and pulling the clamp apart. See Figure 8-14.
2. Remove the tool flange. For the tool flange removal procedure, refer to Removing and Installing the Tool Flange on page 71.
3. Remove the upper bellows clamp by removing two M3 screws and pulling the clamp apart.
4. Slide the old bellows down off of the quill.
5. Install a new bellows by sliding it up onto the quill.
6. Re-install the upper bellows clamp. You must align mating surface of the clamp half-rings with the bellows seam—see Figure 8-15. Tighten the screw to secure the bellows.
7. Re-install the tool flange.
8. Place new gaskets in the lower bellows clamp—extra gaskets are shipped in the accessory kit. Then install the clamp over the bottom of the bellows, on the bearing ring just above the tool flange. Align the mating surfaces of the clamp half-rings with the bellows seam—see Figure 8-15. Tighten the screw to secure the clamp.

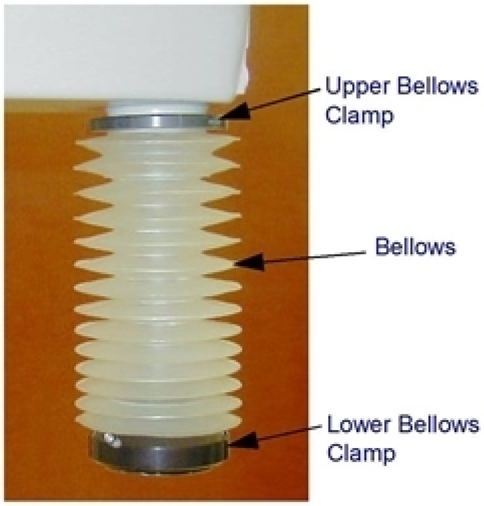


Figure 8-14. Bellows Replacement

NOTE: Align the bellows clamps with the bellows seam, on both upper and lower clamps.

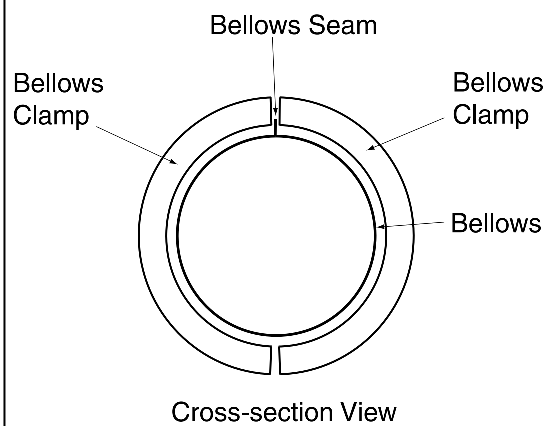


Figure 8-15. Bellows Clamp Alignment

8.7 Dimension Drawing for Cable Seal Assembly

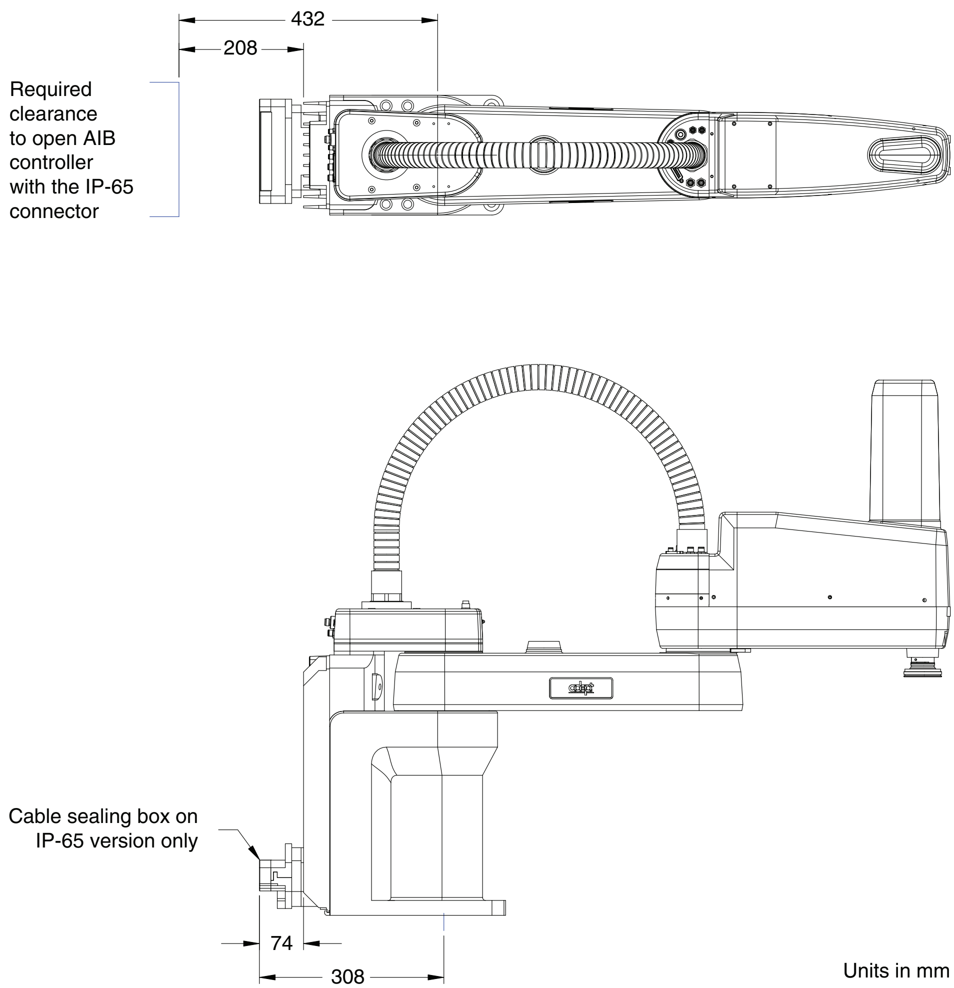


Figure 8-16. Cable Seal Assembly Dimensions

Chapter 9: Cleanroom Robots

The Adept Cobra s600/s800 robots are available in Class 10 Cleanroom models.

> **NOTE:** Class 1 Limits can be achieved by maintaining the robot speed at Speed 50 or below.

This option is a factory-installed configuration. Changes to the robot include the addition of a bellows assembly mounted at the Joint 3 quill, fully sealed access covers, and a two-stage vacuum system to evacuate the arm. This vacuum system incorporates a compressed air vacuum generator mounted in the base of the robot to provide a high vacuum in the outer link and bellows area. An additional high flow rate vacuum source is required to evacuate in the inner link and base.

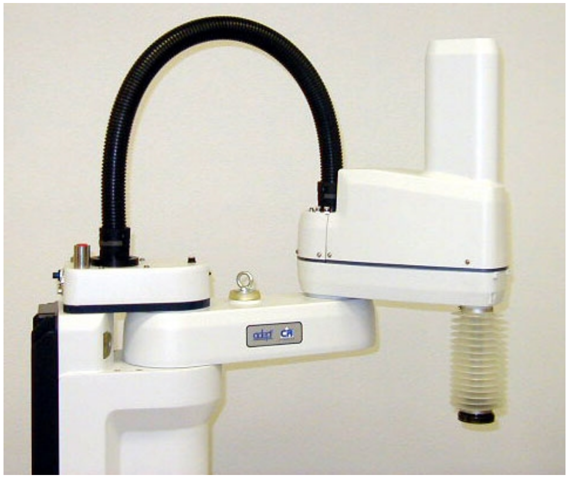


Figure 9-1. Adept Cobra s600 Cleanroom Robot

Cleanroom Specifications

Table 9-1. Adept Cobra Cleanroom Robot Specifications

Robot Performance Specification	See Robot Specifications on page 108.
Ambient Temperature Specification	5 to 35° C (41 to 95° F)

9.1 Connections

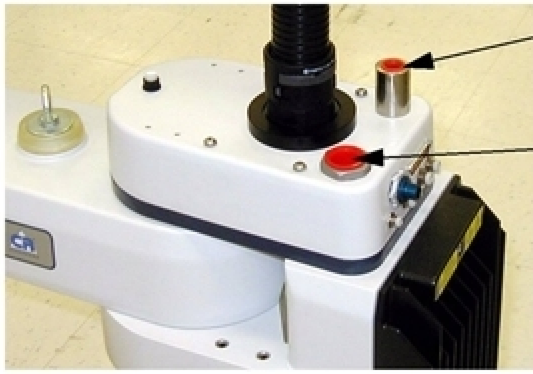


Figure 9-2. Cleanroom Connections

9.2 Requirements

Table 9-2. Cleanroom Robot Requirements

Vacuum source	0.80 m^3/min (28 ft^3/min) minimum volumetric flow rate
	6 mm of water (0.2 inches of water) differential pressure measured between the robot and the vacuum source
	3/4 inch NPT female thread pipe fitting at the back of the robot
Compressed air source	Clean, dry, oil-free compressed air
	75 psi (0.52 MPa)
	1.4 SCFM (.04 m^3/min.) flow rate
	3/8 inch NPT female thread pipe fitting at the back of the robot, flow regulator not supplied
Quill inside diameter	The inside diameter of the quill must be plugged by the user's end-effector in order for sufficient vacuum to develop in the outer link.

9.3 Exclusions and Incompatibilities

Table 9-3. Internally Mounted Hand Valves

Installation considerations	The internal air line normally used to supply the internally-mounted hand valves (Adept Option Kit P/N 02853-000) is instead used to provide vacuum to the bellows/outer link. One of the passive 6 mm user air lines would need to be used instead.
Performance considerations	The air exhausting from the internally-mounted hand valves (Adept Option Kit P/N 02853-000) may be of sufficient quantity/ quality to cause the robot to exceed Class 10 Particulate Limits.

Recommendation	For these reasons, Adept recommends mounting hand valves externally.

9.4 Cleanroom Maintenance

Bellows Replacement

Check the bellows periodically for cracks, wear, or damage. Replace bellows (Adept P/N 04625-000) if necessary, using the procedure below.

1. Remove the lower bellows clamp ring from the bearing ring by loosening the screw on the clamp. See Figure 9-3.
2. Remove the tool flange.

   For the tool flange removal procedure, refer to Removing and Installing the Tool Flange on page 71.
3. Remove the upper bellows clamp ring by loosening the screw on the clamp.
4. Slide the old bellows down off of the quill.
5. Install a new bellows, and reverse the steps listed above.

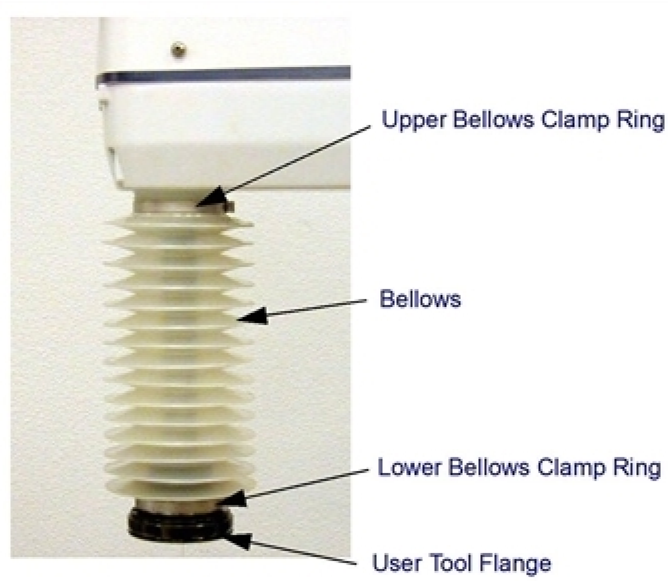


Figure 9-3. Cleanroom Bellows Replacement

Lubrication

The upper and lower quill requires lubrication in the same manner as the standard Cobra s600/s800 robots. See Lubricating Joint 3 on page 57.

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P/N: 03017-000, Rev L1