

## eCobra 600, 800 and 800 Inverted Robots

### User's Guide



I593-E-05

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## Revision History

Revision code	Date	Revised Content
01	June, 2016	Original release.
02	February, 2017	<ul style="list-style-type: none"> <li>• Fixed default signal #s when no SmartController EX is present</li> <li>• Updated Safety chapter, misc. regulatory.</li> <li>• Clarified text about eAIB's RS-232 port when using a SmartController EX.</li> </ul>
03	August, 2017	<ul style="list-style-type: none"> <li>• Clarified the use of "axis" and "joint".</li> <li>• Removed duplicate row in Chapter 8 table.</li> <li>• Minor clarifications to IP65 Option chapter to differentiate between upright and inverted robots.</li> </ul>
04	April, 2018	<ul style="list-style-type: none"> <li>• Updated safety chapter and alert levels throughout manual.</li> <li>• Updated recommended power supply part numbers, T20 part numbers, and XMCP jumper cable part numbers.</li> <li>• Error reporting and Line E-Stop clarification.</li> <li>• Update ACE software disk to ACE software media.</li> <li>• Corrected "SmartVision EX" to "SmartVision MX" in system cable drawing.</li> </ul>
05	March, 2019	<ul style="list-style-type: none"> <li>• Added WEEE Icon and Disposal section to Safety chapter.</li> <li>• Removed www.adept.com.</li> <li>• Added English condition to www.ia.omron.com.</li> <li>• Revised encoder battery replacement interval.</li> <li>• Updated Safety chapter.</li> <li>• Updated status code table in Chapter 5: Operation.</li> <li>• Updated illustrations with call-outs and tables for translation compatibility. Other minor illustration improvements applied.</li> <li>• Removed references to obsolete sDIO unit.</li> <li>• Corrections applied to Chapter 4: System Installation.</li> <li>• Added new figures to illustrate all encoder cable configurations and pinouts in Chapter 4: System Installation.</li> <li>• Removed Class 1 cleanroom note in Chapter 10: Cleanroom Robots.</li> <li>• Adjusted vacuum flow rates and air supply specifications for regular and inverted robots in Chapter 10: Cleanroom Robots.</li> <li>• Adjusted text in Emergency Stop Circuits section in Chapter 4: System Installation.</li> <li>• Added a note about typical IO Blox configurations in Chapter 5: System Operation.</li> <li>• Dual-Robot Configuration Guide renamed to Single and Multiple Robot Configuration Guide.</li> </ul>



# Chapter 1: Introduction

## 1.1 Product Description

eCobra robots are four-joint SCARA industrial robots (Selective Compliance Assembly Robot Arm). Joints 1, 2, and 4 are rotational, Joint 3 is translational. See Figure 1-2.

**NOTE:** The descriptions and instructions in this manual apply to the eCobra 600, eCobra 800, and eCobra 800 Inverted robots. When there are differences, such as in dimensions and work envelopes, the different models will be covered separately.



*Figure 1-1. eCobra 800 Robot*

By adding a SmartController EX or a PLC, the eCobra series robots replace the previous sCobra and Cobra ePLC series robots, so this manual replaces previous eCobra, sCobra, and Cobra ePLC User Guides.

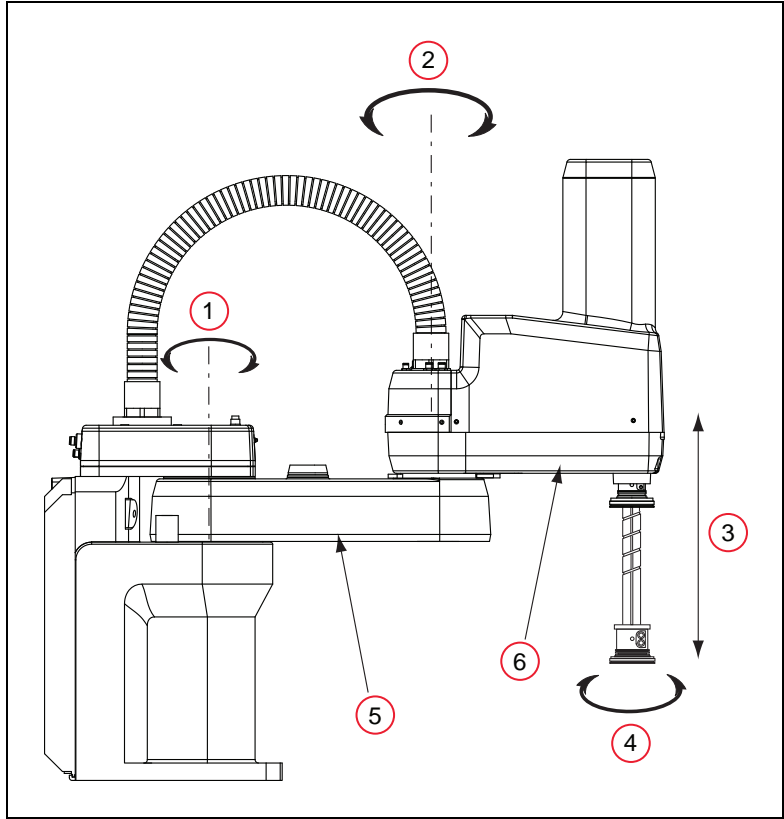


Figure 1-2. Robot Joint Motions - eCobra 600 Robot Shown

Table 1-1. Robot Joint Descriptions

Item	Description
1	Joint 1
2	Joint 2
3	Joint 3
4	Joint 4
5	Inner Link
6	Outer Link

### eCobra Robot Models

There are three tiers of eCobra robots, with 600 and 800 mm upright models and an 800 mm Inverted robot in each tier. In increasing order of performance and features, they are:

- eCobra Lite
- eCobra Standard
- eCobra Pro

eCobra robots of any given size and orientation are identical physically for each of the three tiers. The Pro models offer the fastest performance and the most features and connectivity. The Lite models offer the least. All nine models are covered in this manual.

All eCobra robots will typically be connected to a user-supplied PC running the ACE software.

eCobra robots can optionally be used with a SmartController EX motion controller, if more features and connectivity are needed. A SmartVision MX industrial PC can be added for more vision support. The eCobra Standard and eCobra Pro robots can be used with a user-supplied PLC and the ePLC Connect software option.

## eAIB (Amplifiers in Base)

eCobra robots use an eAIB amplifier. The robots are programmed and controlled using the eAIB. The eAIB, embedded in the robot's base, contains the amplifiers and full servo control for the eCobra robots. The eAIB also provides the platform for running the eV+ OS and language.

### eAIB Features

- 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
- Hardware-based E-Stop and Teach Restrict controls

For improved safety relative to European standards implemented in 2012

The eAIB fits all eCobra robots.

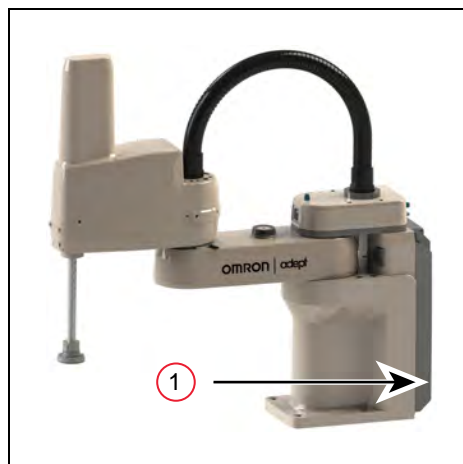


Figure 1-3. (1) eAIB Amplifier on eCobra Robot

## 1.2 eCobra Robot Features And Options

The eAIB controller provides varying levels of vision support and connectivity. Some applications might call for more, in which case you could add a SmartController EX and/or a SmartVision MX industrial PC.

Feature	eCobra Lite	eCobra Standard	eCobra Pro	SmartController EX Option
Vision	-	Yes	Yes	-
on-the-fly	-	-	Yes	-
I/O - max <sup>2</sup>	12/8	44/40	76/72	524/520
XIO	12/8	12/8	12/8	eAIB + 12/8
IEEE 1394	2	2	2	eAIB + 3
IO Blox option	-	8/8 x max 4	8/8 x max 8	-
RS-422/485	-	-	-	1
RS-232	-	1 <sup>1</sup>	1 <sup>1</sup>	3
DeviceNet	-	-	-	Option
Conveyors tracked	-	-	2 <sup>1</sup>	4
PLC support	-	Yes	Yes	-
ePLC I/O	-	-	Yes	-
PackXpert	-	Yes	Yes	Yes
Force Sensing	-	Yes <sup>1</sup>	Yes <sup>1</sup>	-
T20 Pendant option	Yes	Yes	Yes	n/a
IP65 option	Yes	Yes	Yes	n/a
Cleanroom option	Yes	Yes	Yes	n/a
Max Robots	1	1	1	4
Dual Robots	-	-	-	Yes
Max Joints	4	4	4	16
Pass-through, J1 to J2	5 air 24 user electric 1 DeviceNet	5 air 24 user electric 1 DeviceNet	5 air 24 user electric 1 DeviceNet	-
<p><sup>1</sup> Requires eAIB XBELT IO Adapter cable.</p> <p><sup>2</sup> More I/O can be attained using DeviceNet and combinations of RS- ports, if needed.</p>				

## SmartController EX

The SmartController EX motion controller can coordinate up to 4 robots, increasing the number of robot joints to 16 from the eCobra's 4. It increases the I/O available, raises the number of serial ports by 3, and provides for tracking up to 4 additional conveyors.

**NOTE:** Since the eAIB has only one RS-232 port, adding a SmartController EX to the RS-232 port renders the port unusable. If using eV+, "SERIAL:0" will access the eAIB's RS-232 port.

The SmartController EX supports the DeviceNet option, and allows for the use of third-party vision systems. One RS-485 port is available.

The SmartController EX is covered in the *SmartController EX User's Guide*.

## ePLC Connect Software

The ePLC Connect software allows programming and operation of an eCobra robot directly from a PLC, using the software as an interface between the PLC and the robot. Refer to *ePLC Connect 3.0 Software User's Guide*.

## IO Blox

Up to 8 IO Blox units can be added to increase the available I/O ports by 8 inputs and 8 outputs per unit. The IO Blox does not require a SmartController EX. Refer to the *IO Blox User's Guide*.

## SmartVision MX

The SmartVision MX is an industrial PC that provides vision-oriented connectivity, as well as extra I/O. It can drive up to 4 Gigabit and 4 USB 3.0 cameras. The Gigabit ports are PoE, so no extra power is needed to the cameras. Refer to the *SmartVision MX User's Guide*.

## T20 Pendant

The T20 pendant provides manual control of an eCobra robot. This is generally used when teaching pick and place locations. Refer to the *T20 Pendant User's Guide*.

**NOTE:** Omron Adept Technologies, Inc. does not offer a cableless (wireless) pendant.

## Intelligent Force Sensing

The Intelligent Force Sensing system is a hardware and software package that allows eCobra robots to react to sensed forces and moments at the tool flange, reducing force overshoot and stopping time when forces or moments exceed preset thresholds. Refer to the *Intelligent Force Sensing System User's Guide*.

## ACE PackXpert Process Manager

PackXpert provides a point-and-click interface for configuring and programming the workcell. The PackXpert Process Manager is the recommended method for programming most applications. Refer to the *ACE User's Guide*.

## 1.3 How Can I Get Help?

Refer to the corporate website:

<http://www.ia.omron.com>

### Related Manuals

This manual covers the installation, operation, and maintenance of an eCobra 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
<i>Robot Safety Guide</i>	Contains safety information for robots.
<i>ACE User's Guide</i>	Instruction for the use of the ACE software.
<i>SmartController EX User's Guide</i>	Instructions for use of the optional SmartController EX motion controller.
<i>SmartVision MX User's Guide</i>	Instructions for use of the optional SmartVision MX industrial PC.
<i>T20 Pendant User's Guide</i>	Describes the use of the optional T20 manual control pendant.
<i>IO Blox User's Guide</i>	Describes the IO Blox product.
<i>Single and Multiple Robot Configuration Guide</i>	Contains cable diagrams and configuration procedures for a single and multi-robot system.



## 2.1 Dangers, Warnings, and Cautions

### Alert Levels

There are three levels of alert notation used in our manuals. In descending order of importance, they are:



**DANGER:** Identifies an imminently hazardous situation which, if not avoided, is likely to result in serious injury, and might result in fatality or severe property damage.



**WARNING:** Identifies a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, and might result in serious injury, fatality, or significant property damage.



**CAUTION:** Identifies a potentially hazardous situation which, if not avoided, might result in minor injury, moderate injury, or property damage.

### Alert Icons

The icon that starts each alert can be used to indicate the type of hazard. These will be used with the appropriate signal word - Danger, Warning, or Caution - to indicate the severity of the hazard. The text following the signal word will specify what the risk is, and how to avoid it.

Icon	Meaning	Icon	Meaning
	This is a generic alert icon. Any specifics on the risk will be in the text following the signal word.		This identifies a hazardous electrical situation.

### Falling Hazards



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**  
If mounted incorrectly, the robot can fall over and cause serious injury to personnel or damage to itself or other equipment.

### Safety Barriers

To protect personnel from coming in contact with robot unintentionally or objects entering robot's operation zone, install user-supplied safety barriers in the workcell.

### Special Information

There are several types of notation used to call out special information.

**IMPORTANT:** Information to ensure safe use of the product.

**NOTE:** Information for more effective use of the product.

**Additional Information:** Offers helpful tips, recommendations, and best practices.

**Version Information:** Information on differences in specifications for different versions of hardware or software.

## 2.2 What to Do in an Emergency/Abnormal Situation

Press any E-Stop button (a red push-button on a yellow background) and then follow the internal procedures of your company or organization for an emergency situation. If a fire occurs, use a type D extinguisher: foam, dry chemical, or CO<sub>2</sub>.

### Releasing the Brakes

In case of entrapment of a person by the robot, or any other emergency of abnormal situation, the robot can be manually moved to a safe state without high voltage electric power. However only qualified personnel who have read and understood this manual and the Robot Safety Guide should manually move the robot. See Brake Release Button on page 80.



**WARNING: PERSONAL INJURY RISK**

eCobras are not collaborative robots. They require a dedicated work area that will prevent personnel from coming into contact with them during operation.

### Releasing an E-Stop



**CAUTION: PERSONAL INJURY OR PROPERTY DAMAGE RISK**

If the robot's E-Stop is triggered, ensure that the cause of the E-Stop is resolved, and all surrounding areas are clear before releasing the E-Stop.

After the E-Stop button has been manually released, the robot will wait until the motors are manually enabled.

There are two ways to enable the motors:

- Enable power through ACE software installed on your PC.
- Press the ROBOT POWER button on the Pendant.

Once the motors are enabled, the robot will wait two seconds and then resume commanded motion, if there is adequate space to maneuver.

## Emergency Stop Circuit and Buttons

The E-Stop provided complies with ISO 10218-1 (Clause 5.5.2), with stop category 1 (per IEC 60204). The E-stop button complies with ISO 13850. The E-Stop meets the requirements of PL-d per ISO 13849.

If you design your own front panel, it must meet the requirements of ISO 13849, and be at least PL-d. The E-Stop button must comply with IEC 60204-1 and ISO 13850, Clause 5.5.2.

If you choose to use your own E-Stop buttons, they must meet the requirements of IEC 60204-1 and ISO 13850, Clause 5.5.2.

## General Hazards

**IMPORTANT:** The following situations could result in injury or damage to the equipment.

- Do not place objects on the robot.
- Do not exceed the maximum payload capacity.
- Do not exceed the maximum recommended moment of Inertia, speed, and rotation limits. See Technical Specifications on page 153.
- Do not drop the robot, put weights on it or otherwise operate it irresponsibly.
- Do not use unauthorized parts.

## 2.3 Safety Precautions



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**  
An eCobra robot can cause serious injury or death, or damage to itself and other equipment, if the safety precautions in this manual are not observed.



**WARNING: ELECTROCUTION RISK**  
During maintenance, disconnect AC power from the robot, and install a lock-out tag-out to prevent anyone from reconnecting power.

## User's Responsibilities

Safe use of the eCobra robot is your responsibility. To ensure compliance with safety rules and regulations:

- All personnel who install, operate, teach, program, or maintain an eCobra robot system must read this guide, read the Robot Safety Guide, and complete a training course for their responsibilities in regard to the robot.

- All personnel who design an eCobra robot system must read this guide, read the Robot Safety Guide, and must comply with all local and national safety regulations for the location in which the robot is installed.



Figure 2-1. Read Manual and Impact Warning Labels

- The eCobra robot system must not be used for purposes other than described in Intended Use on page 21. Contact Omron Adept Technologies, Inc. if you are not sure of the suitability for your application.
- The environment must be suitable for safe operation of the robot.
- 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.
- The eCobra Robots must be well maintained, so that their control and safety functions continue to work properly.

### Qualification of Personnel

It is the end-user's responsibility to ensure that all personnel who will work with or around robots have attended an appropriate Omron training course and have a working knowledge of the system. The user must provide the necessary additional training for all personnel who will be working with the system.

As noted in this and the Robot Safety Guide, certain procedures should be performed only by skilled or instructed persons. For a description of the level of qualification, we use the standard terms:

- **Skilled persons** have technical knowledge or sufficient experience to enable them to avoid the dangers, electrical and/or mechanical
- **Instructed persons** are adequately advised or supervised by skilled persons to enable them to avoid the dangers, electrical and/or mechanical

All personnel must observe industry-prescribed safety practices during the installation, operation, and testing of all electrically-powered equipment.

**IMPORTANT:** Before working with the robot, every entrusted person must confirm that they:

- Have the necessary qualifications
- Have received the guides (both this user's guide, and the Robot Safety Guide)

- Have read the guides
- Understand the guides
- Will work in the manner specified by the guides

## 2.4 Robot Behavior

### Hardstops

If the eCobra Robot runs into one of its hardstops, the robot's motion will stop completely, an envelope error will be generated, and power will be cut to the robot motors. The robot cannot continue to move after hitting a hardstop until the error has been cleared.

The eCobra's hardstops are capable of completely stopping the robot at any speed, load, and maximum or minimum extension.

### Limiting Devices

There are no dynamic or electro-mechanical limiting devices provided by Omron Adept Technologies, Inc. The robot does not have safety-rated soft axis or space limiting.

However, the user can install their own safety rated (category 0 or 1) dynamic limiting devices if needed, that comply with ISO 10218-1, Clause 5.12.2.

### Singularities

No singularities exist that cause a hazardous situation with an eCobra robot.

## 2.5 Intended and Non-intended Use

### Intended Use

The normal and intended use of these robots does not create hazards. The eCobra robots have been designed and constructed in accordance with the relevant requirements of IEC 60204-1.

The eCobra 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 166 for complete information on the robot specifications. Refer to the Robot Safety Guide for details on the intended use of eCobra robots.



#### **WARNING: PERSONAL INJURY RISK**

eCobra robots are not collaborative robots. They require a dedicated work area that will prevent personnel from coming into contact with them during operation.

#### **Guidelines for safe use:**

- Clean, dry mounting surfaces — surfaces that are routinely kept free of debris and liquids.

- Temperature — 5 to 40°C (41 to 104°F), with a recommended humidity range of 5% to 90%, non-condensing.

### Non-Intended Use

The eCobra robots are not intended for use in any of the following situations:

- Use in the presence of ionizing or non-ionizing radiation
- Use in potentially explosive atmospheres
- Use in medical or life saving applications
- Use in a residential setting. They are for industrial use only
- Use before performing a risk assessment
- Where the equipment will be subject to extremes of heat or humidity

**IMPORTANT:** The instructions for operation, installation, and maintenance given in this guide and Robot Safety Guide must be strictly observed.

Non-intended use of eCobra robots can:

- Cause injury to personnel
- Damage itself or other equipment
- Reduce system reliability and performance

If there is any doubt concerning the application, ask your your local Omron support to determine if it is an intended use or not.

### Robot Modifications

If the user or integrator makes any changes to the robot, it is their responsibility to ensure that there are no sharp edges, corners, or protrusions.

Note that any change to the robot can lead to loss in safety or functionality. The user or integrator must ensure that all safety features are operational after modifications.

## 2.6 Additional Safety Information

Contact your local Omron support for other sources of safety information:

### Manufacturer's Declaration of Incorporation

This lists all standards with which the robot complies. The Manufacturer's Declarations for the eCobra robot and other products are in the *Manufacturer's Declarations*.

## Robot Safety Guide

The Robot Safety Guide, which ships with every robot system, provides detailed information on safety for Omron Adept Technologies, Inc. robots. It also gives resources for information on relevant standards.

## T20 Manual Control Pendant (Option)

The protective stop category for the pendant enable switch is category 1, which complies with the requirements of ISO 10218-1. The pendant is designed in accordance with the requirements of IEC 60204-1 and ISO 13849. The E-Stop button is ISO 13850 compliant.

**NOTE:** Omron Adept Technologies, Inc. does not offer a cableless (wireless) pendant.

The manual control pendant can only move one robot at a time, even if multiple robots are connected to a SmartController EX, and the pendant is connected to the SmartController EX.

## Disposal



Dispose of in accordance with applicable regulations.

Customers can contribute to resource conservation and protecting the environment by the proper disposal of WEEE (Waste Electronics and Electrical Equipment). All electrical and electronic products should be disposed of separately from the municipal waste system via designation collection facilities. For information about disposal of your old equipment, contact your local Omron support.





# Chapter 3: Robot Installation

## 3.1 Installation Overview

The system installation process is summarized in the following table.

**NOTE:** For multi-robot installations, see the *Single and Multiple Robot Configuration Guide*.

Table 3-1. Installation Overview

Task to be Performed	Reference Location
Mount the robot to a flat, secure mounting surface.	See Mounting an Upright eCobra Robot on page 27 or Mounting an eCobra 800 Inverted Robot on page 30.
Install the Front Panel, pendant, and ACE software. The pendant is an option.	See System Installation on page 35.
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 50.
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 54.
Install user-supplied safety barriers in the workcell.	See Installing User-Supplied Safety Equipment on page 62.
Learn about connecting digital I/O through the XIO connector on the eAIB.	See eAIB XIO Connector Signals on page 86.
Learn about starting the system for the first time.	See Starting the System for the First Time on page 94.
Learn about installing optional equipment, including end-effectors, user air and electrical lines, external equipment, solenoids, etc.	See Optional Equipment Installation on page 123.

## 3.2 Transport and Storage

This equipment must be shipped and stored in a temperature-controlled environment, within the range  $-25$  to  $+60^{\circ}$  C ( $-13$  to  $+140^{\circ}$  F). The recommended humidity range is 5% to 90%, non-condensing. It should be shipped and stored in the supplied crate, which is designed to prevent damage from normal shock and vibration. You should protect the crate from excessive shock and vibration.

Use a forklift or pallet jack to transport the packaged equipment. See Figure 3-1.

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 non-upright position; this could damage the robot.

The eCobra 600 robot weighs 41 kg (90 lb), the eCobra 800 robot weighs 43 kg (95 lb), and the eCobra 800 Inverted weighs 51 kg (112 lb), all with no options installed.

## 3.3 Unpacking and Inspecting the 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 Omron Adept Technologies, Inc. as soon as possible.
- If the items received do not match your order, please contact Omron Adept Technologies, Inc. immediately.

Inspect each item for external damage as it is removed from its container. If any damage is evident, contact Omron Adept Technologies, Inc.. See How Can I Get Help? on page 16.

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

## 3.4 Repacking for Relocation

If the robot or other equipment needs to be relocated, reverse the steps in the installation procedures that follow. 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: PROPERTY DAMAGE RISK**

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.

### 3.5 Environmental and Facility Requirements

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

Table 3-2. Robot System Operating Environment Requirements

Ambient temperature	5 to 40° C (41 to 104° F)
Shipping/storage temperature	-25 to 55° C (-13 to 131° F)
Humidity	5% to 90%, non-condensing
Altitude	up to 2000 m (6500 ft)
Pollution degree	2
Robot protection class	IP20 (NEMA Type 1)
IP65 Versions	IP65
Cleanroom rating, cleanroom models only	ISO 4, Fed Reg Class 10
<b>NOTE:</b> For robot dimensions, see Dimension Drawings on page 153.	

### 3.6 Mounting an Upright eCobra Robot

This section applies to the eCobra 600 and eCobra 800 robots, but not the eCobra 800 Inverted robot.

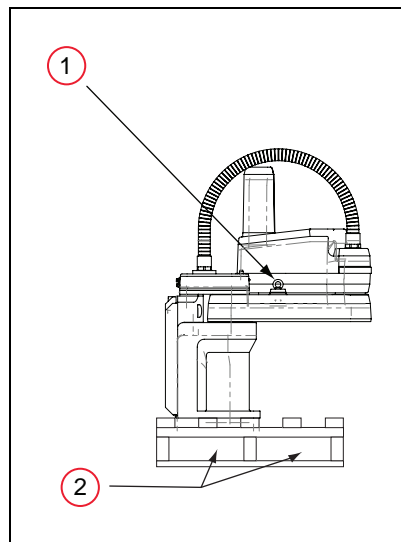


Figure 3-1. eCobra 800 Robot on a Transportation Pallet

Table 3-3. Lifting Points for Robot while on a Transportation Pallet

Item	Description
1	Eyebolt for lifting robot after robot has been unbolted from the transportation pallet.
2	Place for forklift or pallet-jack here.



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**  
Only qualified service personnel may install or service the robot system.

### Mounting Surface

The upright eCobra robots are designed to be mounted on a smooth, flat, level surface. The mounting structure must be rigid enough to prevent vibration and flexing during robot operation. We recommend 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 eCobra 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 will improve the ability to remove and reinstall the robot in the same position.

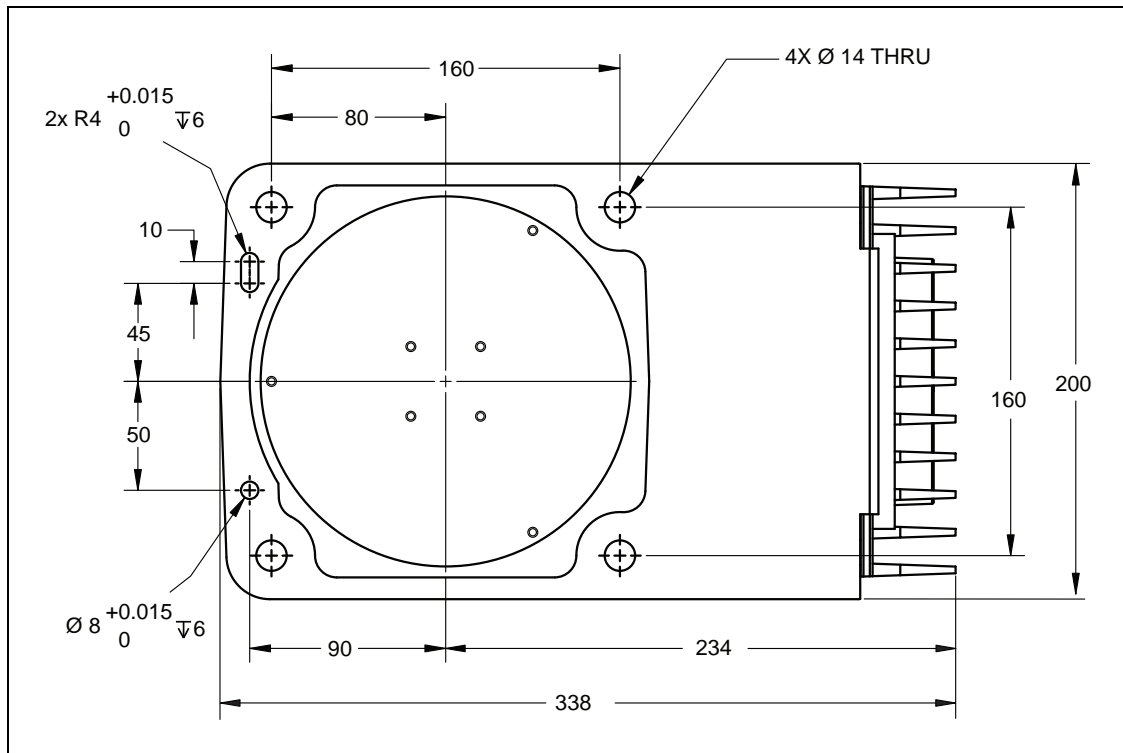


Figure 3-2. Mounting Hole Pattern for Upright eCobra Robots (Units in mm)

## Mounting Procedure

- 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 (mounting hardware is user-supplied).
- If you are using dowel pins for locating the robot, insert those in the mounting surface.
- While the robot is still bolted to the transportation pallet, connect a hydraulic lift to the eyebolt at the top of the inner link. See Figure 3-1.



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**  
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.

- Remove the four bolts securing the robot base to the pallet.  
Retain these bolts for possible later relocation of the equipment.
- Lift the robot and position it directly over the mounting surface.
- Slowly lower the robot while aligning the base and the tapped 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.

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



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**  
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 99 for periodic maintenance.

*Table 3-4. Mounting Bolt Torque Specifications*

Standard	Size	Specification	Torque
Metric	M12 x 1.75	ISO Property Class 8.8	85 N·m
SAE	7/16-14 UNC	SAE J429 Grade 5 or ASTM A449	65 ft-lb

## 3.7 Mounting an eCobra 800 Inverted Robot

### Mounting Surface

The eCobra 800 Inverted robot is designed to be mounted in an inverted position. When designing the mounting structure, you must account for both load and stiffness. The mounting structure must be rigid enough to prevent vibration and flexing during robot operation. Excessive vibration or mounting flexure will degrade robot performance. The mounting structure should be stiff enough so that the first vibration mode is greater than 70 Hz.

The following figure shows the mounting hole pattern.

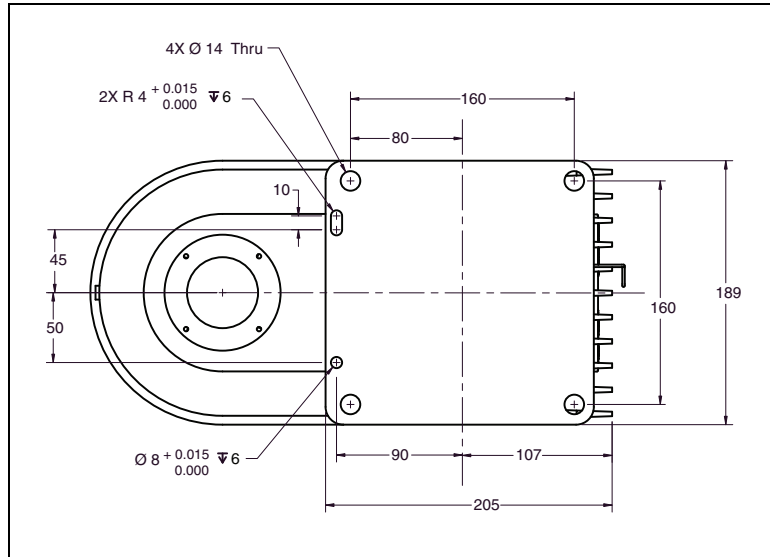


Figure 3-3. Robot Mounting Dimensions for eCobra Inverted Robot (Units in mm)

**NOTE:** On the robot mounting surface, there is a hole and a slot that can be used as locating points for user-installed dowel pins in the mounting surface. Using locating pins can improve the ability to remove and reinstall the robot in the same position.

### Mounting Procedure

- Always use at least two people, and preferably three, to mount the robot.
- The robot should be in the folded position when lifting. See the following figure.

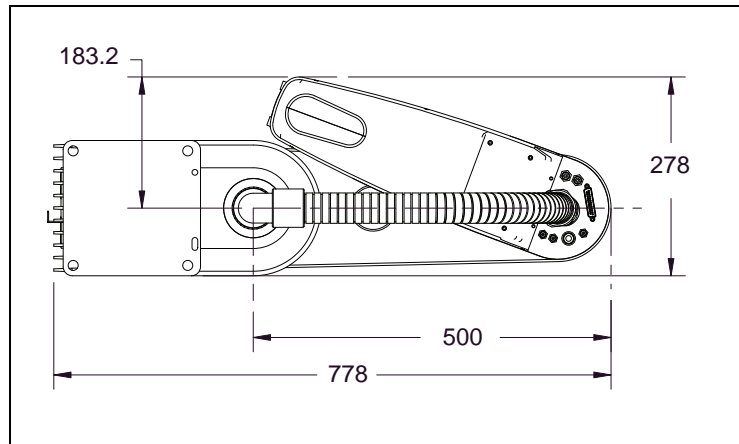


Figure 3-4. Robot in Folded Position (Units in mm)



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**

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.

1. Using the dimensions shown in Figure 3-3. , 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 (mounting hardware is user-supplied).
2. If you are using dowel pins for locating the robot, insert those in the mounting surface.
3. Remove the four screws on top of the wooden robot base protection box. See Figure 3-5.
  - Remove the robot base protection box.
  - Retain the four screws and box for possible later relocation of the equipment.

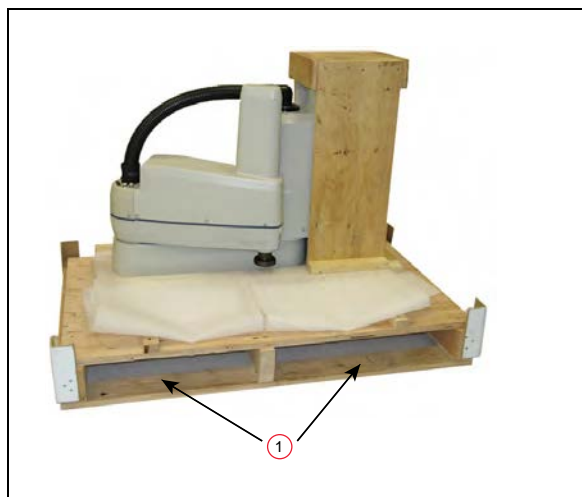


Figure 3-5. Pallet Lifting Device (1) Insertion Point

4. While the robot is still bolted to the transportation pallet, use a forklift or other mechanical lifting device to lift the robot and position it directly under the mounting surface. Make sure that one person watches the robot carefully as it is lifted and transported, to ensure it does not slip or become unbalanced.



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**  
The center of mass of the robot may cause the robot to fall over if the robot is not secured to the pallet.

5. Slowly lift the robot while aligning the base and the tapped mounting holes in the mounting surface.
6. Install, but do not tighten, the user-supplied mounting bolts and washers.



**CAUTION: PROPERTY DAMAGE RISK**  
The base casting of the robot is aluminum and can easily be dented if bumped against a harder surface.

**NOTE:** Verify that the robot is mounted squarely (will not rock back and forth) before tightening the mounting bolts.

7. Remove the bolts securing the robot to the pallet.
  - Retain these bolts for possible later relocation of the equipment.
  - Move the pallet out of the way.
8. Tighten the mounting bolts to the torque specified.

*Table 3-5. Mounting Bolt Torque Specifications*

Standard	Size	Specification	Torque
Metric	M12 x 1.75	ISO Property Class 8.8	85 N·m
SAE	7/16-14 UNC	SAE J429 Grade 5 or ASTM A449	65 ft-lbf

**NOTE:** Check the tightness of the mounting bolts one week after installation, and then recheck every 6 months. See Maintenance on page 99 for periodic maintenance.

### 3.8 Mounting the Front Panel

The Front Panel must be installed outside of the workspace.

**NOTE:** European standards require that the remote High Power push-button be located outside of the workspace of the robot.



### 3.9 Connectors on Robot Interface Panel (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. The cable is user-supplied.

**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 eAIB XIO Connector Signals on page 86. That section also contains signal numbers to access these I/O signals via eV+.

**XBELTIO** — (this is not supported on eCobra Lite robots) adds two belt encoders (Pro only), an RS-232 interface, and either Intelligent Force Sensing or IO Blox support. This requires the eAIB XBELT IO Adapter cable.

**SmartServo x2** (IEEE 1394) — for connecting the IEEE 1394 cable from an optional controller to the robot. The servo connectors can also be used to connect to a second robot or another 1394-based motion axis.

**XSYSTEM** — The Front Panel, optional T20 pendant, and XUSR cable connect here. This uses the eAIB XSYSTEM cable. See System Cables, without SmartController EX on page 35.

If you are using an optional SmartController EX, it uses the eAIB XSYS cable, instead of this cable, and the Front Panel and T20 pendant connect to the SmartController EX.

**ENET** — Two Ethernet ports are available. One will be needed to connect to a PC running ACE software or a user-supplied PLC.

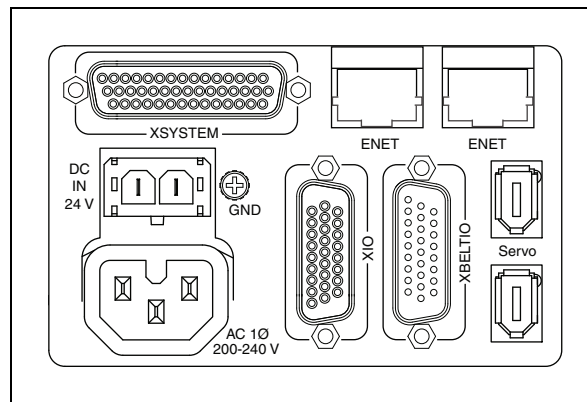


Figure 3-6. Robot Interface Panel



# Chapter 4: System Installation

This chapter does not cover I/O. Refer to Connecting Digital I/O to the System on page 83.

## 4.1 System Cables, without SmartController EX

The letters in the following figure correspond to the letters in Table 4-1. Cables and Parts Description (without SmartController EX). The numbers in the following figure correspond to the numbers in Table 4-2. Connections Installation Steps.

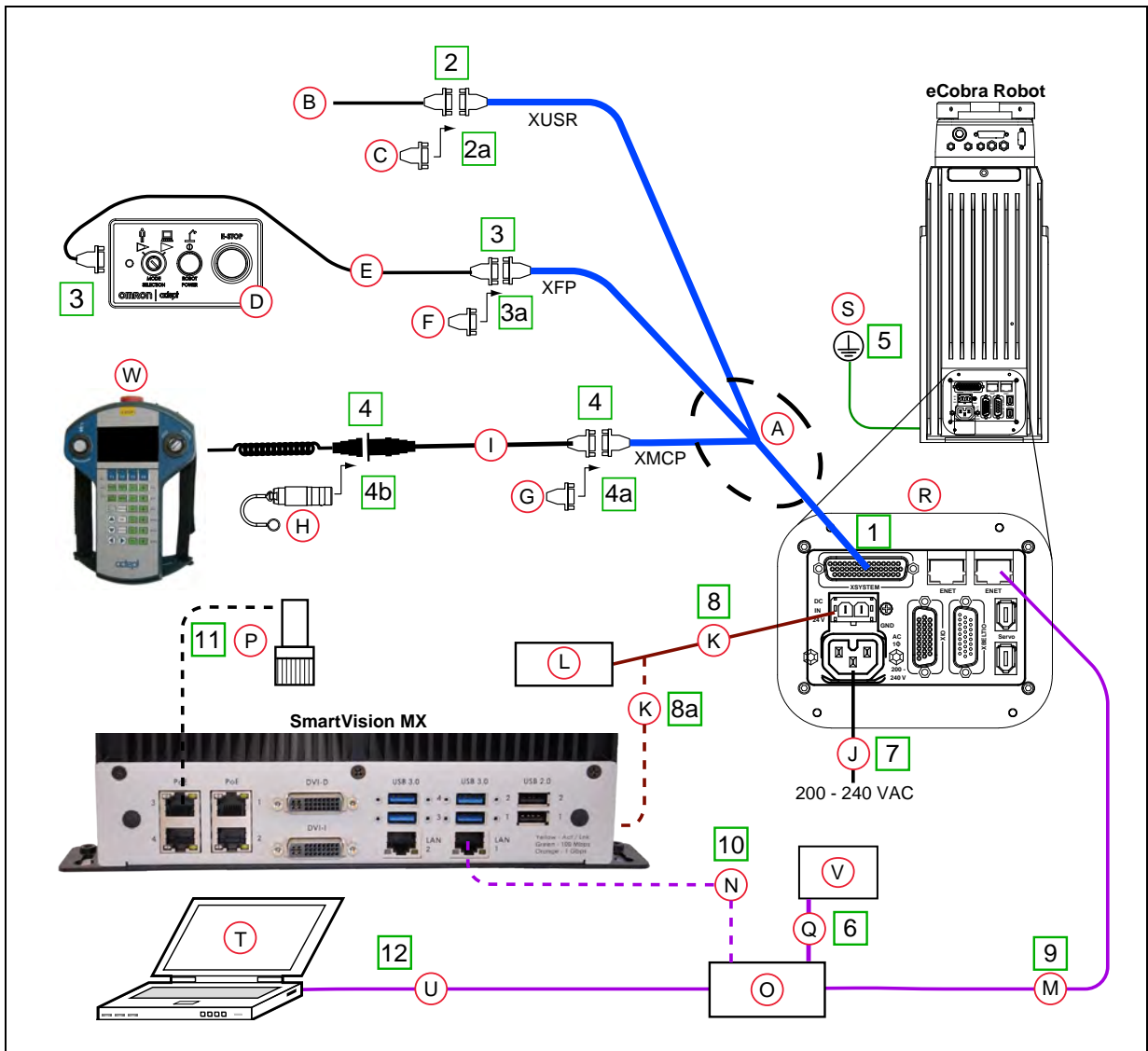


Figure 4-1. System Cable Diagram for eCobra Robots, Pendant and Vision Shown

The figure above includes the optional T20 pendant, optional SmartVision MX industrial PC, and optional PLC. These items may not be present in your system.

**NOTE:** For additional system grounding information, see Connecting 24 VDC Cable on page 52.

### List of Cables and Parts

Open the Accessory box and locate the eAIB XSYSTEM cable. Connect the cables and peripherals as shown in the preceding figure. Installation steps are covered in Cable Installation Overview on page 38.

Table 4-1. Cables and Parts Description (without SmartController EX)

Item	Description	Part #	Standard	Option	User-supplied	Notes
A	eAIB XSYSTEM Cable Assembly	13323-000	X			
B	User E-Stop, Safety Gate	n/a			X	
C	XUSR Jumper Plug	04736-000	X			Required if no E-stop, safety gate or muted safety gate used.
D	Front Panel	90356-10358	X		X	Front Panel (D) or Front Panel Jumper Plug (F) must be used.
E	Front Panel Cable	10356-10500	X		X	
F	Front Panel Jumper Plug	10053-000	X			Front Panel (D) or Front Panel Jumper Plug (F) must be used.
G	XMCP Jumper Plug	10052-000	X			XMCP Jumper Plug (G), T20 Pendant Bypass Plug (H), or T20 Pendant Assembly (W) must be used.
H	T20 Pendant Bypass Plug	10048-000		X		XMCP Jumper Plug (G), T20 Pendant

Item	Description	Part #	Standard	Option	User-supplied	Notes
						Bypass Plug (H), or T20 Pendant Assembly (W) must be used.
I	T20 Pendant Adapter Cable	10051-003		X		
The following three items are available, as an option, in the power supply/cable kit 90565-010						
J	VAC Power Cable	04118-000		X	X	200-240 VAC, single phase
K	24 VDC Power Cable	04120-000		X	X	
L	24 VDC, 6 A Power Supply	04536-000		X	X	85-264 VAC universal input
M	Ethernet Cable - switch -> eAIB	n/a			X	
N	Ethernet Cable - switch -> SmartVision MX	n/a			X	
O	Ethernet switch	n/a			X	
P	Camera and cable	n/a		X	X	
Q	Ethernet Cable - switch -> PLC (only while programming PLC)			X	X	
R	Robot Interface Panel	n/a	X			
S	User-supplied ground wire	n/a			X	
T	PC running ACE Software	n/a			X	
U	Ethernet Cable - PC-> ethernet switch	n/a			X	
V	PLC (optional)				X	
W	T20 Pendant Assembly	10054-010		X		Optional T20 Pendant Kit (10046-010) includes items W, H, and I.

The XUSR, XMCP, and XFP jumpers intentionally bypass safety connections so you can test the system functionality during setup.



**WARNING: PERSONAL INJURY RISK**

Under no circumstances should you run an eCobra system, in production mode, with all three jumpers installed. This would leave the system with no E-Stops.

**Cable Installation Overview**

*Table 4-2. Connections Installation Steps*

Step	Connection Description	Item
1	Connect eAIB XSYSTEM cable to XSYSTEM on eMB-40R.	A, R
2	Connect a user E-Stop or Muted Safety Gate to the eAIB XSYSTEM cable XUSR connector or verify XUSR jumper plug (2a) is installed in eAIB XSYSTEM cable XUSR connector.  Refer to Installing User-Supplied Safety Equipment on page 62 for more information.	B, C
3	Connect Front Panel cable to Front Panel and eAIB XSYSTEM cable XFP connector.  If no Front Panel is used, install FP jumper (3a) on eAIB XSYSTEM cable XFP connector. See NOTE after table.	D, E, F
4	Connect T20 adapter cable and the T20 Pendant to eAIB XSYSTEM cable XMCP connector.  If no T20 Pendant, install XMCP jumper (4a) or T20 Adapter Cable with T20 bypass plug (4b).	G or H, I, T20 Pendant
5	Connect user-supplied ground.  Refer to Grounding the Robot System on page 59 for more information.	S
6	Connect Ethernet cable from PLC to switch, if a PLC is used.  Refer to Configuring a PLC on page 60 for more information.	Q
7	Connect 200-240 VAC to VAC Input on eAIB Interface Panel; secure with clamp.  Refer to System Installation on page 35 for more information.	J, R
8	Connect 24 VDC to DC Input on Interface Panel.  Connect 24 VDC and shield ground to SmartVision MX, if used (8a). See SmartVision MX user's guide for location.  Refer to Connecting 24 VDC Power to Robot on page 50 for more information.	K, L, R
9	Connect Ethernet cable from switch to eAIB.	M, O, R

Step	Connection Description	Item
10	Connect Ethernet cable from switch to SmartVision MX, if used.	N, O
11	Connect optional camera and cable to SmartVision MX, if used.	P
12	Connect Ethernet cable from PC to switch if used.	T, U

**NOTE:** A front panel ships with each eCobra robot system, but you can choose not to use it if you replace its functionality with equivalent circuits. That is beyond the scope of this guide.

## 4.2 System Cables, with SmartController EX

The letters in the following figure correspond to the letters in Table 4-3. Cables and Parts Description (with SmartController EX). The numbers in the following figure correspond to the numbers in Table 4-4. Connections Installation Steps (with SmartController EX).

When the optional SmartController EX is included in the system, the Pendant, Front Panel, and XUSR connections must connect to the SmartController EX.

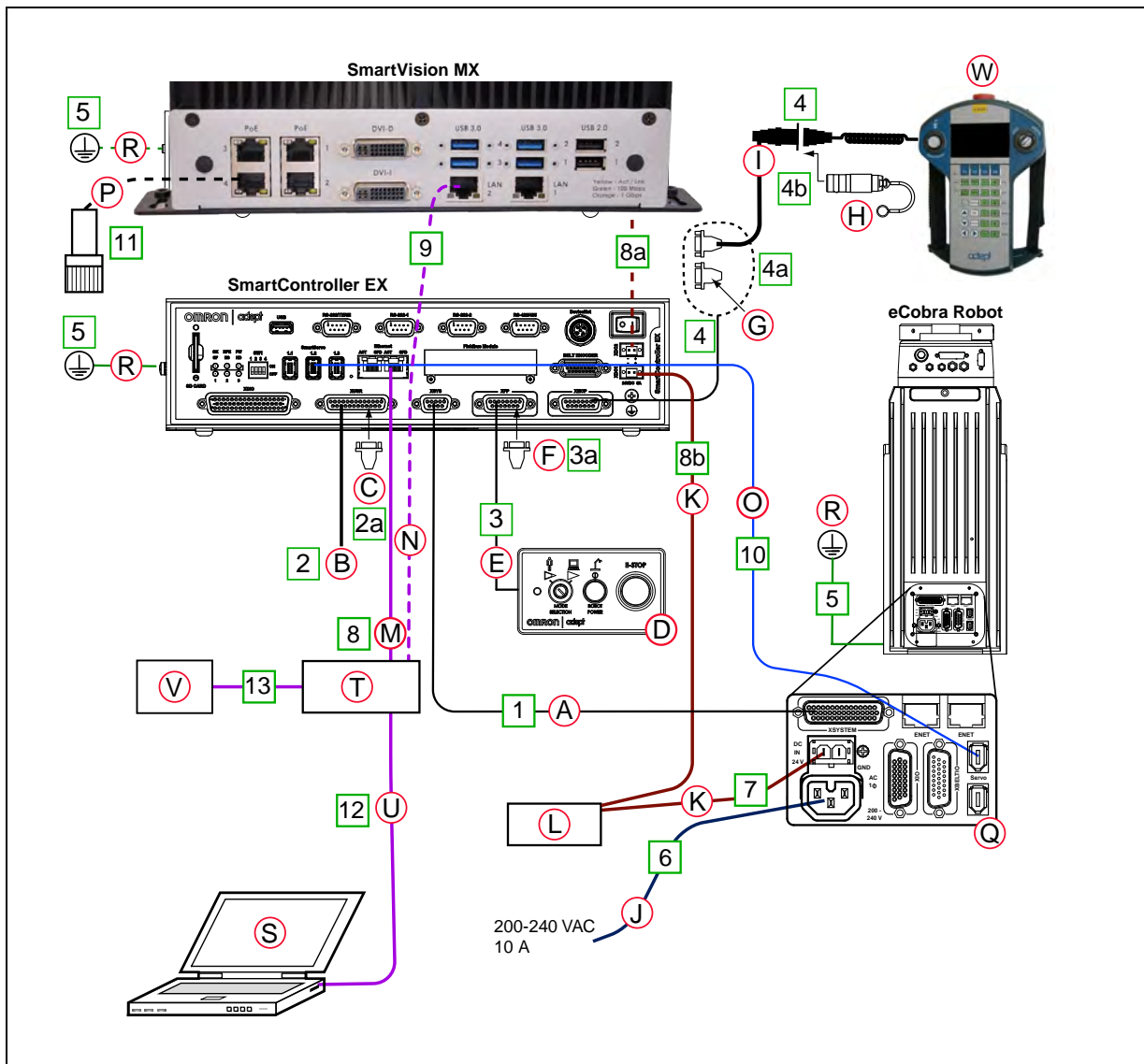


Figure 4-2. System Cable Diagram with SmartController EX



## Installing a SmartController EX Motion Controller

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

1. Mount the SmartController EX and Front Panel.
2. Connect the Front Panel to the SmartController EX.
3. Connect the pendant (if purchased) to the SmartController EX.

Connect a jumper plug, if no pendant is being used.

4. Connect user-supplied 24 VDC power to the controller.

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

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

## List of Cables and Parts

Open the Accessory box and locate the eAIB XSYSTEM cable. Connect the cables and peripherals as shown in the preceding figure. Installation steps are covered in Cable Installation Overview on page 43.

Table 4-3. Cables and Parts Description (with SmartController EX)

Part	Cable and Parts List	Part #	Standard	Option	User-supplied	Notes
A	eAIB XSYS Cable	13323-000	X			
B	User E-Stop, Safety Gate	n/a			X	
C	XUSR Jumper Plug	04736-000	X			Required if no E-stop, safety gate or muted safety gate used.
D	Front Panel	90356-10358	X		X	Front Panel (D) or Front Panel Jumper Plug (F) must be used.
E	Front Panel Cable	10356-10500	X		X	
F	Front Panel Jumper Plug	10053-000	X			Front Panel (D) or Front Panel Jumper Plug (F) must be used.
G	XMCP Jumper Plug	10052-000	X			XMCP Jumper Plug (G), T20 Pendant

Part	Cable and Parts List	Part #	Standard	Option	User-supplied	Notes
						Bypass Plug (H), or T20 Pendant (W) must be used.
H	T20 Pendant Bypass Plug	10048-000		X		XMCP Jumper Plug (G), T20 Pendant Bypass Plug (H), or T20 Pendant (W) must be used.
I	T20 Pendant Adapter Cable	10051-003		X		
The following three items are available, as an option, in the power supply/cable kit 90565-010						
J	VAC Power Cable	04118-000		X	X	200-240 VAC, single phase
K	24 VDC Power Cable	04120-000		X	X	
L	24 VDC, 6 A Power Supply	04536-000		X	X	85 - 264 VAC universal input
M	Ethernet Cable, Switch (if used) -> SmartController EX	n/a			X	
N	Ethernet Cable, Switch (if used) -> SmartVision MX, if used	n/a			X	
O	IEEE 1394 cable	13632-045	X			
P	Camera and cable	n/a		X	X	
Q	Robot Interface Panel	n/a	X			
R	User-supplied ground wire	n/a			X	
S	PC running ACE Software	n/a			X	
T	Ethernet Switch	n/a			X	
U	Ethernet Cable - PC -> ethernet switch	n/a			X	
V	PLC (optional)			X	X	
W	T20 Pendant Assembly	10054-010		X		Optional T20 Pendant Kit (10046-010) includes items W, H, and I.

The XUSR, XMCP, and XFP jumpers intentionally bypass safety connections so you can test the system functionality during setup.



**WARNING: PERSONAL INJURY RISK**

Under no circumstances should you run an eCobra system, in production mode, with all three jumpers installed. This would leave the system with no E-Stops.

## Cable Installation Overview

Power requirements for the SmartVision MX industrial PC are covered in that user guide. For 24 VDC, both the eCobra robot and a SmartVision MX can usually be powered by the same power supply.

Table 4-4. Connections Installation Steps (with SmartController EX)

Step	Connection	Part
1	Connect eAIB XSYS cable to XSYSTEM on eAIB.	A
2	Connect a user E-Stop or Muted Safety Gate to the XUSR connector or verify XUSR jumper plug is installed in XUSR connector (2a). Refer to Installing User-Supplied Safety Equipment on page 1 for more information.	B, C
3	Connect Front Panel cable to Front Panel and XFP connector or if no Front Panel, install FP jumper on XFP connector (3a).	D, E, F
4	Connect Pendant adapter cable to XMCP connector and T20 Pendant. If no Pendant, install XMCP jumper (4a) or bypass plug (4b).	H, I, G, T20 Pendant
5	Connect user-supplied ground to robot, SmartController EX, and Smart Vision MX. See user's guides for locations. Refer to Grounding the Robot System on page 59 for more information.	R
6	Connect 200-240 VAC to VAC Input on eAIB Interface Panel; secure with clamp. Refer to Connecting 200-240 VAC Power to Robot on page 54 for more information.	J, Q
7	Connect 24 VDC to DC Input on Interface Panel. Connect 24 VDC and shield ground to SmartVision MX, if used (8a). See SmartVision MX user's guide for location. Connect 24 VDC to SmartController EX, if used (8b). Refer to Connecting 24 VDC Power to Robot on page 50 for more information.	Q, K, L
8	Connect Ethernet cable to SmartController EX, if used.	M, T
9	Connect Ethernet cable to SmartVision MX, if used.	N, T

Step	Connection	Part
10	Connect IEEE 1394 cable between SmartController EX and eAIB SmartServo.	O, Q
11	Connect optional camera and cable to SmartVision MX, if used.	P
12	Connect Ethernet cable from PC to switch if used.	S, T, U
13	Connect optional PLC to switch, if used. Refer to Configuring a PLC on page 60 for more information.	T, V

## 4.3 Optional Cables

### XIO Breakout Cable

The XIO Breakout cable is for using the I/O on the eAIB. See Optional XIO Breakout Cable on page 93. This cable provides access to 12 inputs and 8 outputs (5 m).

### DB9 Splitter Cable

An optional Y cable attaches at the SmartController EX XSYS connector and splits it into two XSYS connectors. This is part number 00411-000. See the *Single and Multiple Robot Configuration Guide*.

### eAIB XBELT IO Adapter Cable

The optional eAIB XBELT IO Adapter cable split the eAIB XBELTIO port into a belt encoder lead, an Intelligent Force Sensor or IO Blox lead, and an RS-232 lead. If the system has a SmartController EX, this is only needed for Intelligent Force Sensing.

Find the pin connection diagrams in the figures below.

### SmartController EX Belt Encoder Y-Adapter Cable

The optional SmartController EX Belt Encoder Y-Adapter cable split the SmartController EX BELT ENCODER port into two belt encoder leads for encoders 1 and 2 and encoders 3 and 4.

Find the pin connection diagrams in the figures below.

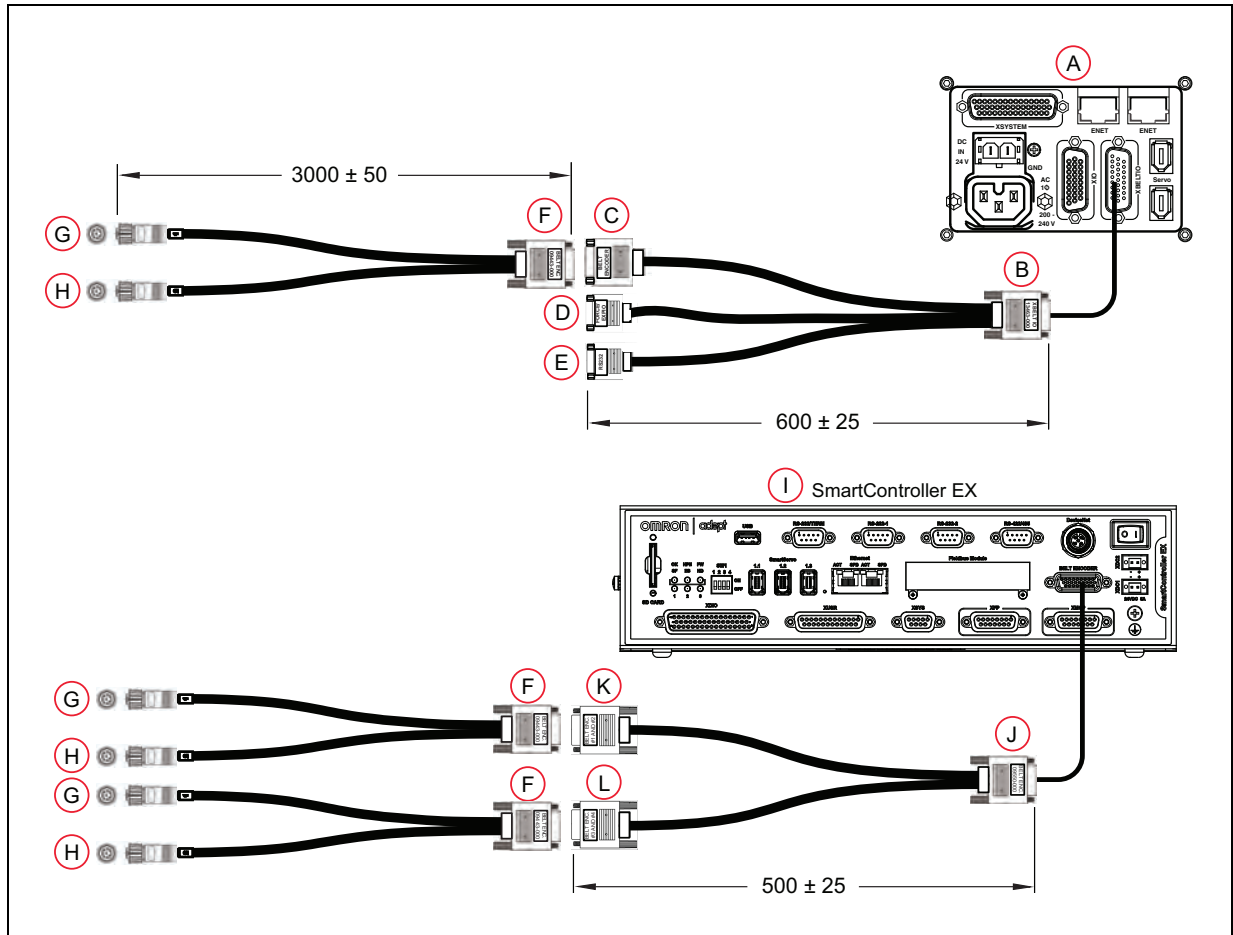


Figure 4-3. System Cable Diagram with Belt Encoders (Units in mm)

Table 4-5. Conveyor Belt Encoder Cables Description

Item	Description	Part #	Standard	Option	User-supplied	Notes
A	Robot Interface Panel	n/a	X			
B	eAIB XBELT IO Adapter Cable Connector	13463-000		X	X	HDB26 Female
C	Belt Branch Connector					DB 15 Male
D	Force / EXPIO Branch Connector					DB9 Male
E	RS232 Branch Connector					DB9 Male
F	Belt Y Splitter Cable Connector	09443-000		X	X	DB15 Female
G	Belt Encoder 1 Connector					M12 Female, 8-pin
H	Belt Encoder 2 Connector					M12 Female, 8-pin
I	SmartController EX (optional)	19300-000		X		
J	SmartController EX Belt Encoder Y Adapter Cable Connector	09550-000		X	X	HDB26 Female
K	Belt Branch Connector, Encoder 1 and 2					DB15 Male
L	Belt Branch Connector, Encoder 3 and 4					DB15 Male

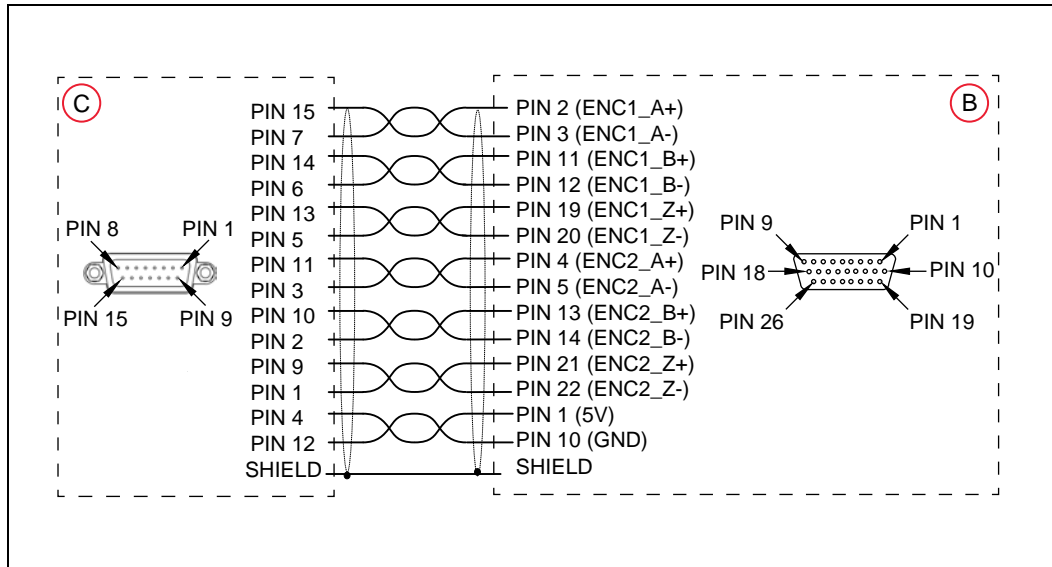


Figure 4-4. eAIB XBELT IO Adapter Cable Pinout - Encoder 1 and 2 Connections

**NOTE:** Cable shields connected to DSUB shell.

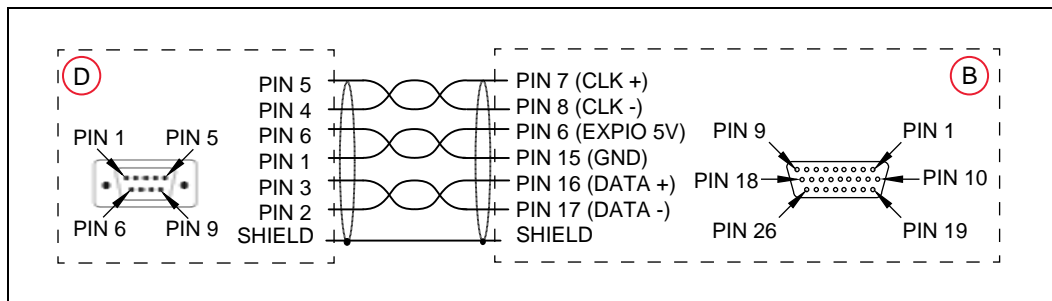


Figure 4-5. eAIB XBELT IO Adapter Cable Pinout - Force / EXPIO Connections

**NOTE:** Cable shields connected to DSUB shell.

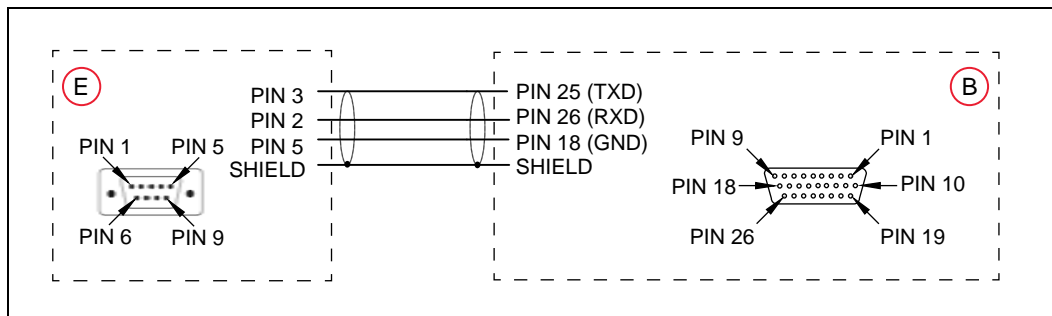


Figure 4-6. eAIB XBELT IO Adapter Cable Pinout - RS232 Connections

**NOTE:** Cable shields connected to DSUB shell.

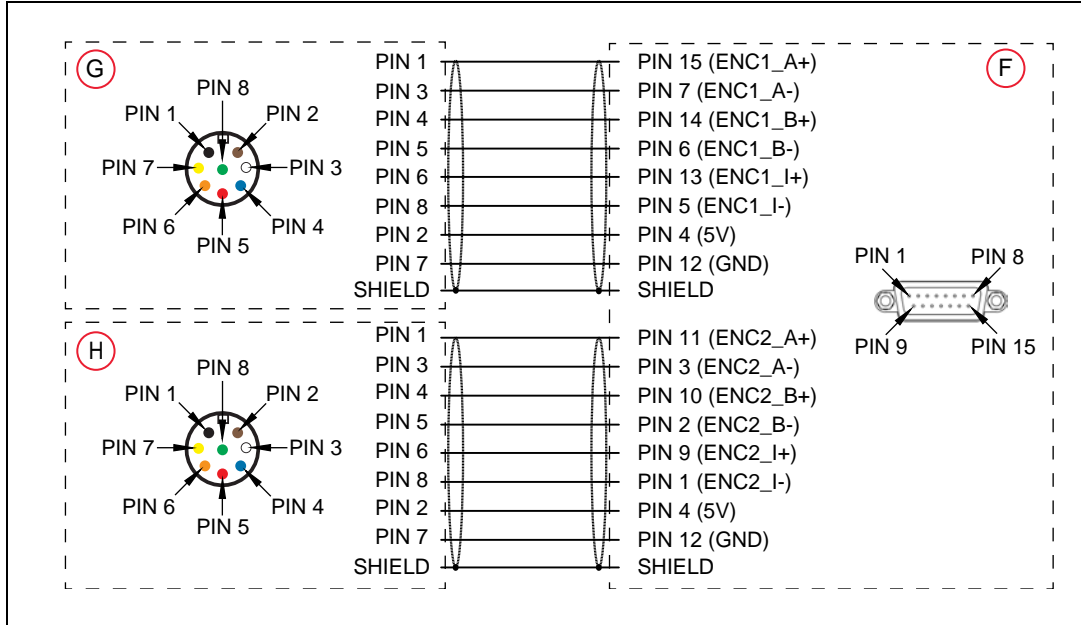


Figure 4-7. Belt Y Splitter Cable Pinout - 2 Encoder Connections

**NOTE:** Cable shields connected to DSUB shell.



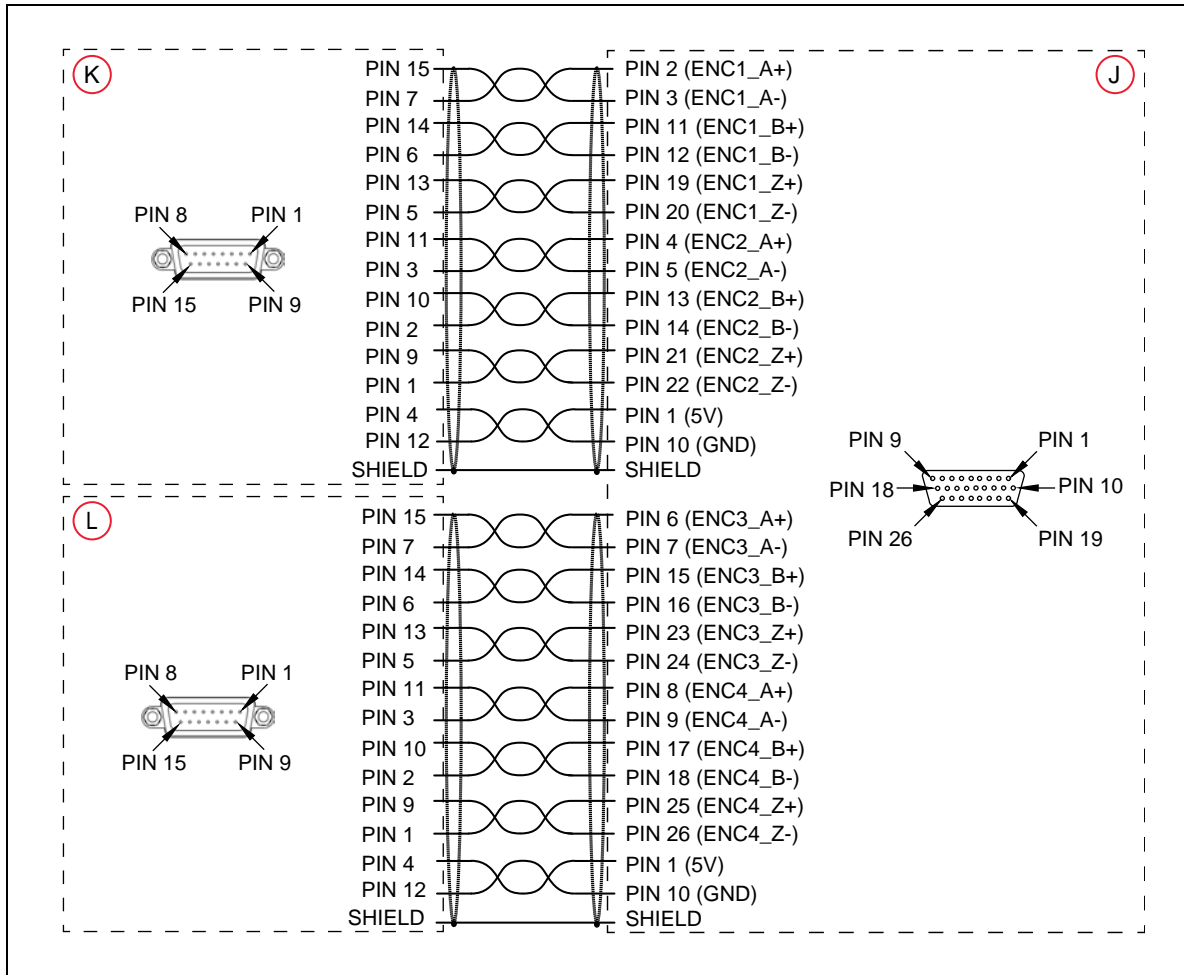


Figure 4-8. SmartController EX Belt Encoder Y Adapter Cable Connections

**NOTE:** Cable shields connected to DSUB shell.

## 4.4 ACE Software

### User-supplied PC

The user loads the ACE software onto the PC and connects it to the eAIB via an Ethernet cable. Depending on the other equipment in the system, there may be an Ethernet switch between the two.

### Installing ACE Software

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

You install ACE from the software media. ACE needs Microsoft .NET Framework. The ACE Setup Wizard scans your PC for .NET, and installs it automatically if it is not already installed.

1. Insert the ACE software media into your PC.

If Autoplay is enabled, the menu is displayed. If Autoplay is disabled, you will need to manually access the media content.

**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 ACE software installation: from the ACE software menu, click Read Important Information.
3. From the ACE software menu, select:  
     Install the ACE Software  
     The 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 ACE Setup wizard, click Exit on the menu to close the menu.

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

## 4.5 Connecting 24 VDC Power to Robot

### Specifications for 24 VDC Power

*Table 4-6. Specifications for 24 VDC User-Supplied Power Supply*

User-Supplied Power Supply	24 VDC ( $\pm 10\%$ ), 150 W (6 A) ( $21.6\text{ V} < V_{in} < 26.4\text{ V}$ )
Circuit Protection <sup>a</sup>	Output must be less than 300 W peak or 8 Amp in-line circuit protection
Power Cabling	1.5 – 1.85 mm <sup>2</sup> (16-14 AWG)
Shield Termination	Braided shield connected to frame ground terminal at both ends of cable. See Figure 4-9.
<sup>a</sup> User-supplied 24 V power supply must incorporate overload protection to limit peak power to less than 300 W, or 8 A in-line circuit protection must be added to the 24 V power source. (In case of multiple units on a common 24 V supply, each unit must be protected individually.)	

**NOTE:** Fuse information is located on the eAIB electronics.

The power requirements for the user-supplied power supply will vary depending on the configuration of the robot and connected devices. We recommend 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.

- Single eCobra robot, no other units: 6 A
- Additional eCobra robots: add 3 A per robot
- SmartVision MX: add 4 to 7 A, depending on camera load
- SmartController EX: add 2 to 5 A, depending on I/O load

**NOTE:** 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 a recommended power supply.



Table 4-7. Recommended 24 VDC Power Supply

Vendor Name	Model	Ratings	Mount
OMRON	S8FS-G15024C	24 VDC, 6.5 A, 150 W	Front Mount
OMRON	S8FS-G15024CD	24 VDC, 6.5 A, 150 W	DIN-Rail Mount

## 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 4-8. 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
	A: 24 V Return B: 24 VDC
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 List of Cables and Parts on page 41.

### Creating 24 VDC Cable

1. Locate the connector and pins shown in Table 4-8.
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.
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.

**NOTE:** If you are using the optional SmartController EX motion controller, you also must create a separate 24 VDC cable for it. That cable uses a different style of connector. See the *SmartController EX User's Guide*.

### Connecting 24 VDC 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 96. 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.

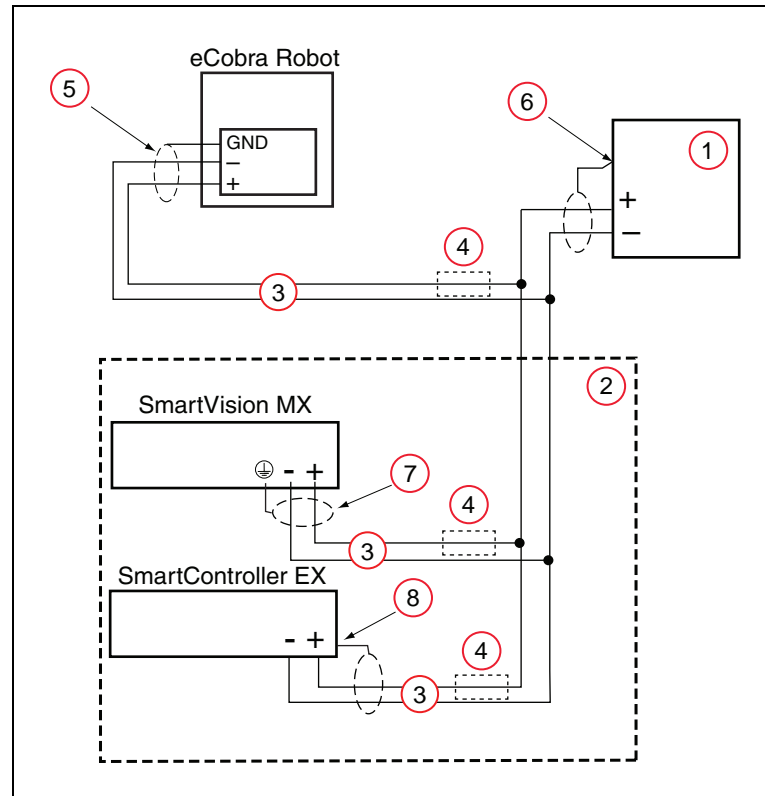


Figure 4-9. User-Supplied 24 VDC Cable, Power Supply

Table 4-9. User-Supplied 24 VDC Cable, Power Supply Description

Item	Description
1	User-supplied Power Supply, 24 VDC
2	Optional Equipment
3	User-supplied, Shielded Power Cable
4	Circuit Protection, 8 A max.
5	Shield - attach from user-supplied cable to ground screw on eCobra robot interface panel.
6	Shield - attach from user-supplied cable to frame ground on power supply.
7	Shield - attach from user-supplied cable to left wire slot of SmartVision MX.
8	Shield - attach from user-supplied cable to side of SmartController EX using star washer and M3 x 6 screw.



**CAUTION: PROPERTY DAMAGE RISK**

The 24 VDC output must be less than 300 W peak or 8 Amp (max) in-line circuit protection must be provided, separately, for each connected robot, SmartController EX, and SmartVision MX.

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

## 4.6 Connecting 200-240 VAC Power to Robot



**WARNING: ELECTROCUTION RISK**

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.



**WARNING: ELECTROCUTION RISK**

During installation, user-supplied fail-safe lockout measures must be used to prevent, unauthorized third parties from turning on power. This is mandated by Clause 5.2.4 of ISO 10218-1.

During any maintenance-related activities, care must be taken involving AC power lockout. It is the user's responsibility to make sure adequate measures are taken to

- lockout/ tagout power to the robot and related equipment.
- make sure that the robot cannot be energized during maintenance, as mandated by Clause 5.2.4 of ISO 10218-1.

### Specifications for AC Power

*Table 4-10. Specifications for 200/240 VAC User-Supplied Power Supply*

Auto-Ranging Nominal Voltage	Minimum Operating Voltage <sup>a</sup>	Maximum Operating Voltage	Frequency/ Phasing	External Circuit Breaker, User-Supplied
200 V to 240 V	180 V	264 V	50/60 Hz 1-phase	10 Amps
<sup>a</sup> Specifications are established at nominal line voltage. Low line voltage can affect robot performance.				

Table 4-11. Typical Robot Power Consumption

eCobra Robot	Move	Average Power (W)	RMS Current (A)	Peak Power (W) <sup>a</sup>
600	No load—Adept cycle <sup>b</sup>	344	1.56	1559
	5.5 kg—Adept cycle <sup>b</sup>	494	2.25	2061
	5.5 kg—all joints move	880	4.00	2667
800	No load—Adept cycle <sup>b</sup>	377	1.71	1406
	5.5 kg—Adept cycle <sup>b</sup>	531	2.41	1955
	5.5 kg—all joints move	794	3.61	2110

<sup>a</sup>For short durations (100 ms).  
<sup>b</sup>For details on Adept cycle, see Robot Specifications on page 166.

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



**WARNING: ELECTROCUTION RISK**

eCobra robot 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.



**WARNING: ELECTROCUTION RISK**

AC power installation must be performed by a skilled and instructed person—refer to the *Robot Safety Guide*. During installation fail-safe lockout measures must be used to prevent, unauthorized third parties from turning on power. This is mandated by Clause 5.2.4 of the ISO 10218-1.

Failure to use appropriate power (less than or more than the rated voltage range of 200-240 VAC) can lead to malfunction or failures of the robot or hazardous situations.

### 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**

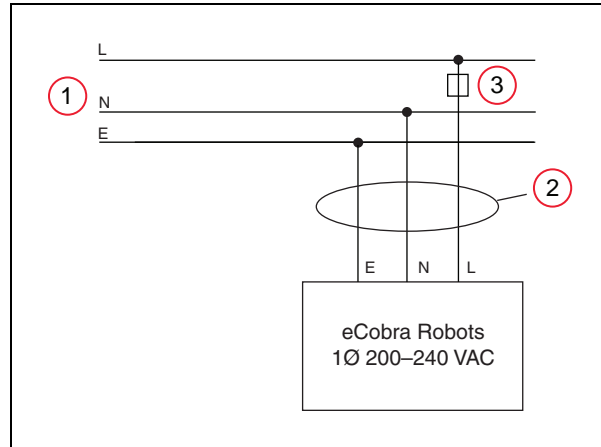


Figure 4-10. Typical AC Power Installation with Single-Phase Supply

Table 4-12. Single-Phase Power Supply Description

Item	Description
1	1 Ø, 200-240 VAC @ 20A L = Line N = Neutral E = Earth Ground
2	User- supplied AC Power Cable
3	User- supplied fuse, slow blow, 10A



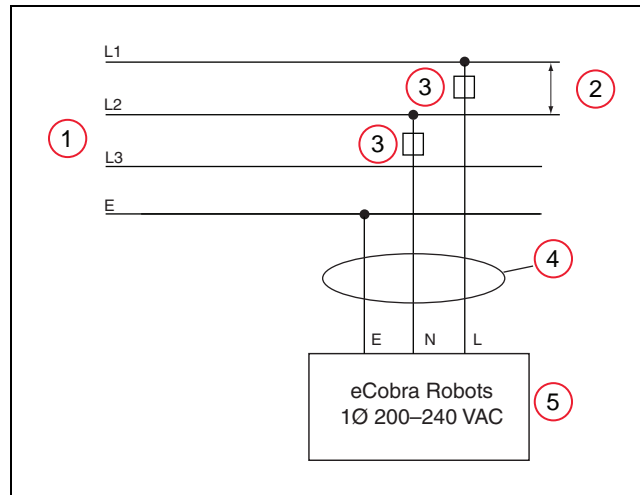


Figure 4-11. Single-Phase Load across L1 and L2 of a Three-Phase Supply

Table 4-13. Three-phase Power Supply Description

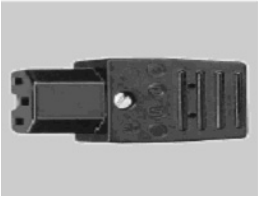
Item	Description
1	3 Ø, 200-240 VAC
2	200 -240 VAC
3	User-supplied fuses, slow blow, 10 A
4	User-supplied AC Power Cable
5	L = Line 1 N = Line 2 E = Earth Ground

**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.

## AC Mating Connector

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

Table 4-14. AC Mating Connector Details

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

**NOTE:** The AC power cable is not supplied with the system.

## 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 4-12.
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.

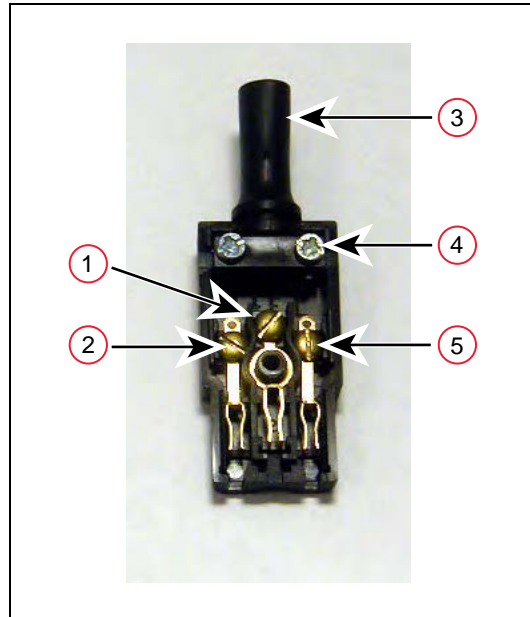


Figure 4-12. AC Power Mating Connector

Table 4-15. AC Power Mating Connector Description

Item	Description
1	Earth
2	Neutral
3	Removable Bushing
4	Cable Clamp
5	Line

### Connecting AC Power Cable

1. Connect the unterminated end of the AC power cable to your facility AC power source. See AC Power Diagrams on page 56. 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.

## 4.7 Grounding the 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 the following figure. 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.

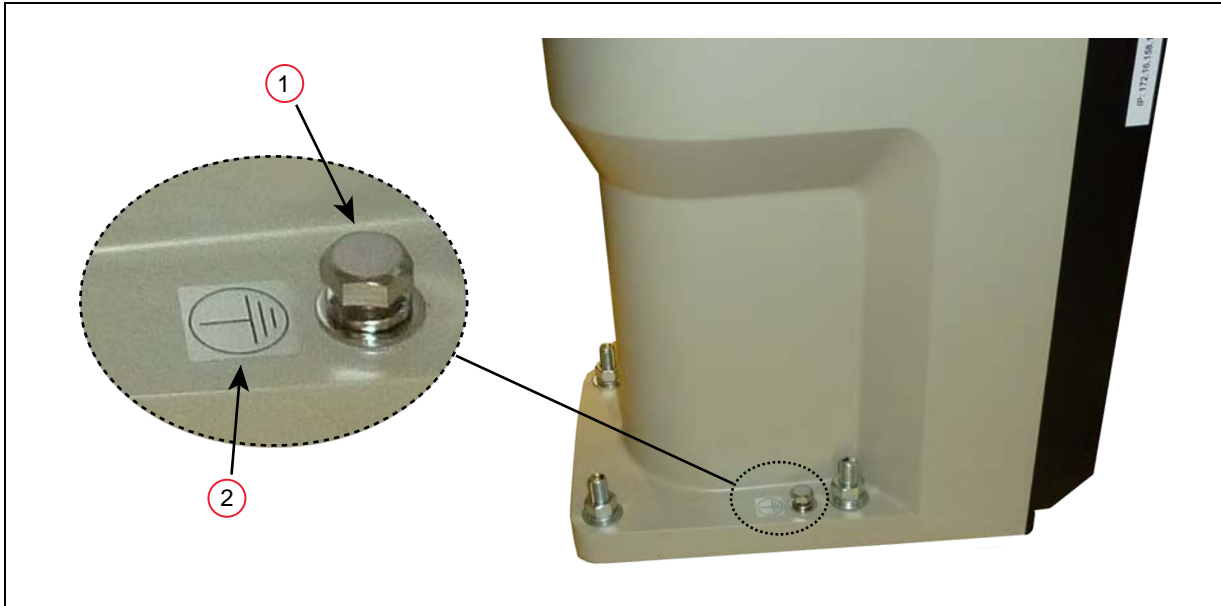


Figure 4-13. (1) Ground Point on Robot Base and (2) Ground Label

**NOTE:** The resistance of the earth ground conductor must be  $\leq 10 \Omega$ .

### Grounding Robot-Mounted Equipment

The following two parts of an eCobra 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 or 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 8-6.



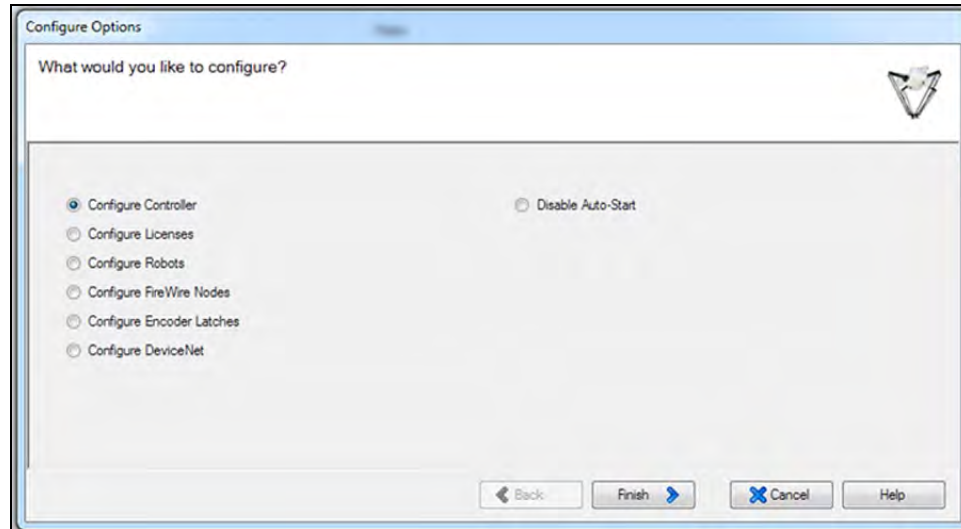
**WARNING: ELECTROCUTION RISK**

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.

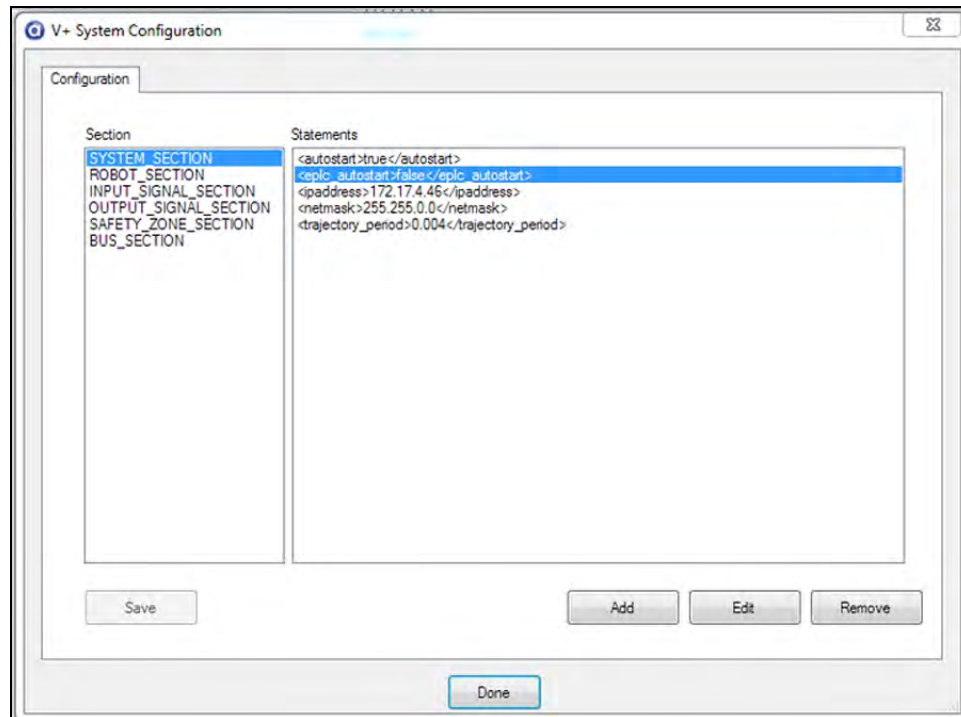
## 4.8 Configuring a PLC

A PLC is user-supplied. This section describes how to configure your PLC for automatic start-up when the system boots.

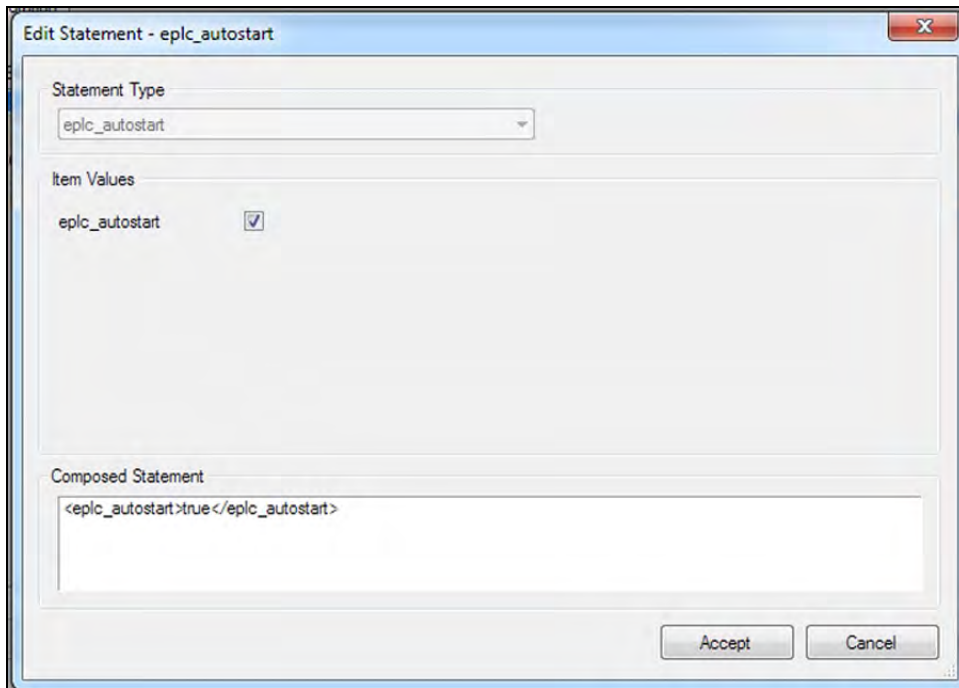
1. Start the ACE software.
2. Open the Controller object.
3. In the Configure tab, select Configure Controller, then click Finish.



4. Select SYSTEM\_SECTION > eplc\_autostart.



5. Click Edit (or double-click the selection).
6. Check the eplc\_autostart box. It defaults to unchecked.



7. Save the configuration by clicking Accept and then Yes.

### 4.9 Installing User-Supplied Safety Equipment

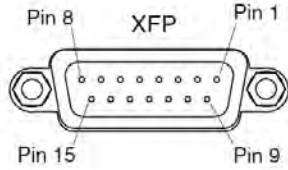
The user is responsible for installing safety barriers to protect personnel from coming in contact with the robot unintentionally. Depending on the design of the workcell, safety gates, light curtains, and emergency stop devices can be used to create a safe environment. Read the *Robot Safety Guide*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

The user-supplied safety and power-control equipment connects to the system through the XUSR and XFP connectors on the eAIB XSYSTEM cable. The XUSR connector (25-pin) and XFP (15-pin) connector are both female D-sub connectors. Refer to the following table for the XUSR pin-out descriptions. See "Contacts Provided by the XFP Connector" for the XFP pin-out descriptions. See the figure E-Stop Circuit on XUSR and XFP Connectors on page 66 for the XUSR wiring diagram.

Table 4-16. Contacts Provided by the XUSR Connector

Pin Pairs	Description	Comments
Voltage-Free Contacts Provided by Customer		
1, 14	User E-Stop CH 1 (mushroom push-button, safety gates, etc.)	N/C contacts, Shorted if NOT Used
2, 15	User E-Stop CH 2 (same as pins 1, 14)	N/C contacts, Shorted if NOT Used
3, 16	Line E-Stop (used for other robot or assembly line E-Stop inter-connection. Does not affect E-Stop indication (pins 7, 20))	N/C contacts, Shorted if NOT Used
4, 17	Line E-Stop (same as pins 3, 16)	N/C contacts, Shorted if NOT Used
5, 18	Muted safety gate CH 1 (causes E-Stop in Automatic mode only)	N/C contacts, Shorted if NOT Used
6, 19	Muted Safety Gate CH 2 (same as pins 5, 18)	N/C contacts, Shorted if NOT Used
Voltage-Free Contacts provided by eCobra		
7, 20	E-Stop indication CH 1	Contacts are closed when Front Panel, pendant, and customer E-Stops are <i>not</i> tripped
8, 21	E-Stop indication CH 2 (same as pins 7, 20)	Contacts are closed when Front Panel, pendant, and customer E-Stops are <i>not</i> tripped
9, 22	Manual/Automatic indication CH 1	Contacts are closed in Automatic mode
10, 23	Manual/Automatic indication CH 2	Contacts are closed in Automatic mode
11, 12, 13, 24, 25	No connection	

Table 4-17. Contacts Provided by the XFP Connector

Pin Pairs	Description	Requirements for User-Supplied Front Panel
Voltage-Free Contacts Provided by Customer		
1, 9	Front Panel E-Stop CH 1	User must supply N/C contacts
2, 10	Front Panel E-Stop CH 2	User must supply N/C contacts
3, 11	Remote Manual/Automatic switch CH 1. Manual = Open Automatic = Closed	Optional - jumper closed for Auto Mode-only operation
4, 12	Remote Manual/Automatic switch CH 2. Manual = Open Automatic = Closed	Optional - jumper closed for Auto Mode-only operation
6, 14	Remote High Power on/off momentary push-button	User must supply momentary push-button to enable High Power to system
Non-voltage-Free Contacts		
5, 13	System-Supplied 5 VDC and GND for High Power On/Off Switch Lamp	User must supply lamp, or use 1 W, 47 ohm resistor - system will not operate if not present
7, 15 <sup>a</sup>	Controller system 5 V power on LED, 5 V, 20 mA	Optional - indicator only
8	No connection	
 <p>The diagram shows a rectangular XFP connector with two mounting lugs on the left and right sides. It features two rows of pins. The top row has pins labeled Pin 8 (left), Pin 1 (right), and Pin 9 (right). The bottom row has pins labeled Pin 15 (left) and Pin 9 (right). The label 'XFP' is centered above the connector.</p>		
See the figure Front Panel Schematic on page 68 for a schematic diagram of the Front Panel.		
<sup>a</sup> Users must exercise caution to avoid inadvertently connecting 24 V signals to these pins, because this will damage the electronics.		

**NOTE:** The system was evaluated by Underwriters Laboratory with a Front Panel. Using a substitute front panel could void UL compliance.



Table 4-18. Remote Pendant Connections on the XMCP Connector

<b>Pin XMCP (15-Pin D-Sub)</b>	<b>Description</b>
1, 9	Pendant E-Stop Push-button CH 1
2, 10	Pendant E-Stop Push-button CH 2
3, 11	Pendant Enable CH 1 (Hold-to-run)
4, 12	Pendant Enable CH 2 (Hold-to-run)
13	Serial GND/Logic GND
7	Pendant TXD: "eV+ to Pendant TXD"
8	Pendant RXD: "eV+ to Pendant RXD"
14	No connection
15	No connection
Shield	Shield GND
6	24 V
5	No connection

The following figure shows an E-Stop diagram for the system. See Emergency Stop Circuits on page 68 for a description of the functionality of this circuit.

## 4.9 Installing User-Supplied Safety Equipment

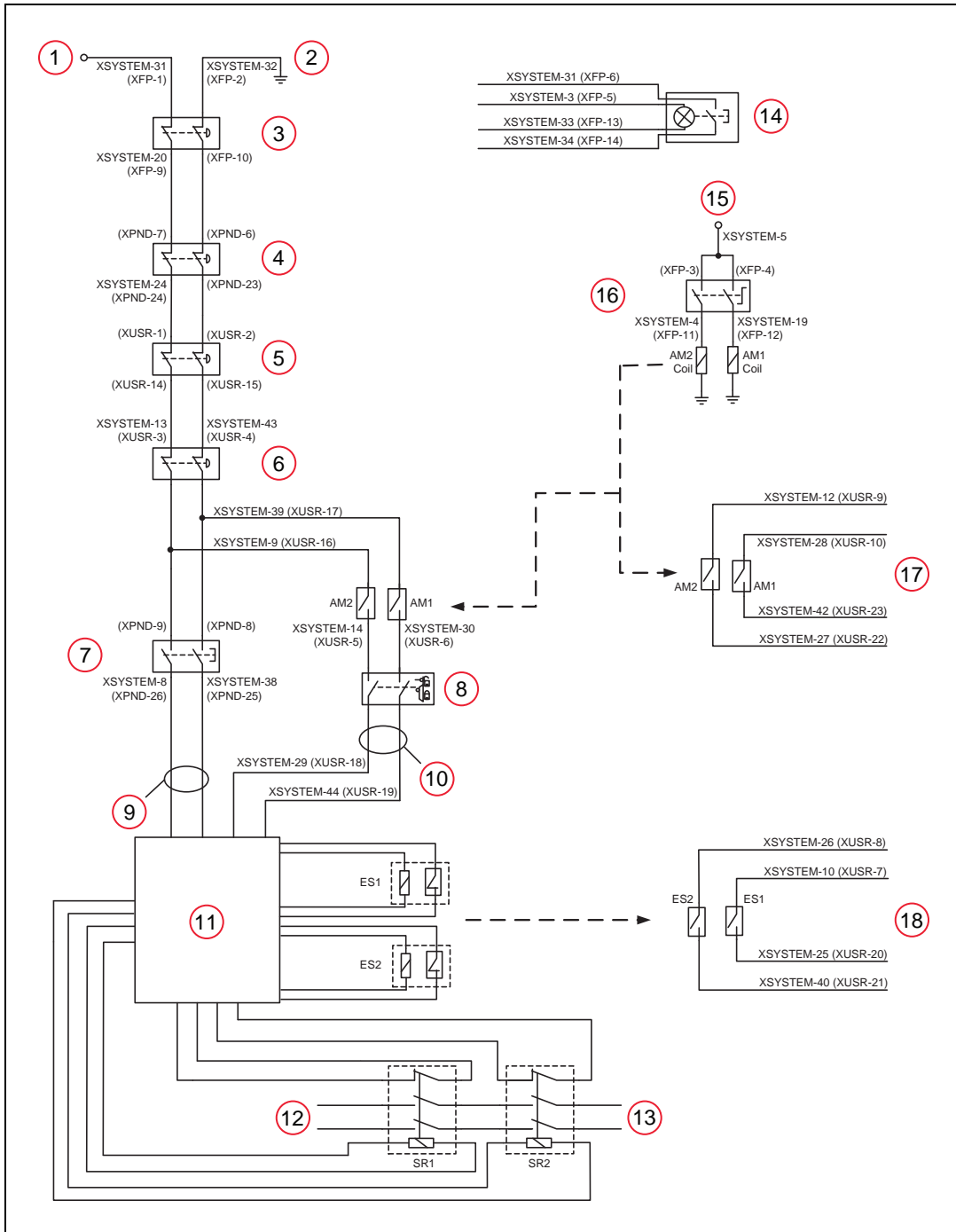


Figure 4-14. E-Stop Circuit on XUSR and XFP Connectors

Table 4-19. E-Stop Circuit on XUSR and XFP Connectors Description

Item	Description
1	ESTOP 24 V Source
2	ESTOP Ground
3	Front Panel ESTOP Pushbutton
4	T20 ESTOP Pushbutton
5	User E-Stop and Gate Interlock (jumper closed when not used, must open both channels independently if used)
6	LINE E-Stop (external user E-Stop system)
7	T20 Pendant Enable
8	Muted Safety Gate - Active in auto mode only (jumper closed when not used)
9	Manual Mode Path
10	Auto Mode Path
11	Force-Guided Relay Cyclic Check Control Circuit
12	Single-Phase AC Input, 200-240 VAC
13	High Power to Amplifiers (internal connections)
14	Front Panel High Power ON / OFF (6 V, 1.2 W bulb)
15	ESTOP 24 V Source
16	Front Panel Auto / Manuals Keyswitch
17	Auto / Manual Output
18	User ESTOP Output

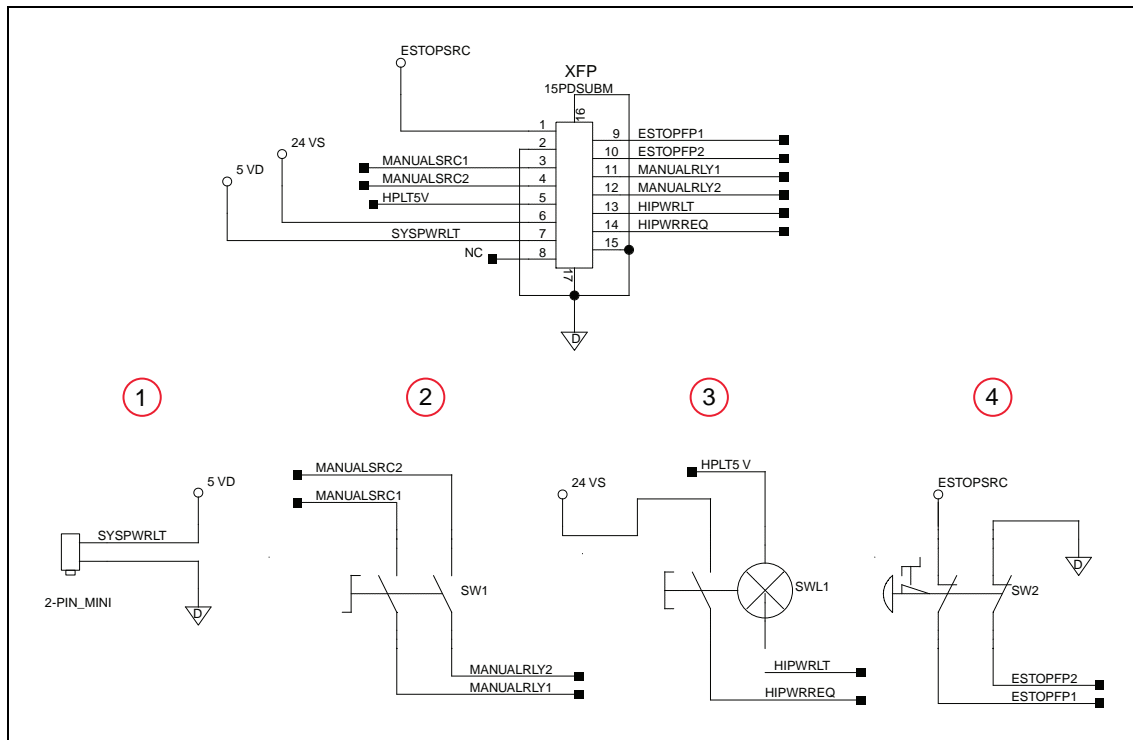


Figure 4-15. Front Panel Schematic

Table 4-20. Front Panel Schematic Description

Item	Description
1	System Power LED
2	Manual / Auto
3	High Power ON / OFF
4	Emergency Stop

### Emergency Stop Circuits

The eAIB XSYSTEM cable provides connections for Emergency Stop (E-Stop) circuits on the XUSR and XFP connectors. This gives the controller system the ability to duplicate E-Stop functionality from a remote location using voltage-free contacts. See Figure 4-14.

The XUSR connector provides external two-channel E-Stop input on pin pairs 1, 14 and 2, 15. The XFP connector provides two-channel E-Stop input on pin pairs 1, 9 and 2, 10.

**NOTE:** These pin pairs must be shorted if not used. Both channels must open independently if used. The controller will flag an error state if one channel is jumpered closed and the other channel is opened, although an Emergency Stop will still occur. It will also flag an error state if the independent channels are crossed, meaning one line from each channel is accidentally connected to the other channel.

### **User E-Stop Indication Contacts - Remote Sensing of E-Stop**

These contacts provide a method to indicate the status of the ESTOP chain, inclusive of the Front Panel Emergency Stop push-button, the pendant Emergency Stop push-button, and the User Emergency Stop Contacts.

**NOTE:** These contacts do not indicate the status of any connections below the User E-Stop contacts. Thus, they will NOT indicate the status of the Line E-Stop, MCP ENABLE, or the Muted Safety gate. If you have a specific need in this area, contact your local Omron support for information on alternate indicating modes.

Two pairs of pins on the XUSR connector (pins 7, 20 and 8, 21) provide voltage-free contacts, one for each channel, to indicate whether the E-Stop chain, as described above, on that channel is closed. Both switches are closed on each of the redundant circuits in normal operation (no E-Stop). The user may use these contacts to generate an E-Stop for other equipment in the workcell. The load on the contacts must not exceed 40 VDC or 30 VAC at a maximum of 1 A.

These voltage-free contacts are provided by a redundant, cyclically-checked, positive-drive, safety relay circuit for Category 3 PL-d per ISO 13849 operation (see Figure 4-14. and the table Contacts Provided by the XFP Connector on page 64 for the customer E-Stop circuitry).

### **Line E-Stop Input**

The XUSR connector on the controller contains a two-channel Line E-Stop input for workcell, production line, or other equipment emergency-stop inputs. Generally, the customer E-Stop Indication contact outputs are used to generate an emergency stop in such external equipment. Thus, if one were to wire the same equipment's outputs into the customer E-Stop input (that is, in series with the local robot's E-Stop push-buttons), a lock-up situation could occur.

The Line E-Stop input comes into the circuit at a point where it cannot affect the customer E-Stop indication relays and will not cause such a lock-up situation. For any situation where two systems should be cross-coupled, for example, the customer E-Stop indication of one controller is to be connected to the input of another controller, the Line E-Stop input is the point to bring in the other controller's output contacts. See the figure E-Stop Circuit on XUSR and XFP Connectors on page 66 for more information.

Do not use the Line E-Stop for such devices as local E-Stop push-buttons, since their status should be reported to the outside on the local user E-Stop indication output contact while the Line E-Stop inputs will not.

### **Muted Safety Gate E-Stop Circuitry**

Two pairs of pins on the XUSR connector (pins 5, 18 and 6, 19) provide connections for a safety gate designed to yield an E-Stop allowing access to the workspace of the robot in Manual mode only, not in Automatic mode. It is up to the customer to determine if teaching the robot in Manual Mode, by a skilled programmer (See Qualification of Personnel in the *Robot Safety Guide*), wearing safety equipment and carrying a pendant, is allowable under local regulations. The E-Stop is said to be "muted" in Manual mode (for the customer E-Stop circuitry, see the figures and tables at the beginning of this section).

The muted capability is useful for a situation where a shutdown must occur if the cell gate is opened in Automatic mode, but you need to open the gate in Manual mode. If the mute gate is opened in Automatic mode, the robot defaults to Manual mode operation when power is re-enabled. In muted mode, the gate can be left open for personnel to work in the robot cell. However, safety is maintained because of the speed restriction.



**WARNING: PERSONAL INJURY RISK**

If you want the cell gate to always cause a robot shutdown, wire the gate switch contacts in series with the user E-Stop inputs. Do not wire the gate switch into the muted safety gate inputs.

### Remote Manual Mode

The Front Panel provides for a Manual Mode circuit. See Remote High Power On/Off Control on page 71 for further details about the customer Remote Manual Mode circuitry.

The Front Panel, or the user-supplied panel, must be incorporated into the robot workcell to provide a “Single Point of Control” (the pendant) when the controller is placed in Manual mode. Certain workcell devices, such as PLCs or conveyors, may need to be turned off when the operating mode switch is set to Manual mode. This is to ensure that the robot controller does not receive commands from devices other than from the pendant, the single point of control.

If the user needs to control the Manual/Automatic mode selection from other control equipment, then a custom splitter cable or complete replacement of the Front Panel may be required. See Front Panel Schematic on page 68. In this situation, a pair of contacts should be wired *in series* with the Front Panel Manual/Automatic mode contacts. Thus, both the Front Panel and the customer contacts need to be closed to allow Automatic mode.



**WARNING: PERSONAL INJURY RISK**

Do not wire user-supplied Manual/Automatic contacts in parallel with the Front Panel switch contact. This would violate the “Single Point of Control” principle and might allow Automatic (high-speed) mode to be selected while an operator is in the cell.

### User Manual/Auto Indication

Two pairs of pins on the XUSR connector (pins 9, 22 and 10, 23) provide a voltage-free contact to indicate whether the Front Panel and/or remote Manual/Automatic switches are closed. The user may use these contacts to control other mechanisms (for example, conveyor, linear modules, etc.) when Manual mode is selected. The load on the contacts should not exceed 40 VDC or 30 VAC at a maximum of 1 A.



**WARNING: PERSONAL INJURY RISK**

Return any suspended safeguards to full functionality prior to selecting Automatic Mode.

### User High Power On Indication

In the optional SmartController EX, eV+ controls a normally-open relay contact on the XDIO connector (pins 45, 46, see the table XDIO Digital I/O Connector Pin Assignments in the SmartController EX manual), that will close when high power has been enabled. The user can use this feature to power an indicator lamp or other device, that signals High Power is On. The limit on these contacts is 1 A at 30 VDC or 30 VAC.

## Remote High Power On/Off Control

The easiest and most effective way to provide the high power on/off control in a remote location is to mount the Front Panel in the desired location with an extension cable.

However, if the user needs to control high power on/off from other control equipment or from a location other than the Front Panel, then a custom splitter cable will be required. See the Front Panel schematic (Front Panel Schematic on page 68) for details of the Front Panel's wiring. In this situation, a second momentary contact for high power on/off would be placed *in parallel with* the Front Panel push-button contact. This second contact should be suppressed when in Manual mode (see the note on "Single Point of Control" below).

This method allows relocating the push-button switch to a more convenient location. Implementation of this method must conform to EN standard recommendations.

**NOTE:** European standards require that the remote High Power push-button be located outside of the workspace of the robot.

Pins 6, 14 and 5, 13 of the XFP connector provide this remote capability. Pins 5, 13 provide power for the lamp, +5 VDC and ground, respectively. Pins 6, 14 are inputs for voltage-free normally-open contacts from a user-supplied momentary push-button switch.



**WARNING: PERSONAL INJURY RISK**

To fulfill the "Single Point of Control" requirement, do not place the Manual/Automatic and High Power On controls in multiple locations. After putting the robot into Manual mode, the operator should remove the key for safety purposes. The system should not be wired so that a PLC or another operator can put the system back into Automatic mode.

## High Power On/Off Lamp

The Front Panel High Power On/Off Lamp (p/n: 27400-29006) will cause an error, from eV+, if the lamp burns out. This error prevents High Power from being turned on. This safety feature prevents a user from not realizing that High Power is enabled because the High Power indicator is burned out. See Changing the Lamp In the Front Panel High-Power Indicator on page 119 for information on changing this lamp.

## Remote Front Panel or User-Supplied Control Panel Usage

Users can mount the Front Panel remotely by using an extension cable or by wiring a user-supplied Front Panel (control panel) to the controller using the 15-pin XFP connector. The Front Panel contains no active components, only switches and lights. Customers should be able to adapt the Front Panel's functionality into their own Front Panel design. To automatically control the Front Panel's signals, use relay contacts instead of switches. See the figure Front Panel Schematic on page 68 for a schematic drawing of the Front Panel, and see the table System Installation on page 35 for a summary of connections and pin numbers.

**NOTE:** The system was evaluated by Underwriters Laboratory with our Front Panel. If you provide a substitute front panel, the system may no longer be UL compliant.

Customers can build an extension cable to place the Front Panel in a remote location. The extension cable must conform to the following specifications:

- Wire Size: must be larger than 26 AWG.
- Connectors: must be 15-pin, standard D-sub male and female.
- Maximum cable length is 10 meters.

**NOTE:** The XMCP and XFP connectors can be interchanged without electrical damage. However, neither the Front Panel nor the pendant will work properly unless they are plugged into the correct connector.

### Remote Pendant Usage

Customers can build an extension cable to place the pendant in a remote location. The extension cable must conform to the following specifications:

- Wire Size: must be larger than 26 AWG.
- Connectors: must be 15-pin, standard D-sub male and female.
- Maximum cable length is 10 meters.

**IMPORTANT:** Do not modify the cable that is attached to the pendant. This could cause unpredictable behavior from the robot system.



# Chapter 5: System Operation

## 5.1 Robot Status LED Description

The robot Status LED indicator is located on the top of the upright robots, and at the top of the status panel for the eCobra Inverted robot. The blinking pattern indicates the status of the robot.

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

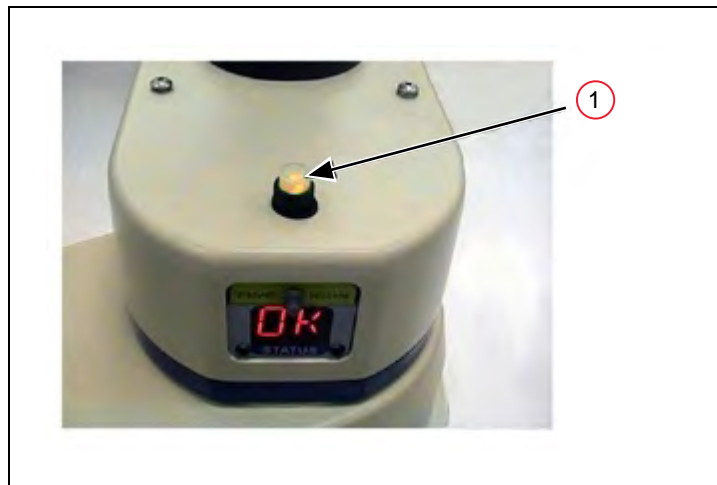


Figure 5-1. (1) Robot Status LED Indicator Location, Upright Model Shown

Table 5-1. 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	OK	Selected Configuration Node
Amber, Fast Blink	Fault Code(s)	Fault, see the next section
Amber, Solid	Fault Code(s)	Fault, see the next section

## 5.2 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 fault codes. The following table gives meanings of the fault codes, which provide information for 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 5-2. (1) Status Panel for Displaying Fault Codes, (2) Z Brake Release Button - Upright Model Shown.

### Status Panel

The status panel, shown in Figure 5-2, displays alpha-numeric codes that indicate the operating status of the robot. The following table gives definitions of the fault codes. These codes provide details for quickly isolating problems during troubleshooting.

In the Status Panel Codes table, the '#' in the LED column represents a single digit. The digits will be displayed as one of the following:

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

Table 5-2. Status Panel Codes

LED	Status Code	V+ Error Message	V+ Error Code	Explanation	User Action
OK	OK	None	N/A	STATUS message-High Power OFF.	None
ON	ON	None	N/A	STATUS message-High Power ON.	None
MR	MA	None	N/A	STATUS message-Robot is in Manual Mode.	None
24	24	*RSC power failure*	-670	The 24 VDC input voltage is out of bounds	Check connections and voltage level

LED	Status Code	V+ Error Message	V+ Error Code	Explanation	User Action
				(too high or low).	from the user-supplied 24 VDC power supply.
<b>A#</b>	A#	*Motor Amplifier Fault*	-1018	A power amplifier fault is indicated on axis #.	Check user motor power connections for shorts or opens. Turn high power back on and restart the program. If the error persists, contact your local Omron support.
<b>AC</b>	AC	*RSC Power Failure*	-670	A loss of AC power was detected.	Check user AC power connections for shorts or opens. Turn high power back on and restart the program. If the error persists, contact your local Omron support.
<b>B#</b>	B#	None	N/A	IO-Blox communications error with IO-Blox (#).	Check user IOBlox connections for shorts or opens. Check IOBlox address switches for proper configuration. Cycle power to the control system. If the error persists, contact your local Omron support.
<b>BA</b>	BA	None	N/A	The encoder backup battery is low.	Replace the encoder backup battery.
<b>D#</b>	D#	*Duty-cycle exceeded* Mtr #	-1021	The indicated motor (#) has been driven hard for too long a period of time. The servo system has disabled power to protect the robot hardware.	Turn high power back on; reduce the speed and/or acceleration for the motion that was in progress or for motions that preceded that motion. Repeat the motion that failed.
<b>E#</b>	E#	*Encoder Fault*	-1025	The servo system has	User actions vary by

LED	Status Code	V+ Error Message	V+ Error Code	Explanation	User Action
				detected an encoder fault.	product. Please reference individual robot manuals for appropriate actions.
<i>ES</i>	ES	*E-STOP detected by robot*	-643	An E-STOP condition has been detected by the robot.	This is a normal response to many E-STOP conditions. Remove the source of the ESTOP and re-enable high power.
<i>F1</i>	F1	*E-STOP detected by robot*	-643	The End-Of-Arm Break-away Sensor has tripped (open circuit). Reporting of this error can be enabled / disabled via ACE.	Re-close the break-away circuit and re-enable high power.
<i>FM</i>	FM	None	N/A	Firmware version mismatch.	Contact your local Omron support.
<i>FW</i>	FW	*1394 communications timeout*	-927	The IEEE 1394 communications system has failed to initialize or has lost communications with the SmartController EX.	This will occur normally if the SmartController EX is powered down separately from the robot systems. If it occurs unexpectedly, check the connections and integrity of the 1394 cabling.
<i>h#</i>	h#	*Robot overheated*	-606	The temperature sensor on the embedded processor board has reached its temperature limit. It may be necessary to slow the motion or insert pauses to reduce overall heating.	Check for excessive ambient temperature, inadequate ventilation, and proper function of any cooling fans.
<i>H#</i>	H#	*Motor overheating* Mtr #	-1016	The motor encoder temperature sensor indicates an overtemperature.	Reduce the speed, acceleration and/or deceleration of the robot motions, or introduce delays in the application cycle to give the motor an opportunity to cool.

LED	Status Code	V+ Error Message	V+ Error Code	Explanation	User Action
<b>HV</b>	hV	*RSC power failure*	-670	The high-voltage DC bus for the amplifiers is out of bounds (too high or low).	This may occur when AC power is unexpectedly removed. Check AC connections and re-enable high power. If the error persists, contact your local Omron support.
<b>I#</b>	I#	None	N/A	Servo initialization stages. These steps normally sequence (I0, I1, ...) on the display during normal system boot.	None, unless an initialization code persists longer than 30 seconds. This may indicate servo initialization has failed. Contact your local Omron support.
<b>M#</b>	M#	*Motor stalled* Mtr #	-1007	A motor stall occurs when the maximum allowed torque for a given motor was applied for longer than the defined timeout period. This typically occurs when an obstacle is encountered.	Check for obstacles and free movement of all joints. Turn high power back on and repeat the motion that failed.
<b>P0</b>	P0	*Power system failure* Code 0	-1115	The dual-channel brake circuit has reported a cyclic check error.	Contact your local Omron support.
<b>P1</b>	P1	*Power system failure* Code 1	-1115	The power system has unexpectedly turned off power.	On PA-4 chassis, further information may be indicated on the PA-4 status lights. Refer to Adept PA-4 Power Chassis User's Guide for details. Contact your local Omron support if the error persists.
<b>P2</b>	P2	*Power system failure* Code 2	-1115	The high-voltage DC bus to the regenerative energy dump circuit has experienced an over-voltage.	Contact your local Omron support.
<b>P3</b>	P3	*Power system	-1115	The regenerative energy	Contact your local

LED	Status Code	V+ Error Message	V+ Error Code	Explanation	User Action
		failure* Code 3		dump circuit has exceeded its max short-term dump rating.	Omron support.
<b>P4</b>	P4	*Power system failure* Code 4	-1115	The high-voltage DC bus did not discharge its voltage when expected. (Note: This error is only relevant to legacy Cobra AIB systems.)	Contact your local Omron support.
<b>P5</b>	P5	*Power system failure* Code 5	-1115	An inrush error was detected by the power sequencer. This means the high-voltage DC bus failed to rise at the expected rate when power was enabled.	This can occur if AC power is abruptly removed during the high-power enable sequence. If it occurs unexpectedly, contact your local Omron support.
<b>PR</b>	PR	None	N/A	A servo task has overrun its allotted execution window.	If the problem persists, contact your local Omron support.
<b>RC</b>	RC	*RSC communications failure*	-651	There is a failure to communicate with the Robot Signature Card.	Contact your local Omron support.
<b>S0</b>	S0	*Safety System Fault* Code 0	-1109*	The robot hardware did not detect that the front-panel high-power button was pressed prior to the servo system attempting to enable power.	Contact your local Omron support.
<b>S1</b>	S1	*Safety System Fault* Code 1	-1109*	The SmartController EX has signaled a power off condition to the robot via the HIPWR_DIS line on the XSYS interface. This fault indication typically accompanies other fault conditions that cause "fatal error" on the SmartController EX error (such as a loss in IEEE-1394 communication).	Check for other messages on the SmartController EX that may indicate a fatal error. If the error source can be eliminated, re-enable power.
<b>S2</b>	S2	*Safety System Fault* Code 2	-1109*	The safety system exper-	If the problem persists, contact your

LED	Status Code	V+ Error Message	V+ Error Code	Explanation	User Action
				perienced a failure on channel 1 during the cyclic check of dual-channel power system. This may indicate a welded relay contact or other hardware failure.	local Omron support.
<b>S3</b>	S3	*Safety System Fault* Code 3	-1109*	The safety system experienced a failure on channel 2 during the cyclic check of dual-channel power system. This may indicate a welded relay contact or other hardware failure.	If the problem persists, contact your local Omron support.
<b>S4</b>	S4	*Safety System Fault* Code 4	-1109*	The internal E-STOP delay timer timed out and power has been turned off. Under normal circumstances, software sequences the shutdown prior to the timeout, averting this message.	If the problem persists, contact your local Omron support.
<b>S5</b>	S5	*Safety System Fault* Code 5	-1109*	The power system was not properly unlocked by software during a power sequence while in manual mode.	Contact your local Omron support.
<b>S6</b>	S6	*Safety System Fault* Code 6	-1109*	The CAT-3 hardware safety system detected an encoder OVERSPEED and power has been turned off. This circuitry is active in manual mode only, on select robots which have the CAT-3 teach mode option installed.	This fault is triggered on purpose during specific commissioning tests for the CAT-3 system. If the fault occurs during normal operation, contact your local Omron support.
<b>S9</b>	S9	*Safety System Fault* Code 9	-1109*	A watchdog circuit that cross-checks the clocks for the dual-channel safety system is reporting an error.	Contact your local Omron support.
<b>SE</b>	SE	*Safety System	-648	The E-Stop Delay has	Commission and

LED	Status Code	V+ Error Message	V+ Error Code	Explanation	User Action
		Not Commissioned*		not been commissioned and verified.	verify the E-Stop Delay.
<b>SW</b>	SW	None	N/A	Software watchdog timer timeout. On some products it is normal for this to occur momentarily during a servo reset.	If the problem persists, contact your local Omron support.
<b>T0</b>	T0	*Safety System Fault* Code 10	-1109	An error was detected during a software self test of a secondary safety and monitoring circuit (SRV_DIRECT / SRV_STAT).	Contact your local Omron support.
<b>TR</b>	TR	*Safety System Not Commissioned*	-648	The Teach Restrict feature has not been commissioned and verified.	Commission and verify the Teach Restrict feature.
<b>V#</b>	V#	*Hard envelope error* Mtr #	-1027	The indicated motor was not tracking the commanded position with sufficient accuracy as set by ACE.	Turn on high power and try to perform the motion at a slower speed. Make sure that nothing is obstructing the robot's motion. If the error recurs, contact your local Omron support.

**NOTE:** For more information on status codes, refer to the Status Codes for Embedded Products document.

## 5.3 Brakes

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

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.

### 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 5-2. 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 brake.

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



**CAUTION: PROPERTY DAMAGE RISK**

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.

### Remote Brake Release Feature

You can also configure the XIO Input 6.2 (pin 18) to act as an alternate hardware brake release input. The setting is available on the Robot page in the ACE software. The parameter is Remote Brake Release Input. When enabled (True), activating XIO Input 6.2 is identical to pressing the brake button on the status display. The input status will still reflect in the IO register.

If an alternate (user-supplied) brake release button is used, ensure that the brake release button displays a warning similar to the preceding WARNING. This is to comply with ISO 10218-1, Clause 5.13.

## 5.4 Front Panel

**NOTE:** The factory-supplied Front Panel E-Stop is designed in accordance with the requirements of IEC 60204-1 and ISO 13849.

**IMPORTANT:** Any user-supplied front panel E-Stop must be designed in accordance with the requirements of IEC 60204-1 and ISO 13849. The push button of the E-Stop must comply with ISO 13850 (Clause 5.5.2).

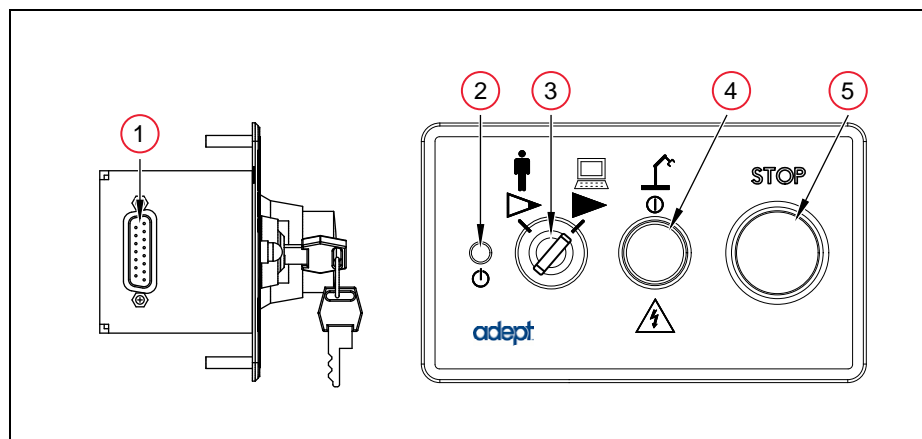


Figure 5-3. Front Panel



1. **XFP connector**

Connects to the XFP connector on the eAIB XSYSTEM cable (or the optional SmartController EX, if one is being used).

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 hardware and software restrictions on robot speed, commanding no more than 250 mm/sec.

There is no high speed mode in manual mode.



**WARNING: PERSONAL INJURY RISK**

If an operator is going to be in the work cell in manual mode, it is strongly recommended that the operator carry an enabling device. The Enable button on the manual control pendant is such a device.



**WARNING: PERSONAL INJURY RISK**

Whenever possible, manual mode operations should be performed with all personnel outside the workspace.

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 a 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.

**IMPORTANT:** Disabling the High Power button violates IEC 60204-1. It is strongly recommended that you not alter the use of the High Power button.

**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.

## 5.5 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.

**NOTE:** A typical IO Blox configuration is shown in Figure 5-4. Other configurations may be possible. Contact your local Omron support for more information.

Table 5-3. Digital I/O Connection Options

Product	I/O Capacity	For more details
XIO Connector on robot	12 inputs 8 outputs	see eAIB XIO Connector Signals on page 86
Optional IO Blox Device, connects to robot	8 inputs, 8 outputs per device; up to eight IO Blox devices per robot	see <i>IO Blox User's Guide</i> . Not available with eCobra Lite.
The following I/O connector and module require the optional SmartController EX motion controller		
XDIO Connector on SmartController EX	12 inputs 8 outputs	<i>SmartController EX User's Guide</i>

### 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 93. 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 *XIO Termination Block Installation Guide* for details.

### Default Digital I/O Signal Configuration

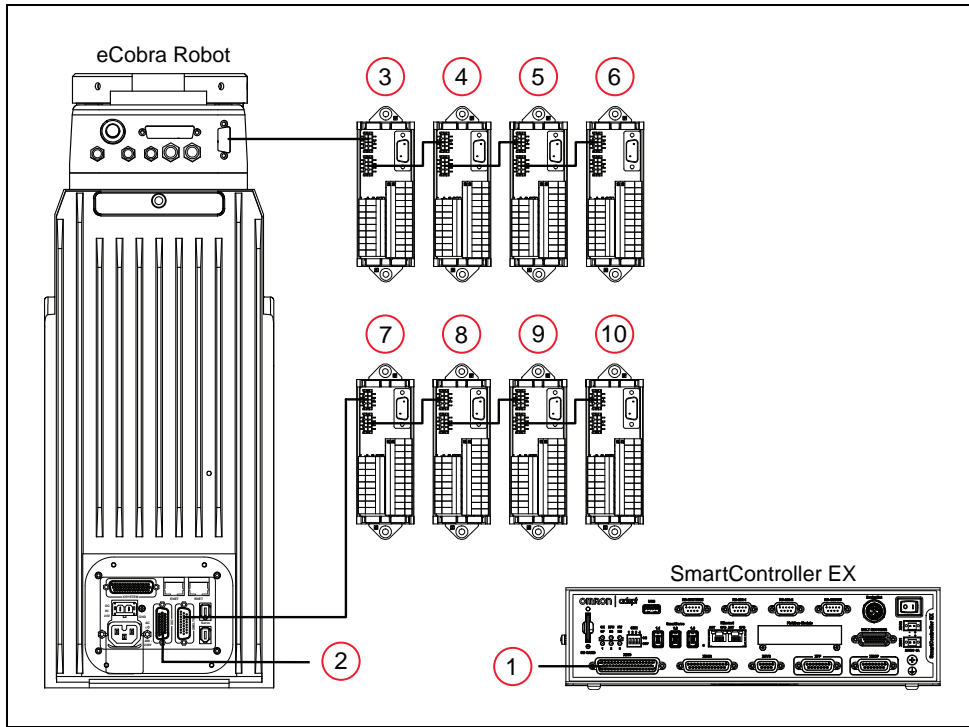


Figure 5-4. Connecting Digital I/O to the System

Table 5-4. Default Digital I/O Signal Configuration, Single Robot, no SmartController EX

Item	Location	Type	Signal Range
2	Robot 1 XIO connector <sup>a</sup> On eAIB panel.	Inputs	1001–1012
		Outputs	0001–0008
3	IO Blox 1	Inputs	1033–1040
		Outputs	0033–0040
4	IO Blox 2	Inputs	1041–1048
		Outputs	0041–0048
5	IO Blox 3	Inputs	1049–1056
		Outputs	0049–0056
6	IO Blox 4	Inputs	1057–1064
		Outputs	0057–0064
7	IO Blox 5	Inputs	1065–1072
		Outputs	0065–0072

Item	Location	Type	Signal Range
8	IO Blox 6	Inputs	1073–1080
		Outputs	0073–0080
9	IO Blox 7	Inputs	1081–1088
		Outputs	0081–0088
10	IO Blox 8	Inputs	1089–1096
		Outputs	0089–0096
<sup>a</sup> For Multi-Robot systems, see <i>Single and Multiple Robot Configuration Guide</i> .			

Table 5-5. Default Digital I/O Signal Configuration, Single Robot, with SmartController EX

Item	Location	Type	Signal Range
1	SmartController EX (optional) XDIO connector	Inputs	1001–1012
		Outputs	0001–0008
2	Robot 1 XIO connector <sup>a</sup>  On eAIB panel.	Inputs	1097–1108
		Outputs	0097–0104
3	IO Blox 1	Inputs	1113–1120
		Outputs	0105–0112
4	IO Blox 2	Inputs	1121–1128
		Outputs	0113–0120
5	IO Blox 3	Inputs	1129–1136
		Outputs	0121–0128
6	IO Blox 4	Inputs	1137–1144
		Outputs	0129–0136
<b>NOTE:</b> The signal number sequence at this point jumps ahead - it is not contiguous from IO Blox 4 to IO Blox 5.			
7	IO Blox 5	Inputs	1289–1296
		Outputs	0257–0264
8	IO Blox 6	Inputs	1297–1304
		Outputs	0265–0272
9	IO Blox 7	Inputs	1305–1312
		Outputs	0273–0280

Item	Location	Type	Signal Range
10	IO Blox 8	Inputs	1313–1320
		Outputs	0281–0288
<sup>a</sup> For Multi-Robot systems, see <i>Single and Multiple Robot Configuration Guide</i> .			

### eAIB XIO Connector Signals

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 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 5-6. XIO Signal Designations

Pin No.	Designation	Signal Bank	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
17	Input 5.2	2	1107
18	Input 6.2	2	1108
19	Output 1		0097

Pin No.	Designation	Signal Bank	eV+ Signal Number
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

### 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.

For REACTI programming, high-speed interrupts, or vision triggers:

- With a SmartController EX, you can only use the EX XDIO inputs.
- Without a SmartController EX, you can only use the XIO inputs.

See the *eV+ Language User's Guide* for information on digital I/O programming.

**XIO Input Specifications***Table 5-7. 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 $\Omega$ minimum
Current at $V_{in} = +24$ VDC	$I_{in} \leq 6$ mA
Turn on response time (hardware)	5 $\mu$ sec maximum
Software scan rate/response time	16 ms scan cycle/ 32 ms max response time
Turn off response time (hardware)	5 $\mu$ sec maximum
Software scan rate/response time	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**

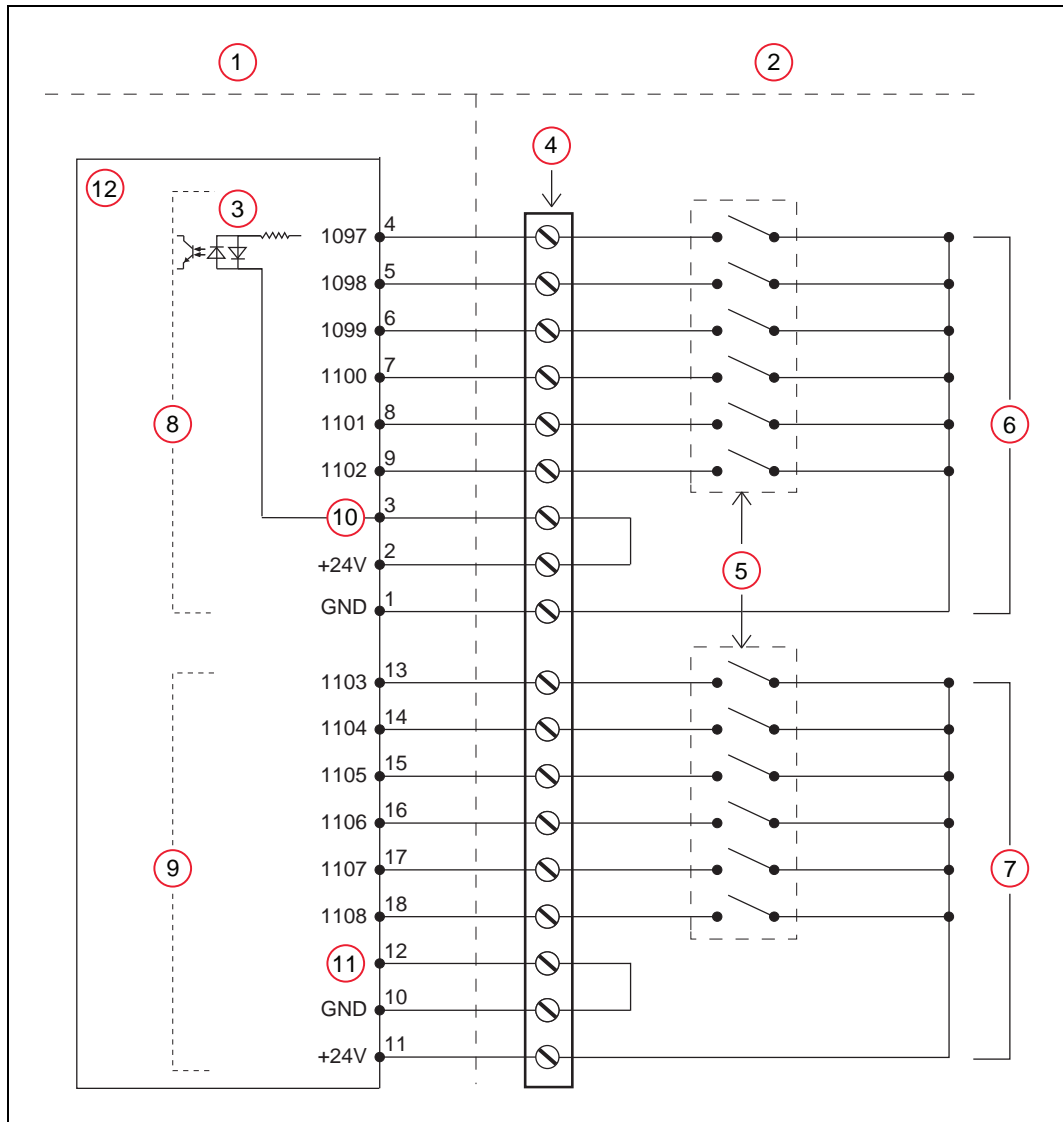


Figure 5-5. Typical User Wiring for XIO Input Signals

**NOTE:** All input signals can be used for either sinking or sourcing configurations.

Table 5-8. Typical User Wiring for XIO Input Signal Description

Item	Description
1	Supplied Equipment
2	User-supplied Equipment
3	Equivalent Circuit
4	Wiring Terminal Block
5	Typical User Input Signals (part present sensor, feeder empty sensor, part jammed sensor, sealant ready sensor, etc.)
6	Bank 1 configured for Sinking (NPN) inputs
7	Bank 2 configured for Sourcing (PNP) inputs
8	Input Bank 1
9	Input Bank 2
10	Bank 1 Common
11	Bank 2 Common

**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 poly-fuse.

The outputs are accessed through direct connection to the XIO connector. See Table 5-6. Optionally, use the XIO Termination Block. See the documentation supplied with the termination block for details.

**XIO Output Specifications**

Table 5-9. XIO Output Circuit Specifications

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

**Typical Output Wiring Example**

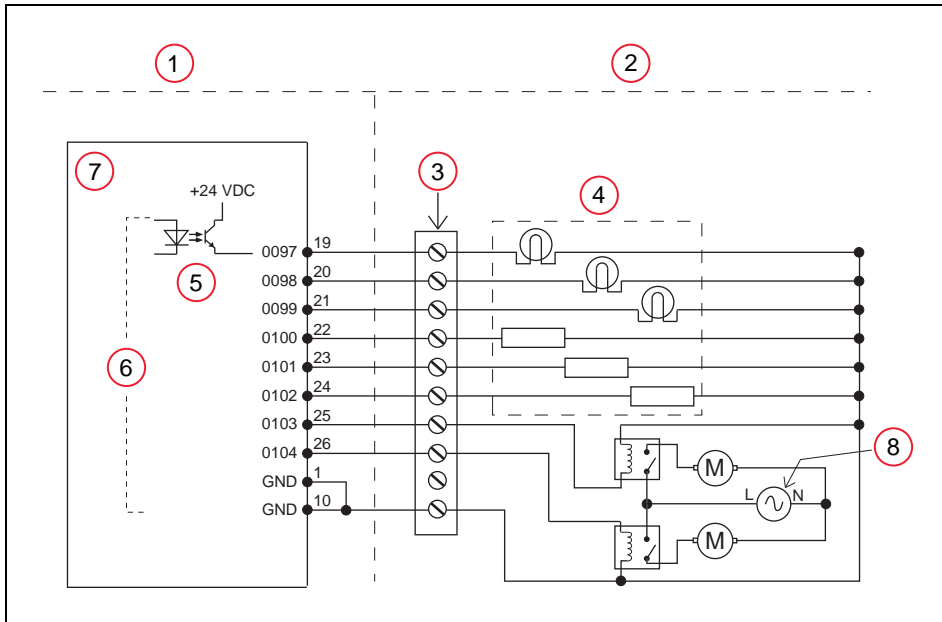


Figure 5-6. Typical User Wiring for XIO Output Signals

Table 5-10. Typical User Wiring for XIO Output Signal Description

Item	Description
1	Supplied Equipment
2	User-supplied Equipment
3	Wiring Terminal Block
4	Typical User Loads
5	Equivalent Circuit
6	Outputs 1 - 8
7	XIO Connector (26-Pin Female D-Sub)
8	Customer AC Power Supply

## 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 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 5-7. Optional XIO Breakout Cable

Table 5-11. 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

Pin No.	Signal Designation	Wire Color
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

## 5.6 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
- Moving each joint 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 system has been properly installed.



**WARNING: PERSONAL INJURY OR PROPERTY DAMAGE RISK**  
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:

**NOTE:** The first three connections are made via the eAIB XSYSTEM cable if you are not using an optional SmartController EX motion controller.

- Front Panel to the XSYSTEM on the eAIB.
- Pendant to the XSYSTEM on the eAIB.
- XUSR to the XSYSTEM on the eAIB.
- User-supplied 200/240 VAC power to the robot 200/240 VAC connector.
- User-supplied 24 VDC power to the robot 24 VDC connector.

If you are using an optional SmartController EX, you should check the following:

- eAIB XSYS cable between the robot interface panel XSYSTEM connector and XSYS connector on the SmartController EX, and the latching screws tightened.
- Front Panel to the SmartController EX.
- Pendant to the SmartController EX, via the pendant adapter cable.
- User-supplied 24 VDC power to the controller.
- User-supplied ground wire between the SmartController EX and ground.
- One end of the IEEE 1394 cable into the SmartServo connector on the SmartController EX, and the other end into a SmartServo connector on the robot interface panel.

### 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 ACE.

1. Manually move the robot joints away from the folded shipping position.  
See Transport and Storage on page 25.
2. Turn on the 200/240 VAC power.



**WARNING: ELECTROCUTION RISK**

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

3. Turn on the 24 VDC power to the robot.
  - The Status Panel will display OK.
  - The Robot Status LED will be off.
4. Verify the Auto/Manual switch on the Front Panel is set to Auto Mode.

### Starting ACE

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

1. Turn on the user-supplied PC and start ACE.
  - Double-click the ACE icon on your Windows desktop,  
or
  - From the Windows Start menu bar, select:  
**Start > Programs > Omron > ACE x.y**  
where x is the ACE major version, and y is the ACE minor version. For example, for ACE 3.6, it would be:  
Start > Programs > Omron > ACE 3.6
2. On the ACE Getting Started screen:
  - Select Connect To Controller.
  - 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 ACE and connected to the controller, enable high power to the robot motors.

### Using ACE to Enable High Power

1. From the 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 5-3. (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.

**IMPORTANT:** Disabling the High Power button violates IEC 60204-1. It is strongly recommended that you not alter the use of the High Power button.

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 73.

## 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 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 ACE software. For details, see the *ACE User's Guide*.

Verify that the Teach Restrict speed limitation is working correctly by running the Teach Restrict verification procedure. Refer to the Teach Restrict Verification Utility on page 114.

## 5.7 Learning to Program the eCobra Robot

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

For eV+ programming information, refer to the eV+ user and reference guides.



# Chapter 6: Maintenance

## 6.1 Field-Replaceable Parts



**WARNING: ELECTROCUTION RISK**

Only qualified service personnel may install or service the robot system. All maintenance work must be performed by a skilled and instructed personnel - refer to the Robot Safety Guide.



**WARNING: ELECTROCUTION RISK**

During maintenance, user-supplied fail-safe lockout measures must be used to prevent, unauthorized third parties from turning on power. This is mandated by Clause 5.2.4 of ISO 10218-1.

During any maintenance-related activities, care must be taken involving AC power lockout. It is the user's responsibility to make sure adequate measures are taken to

- lockout/ tagout power to the robot and related equipment.
- make sure that the robot cannot be energized during maintenance, as mandated by Clause 5.2.4 of ISO 10218-1.

The following parts are the only field-replaceable parts:

*Table 6-1. Field-replaceable Parts*

Part	Omron Adept Technologies, Inc. Part Number	
Encoder battery	09977-000 (3.6 V, 6.8 Ah) (This has replaced part number 02704-000)	
eAIB (Amp-In-Base)	eCobra 600	eCobra 800
	19800-600	19800-800
MicroSD card	12053-000	

These parts must only be replaced with the parts listed in the preceding table.

## 6.2 Periodic Maintenance Schedule

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

See also Cleanroom Maintenance on page 191 and Customer Requirements on page 181.

Table 6-2. Inspection and Maintenance

Item	Period	Reference
Safety Labels	1 week	
Check E-Stop, enable and key switches, and barrier interlocks	6 months	Warning Labels on page 100
Check robot mounting bolts	6 months	Checking Robot Mounting Bolts on page 103
Check for signs of oil around Harmonic Drive® area.	3 months	Checking for Oil Leakage on page 103.
Lubricate Joint 3 ball screw	3 months	Lubricating Joint 3 on page 104
Replace encoder battery	2 to 4 years	Replacing the Encoder Battery Pack on page 117

**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: ELECTROCUTION RISK**  
Lockout and tagout power before servicing.



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

## 6.3 Warning Labels

**NOTE:** Labels giving instructions for lifting or installing are not considered warning labels. They may be removed by the user, and do not need to be checked.

All warning labels on the eCobra robot should be checked on a weekly basis for being present and legible. If any of the labels are missing or illegible, they should be replaced. The labels, with part numbers, are:

- Read User's Guide, Impact Warning Label, 18241-000

These labels instruct the user to read the user's guide before using the robot, and to be aware of the potential of impact by the robot.



Figure 6-1. Read Manual and Impact Warning Label

This is placed in the following location on the robot:



Figure 6-2. Location of Read Manual and Impact Warning Label (Inverted Model Shown).

- Gravity/Brake Release Label, 18272-000

This label warns about the possibility of a robot joint dropping suddenly when the brake release is pressed because of gravity. In the case of the eCobra, this applies to the quill and tool flange.



*Figure 6-3. Brake Release/Gravity Label*

- Lifting Point Label, 08613-000

This label is partially around the eyebolt, marking that as a point to lift from.



*Figure 6-4. Lifting Eyebolt Label*

## 6.4 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.

## 6.5 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-lbf).

Also check the tightness of all cover plate screws. Tighten to 1.6 N·m (14 in-lbf).

## 6.6 Checking for Oil Leakage

The eCobra 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 Drives. Check these locations:

- the area around Joint 1
- the area around Joint 2
- inside the base of the robot, by opening the eAIB chassis and inspecting internally.



**WARNING: ELECTROCUTION RISK**

Remove all power to the robot before opening the eAIB chassis.

Contact Omron Adept Technologies, Inc. if you find any signs of oil in these areas.

## 6.7 Lubricating Joint 3

Use LG-2 Grease (Lithium Soap/Synthetic Hydrocarbon), P/N: 90401-04029.



**CAUTION: PROPERTY DAMAGE RISK**

Using improper lubrication products on an eCobra robot may cause damage to the robot.

1. Turn off main power to the robot.

If an optional SmartController EX is being used, turn off main power to that, too.

2. Remove the outer link cover by removing screws located on the sides and top of the cover. Carefully remove the cover.

**NOTE:** When the outer link cover is removed, you see the label shown in Figure 7-4. 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 IP65 version, refer to Robot Outer Link Cover Removal and Reinstallation on page 178 for instructions on removing the link cover, and IP65 Bellows Replacement on page 185 for instructions on removing the bellows.

For the Cleanroom version, refer to Bellows Replacement on page 191 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. Apply grease to the three vertical grooves and the spiral groove (see Chapter 6:



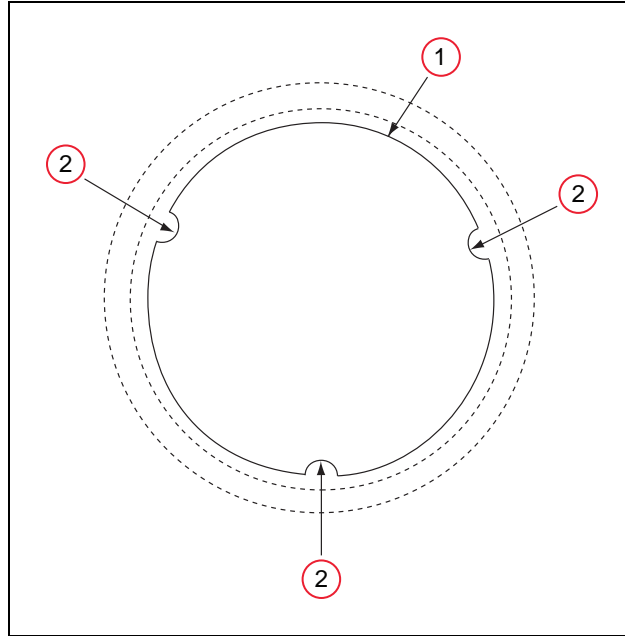


Figure 6-5. (1) Quill Shaft, (2) Vertical Groove Lubrication Points, Top-view Looking Down

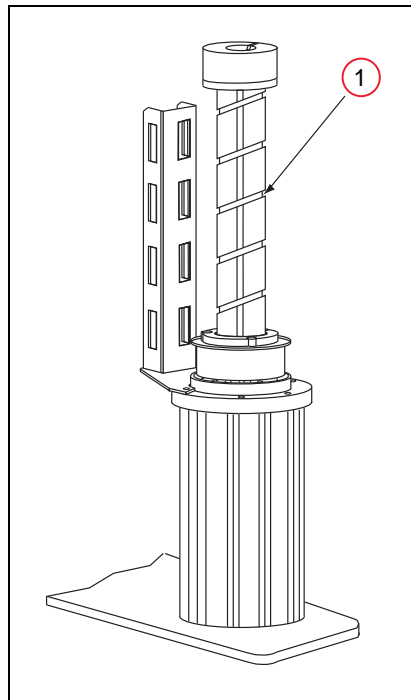
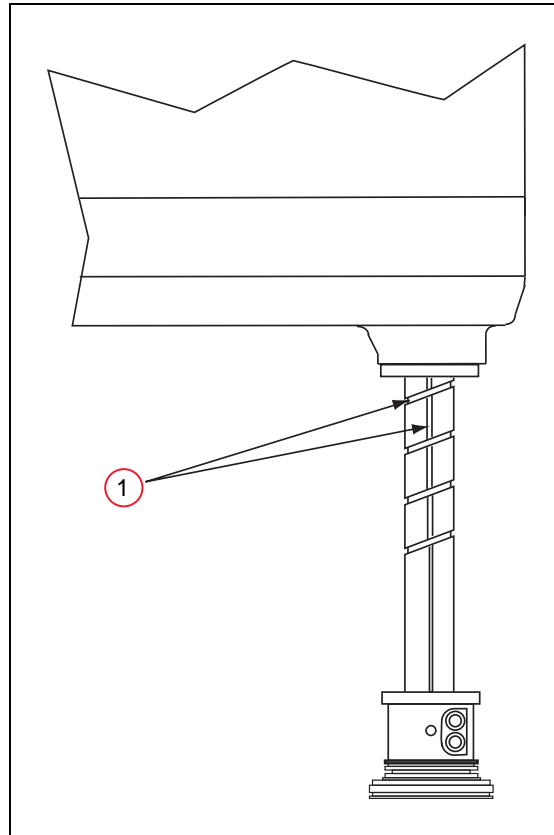


Figure 6-6. (1) Upper Quill Spiral Groove Lubrication Point

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 (see

figure below).



*Figure 6-7. (1) Lower Quill Grease Locations*

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, reinstall or replace the bellows.

## 6.8 Replacing the eAIB Chassis



**CAUTION: PROPERTY DAMAGE RISK**  
Follow appropriate ESD procedures during the removal/replacement phases.

### Removing the eAIB Chassis

1. Switch off the 24 VDC input supply to the chassis.
2. Switch off the 200/240 VAC input supply to the chassis.
3. Switch off the optional SmartController EX, if you are using one.
4. Disconnect the 24 VDC supply cable from the chassis +24 VDC input connector. For the connector location, see Figure 3-6.
5. Disconnect the 200/240 VAC supply cable from the chassis AC Input connector.
6. Disconnect the eAIB XSYSTEM cable from the chassis XSYSTEM connector.
7. Disconnect any other cables, which may be connected to the chassis, such as XIO, RS-232, 1394, or any others.
8. 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 6-8. (1) Securing Screw on eAIB Chassis

9. 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.

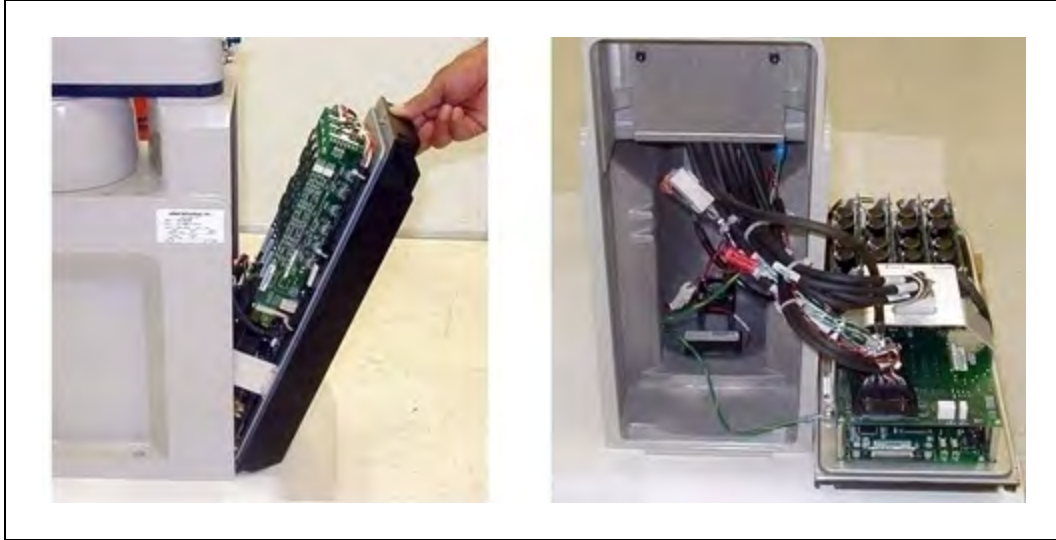


Figure 6-9. Opening and Removing Chassis

10. Disconnect the white amplifier cable from the (1) amplifier connector located on the chassis bracket. See the following figure.

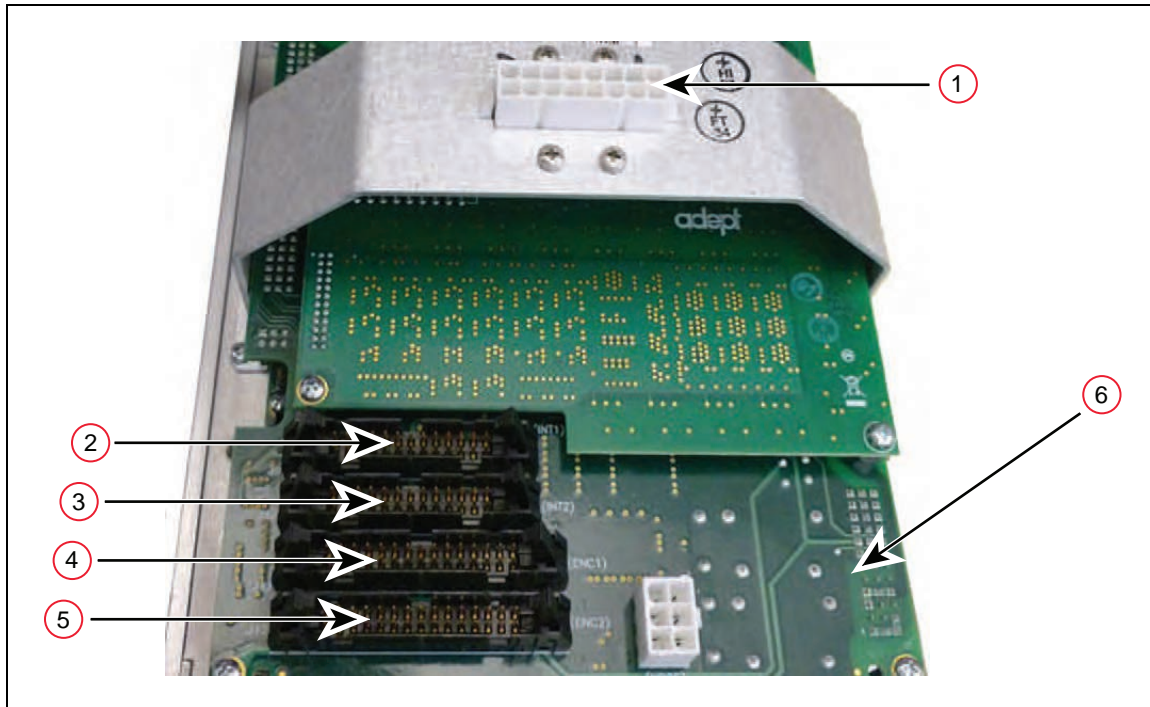


Figure 6-10. Connectors on Chassis and ePMAI Board

11. Carefully disconnect the INT1 (2), INT2 (3), ENC1 (4), and ENC2 (5) cables from their connectors on the ePMAI board (6), by disengaging the securing latches. See the previous figure.
12. 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.

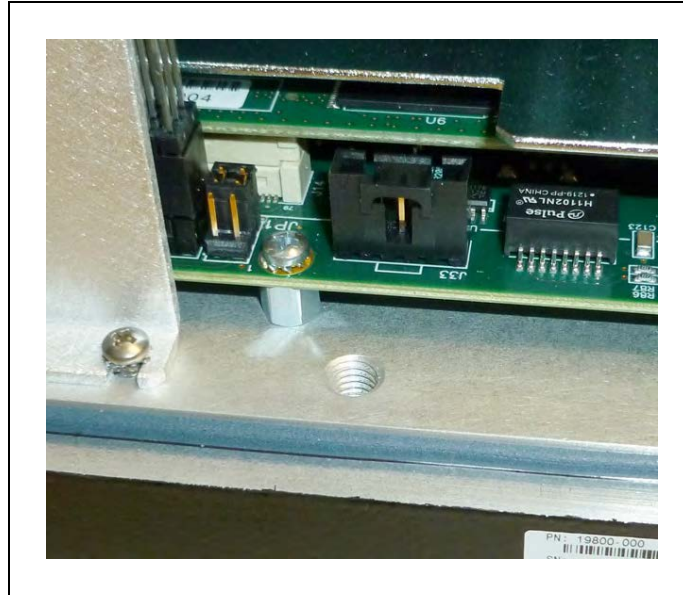


Figure 6-11. Ground Screw Hole on eAIB Chassis

13. Tag the chassis with the appropriate fault diagnosis faults/errors and robot serial number information.

### Installing a New 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, connect the ground wire to the chassis.
4. Reconnect the cables you removed from their connectors on the ePMAI board, and engage the securing latches.
5. Connect the “white” amplifier cable to the amplifier connector located on the chassis bracket.
6. Carefully insert the chassis into the robot base in the groove at the bottom of the base. 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 6-8.
8. Connect the 200/240 VAC supply cable to the chassis AC input connector.

9. Connect the eAIB XSYSTEM cable to the chassis XSYSTEM connector, or, if you are using an optional SmartController EX, connect the eAIB XSYS cable to the chassis XSYSTEM connector.
10. Connect any other cables that were connected to the chassis, such as XIO, RS-232, 1394, or any others.  
  
If you are using an optional SmartController EX, connect the XSYS end of the eAIB XSYS cable to the XSYS port on the controller.
11. Connect the 24 VDC supply cable to the chassis +24 VDC input connector.
12. Switch on the 200/240 VAC input supply to the chassis.
13. Switch on the 24 VDC input supply to the chassis.
14. Switch on the optional SmartController EX, if you are using one.
15. Once the system has completed booting, test the system for proper operation.

### 6.9 Commissioning a System With An eAIB

Commissioning a system involves synchronizing the robot with the eAIB.

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

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 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 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.
- ACE software must be installed.
- The Front Panel keyswitch must be in Auto mode.

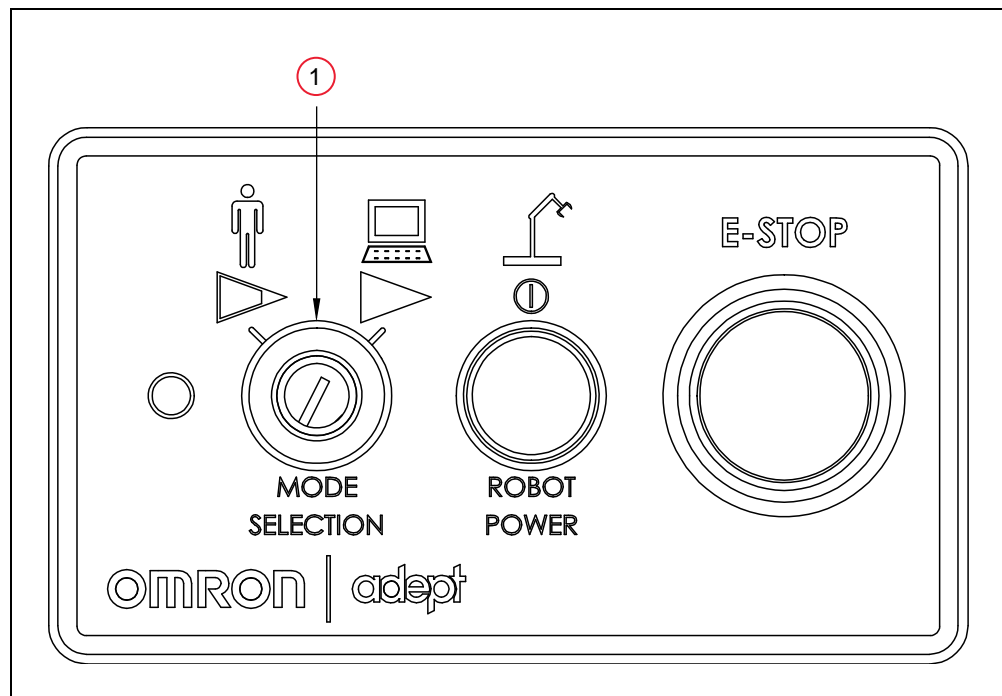


Figure 6-12. (1) Front Panel Keyswitch in Auto Mode

- 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 6-13. eAIB Commissioning Jumper*

- A 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 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 eV+:

**Controller > Control > Reboot eV+**

**NOTE:** This can also be accomplished by momentarily removing 24 VDC power from the controller.

**NOTE:** In this whole section, the term Controller can refer to an eAIB controller, a SmartController EX, or any e-Series controller.



## 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 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 V+:

**Controller > Control > Reboot V+**

**NOTE:** This can also be accomplished by removing 24 VDC power from the controller.

## 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 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 V+:

**Controller > Control > Reboot V+**

**NOTE:** This can also be accomplished by momentarily removing 24 VDC power from the controller.

### 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: PERSONAL INJURY RISK**

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

From within the 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 a 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 V+:

**Controller > Control > Reboot V+**

**NOTE:** This can also be accomplished by removing 24 VDC power from the controller.

7. Reset the Front Panel keyswitch to Auto mode.

## **6.10 Replacing a MicroSD Card**

**NOTE:** Without a functioning MicroSD card, the eAIB will not function, to the point that it will not even indicate that it is receiving power.

### **Removing a MicroSD Card from an eAIB**

1. Make sure that the eAIB controller is powered off.
2. Remove the eAIB from the robot.  
Refer to Removing the eAIB Chassis on page 107.
3. Lay the chassis on its back next to the robot, so you will have access to the connector end of the eAIB.
4. Unscrew the shoulder screw that secures the MicroSD card retention bracket.  
This requires a 5/64 in. hex key.

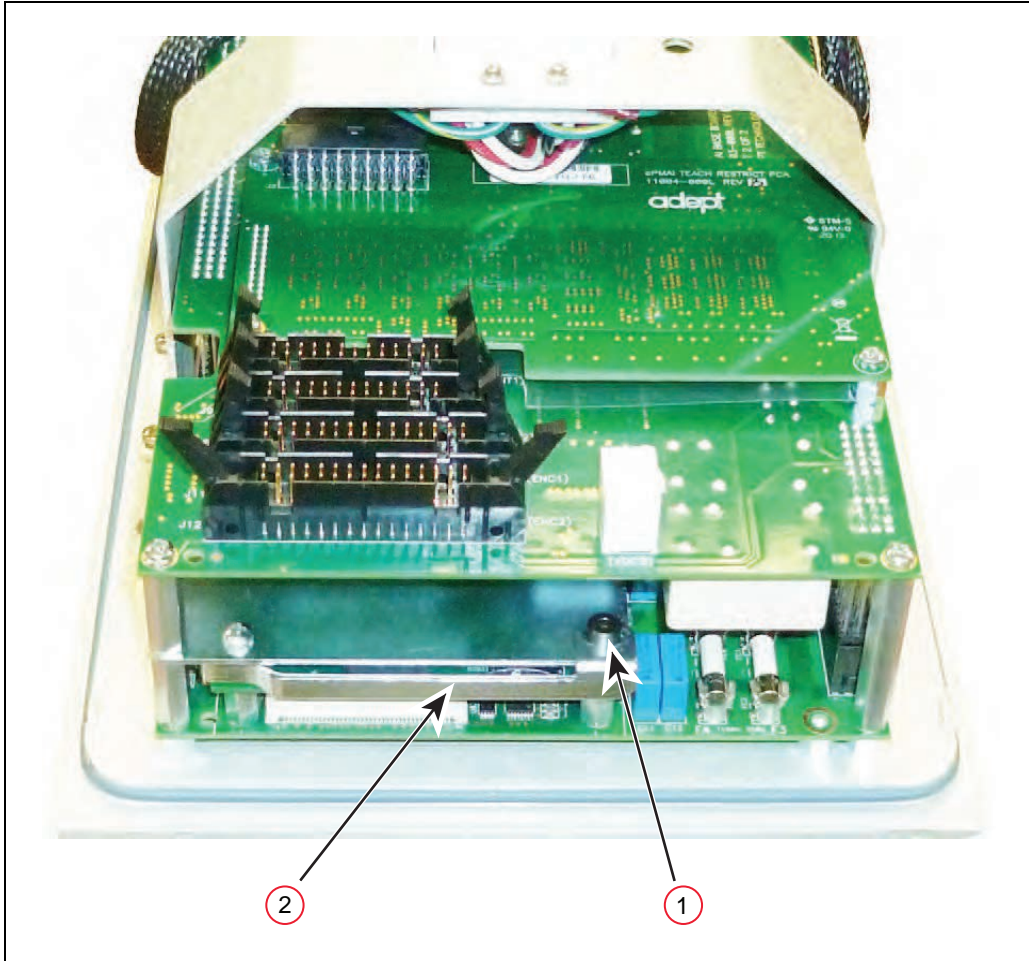


Figure 6-14. Connector-end of eAIB (with cables removed)

5. Remove the (1) shoulder screw and (2) MicroSD retention bracket. See the previous figure.

Save both of these for re-installation.

6. Remove the installed MicroSD card.

This is removed by pressing it all the way in, and then releasing. The card will pop out slightly, and can be pulled out.

See the following figure.

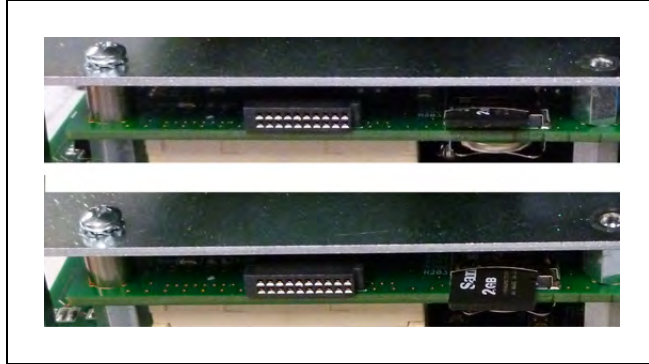


Figure 6-15. (top) MicroSD Card In and (bottom) Partially Out

Continue with the following section.

### Installing a MicroSD Card into an eAIB

This procedure assumes you have already removed the MicroSD card.

1. Install the MicroSD card into its holder in the eAIB controller.  
Press the card in all the way, and gently let it slide back out to a stop.
2. Place the hook end of the MicroSD retention bracket around the 1/4 in. standoff to the left of the MicroSD card holder.

The standoff is directly beneath the Phillips screw, shown towards the left side in the preceding figure.

The slotted tab on the other end of the bracket should line up with the hole shown at the top right side of the preceding figure.

3. Secure the retention bracket with the previously-removed shoulder screw.  
This requires a 5/64 in. hex key.  
Seat the screw so that the bracket is not loose.
4. Push the bracket all the way to the right, to secure the hook end around the standoff.  
It will be somewhat tight, but will slide when pressed hard enough.
5. Re-install the eAIB into the robot.

Refer to Installing a New eAIB Chassis on page 109.

## 6.11 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.

**IMPORTANT:** Replace the battery pack only with a 3.6 V, 6.8 Ah lithium battery pack, 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 24 VDC supply, is applied less than half the time, while the encoder backup battery is in the robot, then the battery should be replaced every 2 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 4 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 24 VDC input supply to the robot.
3. Switch off the 200/240 VAC input supply to the robot.
4. Switch off the optional SmartController EX, if you are using one.
5. Disconnect the 24 VDC supply cable from the robot +24 VDC input connector. For the connector location, see Figure 3-6.
6. Disconnect the 200/240 VAC supply cable from the robot AC input connector.
7. Using a 5 mm hex wrench, carefully unscrew the eAIB chassis securing screw. See Figure 6-8. 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 6-9. This provides access to the battery pack, as shown in the following figure.

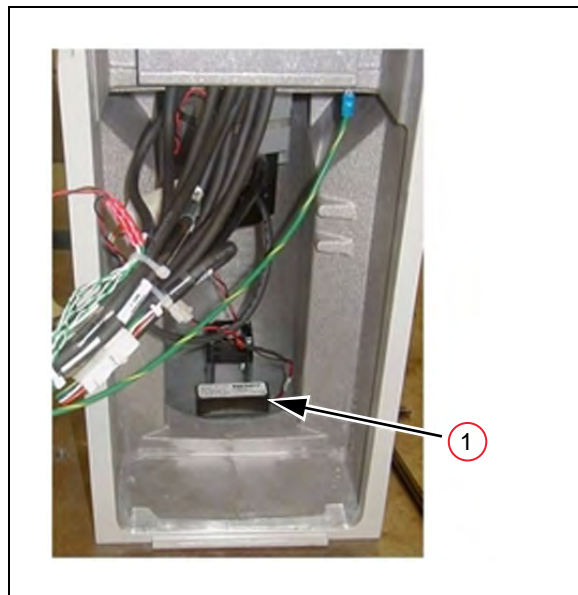


Figure 6-16. (1) Location of Encoder Battery Pack

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.

## 6.12 Changing the Lamp In the Front Panel High-Power Indicator

The system is equipped with circuitry to detect the potentially dangerous condition of a burned-out High Power indicator on the Front Panel. If this lamp is burned out, you cannot enable high power until the lamp has been replaced. Follow this procedure to replace the High Power indicator lamp. The part number for the lamp is 27400-29006.



**WARNING: ELECTROCUTION RISK**  
Lockout and tagout power before servicing.



**WARNING: ELECTROCUTION RISK**  
The procedures and replacement of parts mentioned in this section should be performed only by trained, authorized personnel. The access covers on the Front Panel are not interlocked – turn off and disconnect power before removing the cover.

1. Turn off system power to the robot.
2. Turn off power to the optional SmartController EX, if you are using one.
3. Disconnect the cable between the Front Panel and the eAIB (or controller).
4. Remove the Front Panel from its mounting location.
5. Remove the two screws on the back of the Front Panel.

Save the screws for re-installation.

- Carefully pull the front cover away from the body of the Front Panel.

You will encounter some resistance, as there are three plug-type connectors that you need to disconnect as you pull the front cover away from the body.

**NOTE:** Separate the cover from the body slowly to avoid damaging the two wires that go between the LED and the PC board inside the body. Pull the front cover as straight out as possible. You do not have to disconnect the wires from the PC board, although you can if needed.

- Locate the lamp body in the center of the back side of the front cover. Turn the lamp body approximately 20° in either direction and then pull straight back.
- The lamp body is now free. You can remove the old lamp and insert a new one.
- Re-install the lamp body by pushing it straight into the lamp housing receptacle. Make sure the contacts on the lamp body are properly oriented, as shown in the following figure.
- Make sure to reconnect the wires from the LED if you disconnected them earlier.
- Push the front cover into the body, taking care to align all of the plug-type connectors. Verify that the wires do not get crimped as you reinstall the cover.
- Re-install the two screws on the back of the body.
- Re-install the Front Panel in its mounting.
- Reconnect the cable between the Front Panel and the eAIB (or controller).

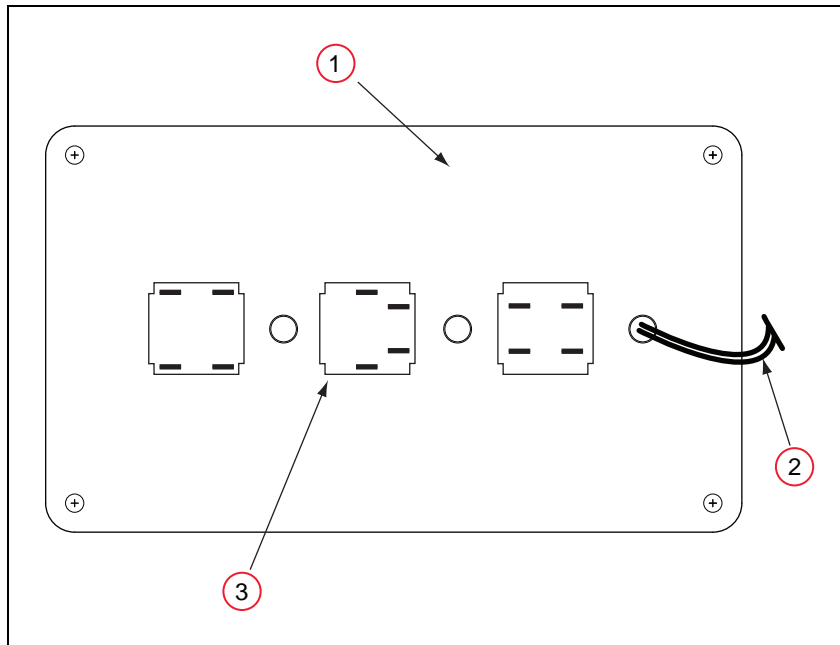


Figure 6-17. Lamp Body Contact Alignment



*Table 6-3. Lamp Body Contact Alignment Description*

<b>Item</b>	<b>Description</b>
1	Back side of Front Panel
2	Wires between LED and body of Front Panel. Be careful when separating Front Panel from body to avoid damaging the wires.
3	High Power ON / OFF Lamp Body



# Chapter 7: Optional Equipment Installation

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## 7.1 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 8-6. 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 60.

**NOTE:** A threaded hole is provided on the tool flange. See Figure 8-6. The user may attach a ground wire through the quill connecting the outer link and the tool flange.

## 7.2 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 7-1. 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.

**NOTE:** Be careful not to lose the steel ball (3.5 mm) that is inside the

flange behind the setscrew.

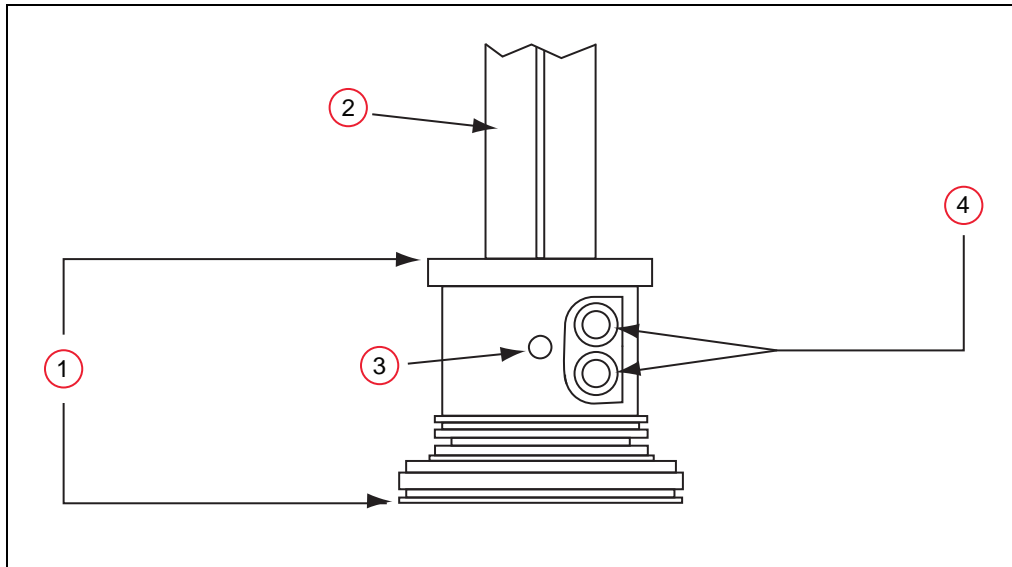


Figure 7-1. Tool Flange Removal Details

Table 7-1. Tool Flange Removal Description

Item	Description
1	Tool Flange Assembly
2	Quill Shaft
3	Setscrew
4	M4 Socket-head Cap Screws

### 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).

## 7.3 User Connections on the Robot

### User Air Lines

There are five user air line connectors on the robot user panel on the back of Joint 1. See Figure 7-2. 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 7-3.

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

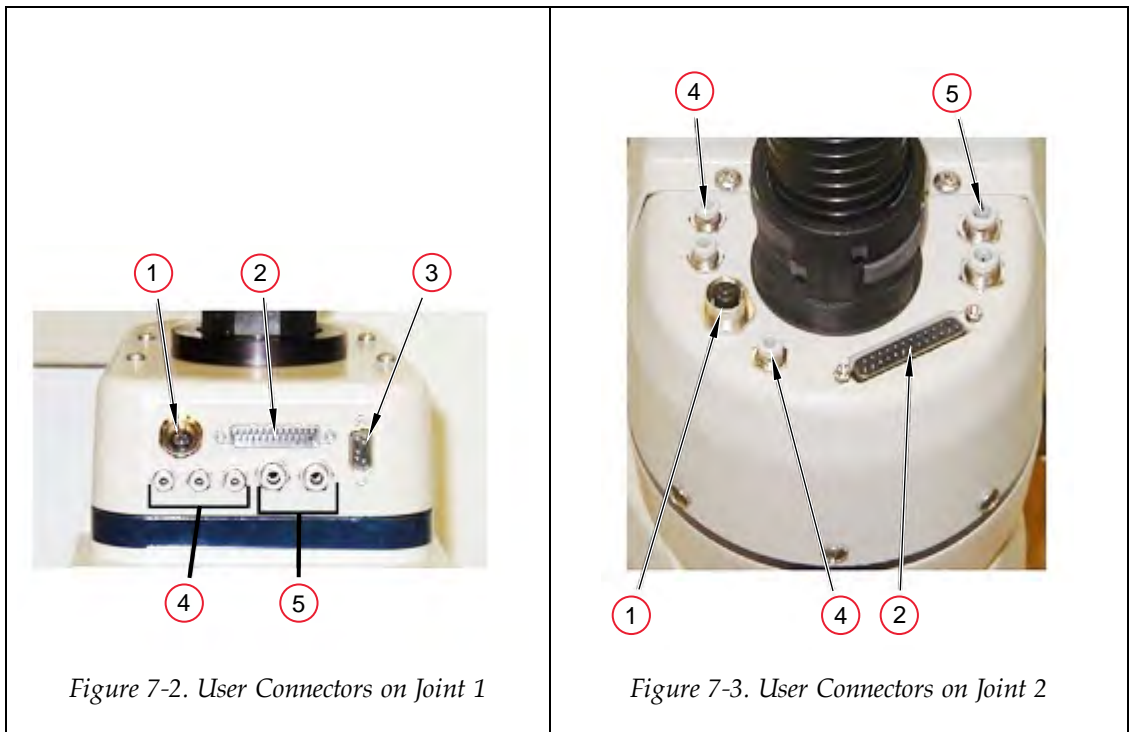


Table 7-2. Robot User Connections Descriptions

Item	Description
1	DeviceNet
2	User Electrical
3	IO Blox
4	4 mm Air Lines
5	6 mm Air Lines

**NOTE:** The IO Blox device is not available with the eCobra Lite. The DeviceNet connector requires the optional SmartController EX motion controller.

**NOTE:** For information on the IO Blox connector, see Connecting Digital I/O to the System on page 83. Also, refer to the *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 7-2. This connector is wired directly to a 25-pin female connector on the top of the outer link. See Figure 7-3. 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<sup>2</sup>, Pin Numbers 1-24, 12 pairs, twisted in pairs as 1&2, 3&4, 5&6, . . . 23&24. Maximum current per line: 1 Amp.

## 7.4 Internal User Connectors

The internal user connectors, OP3/4, EOAPWR, and ESTOP, can be accessed with the Outer Link cover removed—see Figure 7-4. The SOLND connector is located on the opposite of the bulkhead area—see Figure 7-5.



Figure 7-4. Internal User Connectors

Table 7-3. Internal User Connector Descriptions

Item	Description
1	OP3/4
2	J3-BRK
3	EOAPWR
4	ESTOP

**NOTE:** 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.

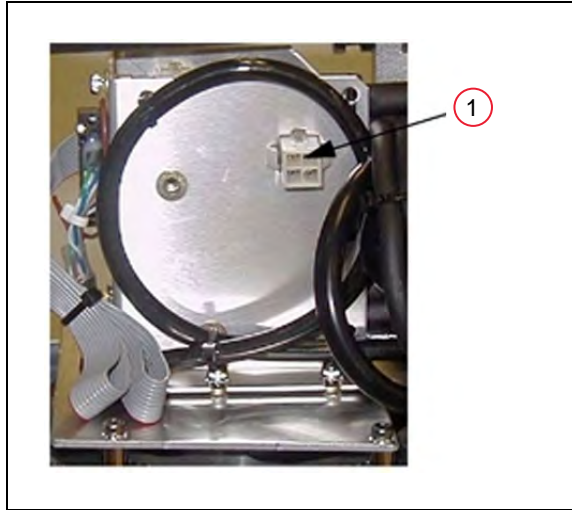
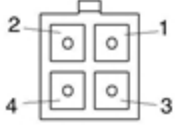


Figure 7-5. (1) SOLND Connector

### 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 132.

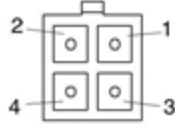
Table 7-4. SOLND Connector Pinout

Pin #	Description	Pin Location
1	Output 3001	 <p>SOLND Connector as viewed on robot</p>
2	Ground	
3	Output 3002	
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		

### 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 7-4.

Table 7-5. OP3/4 Connector Pinout

Pin #	Description	Pin Location
1	Output 3003	 <p>OP3/4 Connector as viewed on robot</p>
2	Ground	
3	Output 3004	
4	Ground	
<p>Mating Connector: AMP/Tyco #172167-1, 4-pin Mini-Universal Mate-N-Lok AMP/Tyco #770985-1, Pin Contact, Mini-Univ. Mate-N-Lok</p>		

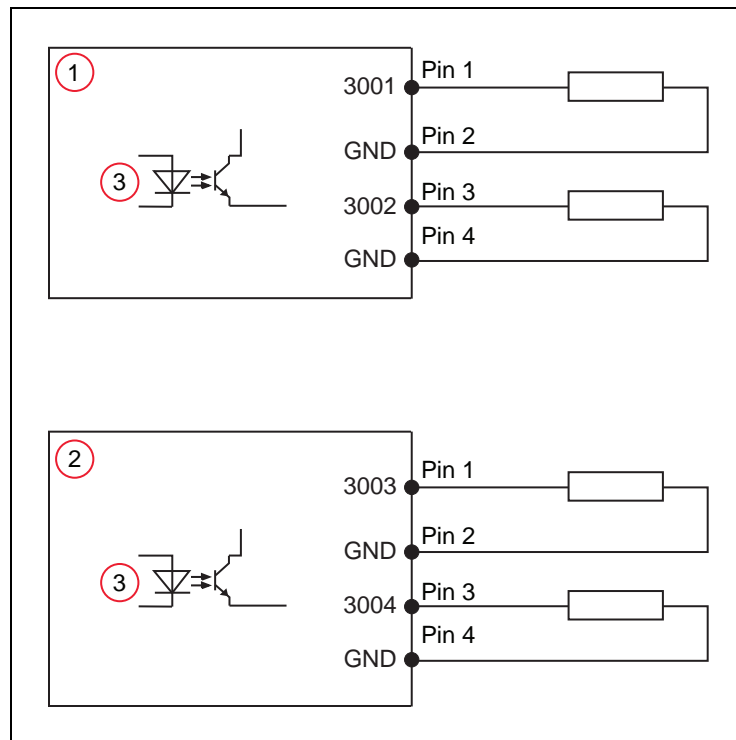


Figure 7-6. OP3/4 and SOLND Circuits



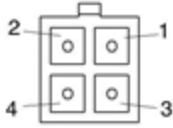
Table 7-6. OP3/4 and SOLND Circuit Descriptions

item	Description	Details
1	SOLND Connector Circuit	For optional Robot Solenoid Kit installation or other user-supplied devices.
2	OP3/4 Connector Circuit	For optional second set of solenoids or other user-supplied devices.
3	+24 VDC (equivalent circuit)	

### 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 7-4.

Table 7-7. EOAPWR Connector Pinout

Pin #	Description	Pin Location
1	24 VDC (see the next table for current specs)	 <p>EOAPWR Connector as viewed on robot</p>
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 7-8. Internal User Connector Output Circuit Specifications

Parameter	Value
Power supply voltage range	24 VDC $\pm$ 10% See Specifications for 24 VDC Power on page 50.
Operational current range, per channel	$I_{out} \leq 700$ mA
Total Current Limitation, all channels on <sup>a</sup>	$I_{total} \leq 1.0$ A @ 50° C ambient $I_{total} \leq 1.5$ A @ 25° C ambient

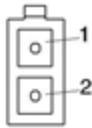
Parameter	Value
On-state resistance ( $I_{out} = 0.5 \text{ A}$ )	$R_{on} \leq 0.32 \ \Omega @ 85^\circ \text{ C}$
Output leakage current	$I_{out} \leq 25 \ \mu\text{A}$
Turn-on response time	125 $\mu\text{sec}$ max., 80 $\mu\text{sec}$ typical (hardware only)
Turn-off response time	60 $\mu\text{sec}$ max., 28 $\mu\text{sec}$ typical (hardware only)
Output voltage at inductive load turnoff ( $I_{out} = 0.5 \text{ A}$ , Load = 1 mH)	$(+V - 65) \leq V_{demag} \leq (+V - 45)$
DC short circuit current limit	$0.7 \text{ A} \leq I_{LIM} \leq 2.5 \text{ A}$
Peak short circuit current	$I_{ovpk} \leq 4 \text{ A}$
<b>aNOTE:</b> 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 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 7-9. 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		

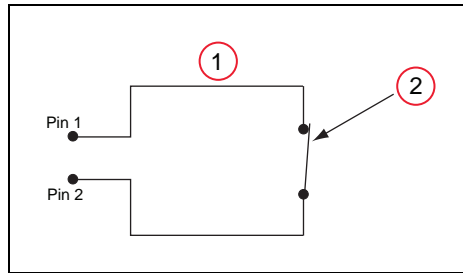


Figure 7-7. Internal E-Stop Connector Circuit

Table 7-10. Internal E-Stop Connector Circuit Description

Item	Description
1	Typical E-Stop Connector Circuit
2	User-supplied normally-closed contact. Can be connected to a break-away sensor to cause an E-Stop condition when circuit is open.  <b>NOTE:</b> This function is disabled by default. It must be enabled in the software.

**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 eAIB, or the optional SmartController EX, if you are using one.

#### **Procedure to Enable the Break-away E-Stop Function**

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

To change the Break-away E-Stop parameter from the ACE software:

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.

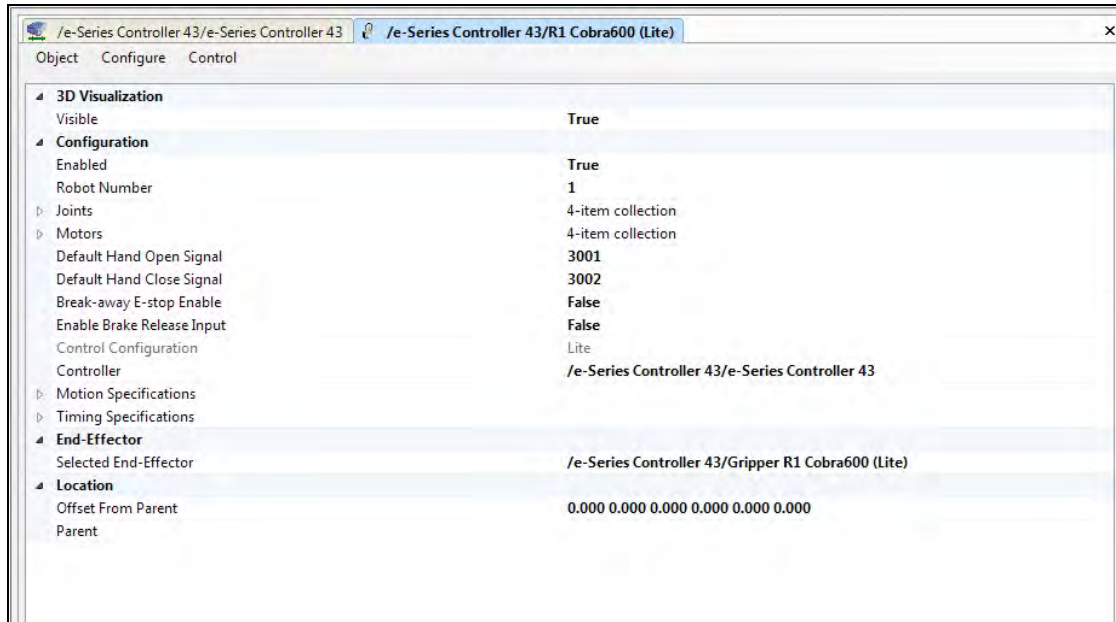


Figure 7-8. Robot Object Editor with Break-away E-Stop Parameter Field

**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.

## 7.5 Mounting Locations for External Equipment

Three locations are provided for mounting external user 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 8-7. and Figure 8-9. 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 140.

## 7.6 Installing the Robot Solenoid Kit

This procedure describes how to mount the 24 V Robot Solenoid option on eCobra robots. The kit is available as 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 7-10. The signals actuating the valves are directly switchable from eV+ using software signals 3001 and 3002. Refer to the SIGNAL command in the eV+ *Language Reference Guide* for additional information. ACE software can also be used.

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. 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.

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

In the eCobra robots, the air lines from Port A on each valve are plugged at the factory (at the solenoid assembly) so that the pack can be used as is as 3-way valves. By removing the plugs, the user can use the assembly as 4-way valves, if needed.

The Solenoid Kit for the eCobra robots is available through Omron Adept Technologies, Inc. Contact your sales representative for current price and availability.

*Table 7-11. 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 (p/n 02853-000)

### Signal Setup

The signals actuating the valves are directly switchable from either eV+ or the 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.

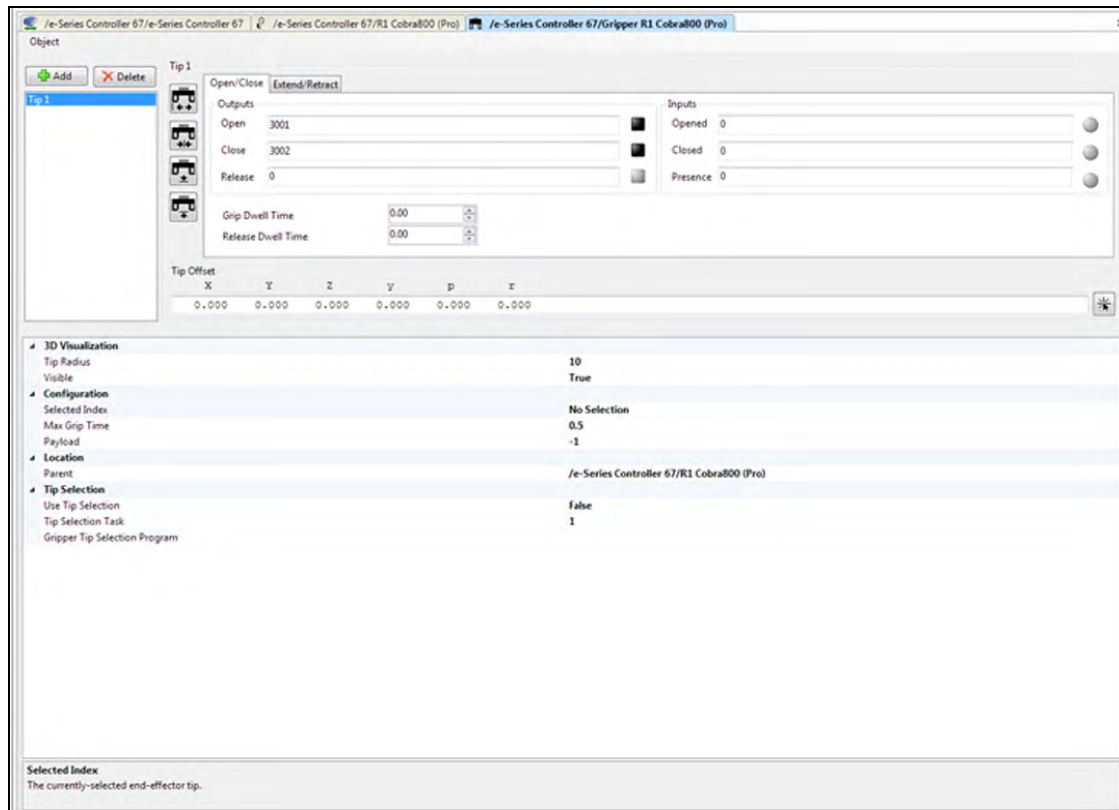


Figure 7-9. Setting Solenoid Signal Values

## Installation

1. Turn off all power to the robot.
2. Remove two screws on an eCobra 600 (three screws on an 800) on each side of the outer link cover. Remove two screws on top and remove the cover.

For the IP65 version, refer to Robot Outer Link Cover Removal and Reinstallation on page 178 for instructions on removing the link cover.

3. Connect the Internal Solenoid Valve Cable assembly (included in the Kit) to the Solenoid Manifold assembly, by plugging the SOL 1 connector into Valve 1 and SOL 2 into

## Valve 2.

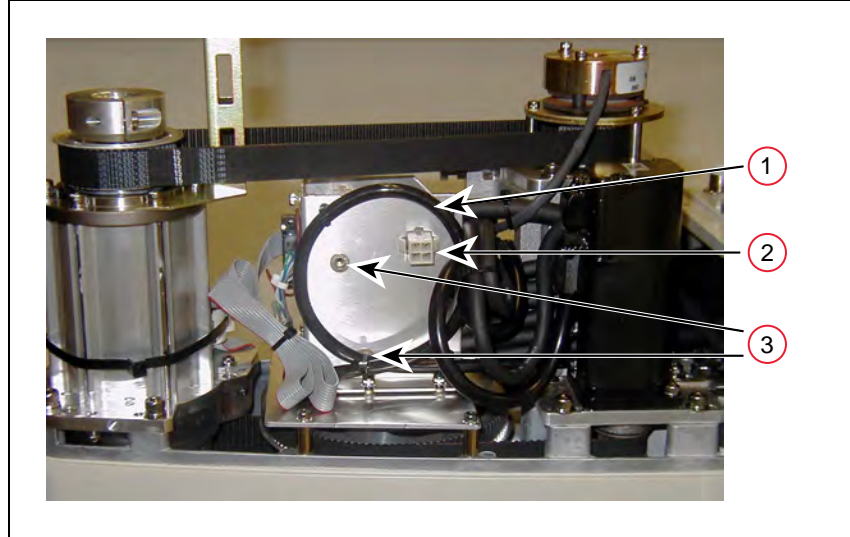


Figure 7-10. Solenoid Mounting Bracket with Connector and Spare Air Line

Table 7-12. Robot Solenoid Kit Description

Item	Description
1	Spare air line
2	Connector for solenoid valves (labeled SOLND)
3	Pem nuts to mount to solenoid manifold

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 the preceding figure.
5. Mount the solenoid manifold onto the bracket using the supplied M3 x 25 mm screws and washers. See Figure 7-11.
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 IP65 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.

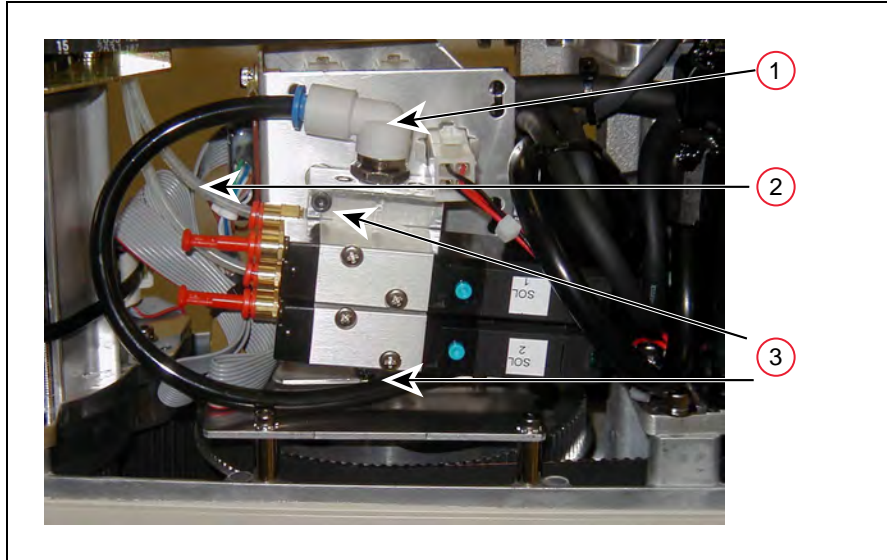


Figure 7-11. Solenoid Placement Using Mounting Hardware

Table 7-13. Solenoid Placement Description

Item	Description
1	Air intake coupling with spare air line
2	Tubing connected to output port
3	Mounting screws for solenoid assembly

9. Install the appropriate lengths of 5/32 inch plastic tubing (supplied) into the two output ports on the manifold.
10. 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.
11. For non-inverted robots:
  - a. Loosen the securing screw on the eAIB chassis, and lower the chassis down flat.
  - b. Remove the cable strap plate by removing two screws and split washers. See the following figure. This allows the harness to move when you lift the J1 cover in the next step. Retain the screws for re-assembly.



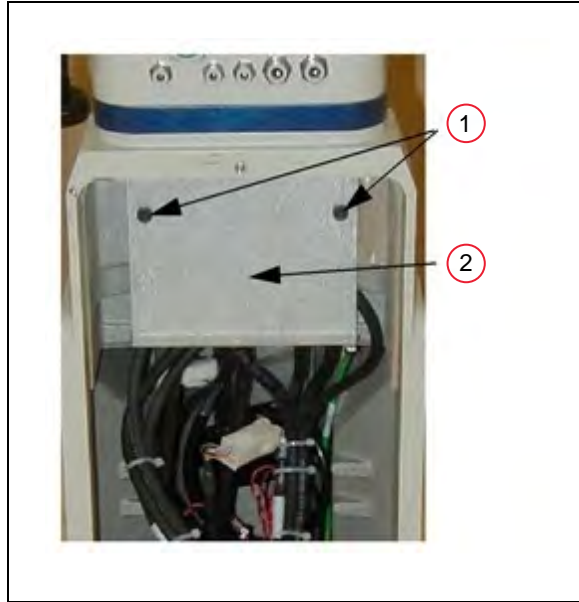


Figure 7-12. Removing the Cable Strap Plate

Table 7-14. Removing the Cable Strap Plate Description

Item	Description
1	Two M5 x 8 screws
2	Cable Strap Plate

- c. Remove the four screws from the Joint 1 cover. See the following figure. Retain the screws for re-assembly.

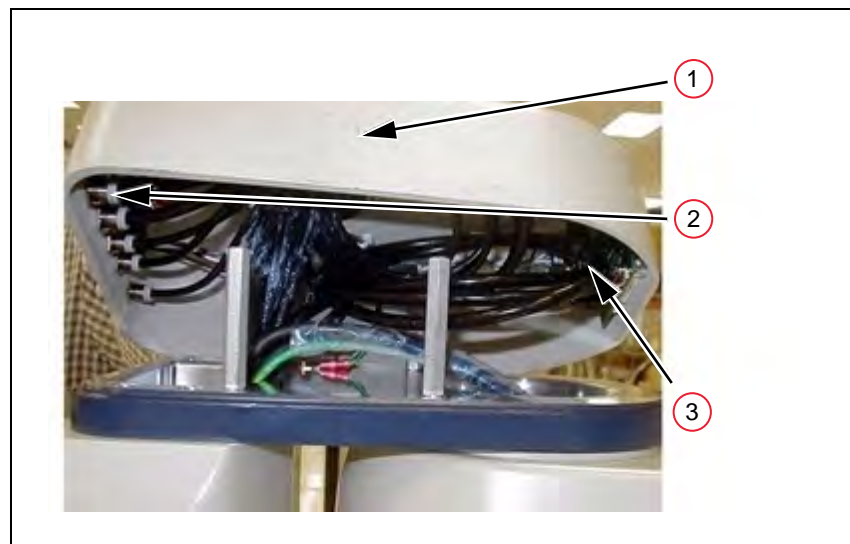


Figure 7-13. Connecting Spare Air Line to User Connector

Table 7-15. Connecting Spare Air line to User Connector Description

Item	Description
1	Joint 1 cover lifted to access spare air line.
2	User air fitting for connecting spare line. Remove factory installed tubing first.
3	Tubing bundle containing spare air line.

- For inverted robots, remove the four screws from the User Connector Panel. See the following figure. Retain the screws for re-assembly

Remove the cover enough so you have access to the tubing.

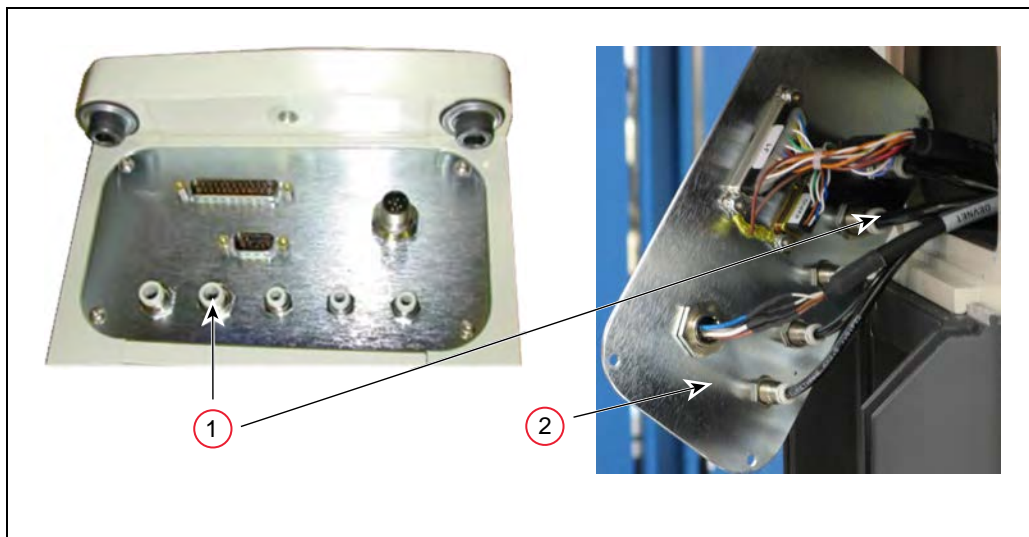


Figure 7-14. Connecting Spare Air Line to User Connector, Inverted Robot

Table 7-16. Connecting Spare Air line to User Connector, Inverted Robot Description

Item	Description
1	User air fitting for connecting spare line. Remove factory installed tubing first.
2	User Connector Panel cover (lifted to access spare air line)

- Disconnect the tubing from the 6 mm User Air fitting shown in the two preceding figures. Fold the tubing out of the way and restrain using cable ties.
- 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. The spare air line for Inverted eCobras is in the robot base, rather than under the cover, as in the non-inverted version.
- 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 7-2. 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 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.

## Testing

Connect the factory air supply to the 6 mm User Air connector.

For the non-IP65 robot, this is the air connector just modified.

Using eV+:

1. Turn on power and boot the system.
2. Once the system boot has completed, type the following commands at the eV+ dot prompt, to activate the solenoids one at a time:

```
.Signal 3001 ↵
```

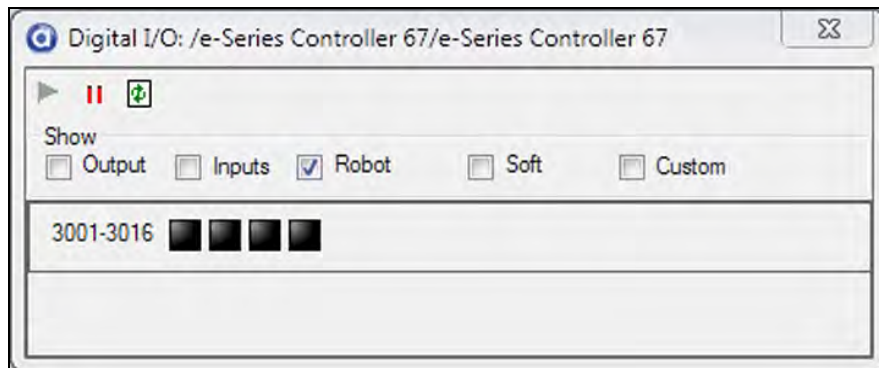
```
.Signal 3002 ↵
```

Using the ACE software:

1. Click the Digital I/O button in the controller toolbar:

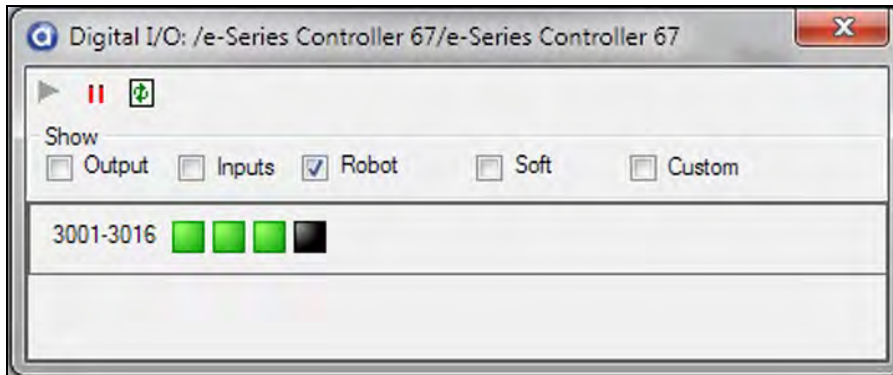


2. The Digital I/O window will open.



3. Check Robot.

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



### CAUTION: PERSONAL INJURY RISK

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

## 7.7 Installing the Camera Bracket Kit

The eCobra 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 7-15. 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.

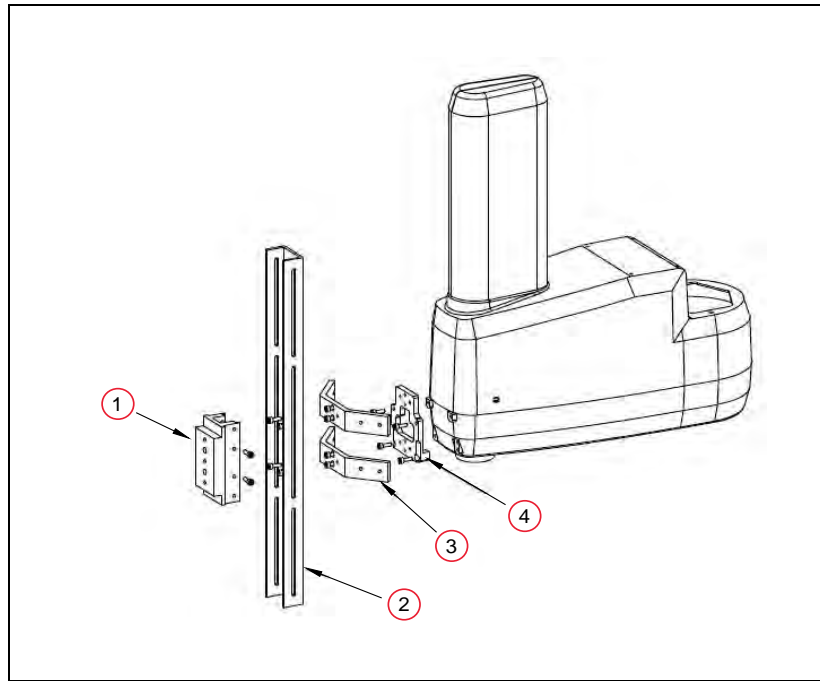


Figure 7-15. Mounting a Camera on the Robot

Table 7-17. Camera Mounting Hardware Description

Item	Description
1	Camera Mount
2	Camera Channel
3	Camera Brackets (optional)
4	Camera Plate

## 7.8 Installing Adjustable Hardstops

We offer an adjustable hardstop kit for Joint 1 and Joint 2 on the eCobra robots. These are user-installed options that can be used to limit the work envelope of the robot. The 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.

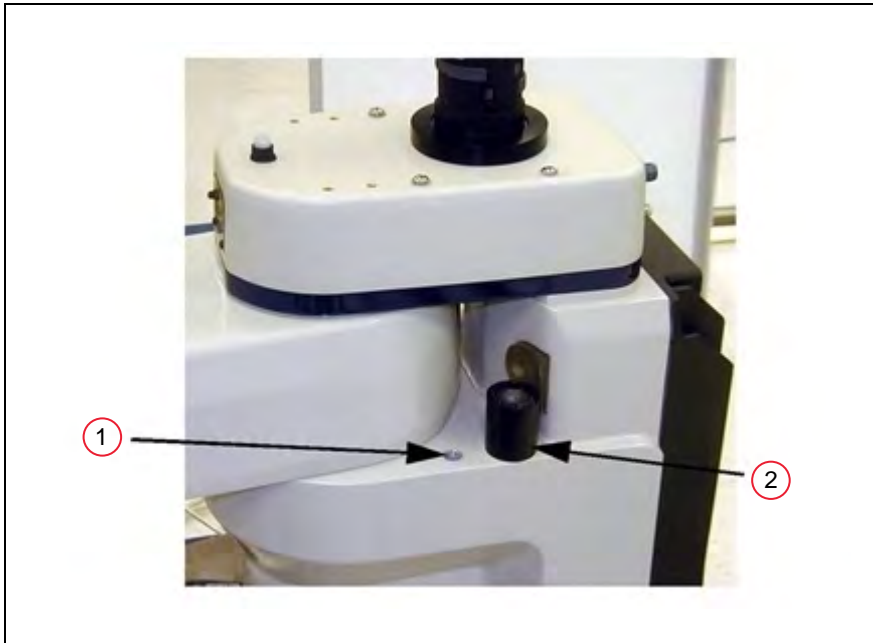


Figure 7-16. Joint 1 Adjustable Hardstops

Table 7-18. Joint 1 Adjustable Hardstop Description

Item	Description
1	Location for Position 1
2	Joint 1 Adjustable Hardstop Installed in Position 2

### 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 ACE software.

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

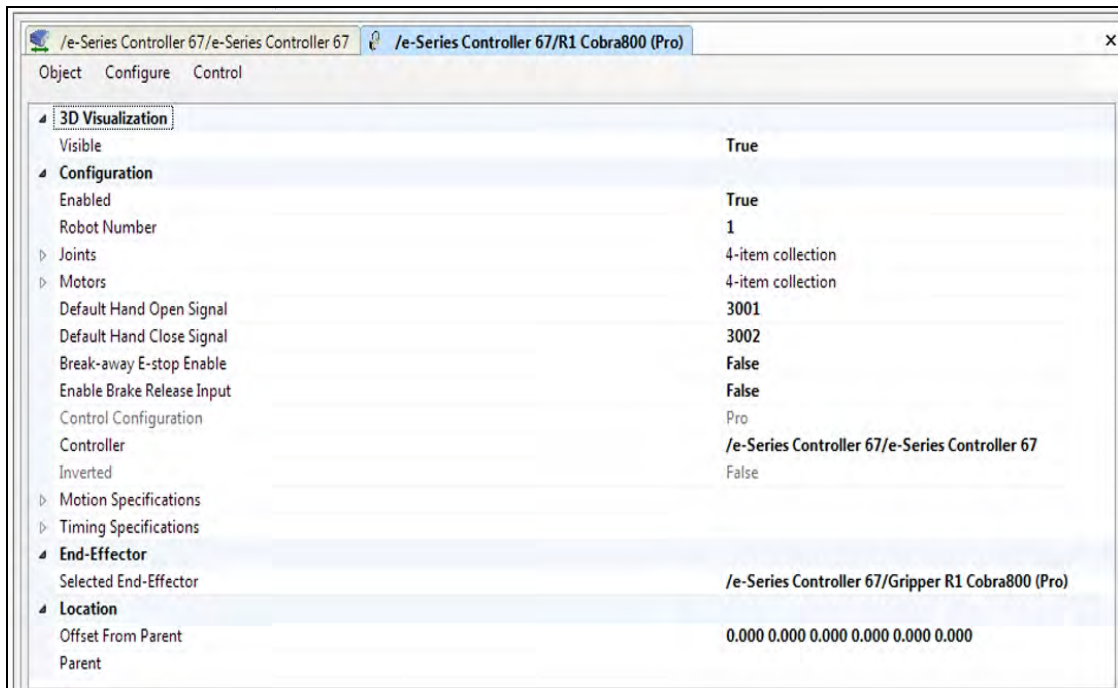


Figure 7-17. Robot Editor, with Joints Collapsed. Note that Joint 1 of the robot is Element 0.

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

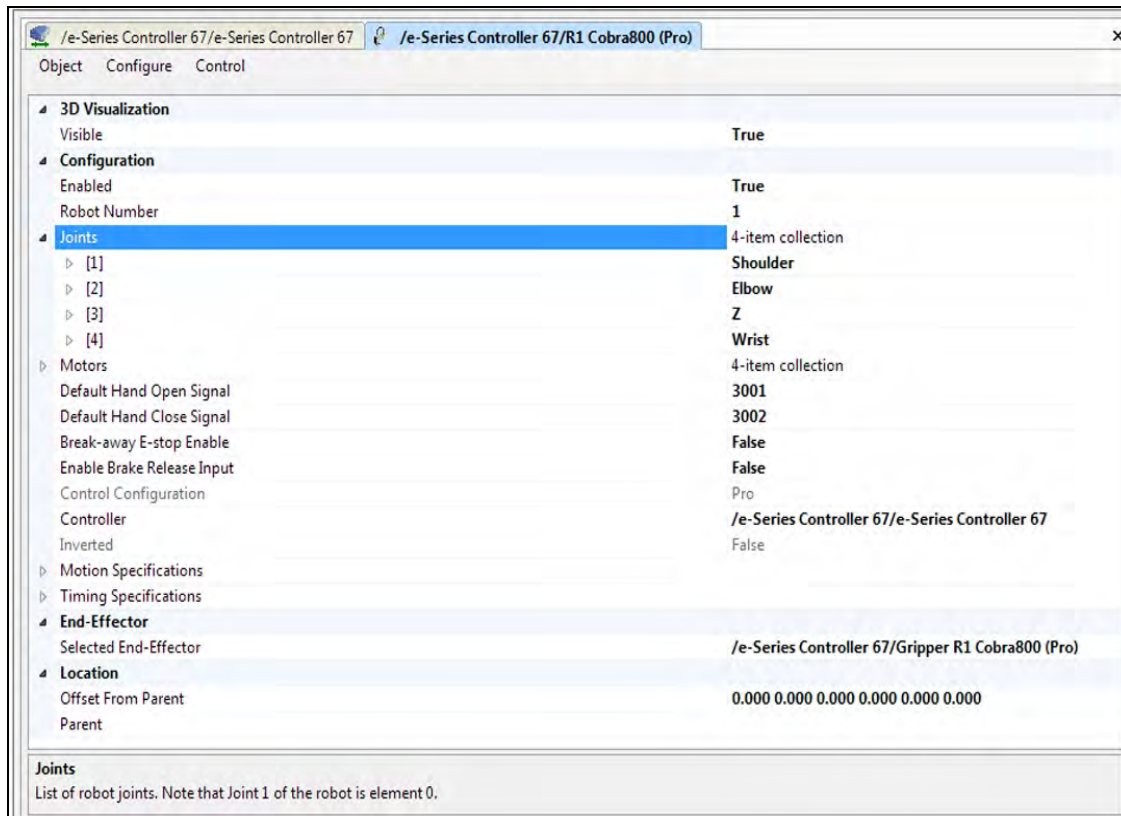


Figure 7-18. Robot Editor, with Joints Expanded

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



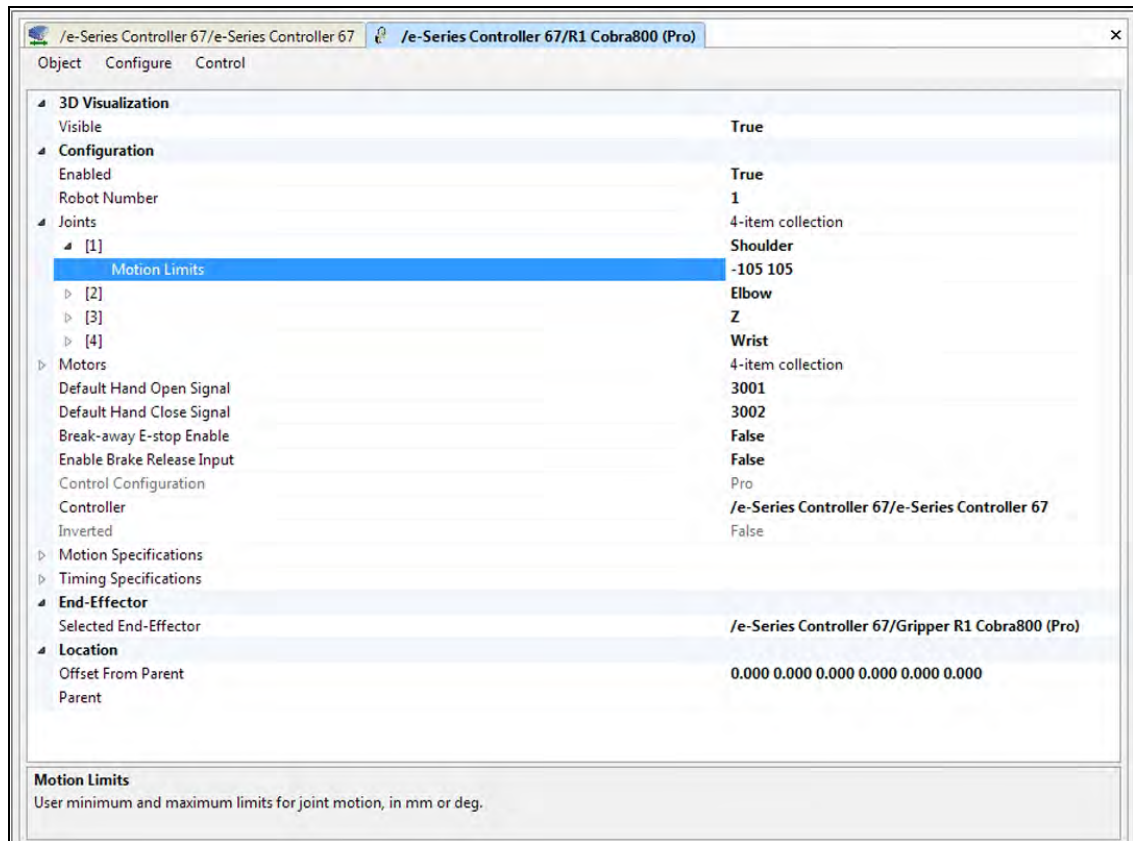


Figure 7-19. Robot Editor, with Joint 1 Expanded

- 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 7-19. Joint 1 Ranges for Adjustable Hardstops

	Hardstop Value	Recommended Joint Limit Softstop
J1 Hardstop Position 1	$\pm 50^\circ$	Lower limit: $-49^\circ$ Upper limit: $+49^\circ$
J1 Hardstop Position 2	$\pm 88^\circ$	Lower limit: $-87^\circ$ Upper limit: $+87^\circ$

- Reboot eV+:

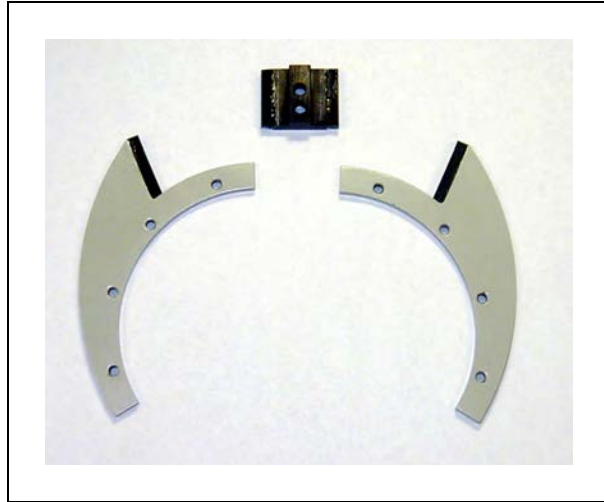
**Controller > Control > Reboot eV+**

**NOTE:** This can also be accomplished by momentarily removing 24 VDC power from the controller.

The new joint limits will be in effect when the system reboot is done.

### Joint 2 Adjustable Hardstops

The Joint 2 Adjustable Hardstop kit (shown in the following figure) 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 7-20. Joint 2 Hardstop Kit*

#### **Installation Procedure**

1. Slide the two adjustable hardstop plates into the space between inner and outer links. See Figure 7-21. Looking up at the inner link from underneath, align the holes in the plates with the holes in the inner link. See Figure 7-22.

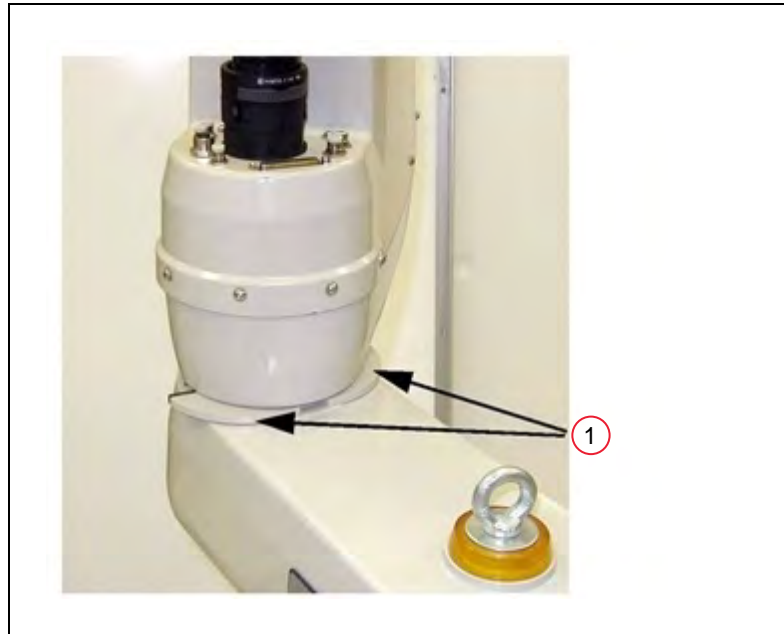


Figure 7-21. (1) Joint 2 Adjustable Hardstop Locations

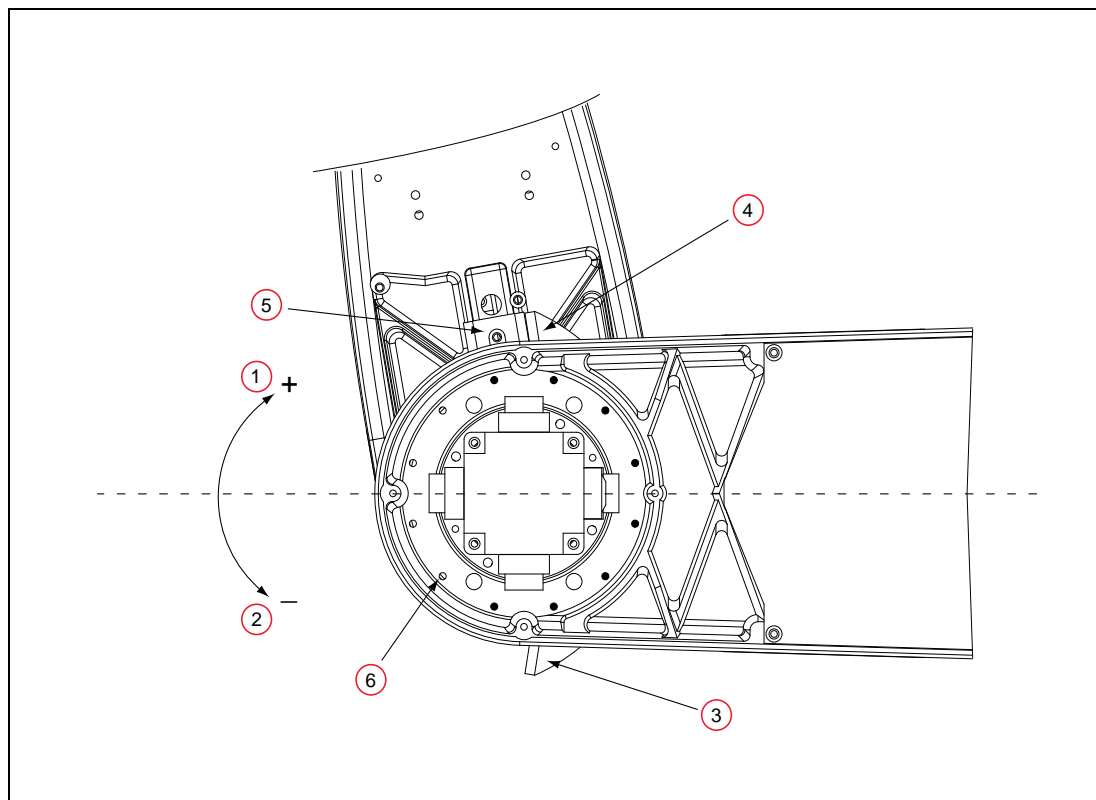


Figure 7-22. Screw Locations for Joint 2 Adjustable Hardstops (under side of Inner Link, looking up)

Table 7-20. Screw Locations for Joint 2 Adjustable Hardstops Description

Item	Description
1	Joint 2 Positive Direction
2	Joint 2 Negative Direction
3	Joint 2 Right Hardstop Plate, Installed in -81 Degree Position
4	Joint 2 Left Hardstop Plate, Installed in +81 Degree Position
5	Joint 2 Fixed Hardstop Device
6	12 Thru Holes for M5 x 10 Screws, for Installing Joint 2 Hardstops, Located 30 Degrees Apart

- 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 hardstop sides do not have to be in the same position, so the workspace does not have to be symmetrical.

- Slide the fixed hardstop device into the slot on the underside of the outer link. See Figure 7-23.



Figure 7-23. (1) Fixed Hardstop Block for Joint 2

- 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-lbf).

### Modifying Joint Limit Softstop Locations for Joint 2

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

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

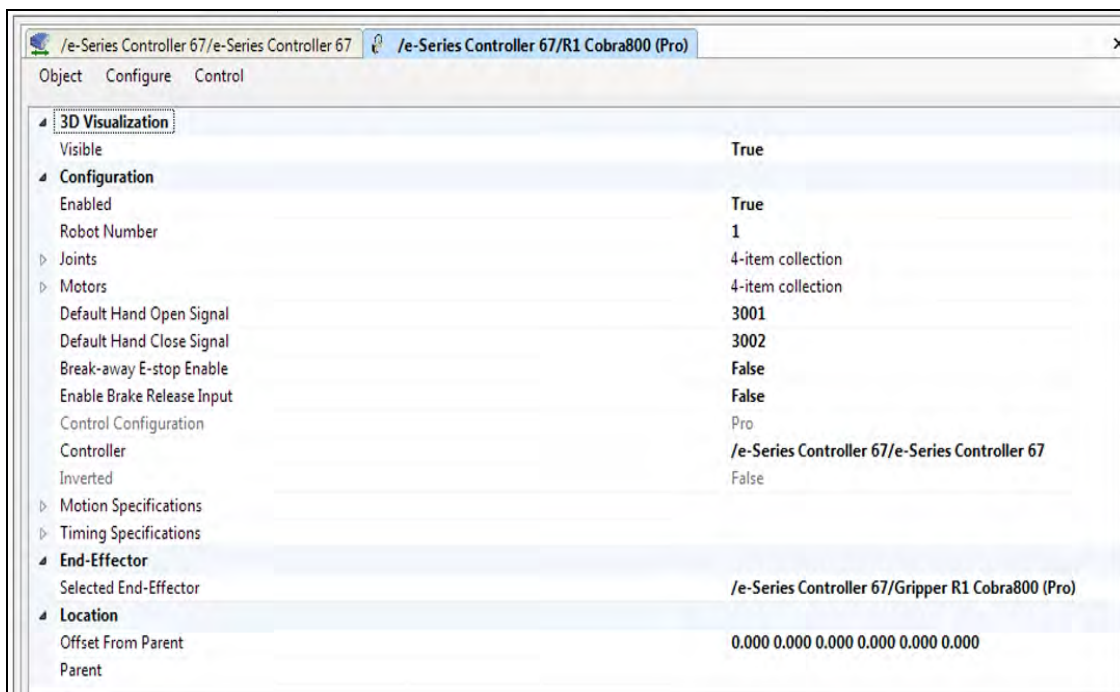


Figure 7-24. Robot Editor, with Joints Collapsed

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

## 7.8 Installing Adjustable Hardstops

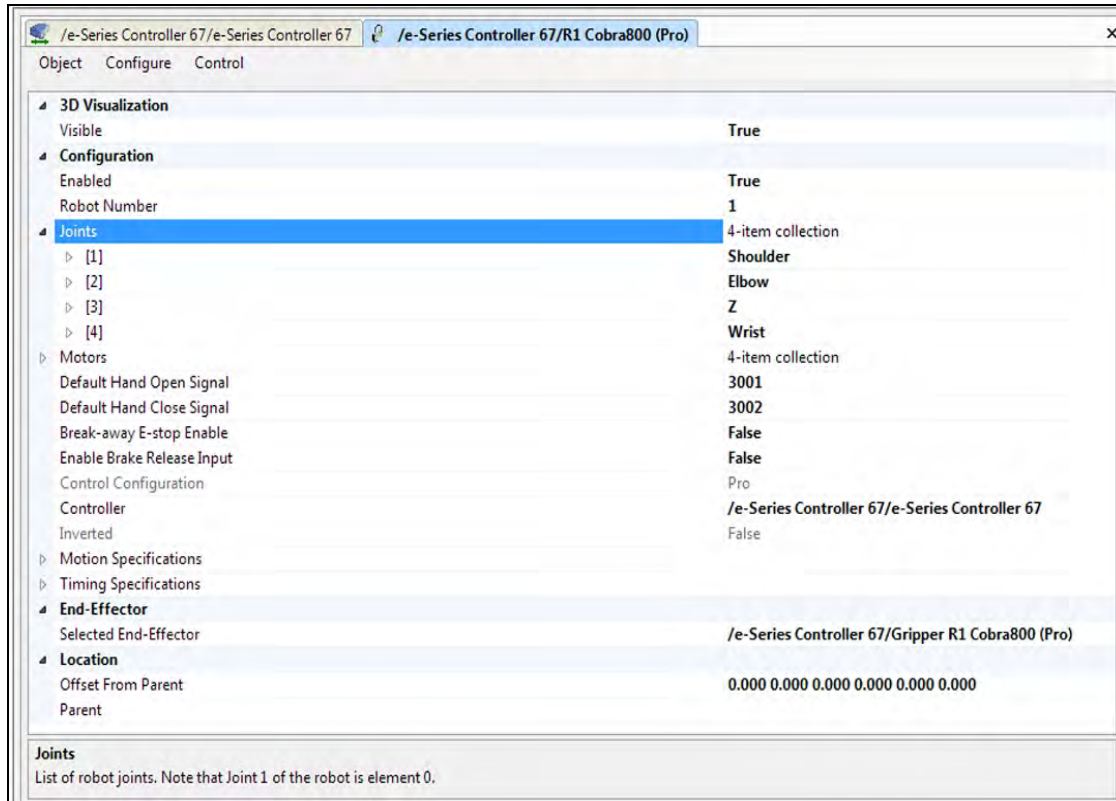


Figure 7-25. Robot Editor, with Joints Expanded

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

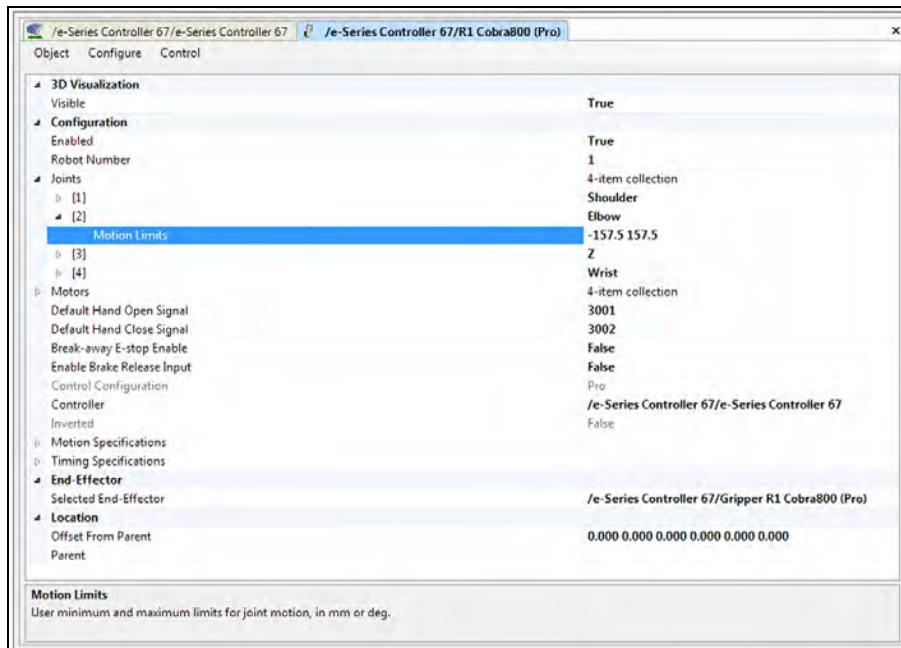


Figure 7-26. Robot Editor, with Joint 2 Expanded

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

Table 7-21. Joint 2 Ranges for Adjustable Hardstops

	Hardstop Value	Recommended Joint Limit Softstop
J2 Hardstop Position 1	$\pm 81^\circ$	Lower limit: $- 80^\circ$ Upper limit: $+ 80^\circ$
J2 Hardstop Position 2	$\pm 51^\circ$	Lower limit: $- 50^\circ$ Upper limit: $+ 50^\circ$
J2 Hardstop Position 3	$\pm 21^\circ$	Lower limit: $- 20^\circ$ Upper limit: $+ 20^\circ$
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 $30^\circ$ apart.		

6. Reboot eV+:

**Controller > Control > Reboot eV+**

**NOTE:** This can also be accomplished by momentarily removing 24 VDC power from the controller.

The new joint limits will be in effect when the system reboot is done.





# Chapter 8: Technical Specifications

## 8.1 Dimension Drawings

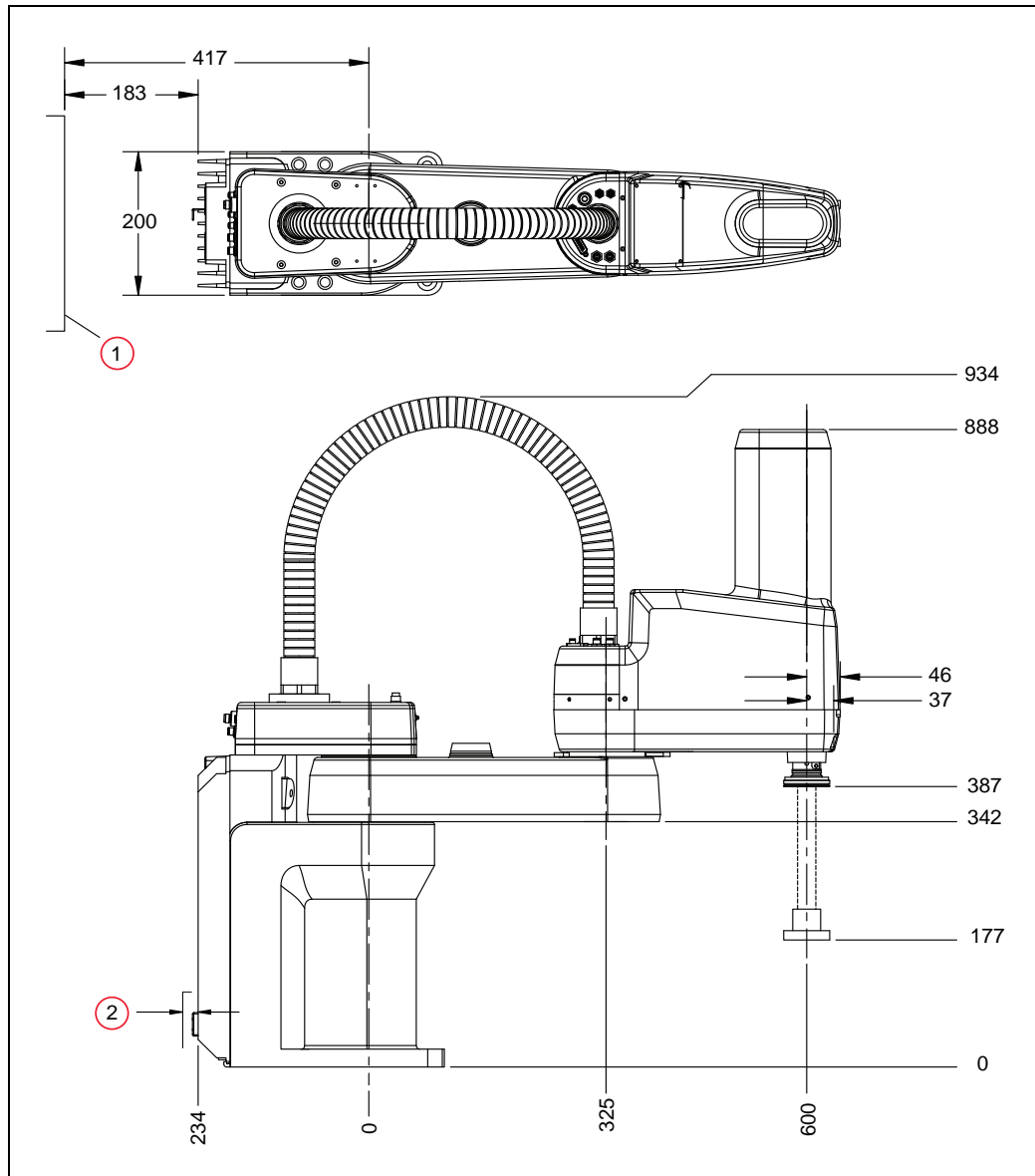


Figure 8-1. eCobra 600 Robot Top and Side Dimensions (Units in mm)

Table 8-1. eCobra 600 Robot Top and Side Dimension Description

Item	Description
1	Required Clearance to Open eAIB Chassis
2	31 mm Required Cable Clearance

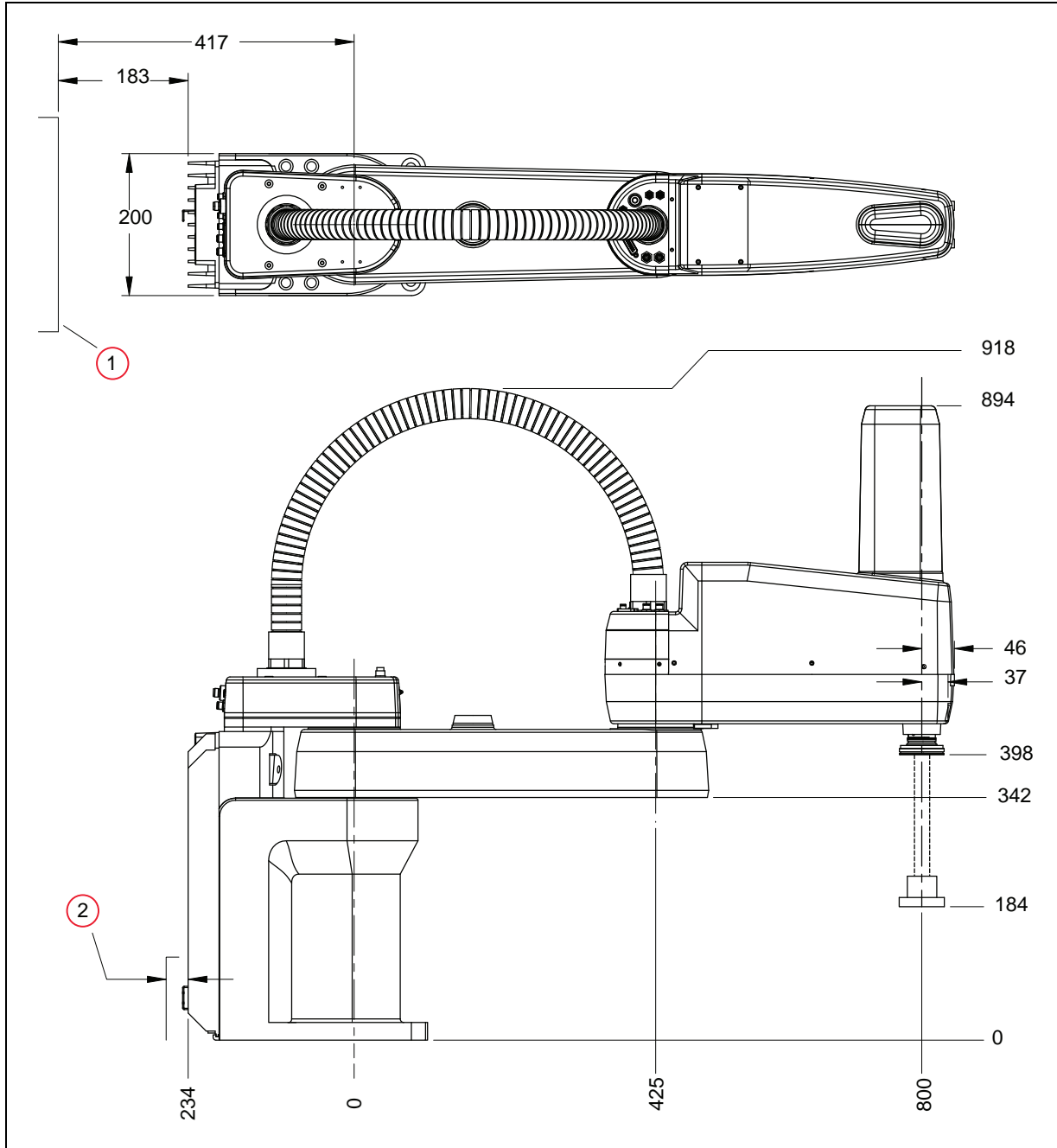


Figure 8-2. eCobra 800 Robot Top and Side Dimensions (Units in mm)

Table 8-2. eCobra 800 Robot Top and Side Dimension Description

Item	Description
1	Required Clearance to Open eAIB Chassis
2	31 mm Required Cable Clearance

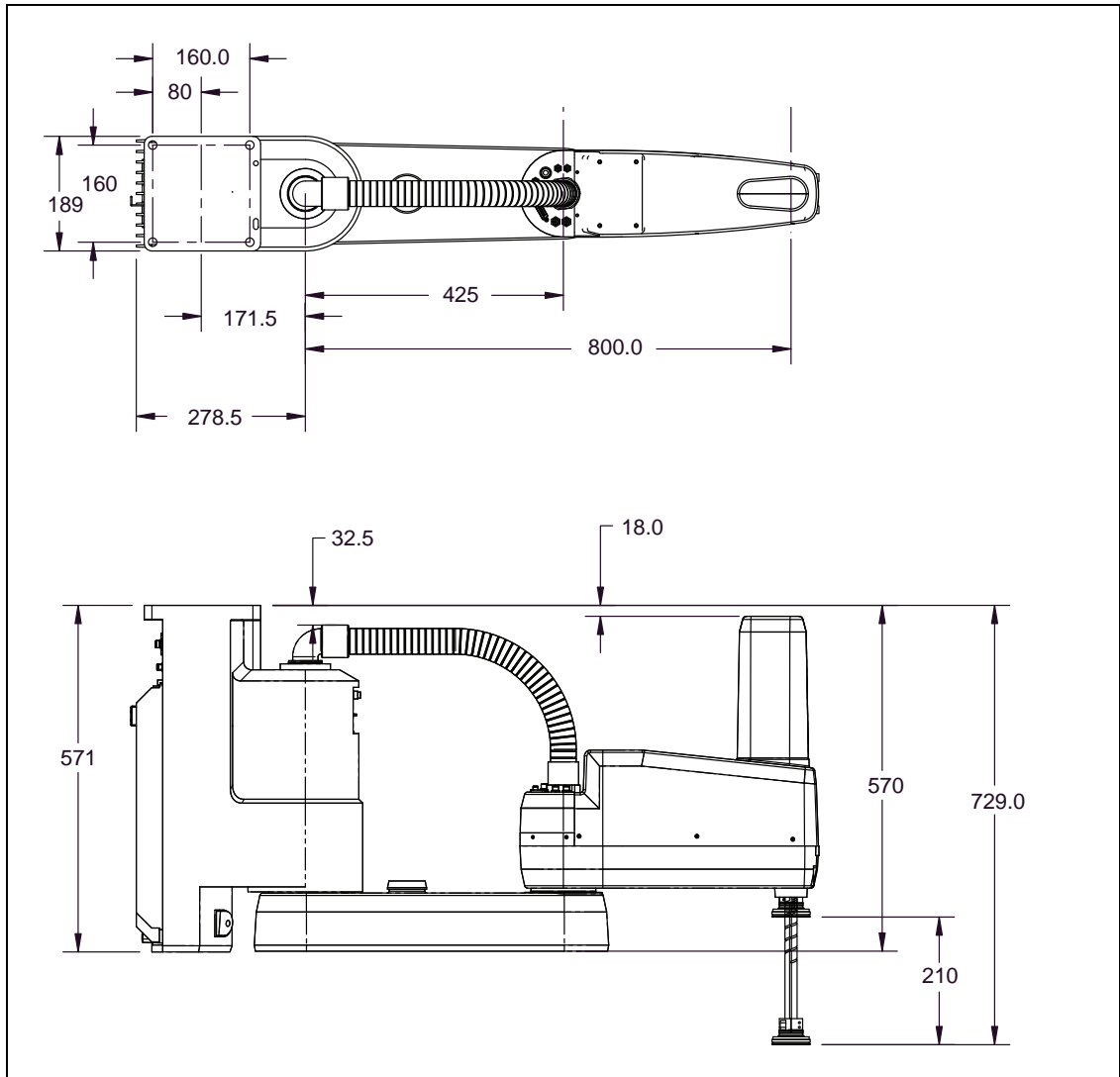


Figure 8-3. eCobra 800 Inverted Robot Top and Side Dimensions (Units in mm)

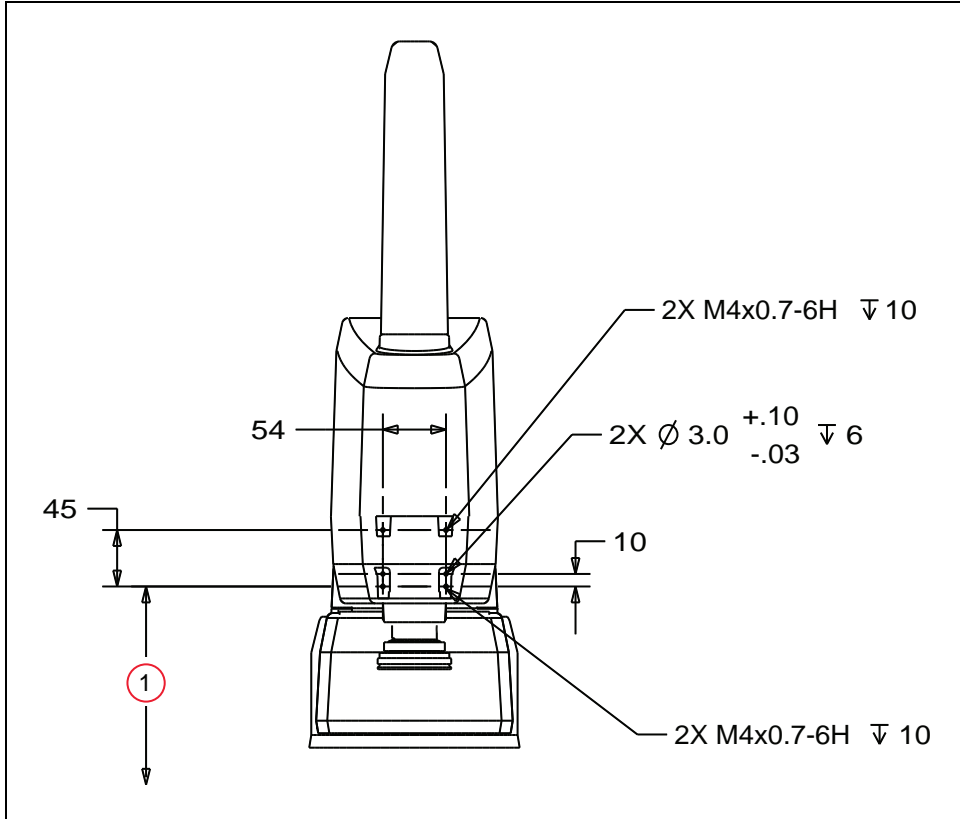


Figure 8-4. Dimensions of the Camera Bracket Mounting Pattern, Upright eCobra (Units in mm)

Table 8-3. Camera Bracket Mounting Pattern Dimension Description, Upright eCobra robot

Item	Description
1	457 mm to Base of robot

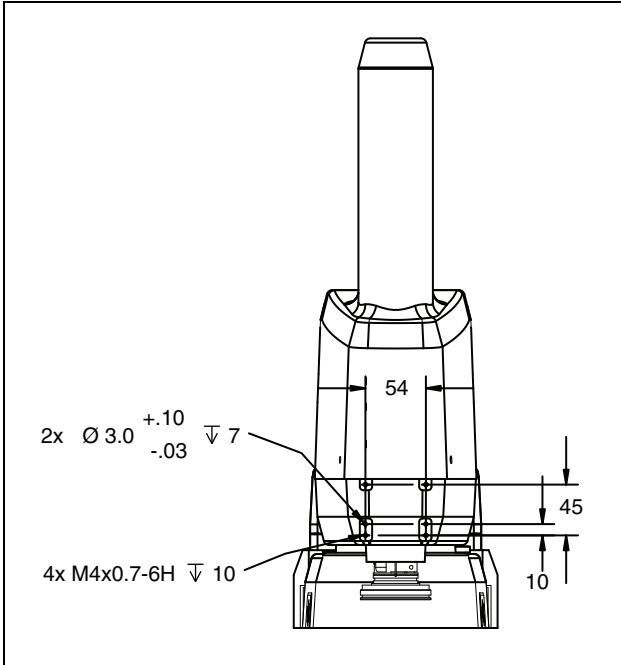


Figure 8-5. Dimensions of the Camera Bracket Mounting Pattern, Inverted eCobra (Units in mm)

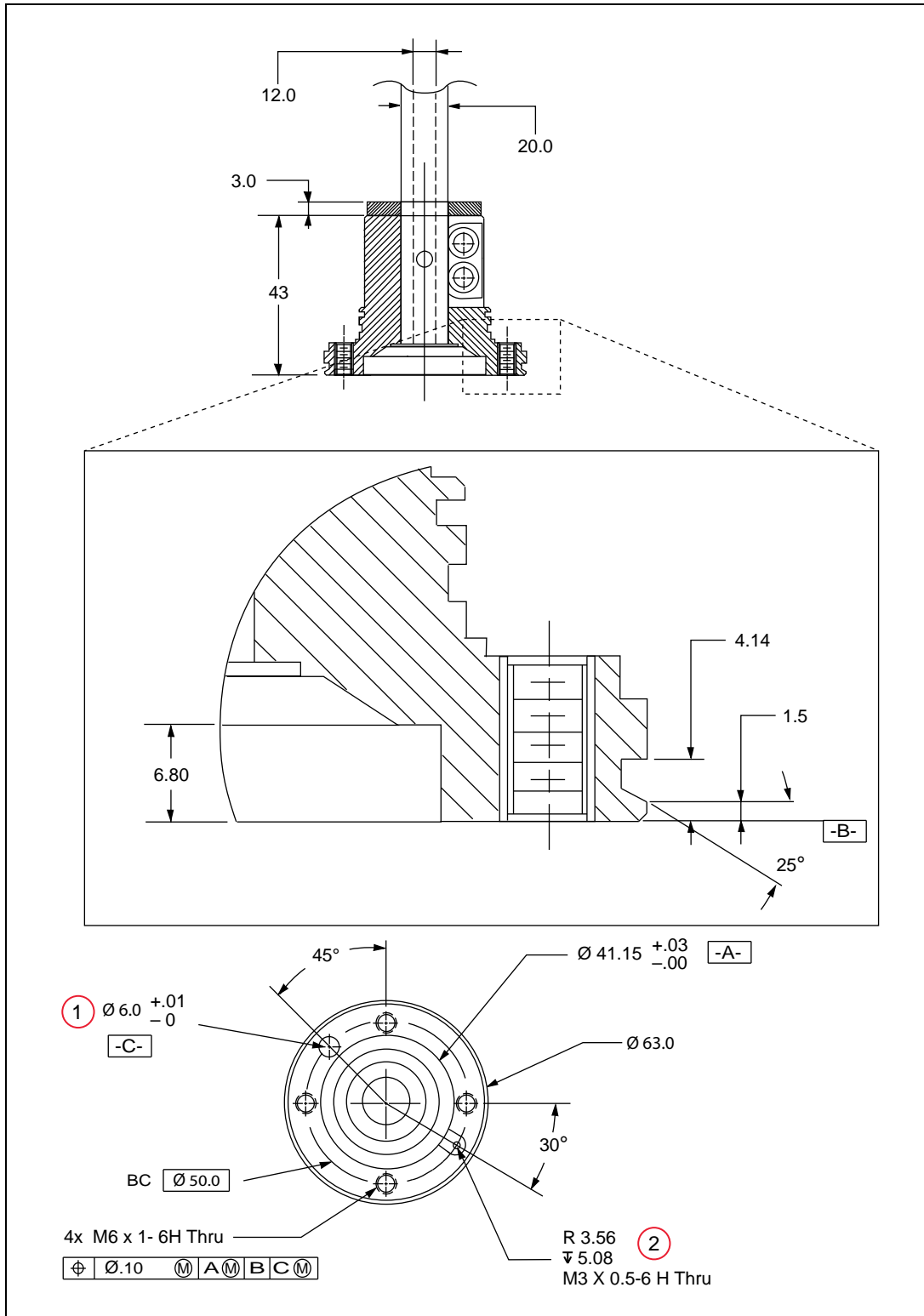


Figure 8-6. Tool Flange Dimensions for eCobra Robots (Units in mm)

Table 8-4. Tool Flange Description

Item	Description
1	Dowel Pin Hole
2	User Ground

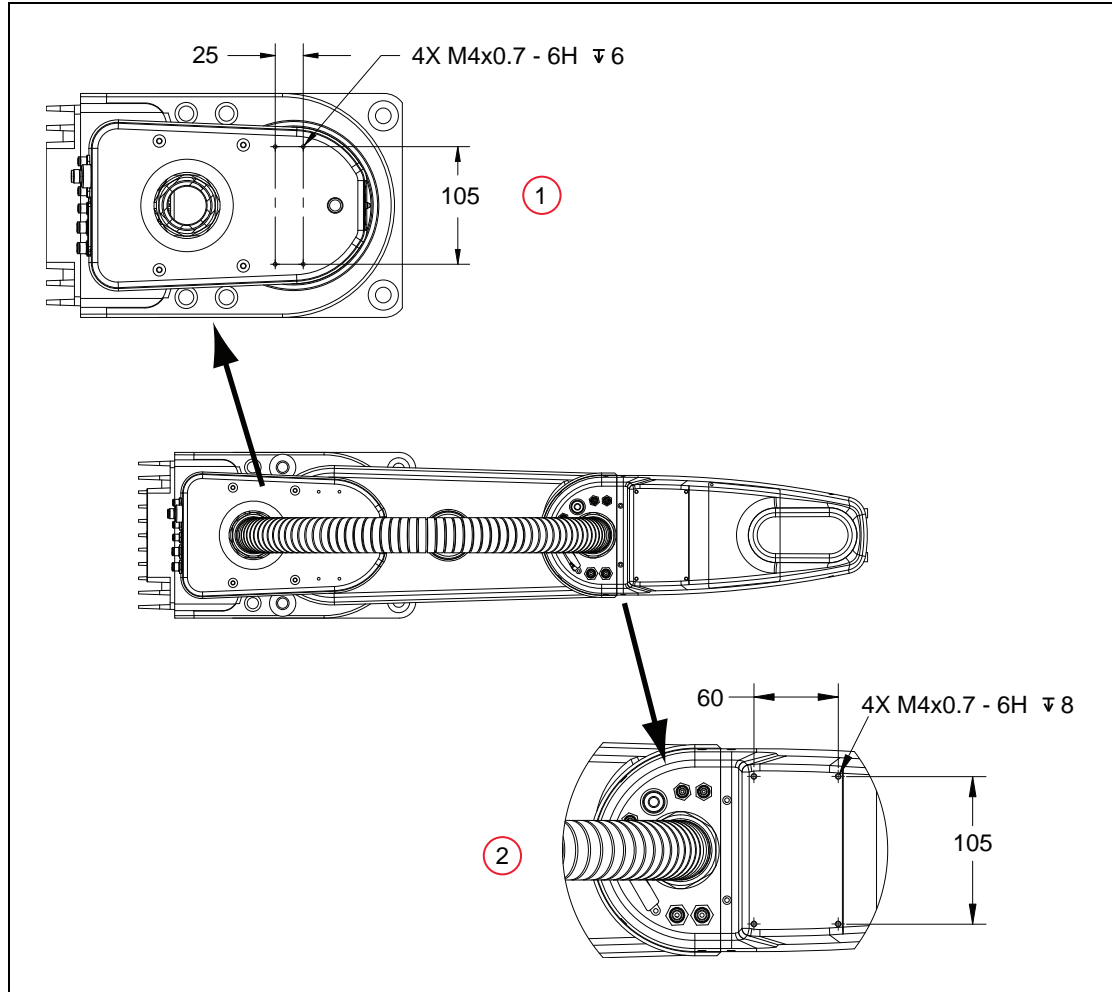


Figure 8-7. External Tooling on Top of Robot Arm, Upright eCobra (Units in mm)

Table 8-5. External Tooling Description, Upright eCobra

Item	Description
1	Inner Link Mounting Locations
2	Outer Link Mounting Locations

Figure 8-8.

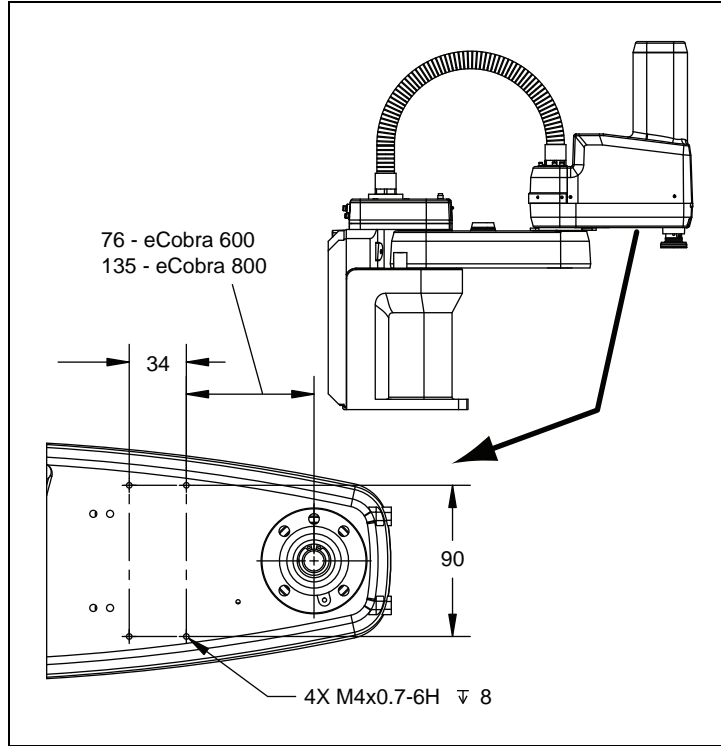


Figure 8-9. External Tooling on Underside of Outer Link, Upright eCobra (Units in mm)

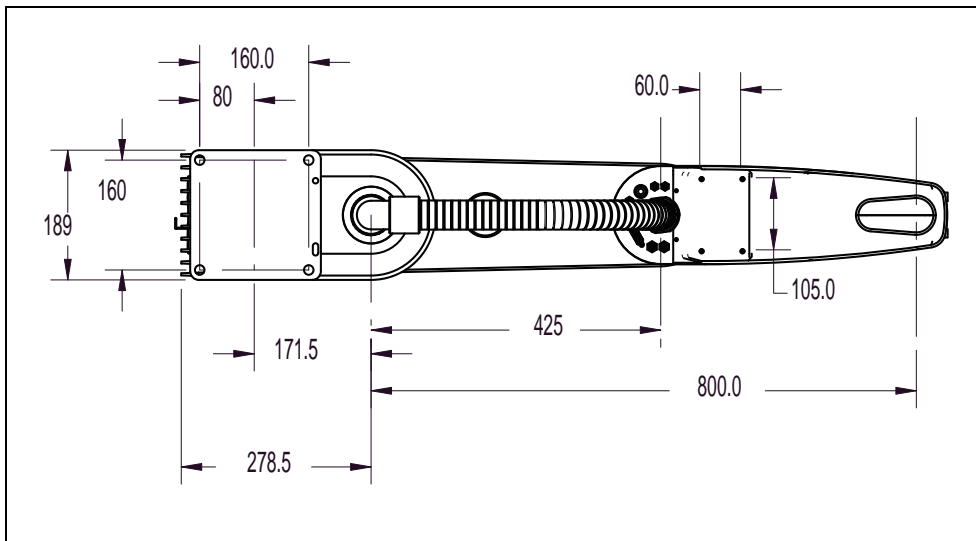


Figure 8-10. External Tooling on Top of Robot Arm, Inverted eCobra (Units in mm)



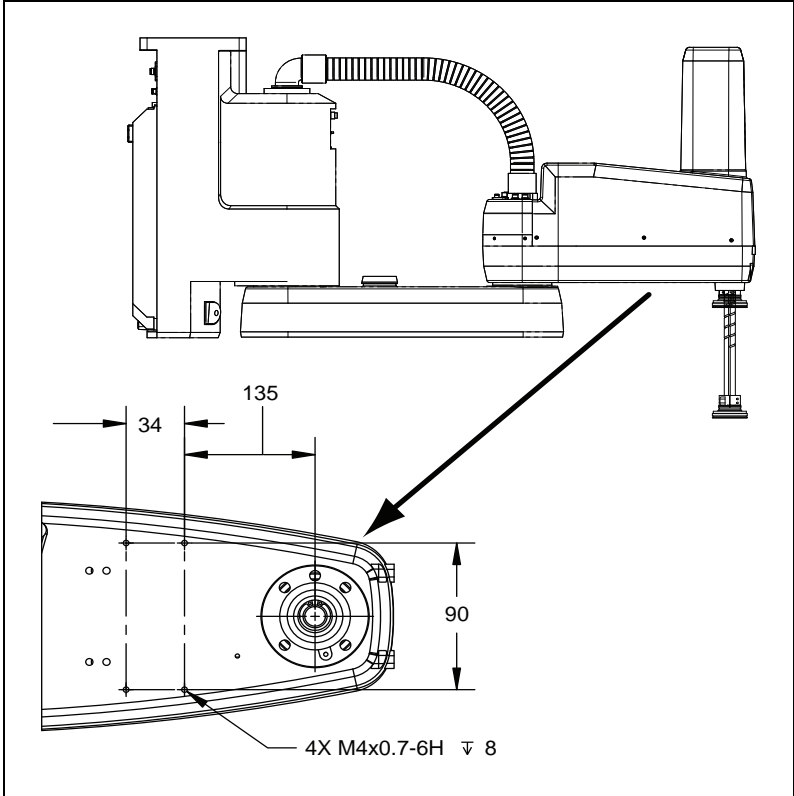


Figure 8-11. External Tooling on Underside of Outer Link, Inverted eCobra (Units in mm)

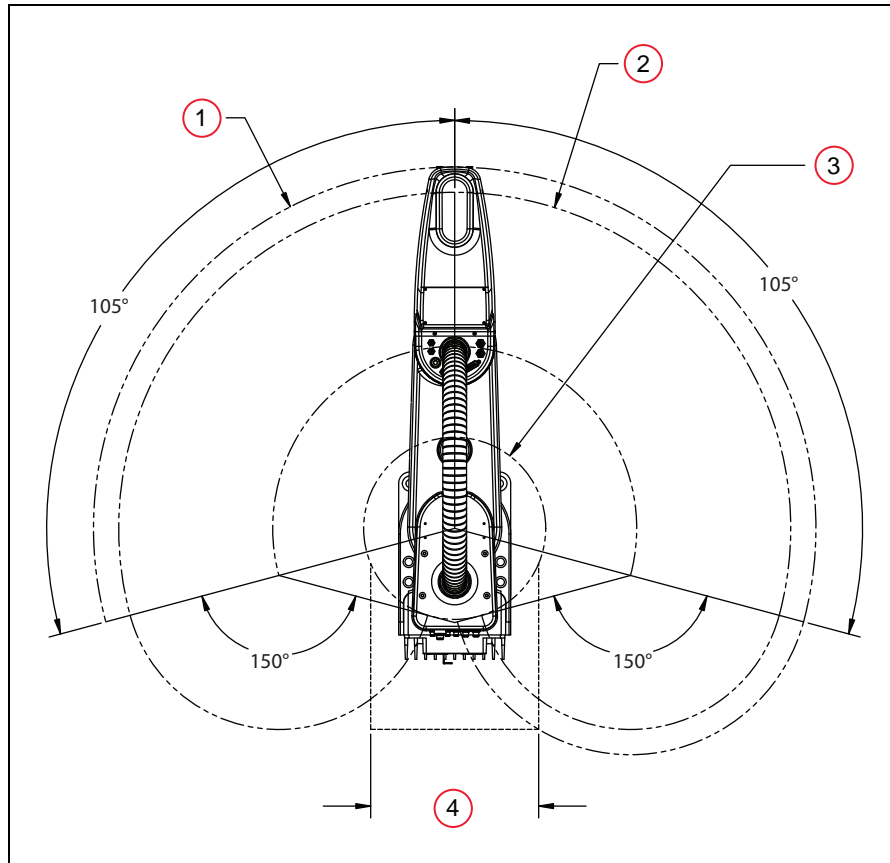


Figure 8-12. eCobra 600 Robot Working Envelope

Table 8-6. eCobra 600 Robot Working Envelope Description

Item	Description
1	Maximum Intrusion Contact Radius (R 647 mm)
2	Maximum Radial Reach Functional Area (R 600 mm)
3	Minimal Radial Reach (R 162.6 mm)
4	Cartesian Limits (300 mm)

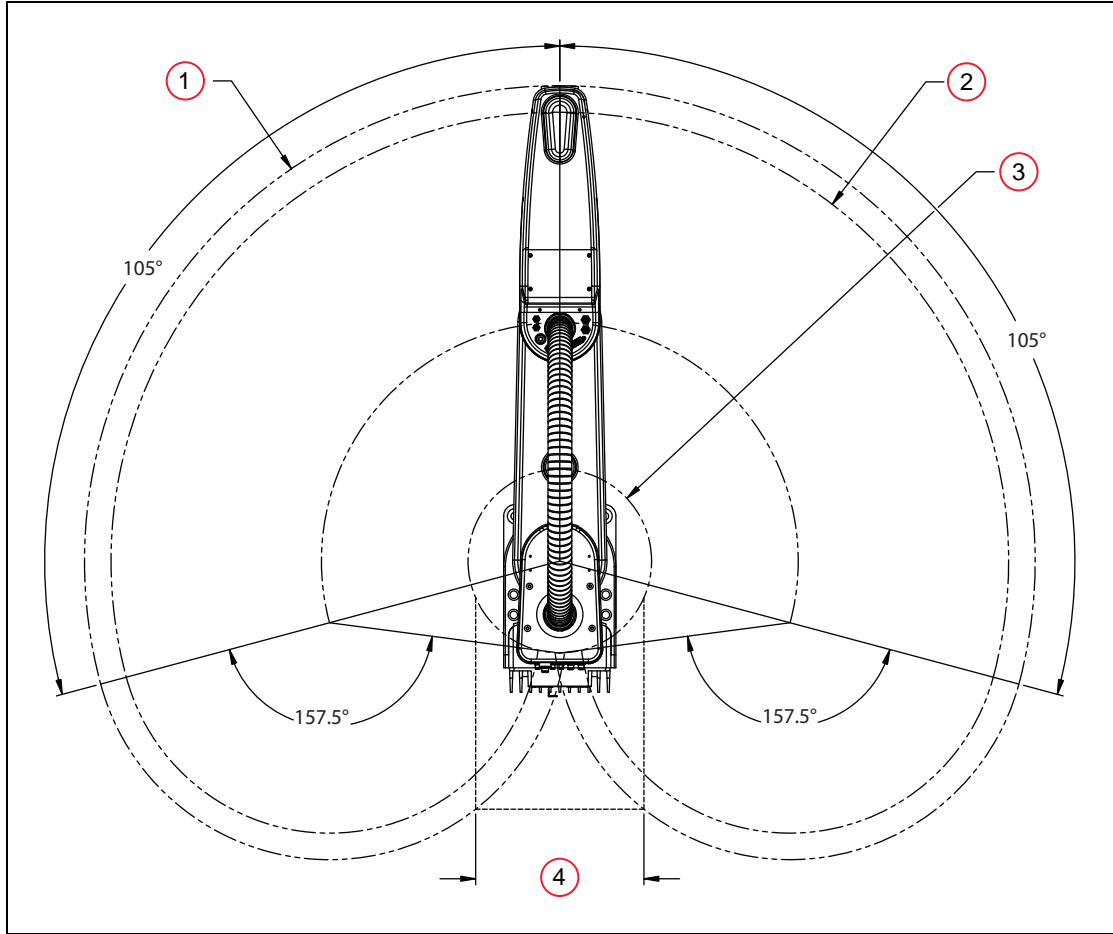


Figure 8-13. eCobra 800 Robot Working Envelope

Table 8-7. eCobra 800 Robot Working Envelope Description

Item	Description
1	Maximum Intrusion Contact Radius (R 847.3 mm)
2	Maximum Radial Reach Functional Area (R 800 mm)
3	Minimal Radial Reach (R 163.6 mm)
4	Cartesian Limits (300 mm)

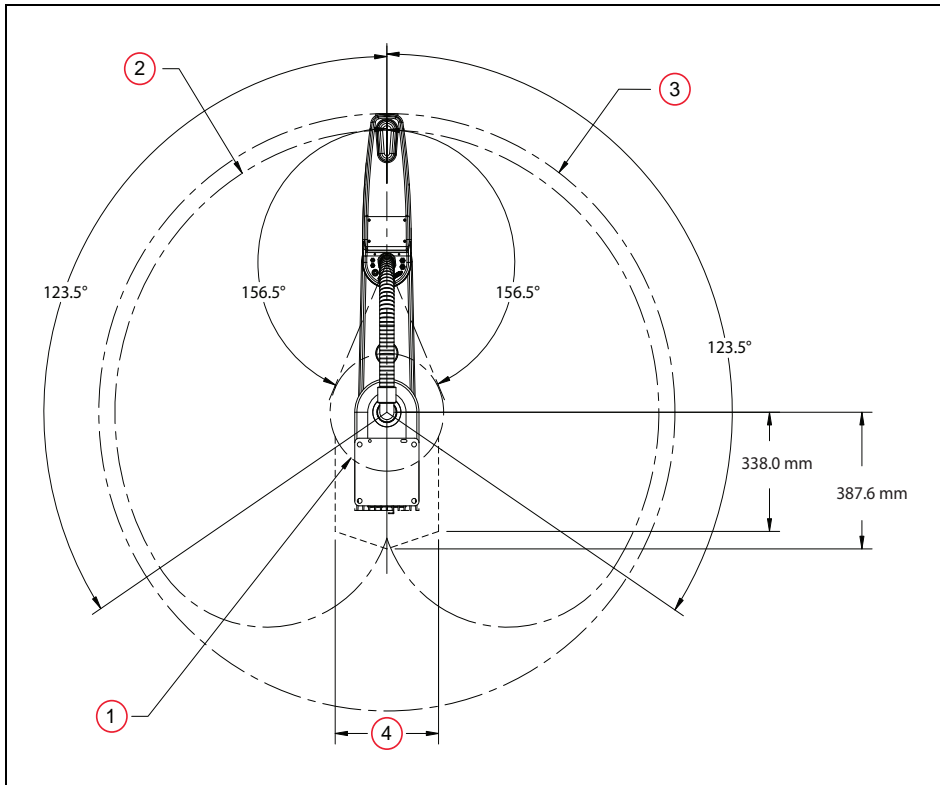


Figure 8-14. eCobra 800 Inverted Robot Working Envelope

Table 8-8. eCobra 800 Inverted Robot Working Envelope Description

Item	Description
1	Minimum Radial Reach (R 167.0)
2	Maximum Radial Reach Functional Area (R 800.0 mm)
3	Maximum Intrusion Contact Radius (R 847.3 mm)
4	Cartesian Limits (314.0 mm)

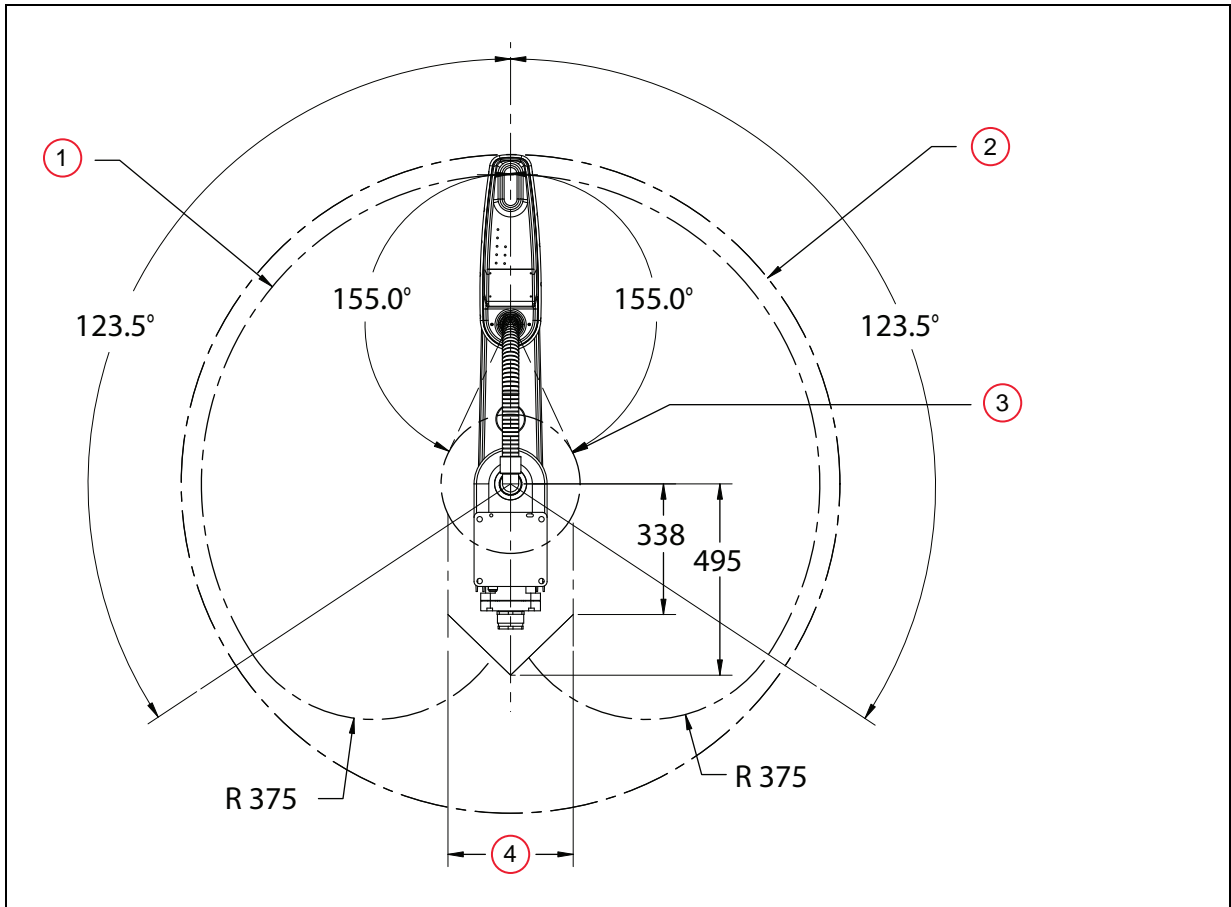


Figure 8-15. eCobra 800 Inverted, IP65, Working Envelope

Table 8-9. eCobra 800 Inverted Robot, IP65, Working Envelope Description

Item	Description
1	Maximum Radial Reach Functional Area (R 800.0 mm)
2	Maximum Intrusion Contact Radius (R 852.12 mm)
3	Minimum Radial Reach (R 179.90 mm)
4	Cartesian Limits (324.0 mm)

## 8.2 Robot Specifications

### Physical

Table 8-10. eCobra Robot Physical<sup>a</sup>

Description	eCobra 600 Robot	eCobra 800 Robots (both)
Reach	600 mm	800 mm
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)
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)	
Weight (without options)	41 kg (90 lb)	43 kg (95 lb)/ 51 kg (112 lb) Inverted
<sup>a</sup> Specifications subject to change without notice.		

## Performance

Table 8-11. eCobra Robot Performance<sup>a</sup>

Description	eCobra 600 Robot	eCobra 800 Robots (both)
Moment of Inertia	Joint 4 - 450 kg-cm <sup>2</sup> (150 lb-in <sup>2</sup> ) - max	Joint 4 - 450 kg-cm <sup>2</sup> (150 lb-in <sup>2</sup> ) - 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
Adept Cycle—2 kg payload, sustained (no J4 rotation)		
eCobra Lite	0.66 sec	0.73 sec
eCobra Standard	0.55 sec	0.62 sec
eCobra Pro	0.45 sec	0.54 sec
Repeatability		
X, Y	±0.017 mm	±0.017 mm
Z	±0.003 mm	±0.003 mm
Theta	±0.019°	±0.019°
Joint Range		
Joint 1	±105°	±105°/±123.5° Inverted
Joint 2	±150°	±157.5°/±156.5° Inverted
Joint 3	210 mm	210 mm
Joint 4	±360°	±360°
<sup>a</sup> Specifications subject to change without notice.		

## Stopping Distances and Times

The following graphs present information required by Clause 7.2 n) of ISO 10218-1. This information should be used to calculate the safe distance needed when designing and installing safeguarding devices.

The graphs show the time elapsed and distances traveled between the initiation of a stop signal and the cessation of all robot motion.

For stop category 1, the stopping time and distance values depend on the speed, load, and extension of the robot, stated for 33%, 66% and 100% of the maximum payload (5.5kg). Data provided is for the three joints of greatest displacement (J1, J2 and J3).

**NOTE:** Where lines overlap (and may not be visible) differences are not significant.

**Key to Graphs**

Item	Meaning
Blue Line	Payload 33%
Red Line	Payload 66%
Green line	Payload 100%
1	Stopping Distance (mm)
2	Stopping Distance (degrees)
3	Stopping Time (seconds)
4	Speed (%)

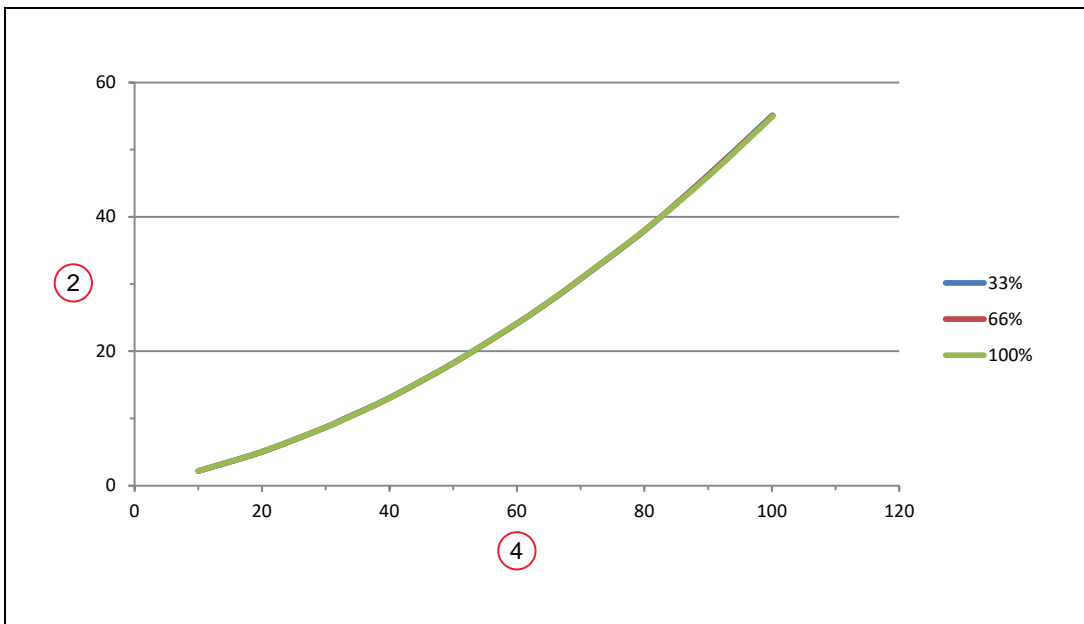


Figure 8-16. Joint 1 Stopping Distance for eCobra 600, in Degrees



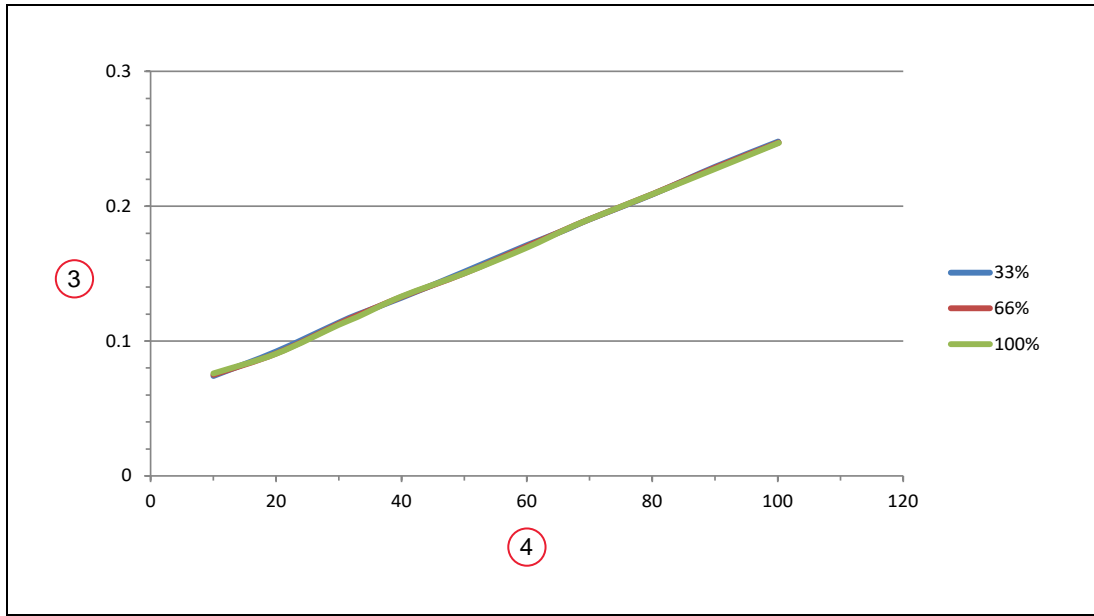


Figure 8-17. Joint 1 Stopping Time for eCobra 600, in Seconds

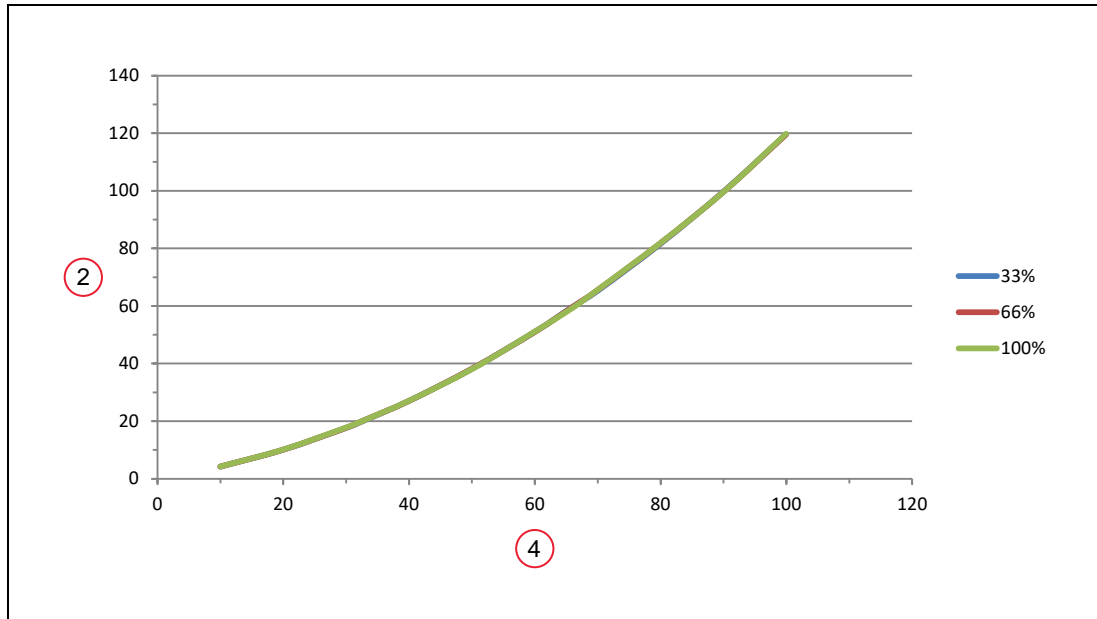


Figure 8-18. Joint 2 Stopping Distance for eCobra 600, in Degrees

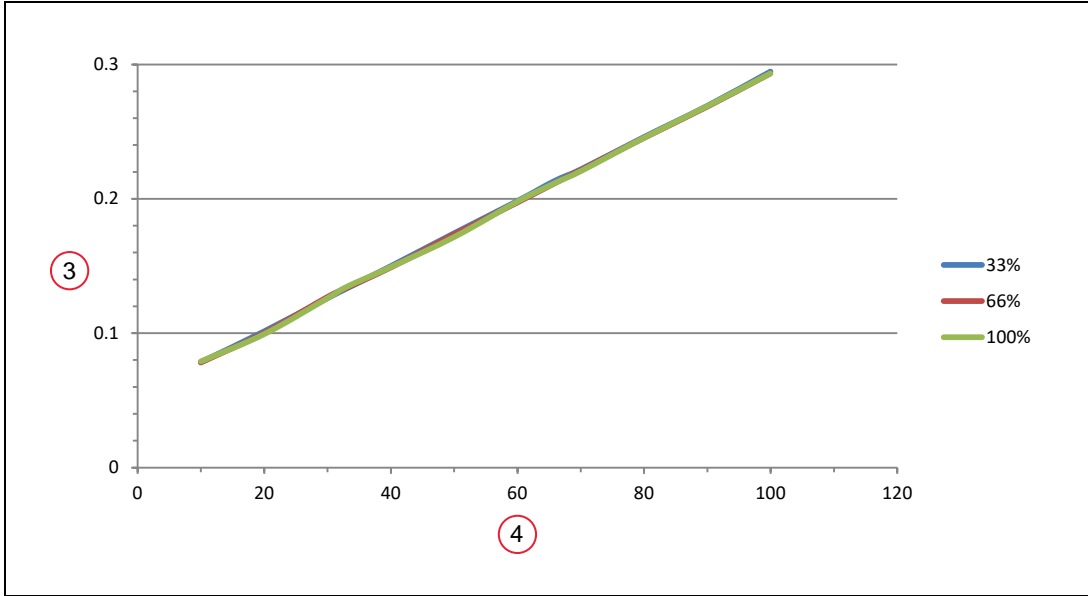


Figure 8-19. Joint 2 Stopping Time for eCobra 600, in Seconds

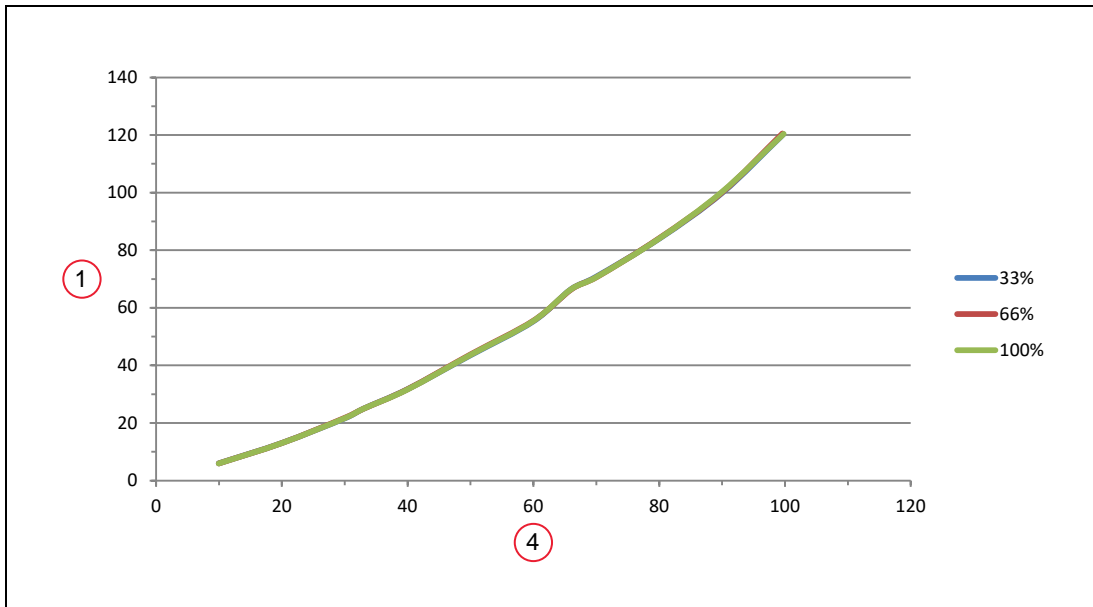


Figure 8-20. Joint 3 Stopping Distance for eCobra 600, in Millimeters

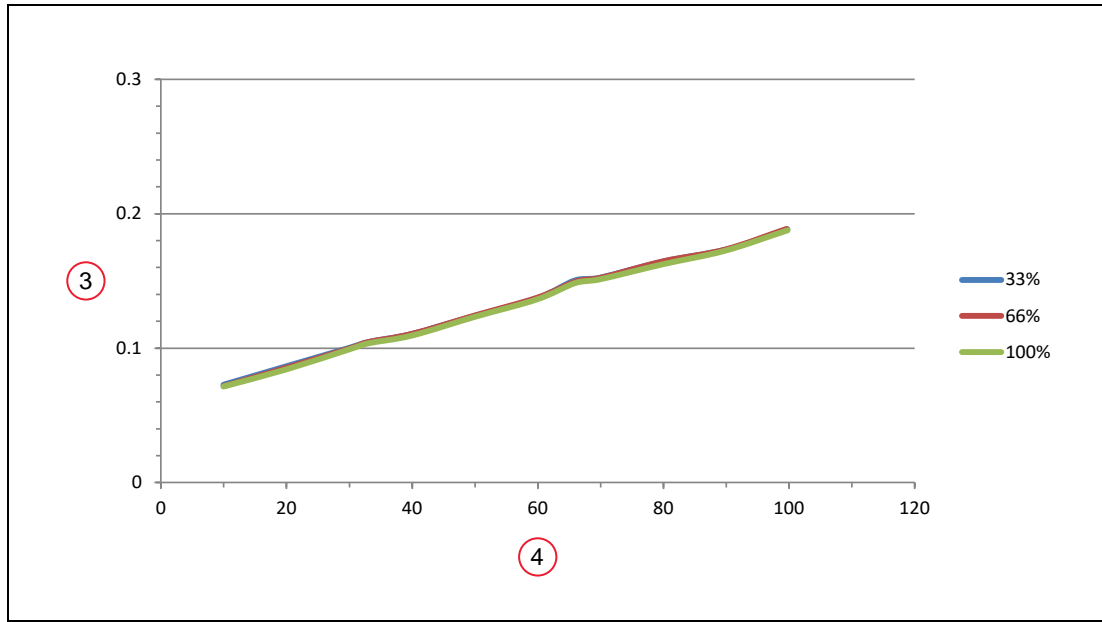


Figure 8-21. Joint 3 Stopping Time for eCobra 600, in Seconds

**NOTE:** The following graphs apply to both the eCobra 800 upright and eCobra 800 Inverted robots.

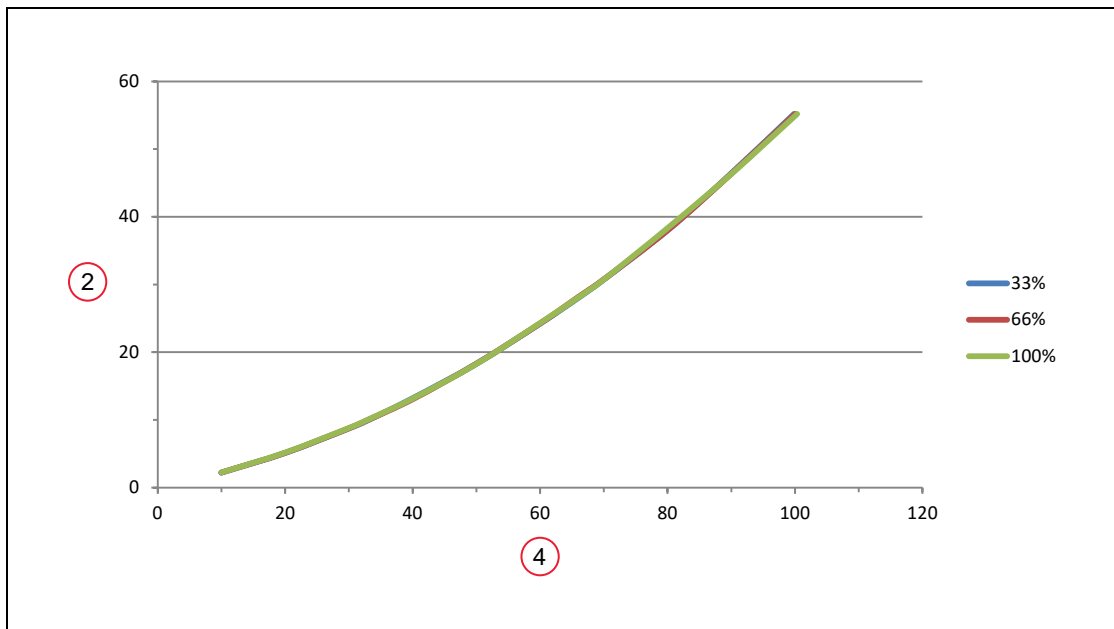


Figure 8-22. Joint 1 Stopping Distance for eCobra 800, in Degrees

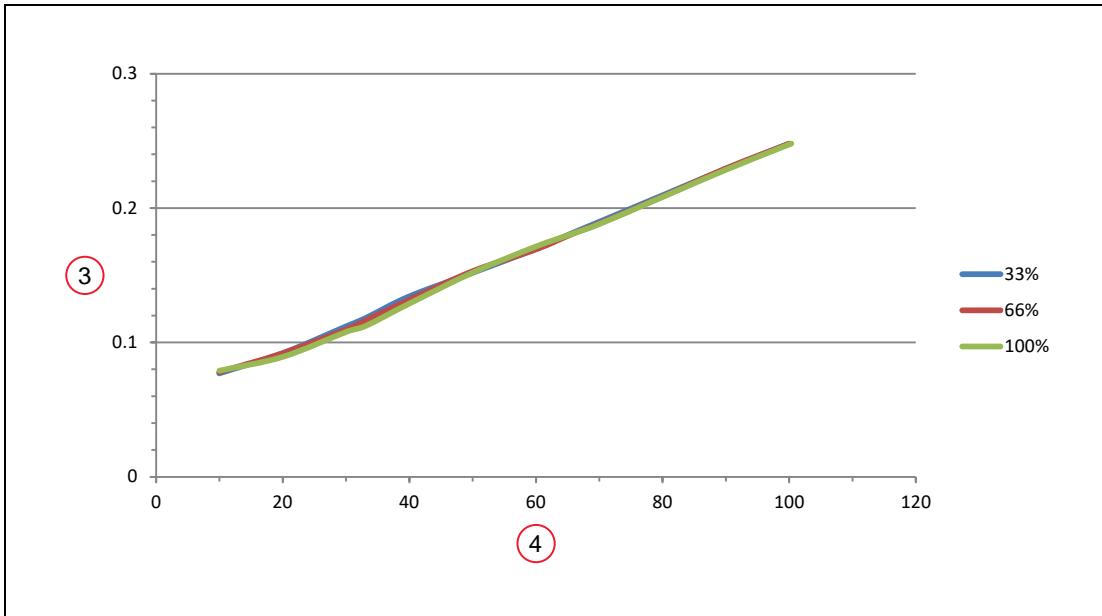


Figure 8-23. Joint 1 Stopping Time for eCobra 800, in Seconds

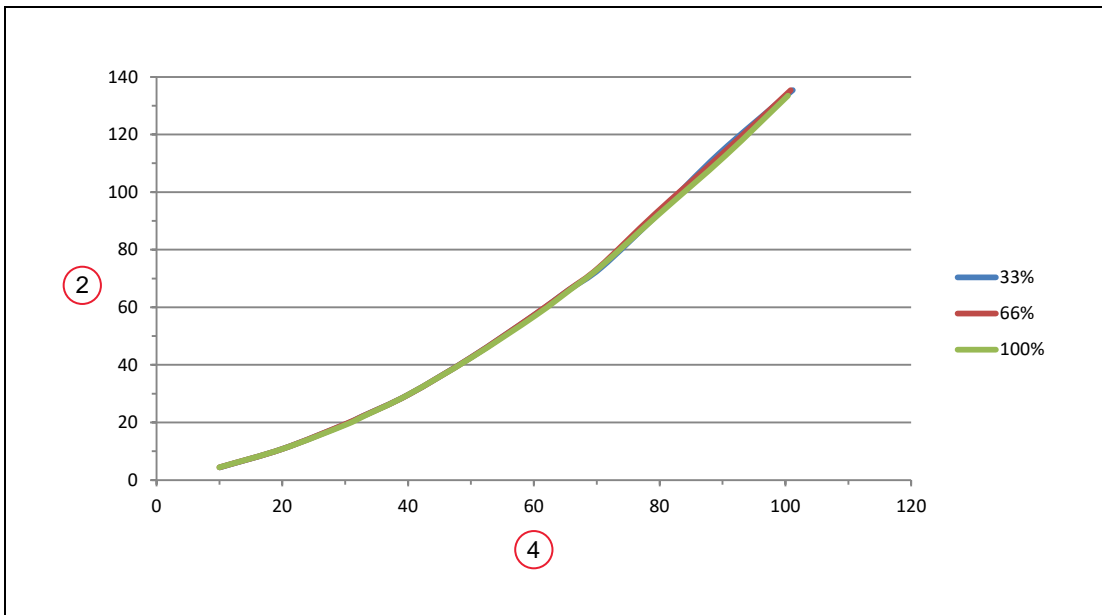


Figure 8-24. Joint 2 Stopping Distance for eCobra 800, in Degrees

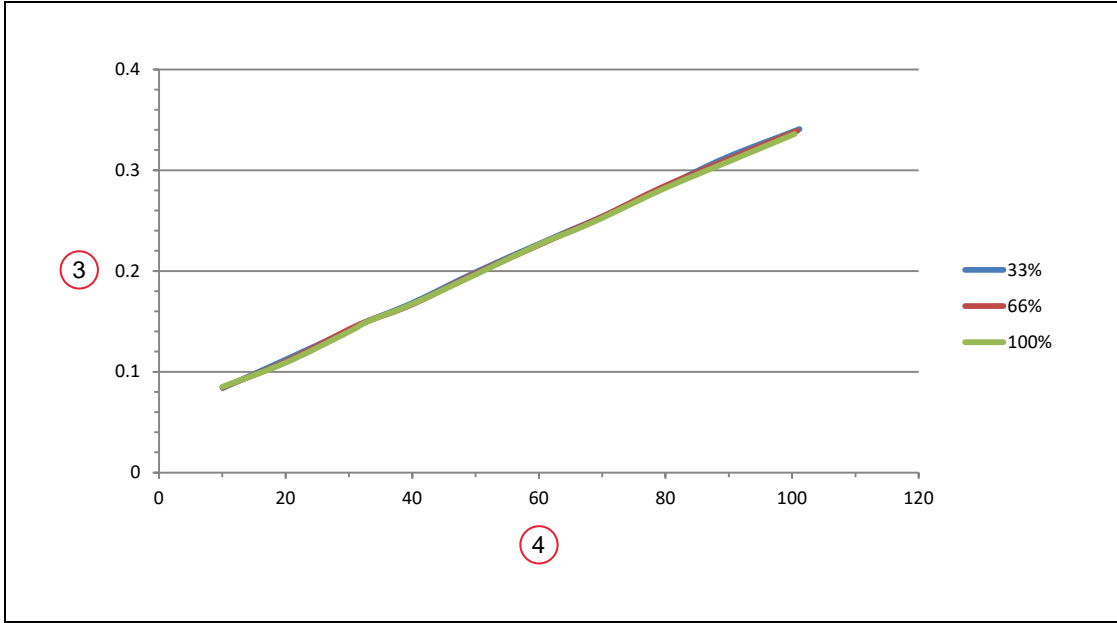


Figure 8-25. Joint 2 Stopping Time for eCobra 800, in Seconds

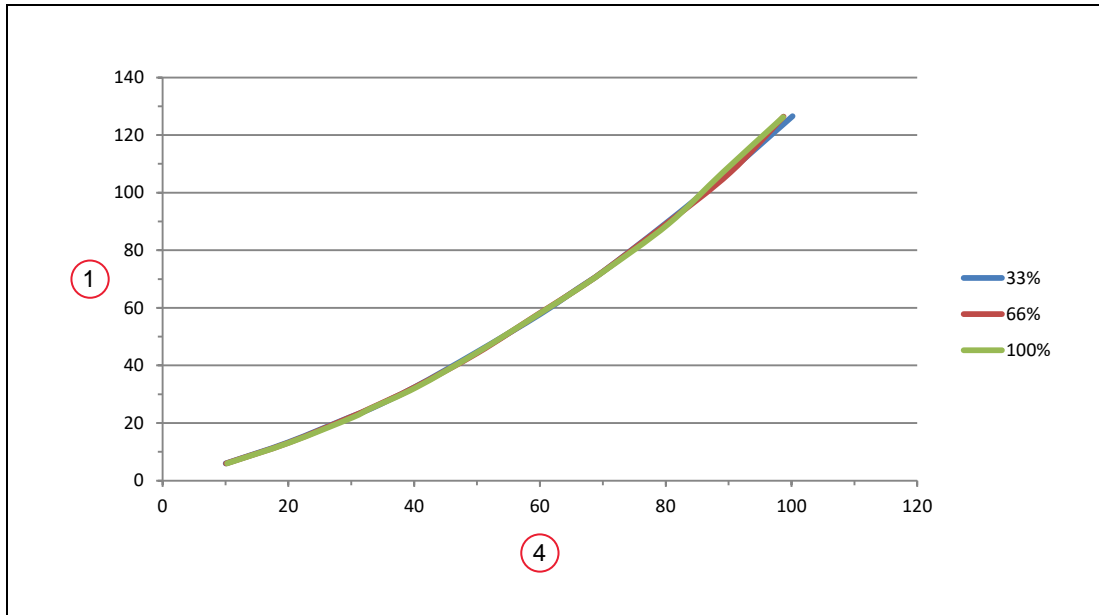


Figure 8-26. Joint 3 Stopping Distance for eCobra 800, in Millimeters

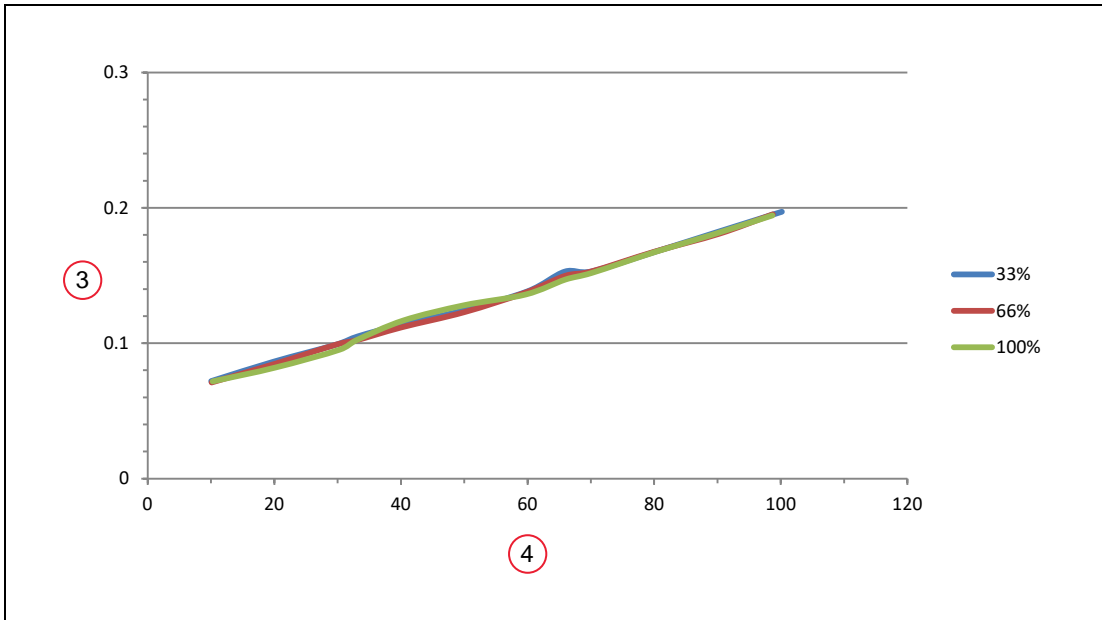


Figure 8-27. Joint 3 Stopping Time for eCobra 800, in Seconds

Stopping distances and times will not degrade as a result of either aging or normal use. Stopping distance will vary only if there is an actuating mechanism failure, which may require replacement of the failed component.

If an integrator wants to perform their own measurement of stopping distances and time in a real cell with a real robot and with real tools and loads, contact your local Omron support.

### Hardstops and Softstops

Table 8-12. Softstop and Hardstop Specifications

Joint	eCobra 600		eCobra 800/800 Inverted	
	Softstop	Hardstop – Approximate	Softstop	Hardstop – Approximate
Joint 1	± 105	± 108	± 105/±123.5	± 108/±127.5
Joint 2	± 150	± 151	±157.5/±156.5 ±155 Inv. IP65	± 160 ±158.5 Inv. IP65
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

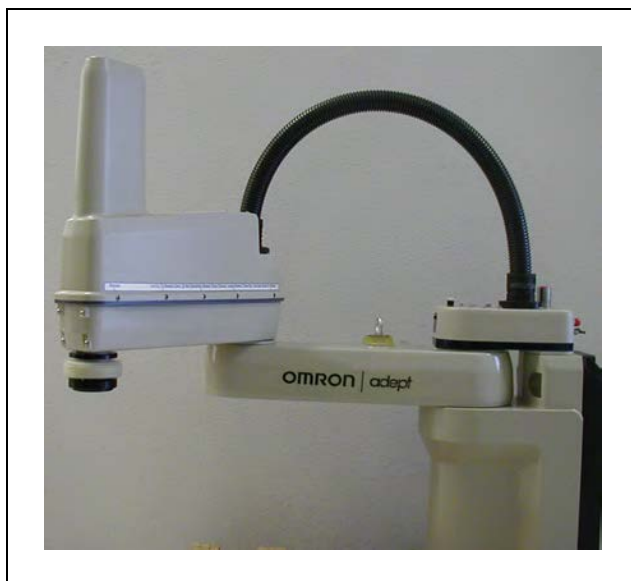
## Chapter 9: IP65 Option

### 9.1 eCobra 800 Robots IP65 Classification

The factory-installed IP65 option kit provides an improved level of dust and water protection. IP65 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 IP65 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 IP65 Water Protection—“Water projected in jets against the robot enclosure from any direction shall have no harmful effects”

**NOTE:** The IP65 Option is available only for the eCobra 800 and eCobra 800 Inverted robots.



*Figure 9-1. eCobra 800 Robot—IP65 Version*

## 9.2 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.



Figure 9-2. 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 M4 x 50 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 9-3. Cable Seal Housing Installed



3. Attach all system cables to the robot. See Figure 4-1.
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 9-4.
  - 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 9-5 for the lower flange in the installed position.



Figure 9-4. Installing Lower Flange

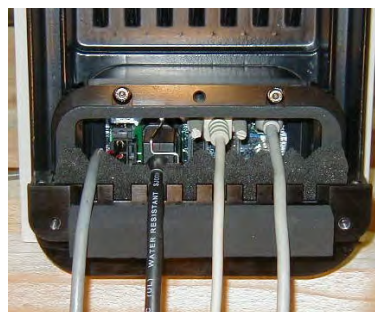


Figure 9-5. Lower Flange in Position

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 cables 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 9-6.

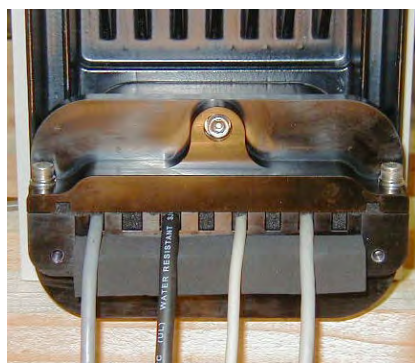


Figure 9-6. Upper Flange Installed

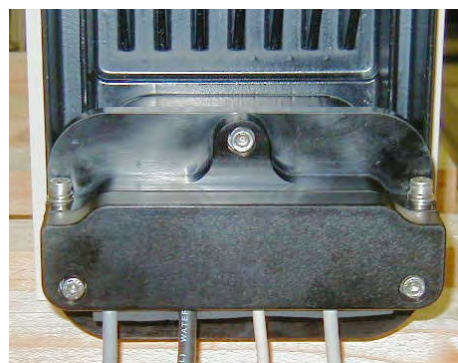


Figure 9-7. Splash Guard Installed

8. Install the splash guard using two M6 x 20 screws, two M6 lock washers, and two M6 flat washers. See Figure 9-7.

## 9.3 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 robot.
2. Turn off power to the optional SmartController EX, if one is being used.
3. 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.
4. Unscrew the collar nut on the top of the outer link. See Figure 9-8.
5. Remove 2 screws and nylon washers on the top of the outer link.
6. 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.
7. For the 8 screws along the side of the cover (4 on each side; see Figure 9-8. ), 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: PROPERTY DAMAGE RISK**

**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.

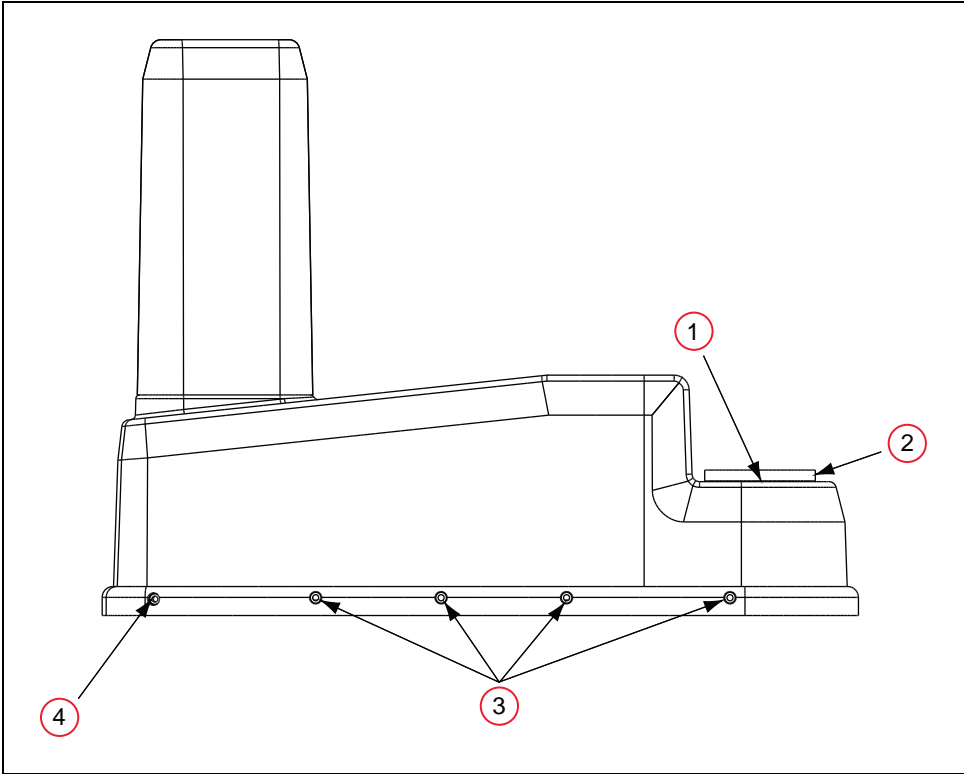


Figure 9-8. Cover Removal Instructions

Table 9-1. Cover Removal Description

Item	Description
1	Remove this screw (one on each side)
2	Collar Nut
3	Remove these screws (4 on each side)
4	Remove this screw (one on each side)

- 8. 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 9-9.

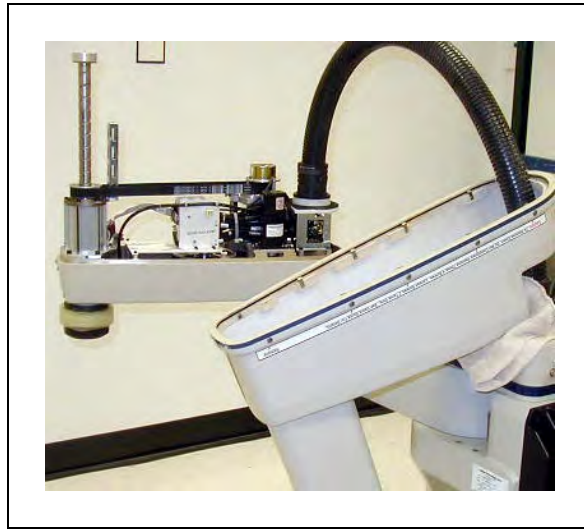


Figure 9-9. IP65 Robot with Outer Link Cover Removed

### 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.

## 9.4 Customer Requirements

The IP65 robot provides most of the hardware needed to achieve an IP65 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 upright robot and just above the eAIB of the inverted robot). These two requirements, sealing the tool flange and pressurizing the robot, are critical to achieving the IP65 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 IP65 robot.

The tool flange for the IP65 robot has an additional protective shield on the outer edge that is not present on the standard robot tool flange. See eCobra 800 IP65 Tool Flange (Units in mm) on page 181 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 8-6. are correct.

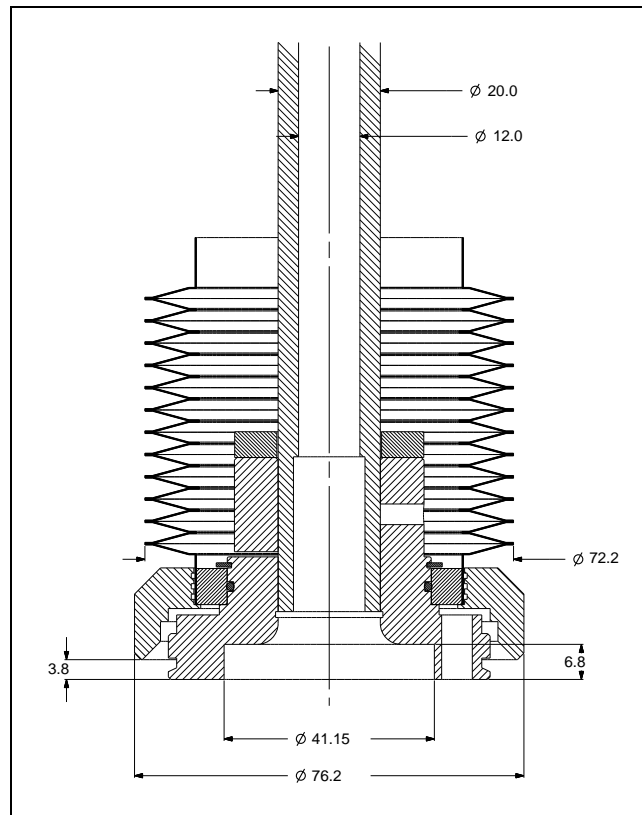


Figure 9-10. eCobra 800 IP65 Tool Flange (Units in mm)

## 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 upright robot and just above the eAIB of the inverted robot. See the following figure.

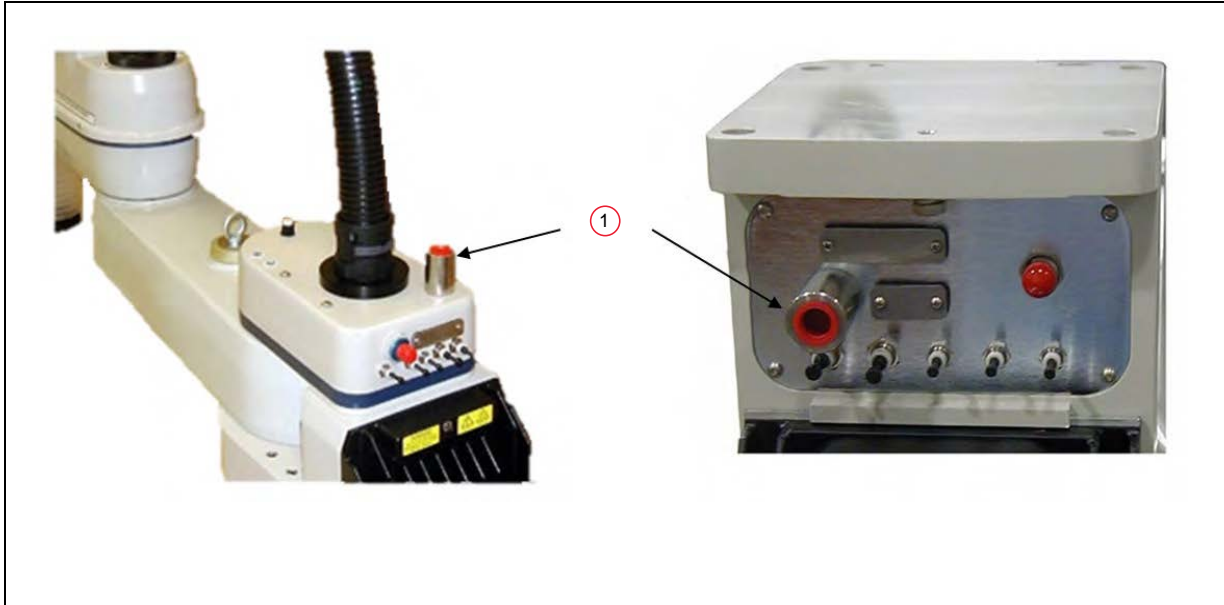


Figure 9-11. (1) Compressed Air Fitting on upright robot (left) and inverted robot (right)

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

Table 9-2. Compressed Air Specifications

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



### CAUTION: PROPERTY DAMAGE RISK

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.

## 9.5 User Connectors

### User Electrical and DeviceNet

On the back of the upright robot's Joint 1 cover and the inverted robot's base, the user electrical, IO Blox, and DeviceNet connectors are filled with removable plugs at the factory. See Figure 9-12. 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 IO Blox device is not available with the eCobra Lite. The DeviceNet connector requires the optional SmartController EX motion controller.

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

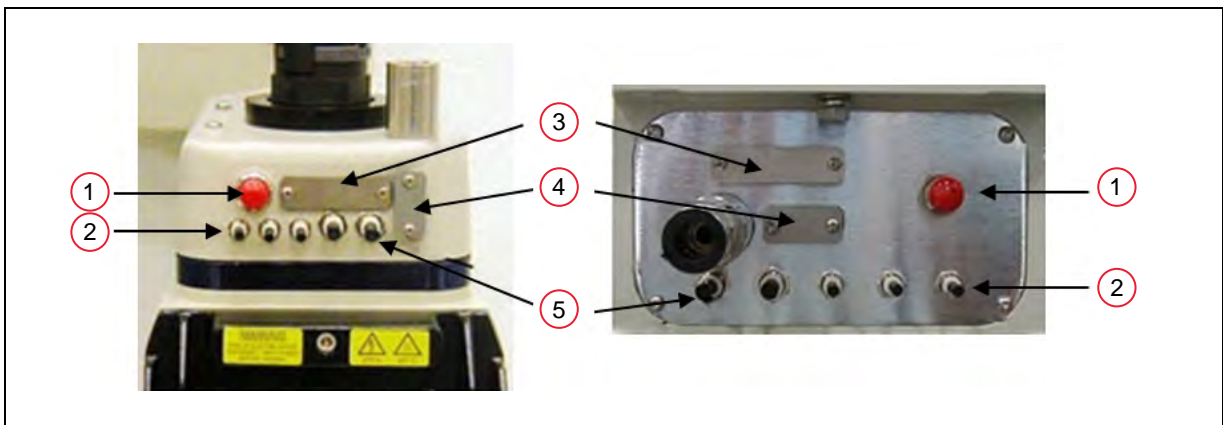


Figure 9-12. User Connectors on upright robot (left) and inverted robot (right)

Table 9-3. User Connector Descriptions

Item	Description
1	DeviceNet
2	4 mm Air Lines (x3)
3	User Electric
4	IO Blox
5	6 mm Air Lines (x2)

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.

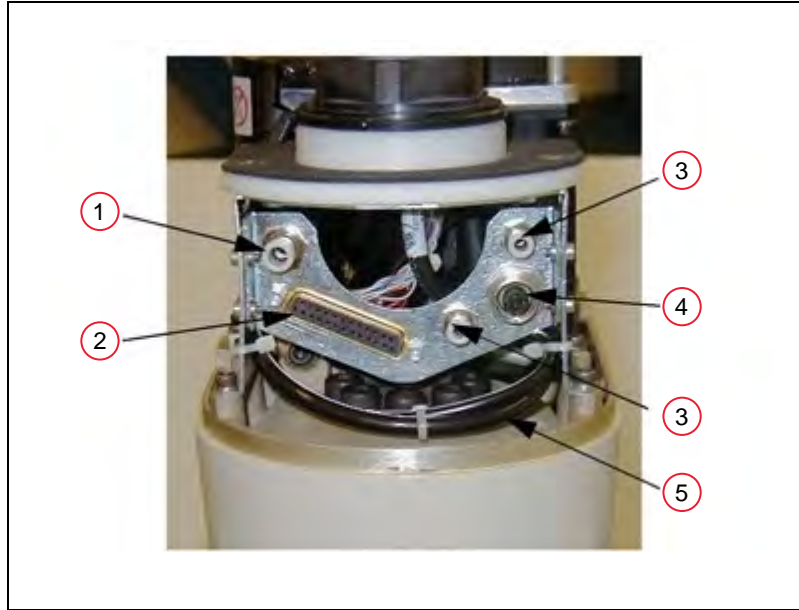


Figure 9-13. IP65 Internal Connectors with Outer Link Cover Removed

Table 9-4. IP65 Internal Connector Description

Item	Description
1	6 mm Air Line
2	User Electric
3	4 mm Air Line
4	DeviceNet
5	Spare Air Lines (x2)

### User Air Lines

The user air line connectors are fitted with removable plugs at the factory. See Figure 9-12.

The user air line connectors on the outer link are accessible with the cover removed. See Figure 9-13. 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.

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

### Robot Solenoid Option

In an IP65 robot, if you are installing the internally-mounted solenoid hand valves (Option Kit p/n 02853-000), you must use a different air line than described in Installing the Robot Solenoid Kit on page 132.



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 9-12. and Figure 9-13.

## 9.6 Maintenance

### IP65 Bellows Replacement

Check the bellows, 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 9-14.
2. Remove the tool flange. For the tool flange removal procedure, refer to Removing and Installing the Tool Flange on page 123.
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 9-15. 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 9-15. Tighten the screw to secure the clamp.

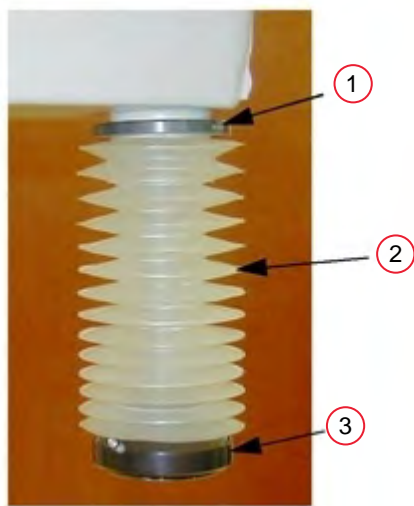


Figure 9-14. Bellows Replacement

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

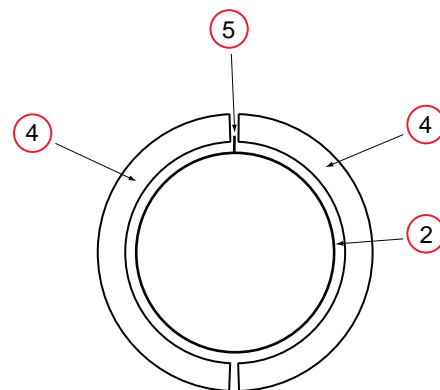


Figure 9-15. Bellows Clamp Alignment (Cross-Section View)

Table 9-5. Bellows Replacement Description

Item	Description
1	Upper Bellows Clamp
2	Bellows
3	Lower Bellows Clamp
4	Bellows Clamp
5	Bellows Seam

### 9.7 Dimension Drawing for Cable Seal Assembly

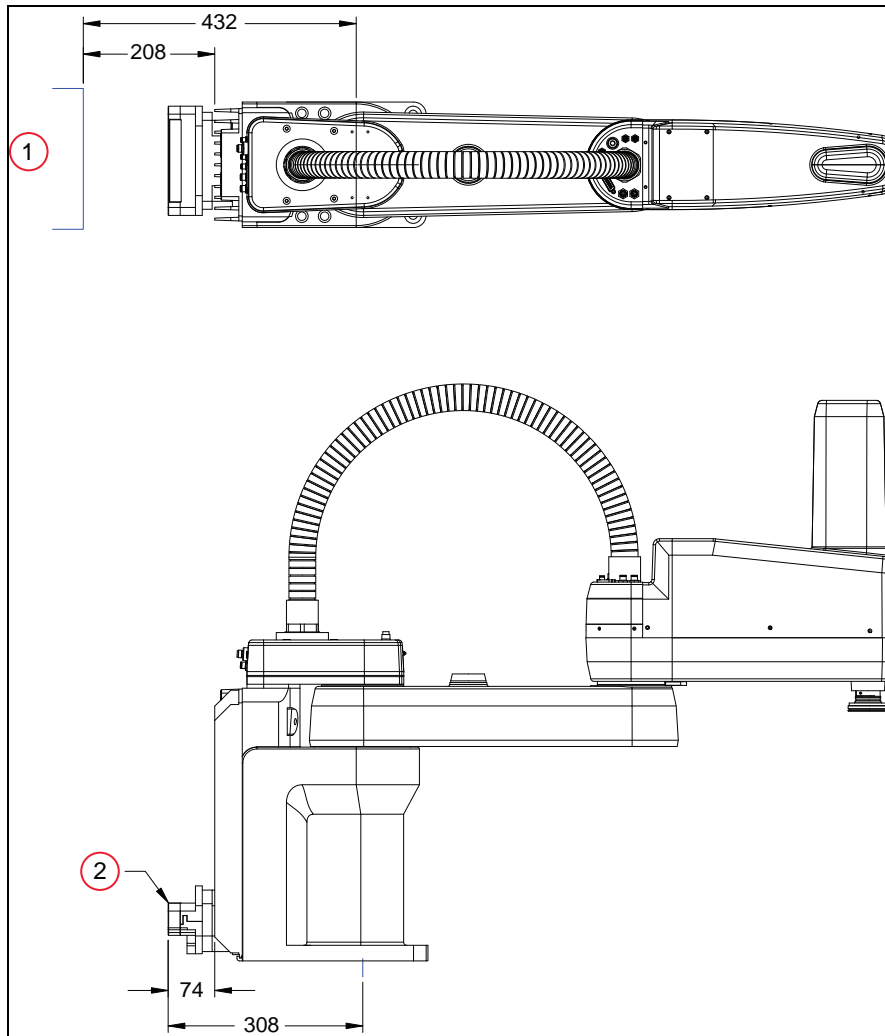


Figure 9-16. Cable Seal Assembly Dimensions (Units in mm)

Table 9-6. Cable Seal Assembly Dimensions Description

<b>Item</b>	<b>Description</b>
1	Required clearance to open eAIB controller with IP65 connector
2	Cable sealing box on IP65 version only



# Chapter 10: Cleanroom Robots

The eCobra robots are available in Class 10 Cleanroom models.

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 10-1. eCobra 600 Cleanroom Robot

## Cleanroom Specifications

Table 10-1. eCobra Cleanroom Robot Specifications

Robot Performance Specification	See Robot Specifications on page 166.
Ambient Temperature Specification	5 to 35° C (41 to 95° F)

## 10.1 Connections



Figure 10-2. Cleanroom Connections

Table 10-2. Cleanroom Connection Description

Item	Description
1	Compressed Air Inlet Port, 3/8 Inch NPT Female Fitting
2	High Flow - Low Vacuum Port, 3/4 Inch NPT Female Fitting

## 10.2 Requirements

Table 10-3. Cleanroom Robot Requirements

Vacuum source	eCobra 600/800: 0.80 m <sup>3</sup> /min (28 ft <sup>3</sup> /min) at 6 mm (0.2 inches) water pressure differential. eCobra 800 Inverted: 0.2 m <sup>3</sup> /min (7 ft <sup>3</sup> /min) at 109 mm (4.3 inches) water pressure differential. 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 ft <sup>3</sup> /min (.04 m <sup>3</sup> /min)
	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.

## 10.3 Exclusions and Incompatibilities

Table 10-4. Internally Mounted Hand Valves

Installation considerations	The internal air line normally used to supply the internally-mounted hand valves (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 (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, we recommend mounting hand valves externally.

## 10.4 Cleanroom Maintenance

### Bellows Replacement

Check the bellows periodically for cracks, wear, or damage. Replace bellows (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 10-3.
2. Remove the tool flange.  
For the tool flange removal procedure, refer to Removing and Installing the Tool Flange on page 123.
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.

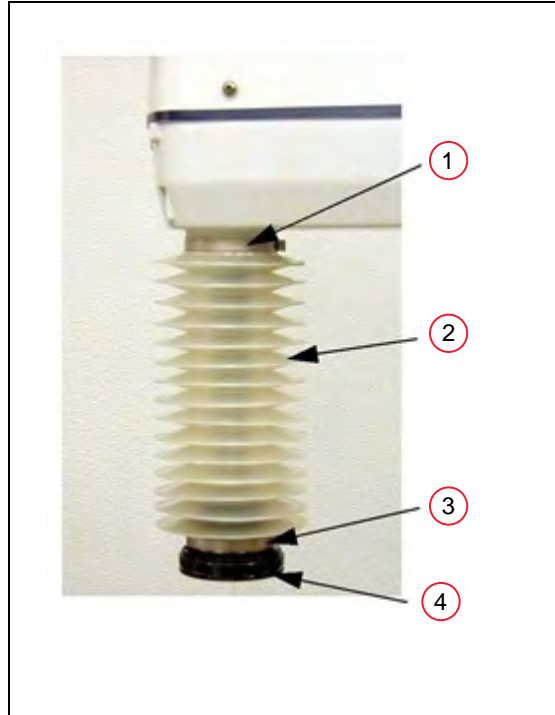


Figure 10-3. Cleanroom Bellows Replacement

Table 10-5. Cleanroom Bellows Replacement Description

Item	Description
1	Upper Bellows Clamp Ring
2	Bellows
3	Lower Bellows Clamp Ring
4	User Tool Flange

### Lubrication

The upper and lower quill requires lubrication in the same manner as the standard eCobra robots. See Lubricating Joint 3 on page 104.





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