OMRON

i4H

Robots

User's Manual

i4-650H
i4-750H
i4-850H

I660-E-02

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Introduction

Thank you for purchasing the i4H robot.
This manual is OMRON's original instructions describing the setup, operations, and user maintenance of the i4H robot robot (herein also referred to as robot).
Please read this manual and make sure you understand the functionality and performance of the robot before attempting to use it.
Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of factory automation (FA) systems and robotic control methods.

- Personnel in charge of introducing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of installing and maintaining FA systems.
- Personnel in charge of managing FA systems and facilities.

Applicable i4L Robot Models

This manual provides information for all i4H-series robot models..
When information varies between different robot models, details are provided. When information is common to all robot models, an illustration of a single robot model is typically shown.

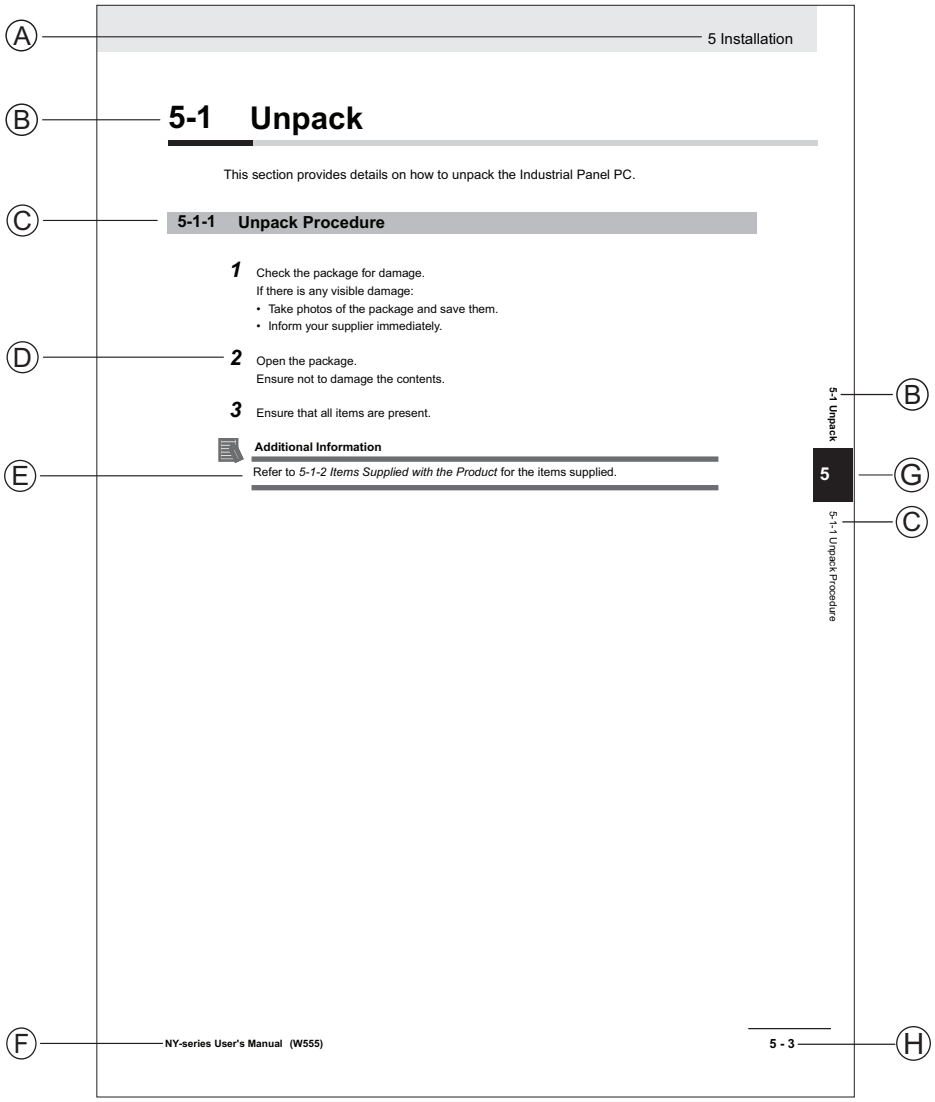
Units

Unless otherwise noted, length dimensions are in millimeters and all units are metric.

Manual Information

Page Structure

The following page structure is used in this manual.



Note: This illustration is provided as a sample. It will not literally appear in this manual.

Item	Explanation	Item	Explanation
A	Level 1 heading	E	Special Information
B	Level 2 heading	F	Manual name
C	Level 3 heading	G	Page tab with the number of the main section
D	Step in a procedure	H	Page number

Special Information

Special information in this manual is classified as follows:

Precautions for Safe Use

Precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operation easier.

Version Information

Information on differences in specifications and functionality between different versions.

Sections in this Manual

1 Overview
2 Specifications
3 Installation
4 Operation
5 Troubleshooting
6 Maintenance
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Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the i4H robot. The safety precautions that are provided are extremely important to safety.
Always read and heed the information provided in all safety precautions.
The following notation is used.

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	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

Symbols

	The circle and slash symbol indicates operations that you must not do. The specific operation is shown in the circle and explained in text. This example indicates prohibiting disassembly.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for electric shock.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a general precaution.
	The filled circle symbol indicates operations that you must do. The specific operation is shown in the circle and explained in text. This example shows a general precaution for something that you must do.
	The triangle symbol indicates precautions (including warnings). The specific operation is shown in the triangle and explained in text. This example indicates a precaution for high temperatures.

Dangers

⚠ DANGER

General

An i4H robot can cause serious injury or death, or damage to itself and other equipment, if the following safety precautions are not observed:

- All personnel who install, operate, teach, program, or maintain the system must read this guide, read the *Robot Safety Guide (Cat. No. I590)*, and complete a training course for their responsibilities in regard to the robot.
- All personnel who design the robot system must read this guide, read the *Robot Safety Guide (Cat. No. I590)*, and must comply with all local and national safety regulations for the location in which the robot is installed.
- The robot system must not be used for purposes other than described in *1-1 Intended Use* on page 1-2. Contact your local Omron support if you are not sure of the suitability for your application.
- The user is responsible for providing safety barriers around the robot to prevent anyone from accidentally coming into contact with the robot when it is in motion.
- Power to the robot and its power supply must be locked out and tagged out before any maintenance is performed.
- When the robot or robotic equipment is not investigated in conjunction with a system work cell, the instructions shall call attention to the following: the interlocked portion of barrier shall be installed, applied, and maintained so that it has the capability of being easily unlocked from the inside of the safeguarded space, with or without power available, when the possibility of full body access exists.

i4H robots are not collaborative robots. They require a dedicated work area that will prevent personnel from coming into contact with them during operation.
The normal and intended use of these robots does not create hazards.
These robots have been designed and constructed in accordance with the relevant requirements of IEC 60204-1.
These robots are intended for use in parts assembly and material handling for payloads up to 15.0 kg.
Refer to the *Robot Safety Guide (Cat. No. I590)* for details on the intended use of our robots.
These robots are intended for industrial use only.
Perform a risk assessment before using.
These robots are not intended for:

- 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.

Installation

The robot system must be installed with user-supplied interlock barriers. The interlocked barriers must open the E-Stop circuit in the event of personnel attempting to enter the work cell when High Power is enabled. Failure to install suitable guarding or interlocks could result in injury or death. We strictly prohibit installation, commissioning, or operation of any robot without adequate safeguards. These must be compliant with applicable local and national standards.

The placement of safety controls shall avoid requiring a person to enter a hazardous area to actuate them.	
Controls shall be located outside of the safeguarded space, except for certain controls such as emergency stops or a teach pendant, where based on a risk assessment they may be located within the safeguarded space.	
After installing the robot, you must test it before you use it for the first time. Failure to do this could cause death, serious injury, or equipment damage.	
Failure to ground robot-mounted equipment or tooling that uses hazardous voltages could lead to injury or fatality of a person touching the end-effector during an electrical fault.	
Any High Power push-buttons must be installed outside of the robot's workspace.	

Warnings

⚠ WARNING

General

The instructions for operation, installation, and maintenance given in this document must be strictly observed.	
If air pressure is present, disconnect it from the robot when servicing end-of-arm tooling or other pneumatic components to prevent unsecured pneumatic air lines from accidentally injuring personnel.	
Do not move the robot links if the robot is not secured. Failure to comply could result in the robot falling and causing either personnel injury or property damage.	

Installation

Ensure that installation and post-installation checks of the product are performed by personnel in charge who possess a thorough understanding of the machinery to be installed.	
The AC power installation must be performed by a skilled, and instructed person. For more information on this refer to the *Robot Safety Guide (Cat. No. I590)*. During the AC power installation, unauthorized third parties must be prevented from turning the power on through the use of fail-safe lockout measures.	
Ensure compliance with all local and national safety and electrical codes for the installation and operation of the robot system.	

Provide appropriately-sized Branch Circuit Protection and Lockout / Tagout Capability in accordance with the National Electrical Code and any local codes.	
Use a crane and straps to lift the robot by the inner arm and controller handle. Never lift the robot by the quill. Failure to comply could result in the robot falling and causing either personnel injury or equipment damage.	
If you supply your own Front Panel, its design must comply with the requirements of IEC 60204-1 and ISO 13849. The E-Stop's push button must comply with ISO 13850 (Clause 5.5.2).	
Disabling the High Power button violates IEC 60204-1. Do not alter its functionality.	
If a robot is mounted to a surface with inadequate stiffness, damage to the z-axis quill or other mechanical components can result from excessive oscillation during operation.	
The robot can fall over if it is not properly secured with mounting hardware.	
The robot must be installed to avoid interference with buildings, structures, utilities, other machines and equipment that may create trapping or pinch points. It must be installed in accordance with Standard for Robots and Robotic Devices – Safety Requirements for Industrial Robots – Part 2: Robot Systems and Integration, ISO 10218-2.	
Ensure that interconnecting cables or pneumatic lines are routed away from the robot workspace.	
To reduce the risk of fire or electric shock, install the robot in a controlled environment relatively free of contaminants.	
Do not remove the shipping brackets or move the robot links until the robot has been secured to its mounting surface. Failure to comply could result in the robot falling and causing either personnel injury or property damage.	

Operation

Before starting the operation of equipment, always confirm that the safety equipment of the robot works properly. If a malfunction of the safety equipment is detected, follow the troubleshooting procedure.	
Use the total weight of the end-of-arm tooling and the payload to stay within the payload rating of the robot. Ensure that the system never exceeds that maximum payload.	
Perform a full risk assessment which includes the end-of-arm tooling and any payload to prevent crushing, shearing, payload ejection, entanglement, stabbing or puncture hazard.	
Releasing a brake may cause the quill, tool flange, end-of-arm tooling, and payload to drop. To prevent possible injury to personnel or damage to the equipment, make sure that the equipment is supported when releasing the brake and verify that the end-of-arm tooling and payload are clear of all obstructions.	

All signals that pass-through the USER connectors are not associated with any robot controls, emergency stop circuits, or robot power. Implement appropriate safety measures to ensure that these signals are not active during emergency stop conditions or while the robot is powered OFF.	
In Automatic mode, the robot can move unexpectedly. Ensure all personnel remain clear of the cell when Automatic mode is enabled.	
If an operator is going to be in the work cell with the switch in Manual mode, the operator must carry an enabling device such as the T20 pendant.	
Whenever possible, perform Manual mode operations with all personnel outside the workspace.	
The stopping time and distance, or angle, of a robot joint from initiation of a stop signal is not negligible and must be taken into account when designing and applying safeguarding devices.	
Never connect or disconnect system cables while power is applied to the robot. Failure to comply may cause unexpected behavior and can result in personnel injury and equipment damage.	
Never run a robot system with all jumpers installed. This would leave the system with no E-Stops.	
Do not use the robot in hazardous environments (explosive gas, and oil mist).	
The robot shall be operated within its specified temperature range to ensure proper operation.	
The robot's physical hardstop devices are not intended to withstand repeated use. If this occurs, the hardstop may become damaged. Implement proper programming and configuration of joint range limits to prevent hardstop impacts.	

Maintenance

Do not use organic solvents to clean any part of the robot. Organic solvents might damage electronics resulting in an unsafe operating state that could cause injury or damage to equipment.	
You must perform the Lockout and tagout procedure prior to servicing the robot.	
The access covers on the robot are not interlocked. You must turn OFF and disconnect the power before the covers of the robot are removed.	
The procedures and replacement of the parts mentioned in this manual must be performed only by the skilled or instructed persons.	

Cautions

⚠ CAUTION

The design and installation of the complete system must comply with the safety standards and regulations in the country of use. The integrators of the robot should understand the safety laws and regulations in their countries and prevent major hazards from occurring in the complete system.

Precautions for Safe Use

- The Joint 3 quill and the tool flange are not grounded to protective earth. 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.
- Output 8 can be assigned to indicate the robot's High Power state. When High Power is enabled, this output will turn ON. When High Power is not enabled, this output will be OFF. This is not a safety-rated means of indicating a High Power state and should only be used for monitoring the robot status. Use the ACE Software to make this configuration if needed.
- Do not apply the AC power until all installation steps are complete and verified and all safety measures are in place.
- High power cannot be enabled unless all safety circuits are satisfied.
- The LED light ring does not reflect the robot's High Power status. To see the robot's High Power status, use the Front Panel indicator or a user-supplied indicator connected to the XFP connector.
- The braking mechanism operates passively. If 24 VDC Control Power is removed from the system, the brake mechanism will automatically activate. 24 VDC Control Power must be supplied to release the brake. To prevent possible damage to the equipment, remove any payload from the end-of-arm tooling, make sure that Joint 3 is supported while releasing the brake, and verify that the end-of-arm tooling or other installed equipment is clear of all obstructions.
- To comply with ISO 10218-1 when using a remote brake release button, ensure the brake release button displays a warning label to indicate that the z-axis of the robot may fall due to gravity if the brake is released.
- The High Power indicator must be operational to satisfy safety requirements.
- You can contribute to resource conservation and protecting the environment by the proper disposal of Waste Electronics and Electrical Equipment (WEEE). All electrical and electronic products should be disposed of separately from the municipal waste system according to local ordinances using designated collection facilities.

- The product contains lithium batteries with a perchlorate content of 6ppb or higher. When exporting an end product containing the product to or shipping through California, USA, label all packing and shipping containers appropriately. Special handling may apply. Refer to https://dtsc.ca.gov for more information.
- Dispose of any battery that has been dropped or otherwise subjected to excessive shock. Batteries that have been subjected to shock may leak if they are used.
- Batteries may leak, rupture, heat, or ignite. Never short-circuit, charge, disassemble, heat, or incinerate a battery or subject it to strong shock.
- Any person who programs, teaches, operates, maintains, or repairs robots or robot systems shall be trained and can demonstrate competence to safely perform the assigned task.
- Any person who programs, teaches, operates, maintains, or repairs robots or robot systems shall be trained on responding to emergency or abnormal situations.
- Do not connect user-supplied Manual / Automatic contacts or other control signals in parallel with the Front Panel switch contact. This would violate the Single Point of Control principle and might allow Automatic mode to be selected while an operator is in the cell.

- Acoustic emission from these robots may be up to 80 dB (A) at 1 m distance under worst-case conditions. Typical values will be lower, depending on payload, speed, acceleration, and mounting. Appropriate safety measures should be taken, such as ear protection and display of a warning sign.
- Any moving robot requires some distance to stop. This requires more distance at high operating speeds or heavier payloads. When stopping a robot, make sure that there is no interference with other equipment.
- Do not expose the shipping container to excessive shock and vibration. This could damage the robot.
- Using improper lubrication products on the robot may damage it.
- After an operator places the robot in Manual mode using the Front Panel key switch, they should remove the key for safety purposes.
- If the supplied Front Panel is not used, a High Power indicator light must be present in the system. This indicator light must be amber in color. It must be either mounted to the robot or integrated into the work cell where it is visible from all approaches or entry points.
- If a supplementary audible means of robot operation is provided, it shall exceed the ambient noise at the end-use application.
- During manual operation, ensure all persons are a safe distance away from the robot workspace.
- To stop the robot in an emergency, press any E-stop button and then follow the internal procedures of your company or organization defined for an emergency situation.
- If a fire occurs on the robot, use a CO_2 type fire extinguisher.
- In case of entrapment of a person by the robot or any other emergency or abnormal situation, you can manually move the inner and outer links to a safe position while the High Power is disabled. A brake device prevents Joints 3 and 4 from moving when High Power is disabled and can only be released while 24 VDC Control Power is present.
- Prior to placing the robot in Automatic Mode, all safeguards must be returned to their safe state.
- After the robot is placed in Manual mode using the Front Panel key switch, the key should be removed for safety purposes.

Precautions for Correct Use

- Robot motion is not possible until AC power is supplied High Power and has been enabled.
- Control Power must be present before High Power can be enabled.
- This equipment must be shipped and stored in a temperature-controlled environment, within the range –25 to +55° C. The recommended humidity range must be 5 to 90%, non-condensing. It should be shipped and stored in the supplied packaging, which is designed to prevent damage from normal shock and vibration.
- Robot must be operated within its specific temperature ratings to ensure proper operation.
- Placing the robot on its side for extended periods of time can cause oil leaks from the harmonic drive units. Limit the amount of time the robot is placed on its side.
- The T20 pendant can only control the robot it is directly connected to.
- Either a Front Panel or equivalent circuits are required to enable High Power to the robot.
- If the Front Panel High Power ON / OFF indicator fails, you might incorrectly assume that High Power is OFF, and the robot is safe. To prevent this, a failed indicator causes an error (-924) *Front panel HIGH POWER lamp failure* and locks out the High Power enabling until you replace the indicator.
- It is recommended to use an 18 mm (minimum) thick steel plate with a maximum surface roughness of 25 µm that is properly secured to the floor or wall as a robot mounting surface. Mounting surface flatness must not exceed 5 mm.
- The mounting surface should be clean and prepared according to the information provided in the manual before attempting to mount the robot.
- Do not over-tighten the tool flange setscrew. This will cause off-center alignment of the tool flange on the quill.
- Always reduce joint motion limits with software configuration settings when hardstops are used to restrict range of motion.
- Never release the z-axis brake while the quill clamp collar is loose or removed. This can allow the quill to fall out of the robot.
- If Teach Pendant cabling is installed, the jumper plug or the Teach Pendant must be connected to satisfy safety circuits and allow High Power to be enabled.
- Do not disable or bypass the High Power button. This will violate IEC 60204-1.
- Operating the robot outside of the payload and speed constraints described in this document can damage or reduce the service life of the z-axis quill.
- If a Front Panel is not present, the High Power indicator and High Power button signals can be accessed with the XFP system cable connector.
- Attempting to release the brake while High Power is ON will automatically disable High Power. If the robot is moving, this will cause it to stop abruptly.
- Only replace items on the robot system with the parts supplied by OMRON.
- Only use the recommended grease on the joint 3 quill. Refer to the provided Safety Data Sheet for proper handling.
- When removing and replacing the tool flange, you must reinstall it in the same position to avoid losing the calibration for the robot.
- Use surge suppression when switching inductive loads such as relays to prevent damage to the output circuits.
- Any externally mounted equipment is considered robot payload. Consideration to the payload attached to the Tool Flange should be made when mounting external equipment to the robot.

- Avoid rotating the quill / Joint 4 when the brake is released. This could result in an out-of-range condition and may prevent program execution.
- All fastener torque values provided must be applied within ±5%.
- Do not remove factory-installed Joint 1 hardstops.
- Follow appropriate ESD procedures when removing or replacing the amplifier chassis.
- Pneumatic pass-through ports are re-purposed when the optional pneumatic valve kit is installed.
- Robot joints 1 and 2 have no brake mechanism and can be manually moved when power is not present.
- If any damage is detected before unpacking the robot, request that the carrier's agent be present when you unpack the container.
- If the robot mounting structure is not designed with adequate stiffness, robot performance will not meet the specified values.
- When adjusting Joint 1 hardstops, do not let screws or other objects drop into the robot body.
- Keep a minimum of 300 mm clearance behind the robot to avoid unmounting of the robot in case of amplifier chassis replacement and to allow for easy switch setting access.
- Never loosen or remove the quill clamp collar while the z-axis brake is released.

Regulations and Standards

The OMRON i4H robot series are compliant to the following standard:

Regulation/Standard	Description
2006/42/EC	Machinery Directive.
2014/30/EU	EMC Directive.
EN ISO 12100	Safety of Machines - General Principles for Design - Risk Assessment and Reduction.
EN ISO 13849-1	Safety of Machines - Safety Related Parts of Control Systems SRP/CS - Part 1.
EN ISO 10218-1	Robots for Industrial Environments - Safety Requirements - Part 1: Robot.
EN 60204-1	Safety of Machinery - Electrical Equipment of Machines - Part 1 General Requirements.
EN 61000-6-4	EMC - Part 6-4: Emissions Standard for Industrial Environments.
EN 61000-6-2	EMC - Part 6-2: Immunity Emissions Standard for Industrial Environments.

Software Licenses and Copyrights

This product incorporates certain third party software. The license and copyright information associated with this software is available at http://www.fa.omron.co.jp/nj_info_e/.

Related Manuals

Use the following related manuals for reference.

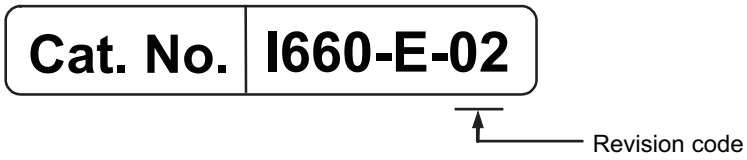
Manual Title	Description
Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)	Instruction for the use of the ACE Version 4 software.
IPC Application Controller User's Manual (Cat. No. I632)	Describes the IPC Application Controller.
T20 Pendant User's Manual (Cat. No. I601)	Describes the setup, operation, and user maintenance for the Teaching Pendant T20.
Robot Safety Guide (Cat. No. I590)	Describes how to use the OMRON robot safely.
V+ User's Manual (Cat. No. I671)	Provides a description of the V+ programming language and functionality.
V+ Keyword Reference Manual (Cat. No. I672)	Provides reference to V+ Keyword use and functionality.

Glossary

Term / Abbreviation	Description
Application Controller	Industrial PC that provides additional functionality to the robot to execute PackManager and Robot Vision Manager applications.
Automatic Mode	Operating state of the robot during normal conditions. In this mode, program execution will control the robot up to the maximum allowable speed.
Control Power	24 VDC supply that energizes control and other non-servo motor circuits.
End-of-arm Tooling	Any device mounted to the robot's tool flange intended for performing work during robot operation.
Emergency Stop	An action or device used to immediately stop the robot. This may be referred to as emergency stop, E-stop, or ESTOP.
Hardstop	Physical limit that restricts the range of motion for a robot axis.
High Power	AC supply that energizes all internal servo motors to allow robot motion.
Joint	Mechanical robot component that connects its moving parts.
LED Light Ring	Multi-colored light ring on Joint 1 that provides a visual indication of the robot operating state.
Link	Mechanical robot component that moves in a radial motion.
Manual Mode	Operating state of the robot during commissioning, position teaching, and other setup operations.
SCARA	Selective Compliance Assembly Robot Arm
T20 Pendant	Optional, handheld device used to manually jog the robot, teach locations, and debug programs without a PC. This is also referred to as a Teach Pendant or a pendant.
Quill	Mechanical robot component that provides motion in the z-axis and rotary motion for the tool flange. This is a ball-screw mechanism.
Work Envelope	Working area that is accessible by the robot considering any end-of-arm tooling and part shapes that are attached.
Workspace	Total area that the robot occupies considering all capable range of motion.

Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.



Revision code	Date	Revised content
02	April 2022	Updates and minor modifications.
01	January 2022	Original production.

1

Overview

This section provides general information about the robot.

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1-1 Intended Use

The i4H robot is a selective compliance assembly robot arm (SCARA) for use within factory environments. It is designed to perform automated motion control typically used with material handling operations.
The i4H robot is capable of high speed, high-precision motion for payloads up to 15 kg. Its durable design and flexible programmability make it ideal for a wide variety of robotic applications.

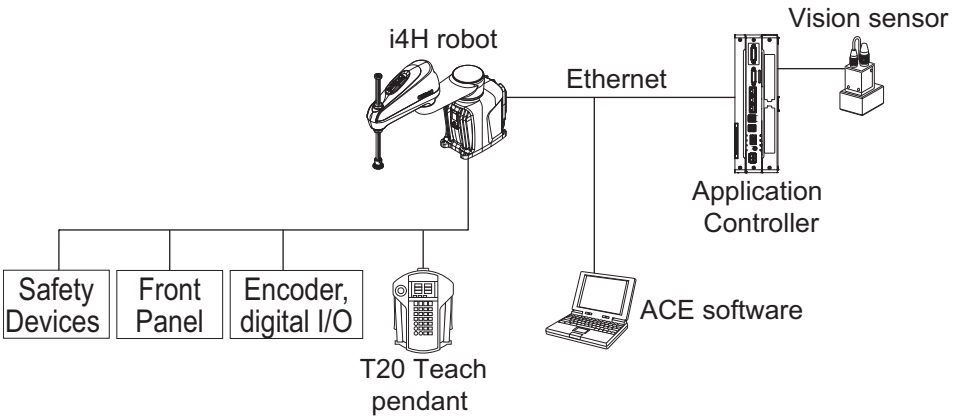
1-2 Robot Features

This section provides information about the features of the i4H robot series. The following items summarize the main features of this robot.

- High speed, precision, and payloads are possible with a robust mechanical design.
- Ethernet communications are built-in for easy integration with other networked devices.
- Various configurations allow a wide variety of mounting options.
- A multi-colored LED light ring provides a highly visible indication of the general robot status.
- An LCD display on the base of the robot provides detailed information about robot operational status.
- Mounting points are available on the exterior of the robot for items such as pneumatic valves or other hardware.
- Pass through electrical and pneumatic ports are available from the base of the robot to the outer link.
- The Primary Interface Panel provides a central location for all cables and connections and a Secondary Interface Panel provides connections for end-of-arm tooling and other hardware.
- An optional pneumatic valve kit can be installed to provide robot-controlled ports at the Secondary Interface Panel.
- Built-in I/O provides 17 inputs and 12 outputs.
- Adjustable hardstops are integrated into the robot body.
- IP65 configuration for applications where wash-down is required.
- Food-grade configuration for applications with direct food contact.
- Electrostatic discharge protection for applications that require handling of sensitive electronic components and assemblies.
- Cleanroom configuration for applications in environmentally controlled conditions.
- A Wall Mount Bracket is offered for mounting the robot to a vertical surface.

1-2-1 Robot System

The robot system provides functionality for conveyor tracking, vision-guided motion, and typical pick-and-place applications. Devices such as encoders, safety equipment, and digital I/O can be connected directly to the robot. An optional Application Controller can be integrated into the system. Refer to *1-6-3 IPC Application Controller* on page 1-18 for more information.

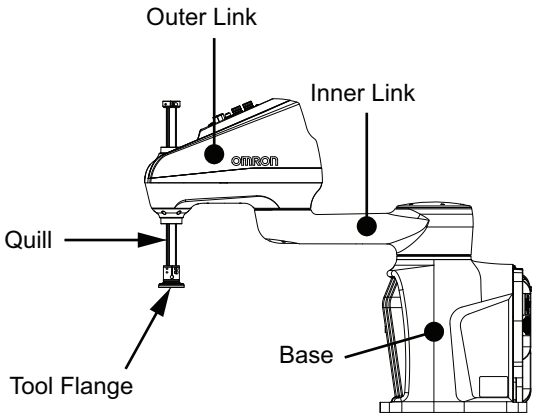


1-2-2 Basic Robot Components

The robot consists of the following components that are referred to throughout this manual. Use the information below to identify the robot's basic components.

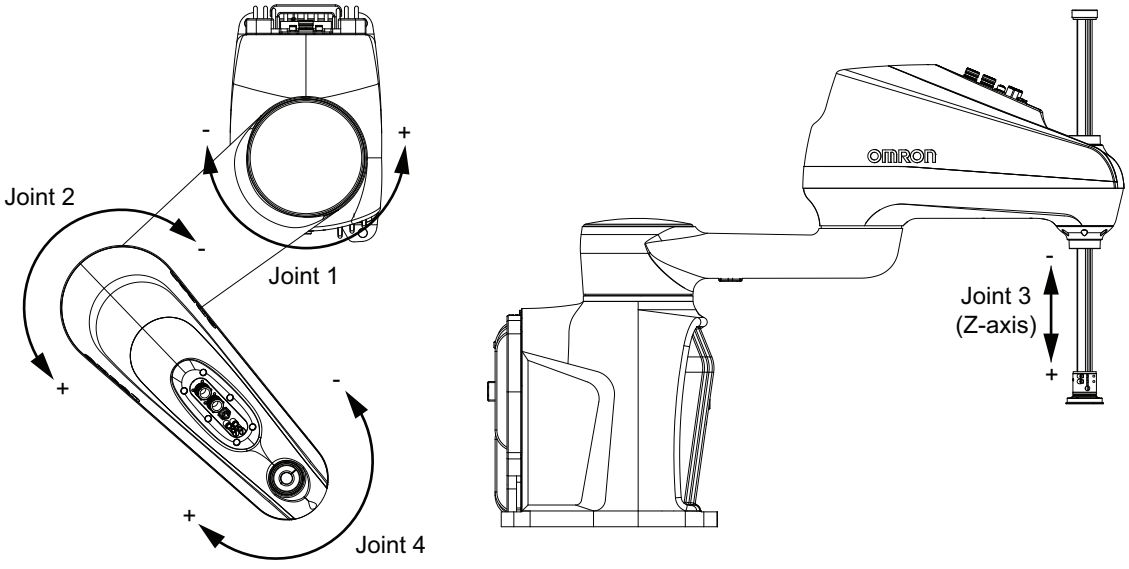
Mechanical Components

Use the image below to identify the robot's mechanical components.



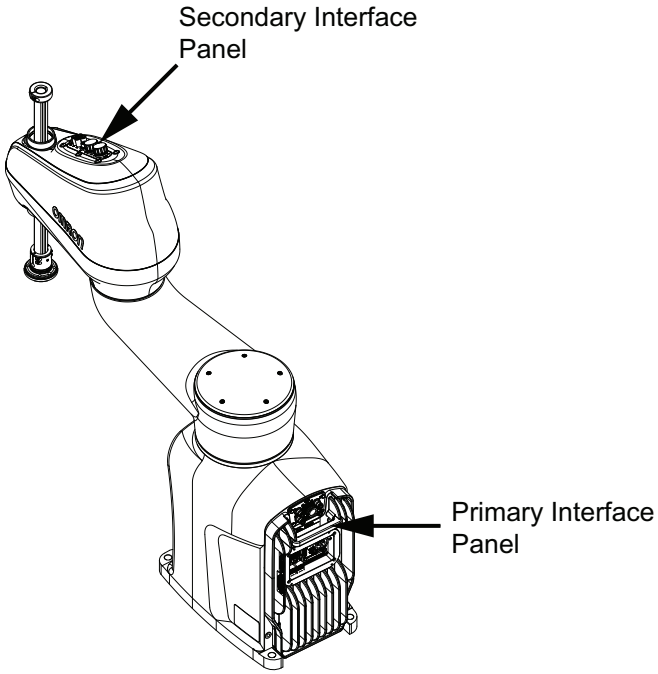
Axes of Motion

Use the following diagrams to understand the robot's 4 axes of motion.



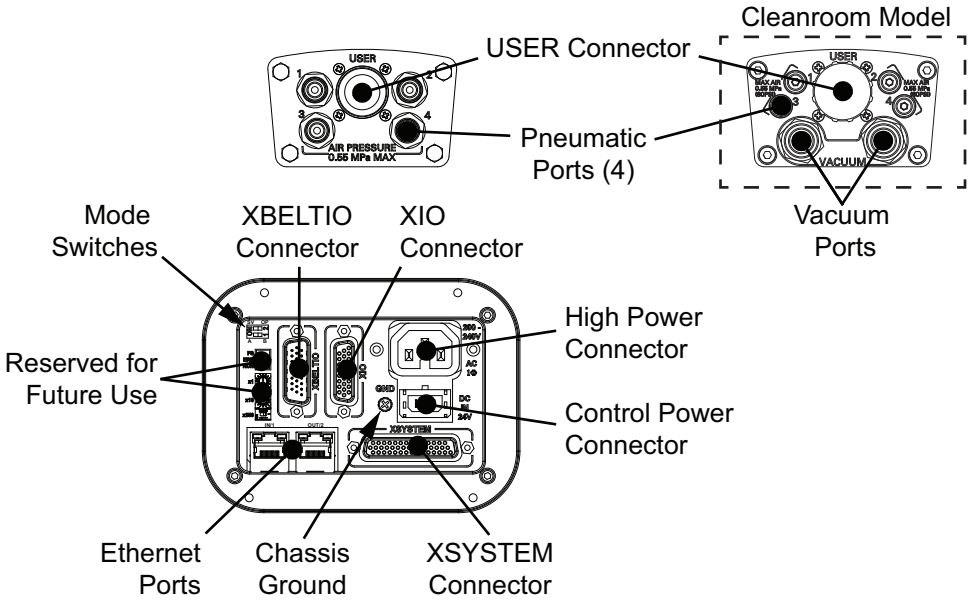
Interface Panels

Use the information below to identify the robot's interface panels and their functions.



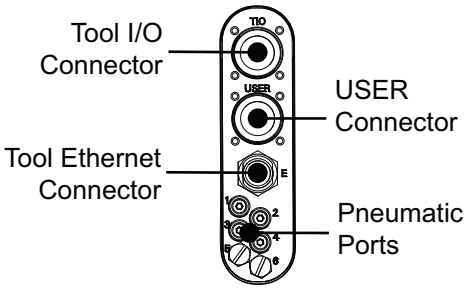
● Primary Interface Panel

The Primary Interface Panel is located on the base of the robot and provides access to the following items.



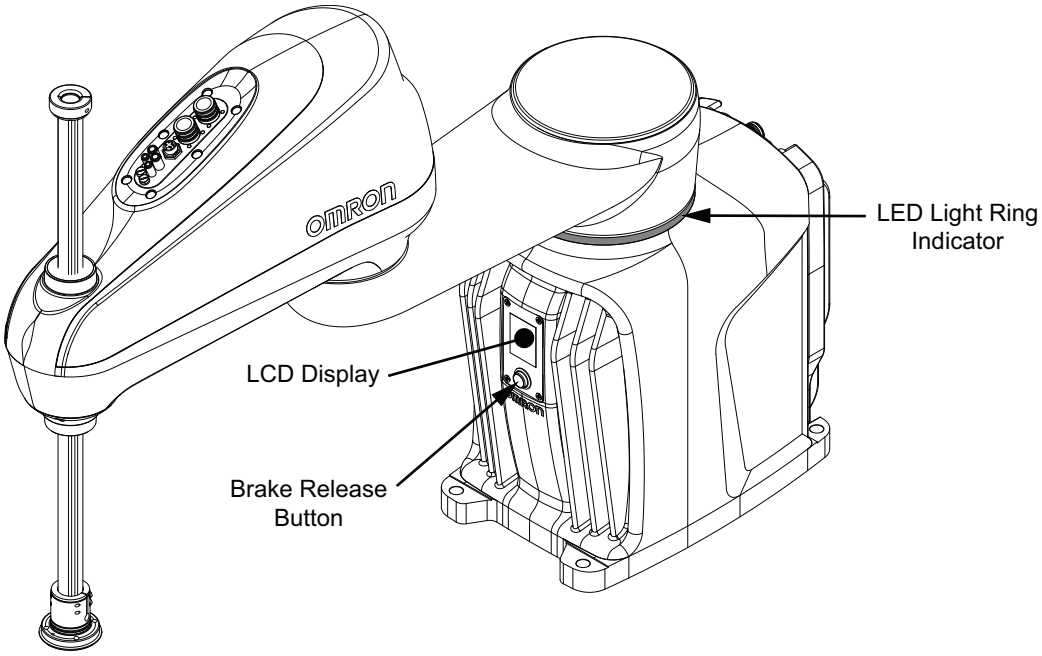
● Secondary Interface Panel

The Secondary Interface Panel is located on top of the outer link and provides access to the following items.



1-2-3 Other Components

Other components are located on the robot as shown in the following image.



Additional Information

Refer to the following sections for more information.

- *4-5 LED Light Ring* on page 4-8
- *4-6 LCD Display* on page 4-9
- *4-7-1 Built-in Brake Release Button* on page 4-10

1-2-4 Front Panel

The Front Panel is a device that provides remote control and status functions when mounted a safe distance outside of the robot workspace. The Front Panel provides the following functions.

- Setting the robot mode to Manual or Automatic mode. Refer to *4-3 Robot Control Modes* on page 4-4 for more information.
- Indicating the robot High Power and Control Power state.
- Enabling robot High Power. Refer to *4-4-1 Robot High Power Operations* on page 4-6 for more information.
- Activating an emergency stop and disabling robot High Power.

The Front Panel is supplied with an extension cable that must be used to connect it to the XFP connector on the XSYSTEM cable.

Design of the factory-supplied Front Panel E-Stop is in accordance with the requirements of IEC 60204-1 and ISO 13849.

⚠ WARNING

- If you supply your own Front Panel, its design must comply with the requirements of IEC 60204-1 and ISO 13849. The E-Stop's push button must comply with ISO 13850 (Clause 5.5.2).
- If an operator is going to be in the work cell with the switch in Manual mode, the operator must carry an enabling device such as the T20 pendant.
- Whenever possible, perform Manual mode operations with all personnel outside the workspace.
- Disabling the High Power button violates IEC 60204-1. Do not alter its functionality.
- In Automatic mode, the robot can move unexpectedly. Ensure all personnel remain clear of the cell when Automatic mode is enabled.

Precautions for Safe Use

If the supplied Front Panel is not used, a High Power indicator light must be present in the system. This indicator light must be amber in color. It must be either mounted to the robot or integrated into the work cell where it is visible from all approaches or entry points.

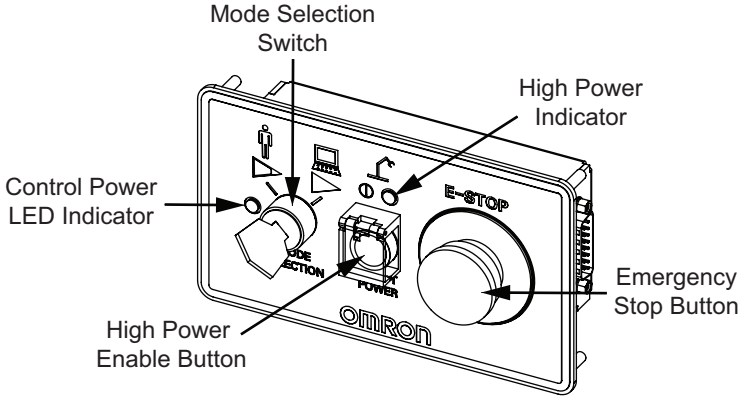
Precautions for Correct Use

- Either a Front Panel or equivalent circuits are required to enable High Power to the robot. Refer to *XFP Wiring Diagram* on page 3-39 for more information.
- If the Front Panel High Power ON / OFF indicator fails, you might incorrectly assume that High Power is OFF, and the robot is safe. To prevent this, a failed indicator causes an error (-924) *Front panel HIGH POWER lamp failure* and locks out the High Power enabling until you replace the indicator. Refer to the *V+ User's Manual (Cat. No. I671)* for more information about error handling. Refer to *High Power Indicator Check Procedure* on page 3-48 for information about High Power indicator operation verification.

Additional Information

Refer to the following sections for more information.

- *3-9-1 Installing the Front Panel* on page 3-35
- *XFP Connections* on page 3-38
- *4-3 Robot Control Modes* on page 4-4
- *4-4-1 Robot High Power Operations* on page 4-6



Use the information in the table below to understand Front Panel item details.

Item	Description
Control Power LED Indicator	Provides an indication that the robot is receiving 24 VDC Control Power with a green LED.
Mode Selection Switch	Controls the robot's operating mode. The left position selects Manual mode. The right position selects Automatic mode. Refer to *4-3 Robot Control Modes* on page 4-4 for more information.
High Power Indicator	Provides an indication of the robot's High Power state with an amber LED. Refer to *4-4 Enabling and Disabling the Robot* on page 4-6 for more information.
High Power Enable Button	Button to request robot High Power.
Emergency Stop Button*1	Button for emergency stopping of the robot.

*1. This switch is a dual-channel, passive E-stop device that supports Category 3 CE safety requirements.

1-2-5 Connectors and Ports

This section describes all connectors and ports on the robot.

USER Connectors

The USER connectors provide pass-through electrical signals from the base of the robot to the end of the arm.
Pass-through electrical signals are typically used for end-of-arm tooling sensing and control.
All USER connector pin associations between the Primary Interface Panel and the Secondary Interface Panel are one-to-one. For example, pins 1 through pins 19 of the USER connector on the Primary Interface Panel are directly connected to pins 1 through 19 of the USER connector on the Secondary Interface Panel.
There are no twisted-pair conductors between the USER connectors on the Primary Interface Panel and the Secondary Interface Panel. Data communication is not recommended for these connectors.

⚠ CAUTION

All signals that pass-through the USER connectors are not associated with any robot controls, emergency stop circuits, or robot power. Implement appropriate safety measures to ensure these signals are not active during emergency stop conditions or while the robot is powered OFF.

Additional Information

Refer to the following sections for more information.
- *USER Cable* on page 1-22
- *2-5-2 Connector and Port Specifications* on page 2-18
- *3-4-3 USER Connector Wiring* on page 3-8
- *A-5-4 USER Cable Pinouts* on page A-10

Control Power Connector

The Control Power connector is used to supply 24 VDC to the robot logic circuits. When power is supplied to this connector, the robot will boot up and control functions such as programming and configuration are possible.
A mating connector is supplied with the robot.

Additional Information

Refer to the following sections for more information.
- *2-3-1 Power Supply Specifications* on page 2-14
- *2-5-2 Connector and Port Specifications* on page 2-18
- *3-10-2 DC Connections* on page 3-44

High Power Connector

The High Power connector is used to supply 200 to 240 VAC to the internal servo amplifiers.
When power is supplied to this connector and High Power has been enabled, the robot is ready to move.
A mating connector is supplied with the robot.

Precautions for Correct Use

- Robot motion is not possible until High Power is supplied and has been enabled.
- Control Power must be present before High Power can be enabled.

Additional Information

Refer to the following sections for more information.
- *2-3-1 Power Supply Specifications* on page 2-14
- *2-5-2 Connector and Port Specifications* on page 2-18
- *3-10-3 AC Connections* on page 3-45

XSYSTEM Connector

The XSYSTEM connector provides connections to external equipment such as a Front Panel, Teach Pendant, and user-supplied safety devices.
The robot is supplied with an XSYSTEM cable and jumper plugs. This cable provides connections for a Front Panel, Teach Pendant, and other user-supplied safety devices.

Additional Information

Refer to the following sections for more information.
- *2-5-2 Connector and Port Specifications* on page 2-18
- *Standard Connections* on page 3-22
- *A-5 Cable Pinouts* on page A-7

XBELTIO Connector

The XBELTIO connector provides access to the following signals.

- Belt encoder inputs 1 and 2
- Expansion I/O
- RS-232

Additional Information

Refer to the following sections for more information.

- *XBELTIO Adapter Cable* on page 1-20
- *2-5-2 Connector and Port Specifications* on page 2-18
- *Optional Connections* on page 3-23
- *A-5 Cable Pinouts* on page A-7

XIO Connector

The XIO connector provides access to built-in I/O of the robot (12 inputs, 8 outputs).

Additional Information

Refer to the following sections for more information.

- *2-5-2 Connector and Port Specifications* on page 2-18
- *XIO Breakout Cable* on page 1-21
- *XIO Cable* on page 1-21
-

Pneumatic Ports

The pneumatic ports provide pass-through air lines from the Primary Interface Panel to the Secondary Interface Panel.

Pneumatic ports are typically used for end-of-arm tooling control.

Precautions for Correct Use

Pneumatic pass-through ports are re-purposed when the optional pneumatic valve kit is installed.

Additional Information

Refer to the following sections for more information.

- *2-5-2 Connector and Port Specifications* on page 2-18
- *3-8 Connecting Pneumatic Equipment* on page 3-33

Tool Ethernet Connector

The Tool Ethernet connector provides Ethernet communications to user-supplied devices that can be mounted to the outer link or end-of-arm tooling. This connector provides an extension of the Ethernet network.

The Ethernet Ports IN/1, OUT/2, and Tool Ethernet Connector are internally connected with a network switch device that does not support cut-through switching (forwarding). Depending on your application, some latency may occur between devices that communicate through these connectors. Special consideration should be made when connecting devices to these ports that require time-critical operations.

Additional Information

Refer to the following sections for more information.
- *2-5-2 Connector and Port Specifications* on page 2-18
- *3-4-2 Tool Ethernet Connector Wiring* on page 3-7

TIO Connector

The TIO connector (Tool I/O) provides 5 inputs and 4 outputs for signaling and control of devices mounted on the outer link or end-of-arm tooling.

Additional Information

Refer to the following sections for more information.
- *TIO Cable* on page 1-22
- *2-5-2 Connector and Port Specifications* on page 2-18
- *3-7-2 TIO Connector Signals and Wiring* on page 3-30
- *A-5-5 TIO Cable Pinouts* on page A-11

Some first-generation models do not support TIO and integrated pneumatic valve control. Contact your local OMRON representative for more information.

1-2-6 IP65 Rating

The IP65 rating is for applications where wash-down is required. The exterior of an IP65 rated robot is designed to be compatible with moderate cleaning agents, commonly used in the routine cleaning of food-processing equipment.

IP65 rated robots are equipped with the following additional features.
- The z-axis quill is lubricated with food grade grease.
- Internal harmonic drives are lubricated with food grade oil.
- A cable seal is provided for all cable connections at the Primary Interface Panel. Refer to *1-6-12 Cable Seal* on page 1-26 for more information.
- Bellows are provided for the Joint 3 quill. Refer to *1-6-9 Bellows* on page 1-24 for more information.
- Various gaskets, seals, and o-rings are installed.

Additional Information

- Exposure to moderate cleaning agents may result in some discoloration of the materials, but no significant material removal will occur.
- The bottom of the Joint 3 quill should be sealed to avoid any liquid drainage or other contamination.

1-2-7 Food-grade Rating

A food-grade rated robot is for use in applications where direct food contact may be possible. Robots with this rating have non-toxic lubrication applied at the factory. The internal harmonic drive units are lubricated with food-grade oil and the Joint 3 quill is lubricated with food-grade grease.

1-2-8 Electrostatic Discharge Protection

Electrostatic discharge protection is available for applications that require handling of sensitive electronic components and assemblies. Robot models with this feature are designed to prevent a buildup of static charge.

Robots with electrostatic discharge protection are equipped with the following additional features.

- A conductive paint is applied to the exterior of the robot.
- Bellows are provided for the Joint 3 quill. Refer to *1-6-9 Bellows* on page 1-24 for more information.
- Various gaskets, seals, and o-rings are present.

Additional Information

Robot models with electrostatic discharge protection are also Cleanroom rated.

1-2-9 Cleanroom Rating

A Cleanroom rated robot option is available for applications in environmentally controlled conditions. Robots with this rating meet ISO 4 / Class 10 standards.

Robots with a Cleanroom rating are equipped with the following additional features.

- Two vacuum ports are provided on the Primary Interface Panel for applying a negative pressure inside the robot.
- Bellows are provided for the Joint 3 quill. Refer to *1-6-9 Bellows* on page 1-24 for more information.
- Various gaskets, seals, and o-rings are present.

Additional Information

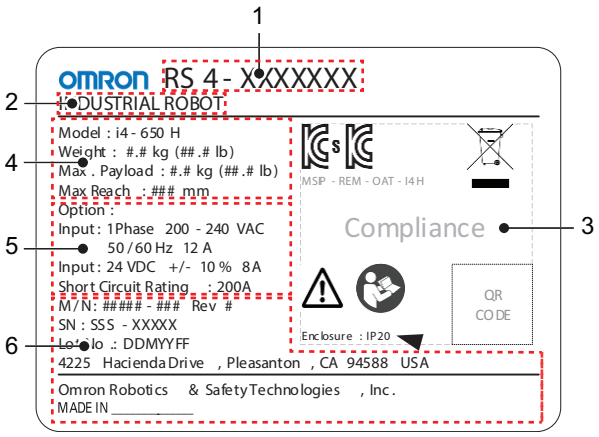
Robot models with a Cleanroom rating also have electrostatic discharge protection.

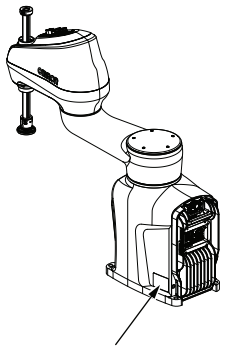
1-3 Information Labels

The information labels contain relevant information about the robot and the controller.
The following examples will be different from your product label.

1-3-1 Robot Label

The robot label is described below.



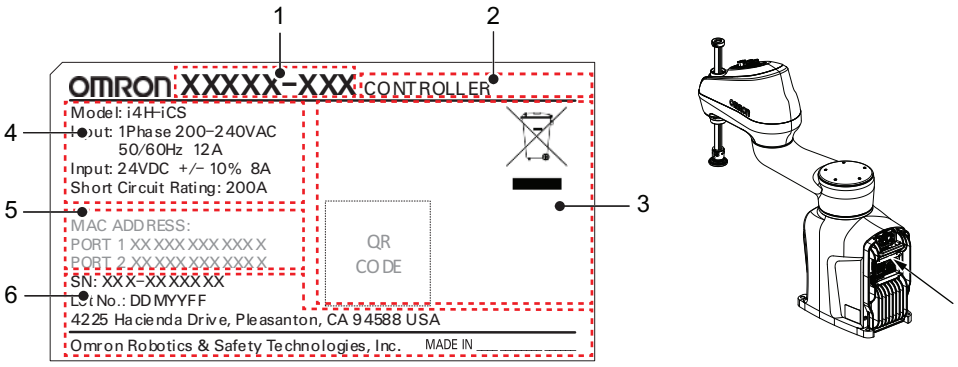


Item	Name	Description
1	Part number *1	The robot part number is displayed.
2	Product type	The product type is displayed.
3	Alerts and compliance	General alerts and compliance information is displayed.
4	Robot information	The robot model, weight, maximum payload, and maximum reach is displayed.
5	Electrical information	General electrical power supply information about the robot is displayed.
6	Production information	The following information is provided. • M/N indicates the model number and revision level. • SN indicates the serial number. • Lot. No. indicates the lot number in the format of DDMYYFF. Month number 1 to 9 for January to September, X for October, Y for November, and Z for December. FF is reserved for internal use. • Product origin information is displayed.

*1. Refer to *1-5 Model Numbers* on page 1-16 for model information.

1-3-2 Controller Label

The controller label is described below.



Item	Name	Description
1	Part number *1	The controller part number is displayed.
2	Product type	The product type is displayed.
3	Alerts and compliance	General alerts and compliance information is displayed.
4	Controller information	The controller model and general electrical power supply information is displayed.
5	MAC Address	MAC address for the robot controller.
6	Production information	The following information is provided. • SN indicates the serial number. • Lot. No. indicates the lot number in the format of DDMYYFF. Month number 1 to 9 for January to September, X for October, Y for November, and Z for December. FF is reserved for internal use. • Product origin information is displayed.

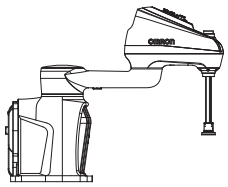
*1. Refer to *1-5 Model Numbers* on page 1-16 for model information.

1-4 Robot Configurations

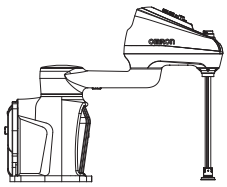
The i4H robot is offered in a variety of configurations with different work envelopes and z-axis stroke lengths.

1-4-1 i4-650H

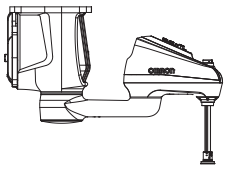
The i4-650H has a reach of 650 mm and is offered in the following configurations.



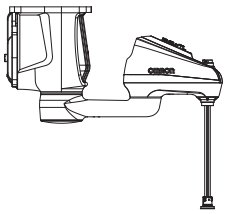
i4-650H Standard



i4-650H Long Quill



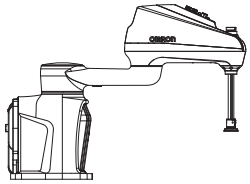
i4-650H Standard Inverted



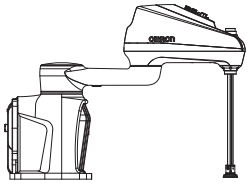
i4-650H Long Qull Inverted

1-4-2 i4-750H

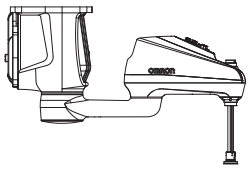
The i4-750H has a reach of 750 mm and is offered in the following configurations.



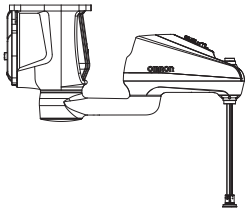
i4-750H Standard



i4-750H Long Quill



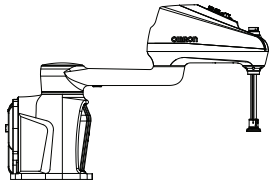
i4-750H Standard Inverted



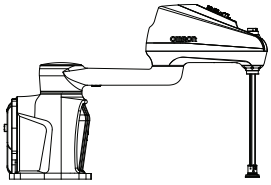
i4-750H Long Qull Inverted

1-4-3 i4-850H

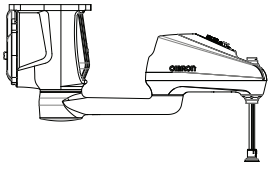
The i4-850H has a reach of 850 mm and is offered in the following configurations.



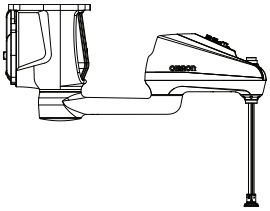
i4-850H Standard



i4-850H Long Quill



i4-850H Standard Inverted



i4-850H Long Qull Inverted

1-5 Model Numbers

Models numbers and descriptions associated with the robot are provided below.

1-5-1 Robot Model Numbers

The information below describes the robot model numbers.

RS4-205□□□□
1 2 3 4 5

Item	Description	Details	Designation
1	Robot Type	SCARA with Ethernet	RS4-205
2	Reach	650 mm	6
		750 mm	7
		850 mm	8
3	Mount Configuration	Standard	5
		Inverted	7
4	Features / Rating	IP20 with standard lubrication	0
		Cleanroom / Electrostatic Discharge Protection	1
		IP65 with Food Grade lubrication	4
		IP20 with Food Grade lubrication	5
5	Z-axis Quill Stroke Length	210 mm (IP20 with standard lubrication / IP65)	2
		210 mm (IP20 with Food Grade lubrication)	3
		410 mm (IP20 with standard lubrication / IP65)	4
		410 mm (IP20 with Food Grade lubrication)	5

1-5-2 Controller Model Numbers

The table below provides all robot controller model numbers and descriptions.

Model Number	Description
i4H-iCS	Internal controller for the robot.

1-6 Optional Hardware

The following optional hardware is available for the robot.

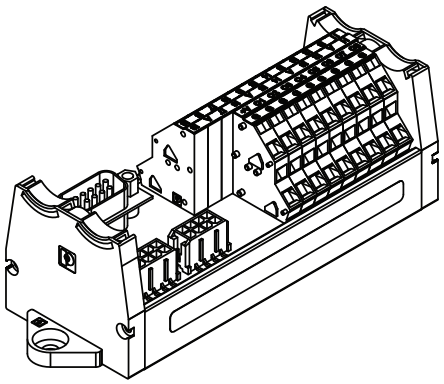
1-6-1 IO Blox

IO Blox units are available to expand the I/O capacity of the robot. Each unit offers 8 inputs and 8 outputs. Up to 4 IO Blox units can be added to the robot.

- The part number for an IO Blox unit connected directly to the robot is 90356-30200.
- The part number for IO Blox units connected to another IO Blox unit is 90356-30100.

Additional Information

Refer to the following areas for more information.
- *3-7-3 IO Blox Connections* on page 3-32
- Omron Adept IO Blox User's Guide (04638-000)



1-6-2 T20 Pendant

The T20 pendant is an optional handheld device that allows you to manually jog the robot, teach locations, and view V+ programs without a PC.

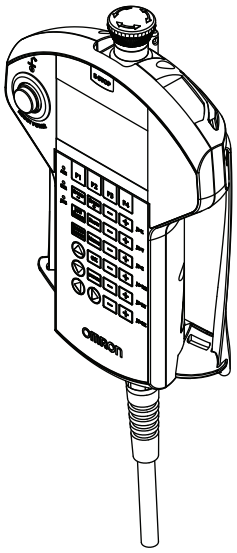
- The part number for the pendant kit is 10046-010. This kit includes the T20 pendant, an adapter cable (3 m), and a jumper plug.
- The adapter cable includes a round, 17-pin connector that can be panel-mounted. It can be mounted to a surface with up to 6.5 mm of thickness and requires an M23 hole.

Precautions for Correct Use

The T20 pendant can only control the robot it is directly connected to.

Additional Information

Refer to the following areas for more information.
- *3-6-1 System Cable Overview* on page 3-22
- *T20 Pendant User's Manual (Cat. No. I601)*

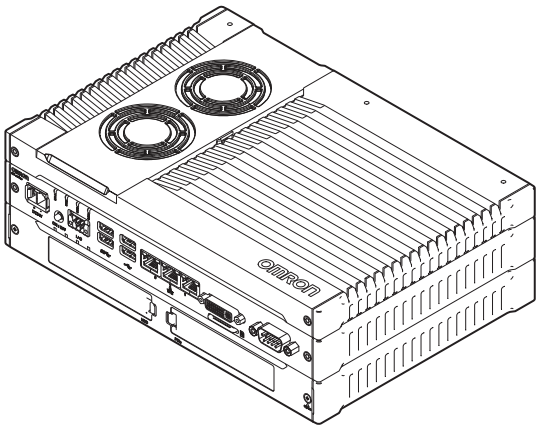


1-6-3 IPC Application Controller

The IPC Application Controller can be added to your system to execute PackManager and Robot Vision Manager applications.
The Pack Manager application controls automated pick-and-place systems with cameras, conveyors, and robots based on the data that you set up in the ACE Software. It is executed on the IPC Application Controller to control the process data and recipe data.
The Robot Vision Manager application processes images captured by cameras based on the data that you set up in the ACE Software. It is executed on the IPC Application Controller.

Additional Information

Refer to the following areas for more information.
- *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)*
- *IPC Application Controller User's Manual (Cat. No. I632)*



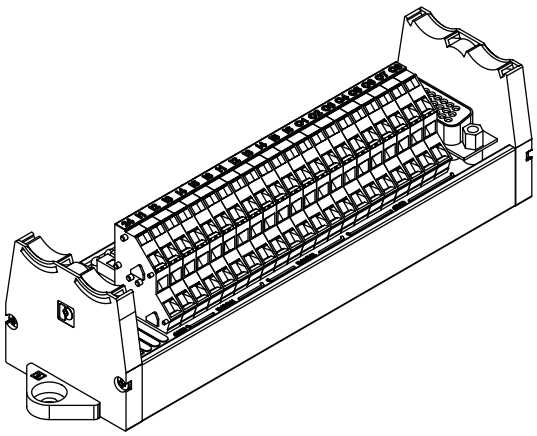
1-6-4 XIO Termination Block

The XIO Termination Block is used to connect digital I/O devices to the robot. This unit provides terminal block connection points for 12 inputs and 8 outputs. LED indicators are provided to indicate

ON/OFF status. Each input has a switch to simulate input signals for troubleshooting or testing purposes.
Use the XIO cable to connect the XIO Termination block to the robot.
The part number for the XIO Termination Block is 90356-40100 (2 m cable included).

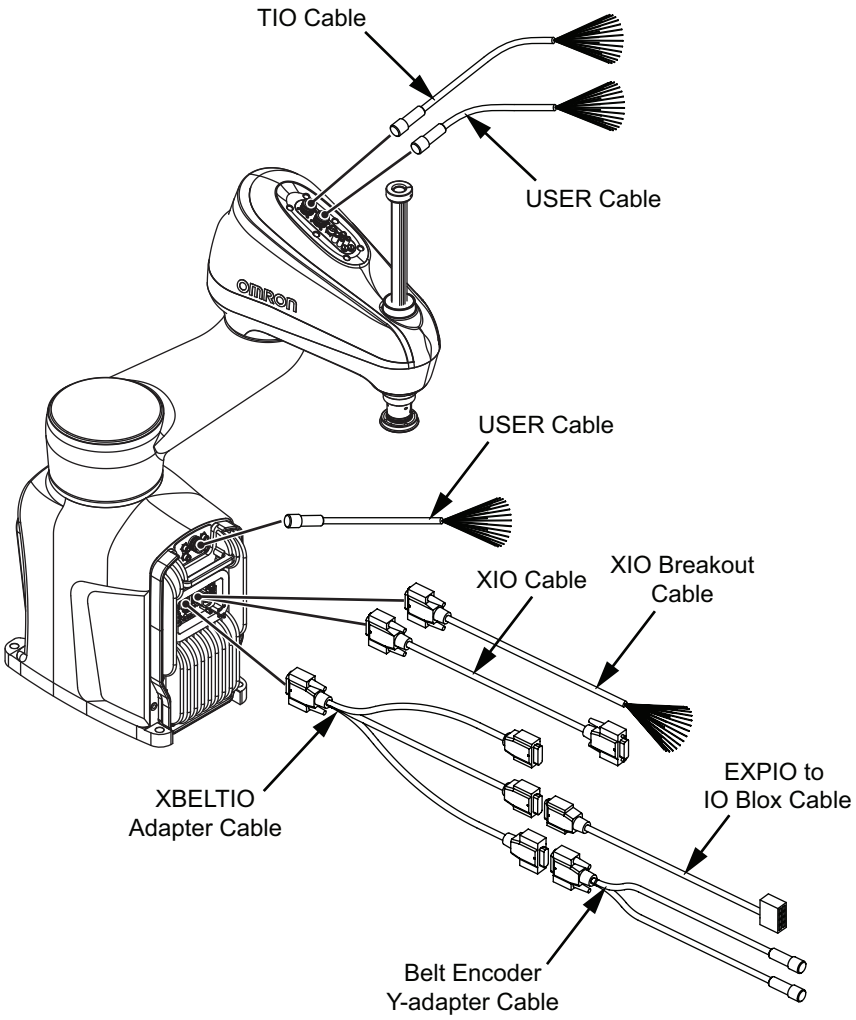
Additional Information

Refer to the following areas for more information.
- *XIO Cable* on page 1-21
-



1-6-5 Optional Cables

This section provides information about optional cables that are available.



XBELTIO Adapter Cable

The optional XBELTIO adapter cable connects to the XBELTIO connector on the Primary Interface Panel. It provides connections for belt encoder, force sensor, RS-232, and IO Blox signals.

- The part number for this cable is 13463-000.
- The length of this cable is 600 mm.

Additional Information

Refer to *A-5-2 XBELTIO Adapter Cable Pinouts* on page A-9 for more information.

Belt Encoder Y-adapter Cable

The optional belt encoder Y-adapter cable connects to the XBELTIO adapter cable's BELT ENCODER connector. This cable provides individual connections for two belt encoder input signals.

- The part number for this cable is 09443-000.
- The length of this cable is 3 m.

Additional Information

Refer to *A-5-3 Belt Encoder Y-adapter Cable Pinouts* on page A-9 for more information.

XIO Breakout Cable

The optional XIO breakout cable connects to the XIO connector on the Primary Interface Panel and provides a method to connect I/O devices directly to the robot without using an XIO Termination Block unit.

- This cable is not compatible with the XIO Termination Block.
- This cable cannot be used together with an XIO cable.
- The part number for this cable is 04465-000.
- The length of this cable is 5 m.

Additional Information

Refer to *3-7-1 XIO Connector Signals and Wiring* on page 3-26 for more information.

XIO Cable

The optional XIO cable connects to the XIO connector on the Primary Interface Panel. It is used to connect an XIO Termination Block to the system.

- This cable cannot be used together with the XIO Breakout cable.
- The part number for this cable is 03695-000.
- The length of this cable is 2 m.

Additional Information

Refer to the following areas for more information.

- *1-6-4 XIO Termination Block* on page 1-18
- *Adept XIO Termination Block Installation Guide (00340-000)*

EXPIO to IO Blox Cable

The optional EXPIO to IO Blox cable connects to the XBELTIO adapter cable's FORCE/EXPIO connector. It allows a direct connection between this connector and optional IO Blox units.

- The part number for this cable is 04677-030.
- The length of this cable is 3 m.

Additional Information

Refer to the following areas for more information.

- *3-7-3 IO Blox Connections* on page 3-32
- *Omron Adept IO Blox User's Guide (04638-000)*

TIO Cable

The optional TIO cable connects to the TIO connector on the Secondary Interface Panel. This cable provides a method to connect I/O signals to the robot from devices that are mounted to the outer link or to the tool flange.

- The part number for this cable is 19140-100.
- The length of the cable is 1.8 m.

Additional Information

Refer to the following sections for more information.

- *TIO Connector* on page 1-11
- *3-7-2 TIO Connector Signals and Wiring* on page 3-30
- *A-5-5 TIO Cable Pinouts* on page A-11

USER Cable

The optional USER cable connects to the USER connectors on the Primary Interface Panel and the Secondary Interface Panel. This cable is typically used for end-effector control and sensing and provides a method to utilize pass-through electrical signals between the connectors on the Primary and Secondary Interface Panels.

- The part number for this cable is 18823-100.
- The length of this cable is 1.8 m.

Additional Information

Refer to the following sections for more information.

- *3-4-3 USER Connector Wiring* on page 3-8
- *A-5-4 USER Cable Pinouts* on page A-10

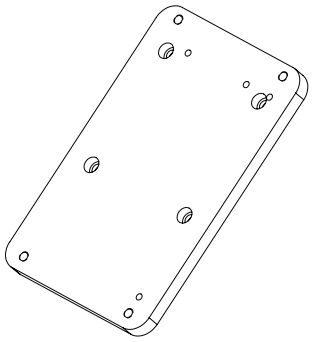
1-6-6 eCobra Mount Adapter

An adapting plate is available that allows the robot to mount to a surface with an eCobra 600/800 hole pattern. This adapter is placed between the robot and the mounting surface and adapts the mounting holes on the surface to fit the robot mounting flange.

- The part number of the eCobra mount adapter is 21636-000.
- The mount adapter is made from 6061-T6 aluminum.

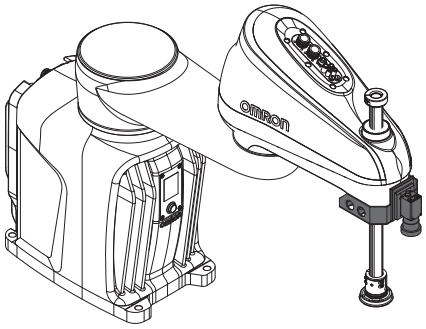
Additional Information

Using this adapter will add an additional 19 mm between the robot and the mounting surface. Refer to *2-1-5 eCobra Mount Adapter Dimensions* on page 2-7 for more information.



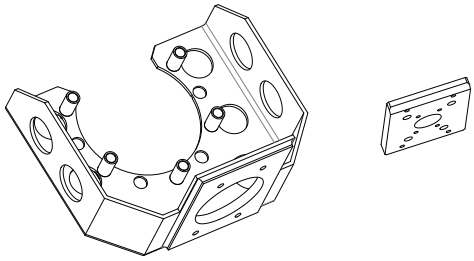
1-6-7 Camera Mounting Bracket and Adapter

A camera mounting bracket can be used to attach a camera to the robot outer link. This is fastened to the bottom of the outer link, near the z-axis quill exit.



Use five M5 X 20 socket head cap screws with 2.5 N-m torque and Loctite 222 or equivalent thread locking compound when attaching the bracket to the robot.
When attaching a Basler or Sentech camera, an adapter plate must be used to fasten the camera to the camera mounting bracket. The adapter plate is positioned between the bracket and the camera. Use four M3 X 10 socket head cap screws with 2.5 N-m torque and Loctite 222 or equivalent thread locking compound when attaching the plate to the adapter bracket.

- The part number of the camera mounting bracket is 18908-000.
- The part number of the adapter plate is 22295-000.
- The adapter plate is made from 6061-T6 aluminum.
- The bracket is made from 5052-H32 aluminum.
- The weight of the camera mounting bracket is 120 grams.
- The weight of the adapter plate is 37 grams.



Additional Information

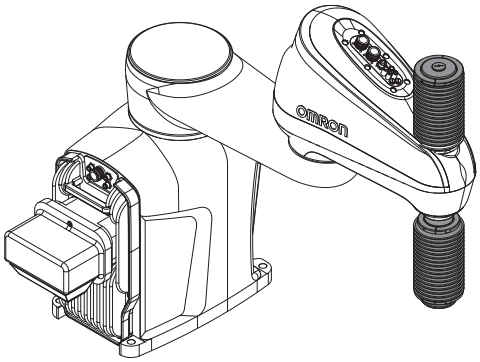
Refer to *2-1-6 Camera Mounting Bracket and Adapter Dimensions* on page 2-8 for more information.

1-6-8 eCobra Tool Flange

An eCobra tool flange is available for the robot that allows reuse of end-of-arm tooling designed for an eCobra 600/800 robot. The eCobra tool flange has the same bolt pattern as the typical eCobra tool flange and it fits the Z-axis quill of the i4H SCARA robot series.
To replace the standard tool flange that is supplied with the robot with the optional eCobra tool flange, use the same procedure found in *6-2-1 Replacing the Tool Flange* on page 6-12.
The part number of the eCobra tool flange is 19106-100F.

1-6-9 Bellows

Bellows are an optional item that can be placed on upper and lower exposed portions of the Joint 3 quill for additional environmental protection.



Bellows prevent debris or liquid from entering the internal compartment of the outer link, protect the Joint 3 quill, and prevent contamination of items external to the robot. This optional item is included for IP65 and Cleanroom rated robots.
A threaded hole is present at the top of the bellows assembly that can be used for a user-supplied seal fitting if cabling or tubing needs to pass through the Joint 3 quill. Thread dimensions of this hole are M20 x 13.5 mm. The bottom of the Joint 3 quill should be sealed to avoid any liquid drainage or other contamination. Refer to *2-1-3 Tool Flange Dimensions* on page 2-6 for more information.
The part number for bellows kits that provide all necessary installation hardware are provided below.

- Standard quill length (210 mm): 19464-003F
- Long quill length (410 mm): 19464-004F

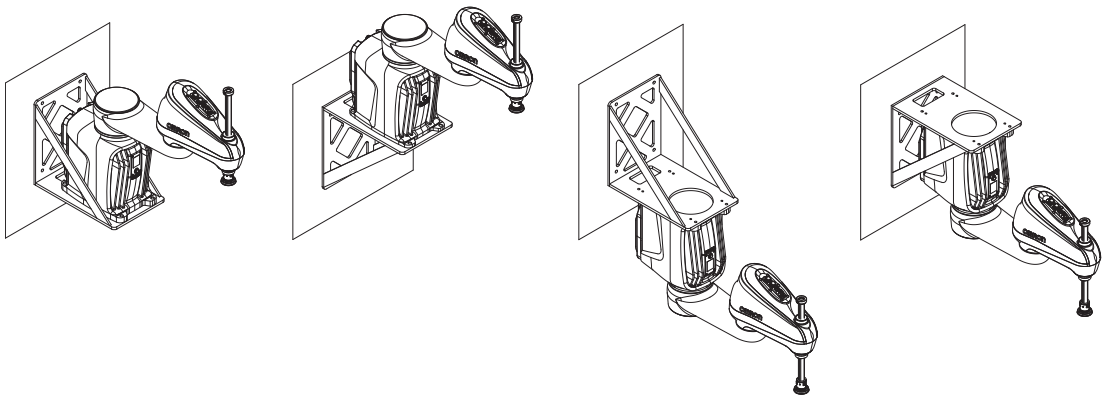
Additional Information

- Bellows hardware adds 47 mm to the top of the quill.
- Refer to *3-4-4 Bellows Installation Procedure* on page 3-8 for more information.

1-6-10 Wall Mount Bracket

A wall mount bracket is available when the robot needs to be mounted to a vertical surface. The wall mount bracket can be used in different orientations with standard and inverted models.
The wall mount bracket is not compatible with robots that have a Cable Seal present if space is limited behind the robot.

- The part number of the wall mount bracket is 20089-000.
- The bracket is made of cold-rolled steel with a painted finish.



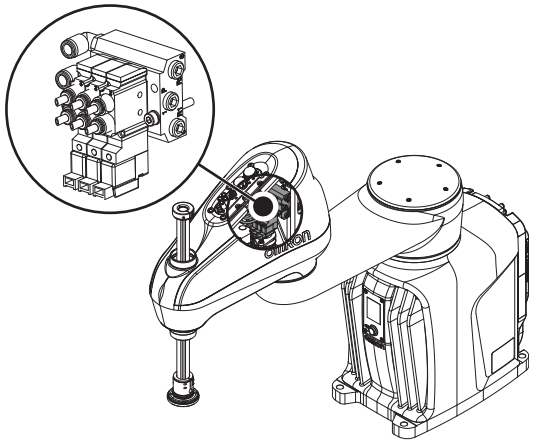
1-6-11 Integrated Pneumatic Valves

Three pneumatic valves can be mounted inside the outer link of the robot. These valves are controlled with V+ signals and can be used with pneumatic devices such as grippers or end-effectors that are connected to the ports on the Secondary Interface Panel.

V+ signal numbers 3001 to 3003 control integrated pneumatic valves.

The part number for the pneumatic valve kit is 19165-000. This kit includes all necessary hardware to install the valves and reroute internal pneumatic air lines.

The pneumatic valve kit includes all necessary hardware to convert the pass-through ports into robot-controlled ports.



Precautions for Correct Use

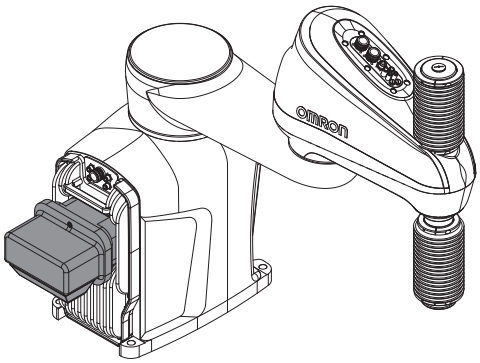
Pneumatic pass-through ports are re-purposed when the optional pneumatic valve kit is installed.

Additional Information

Refer to *3-8-2 Pneumatic Valve Kit* on page 3-33 for more information.

1-6-12 Cable Seal

The Cable Seal provides ingress protection for the connections and components on the Primary Interface Panel. It includes a cable gland that seals around all cables and must be considered during the system cable installation procedure.
The Cable Seal Kit part number for a standard robot is 08765-000. The Cable Seal Kit part number for an inverted robot is 08765-200.



Additional Information

Refer to the following sections for more information.
- *A-1 Cable Seal Kit Installation Procedure* on page A-2
- *2-1-9 Cable Seal Dimensions* on page 2-9

2

Specifications

This section provides specifications for the robot's hardware, performance, electrical connections, installation environment, and other technical aspects of the system.

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2-1 Physical Specifications

This section provides physical specifications for the robot.

2-1-1 Robot Overall Dimensions

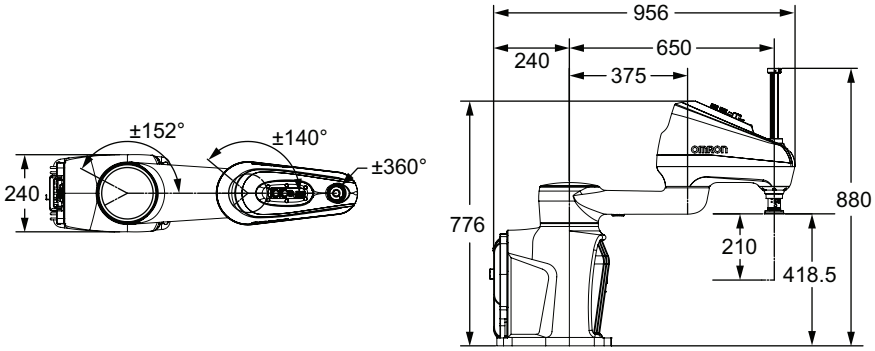
Use the diagrams below to understand the robot's overall physical dimensions and work envelope.

Additional Information

The overall height of the robot increases by 47 mm if bellows are present on the robot.

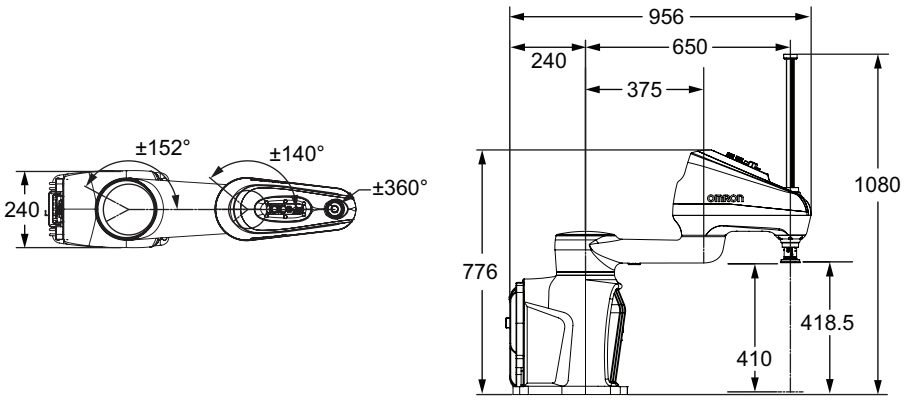
i4-650H Standard Dimensions

Overall dimensions for the i4-650H Standard are provided below.



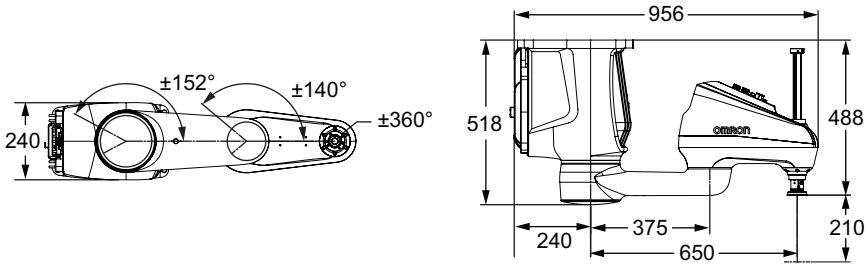
i4-650H Long Quill Dimensions

Overall dimensions for the i4-650H Long Quill are provided below.



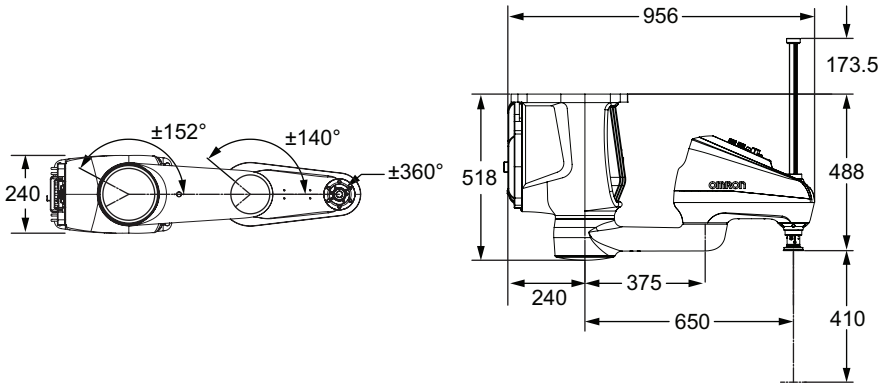
i4-650H Inverted Dimensions

Overall dimensions for the i4-650H Inverted are provided below.



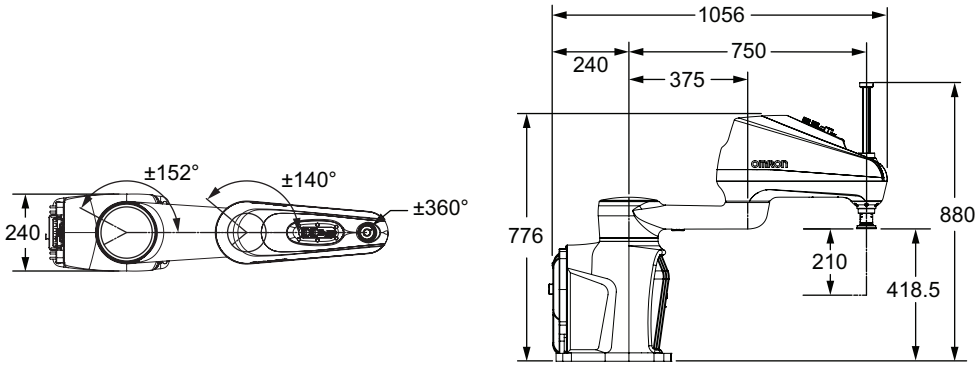
i4-650H Inverted Long Quill Dimensions

Overall dimensions for the i4-650H Inverted Long Quill are provided below.



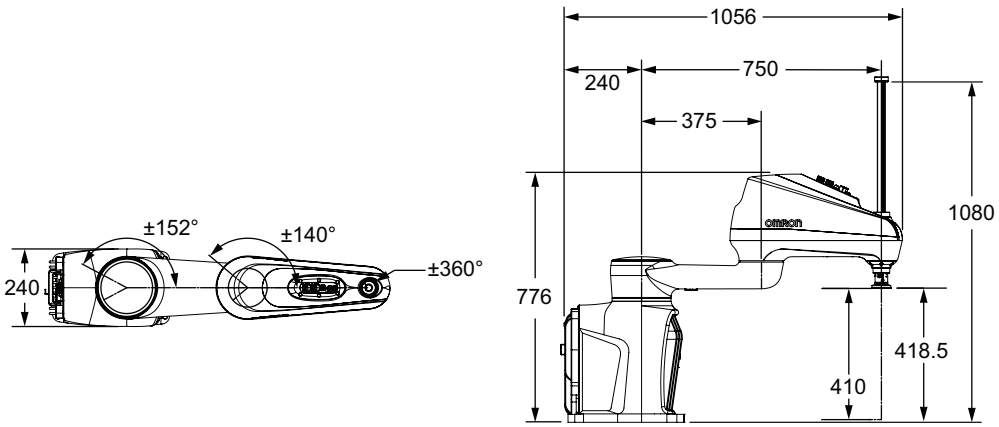
i4-750H Standard Dimensions

Overall dimensions for the i4-750H Standard are provided below.



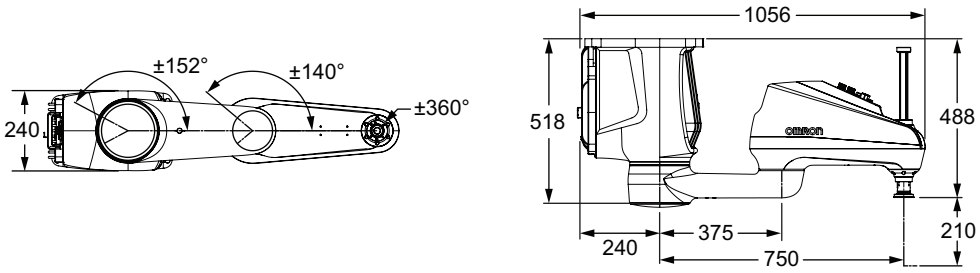
i4-750H Long Quill Dimensions

Overall dimensions for the i4-750H Long Quill are provided below.



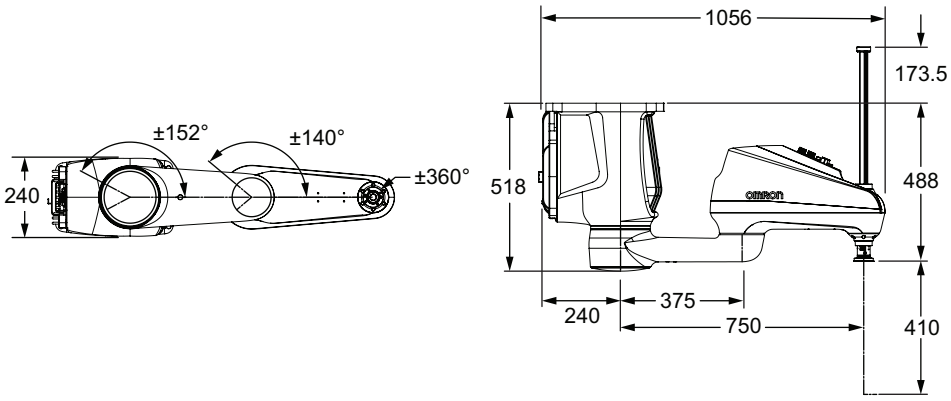
i4-750H Inverted Dimensions

Overall dimensions for the i4-750H Inverted are provided below.



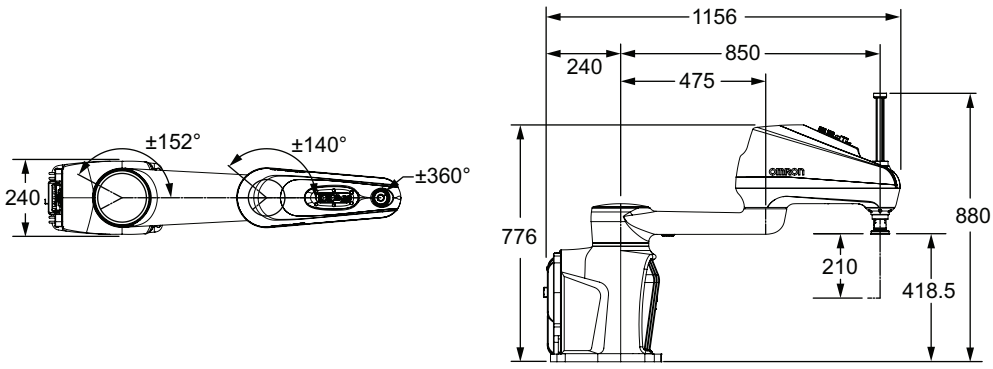
i4-750H Inverted Long Quill Dimensions

Overall dimensions for the i4-750H Inverted Long Quill are provided below.



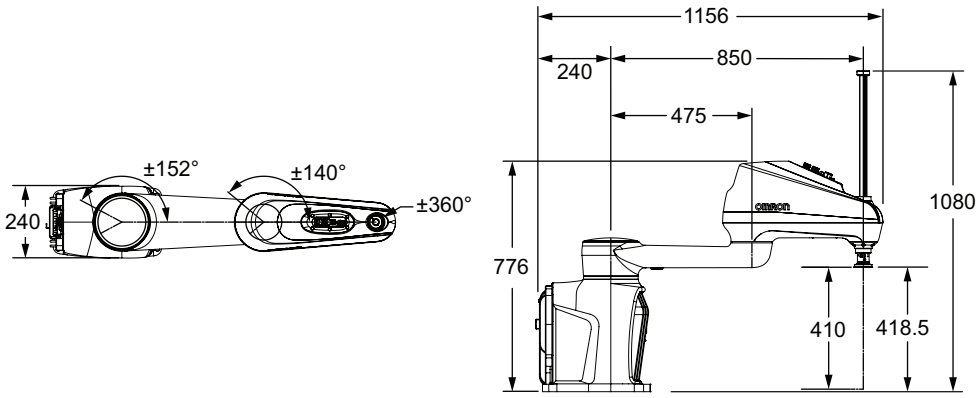
i4-850H Standard Dimensions

Overall dimensions for the i4-850H Standard are provided below.



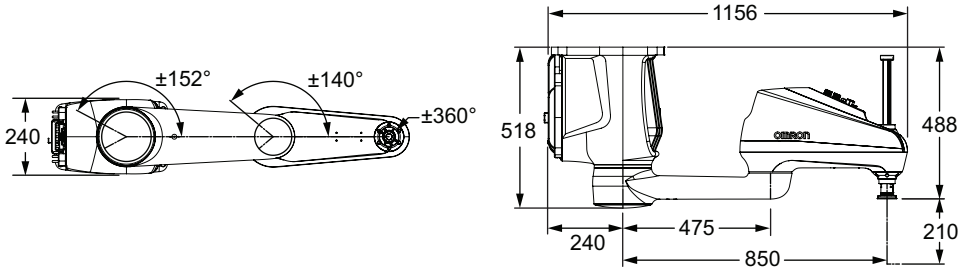
i4-850H Long Quill Dimensions

Overall dimensions for the i4-850H Long Quill are provided below.



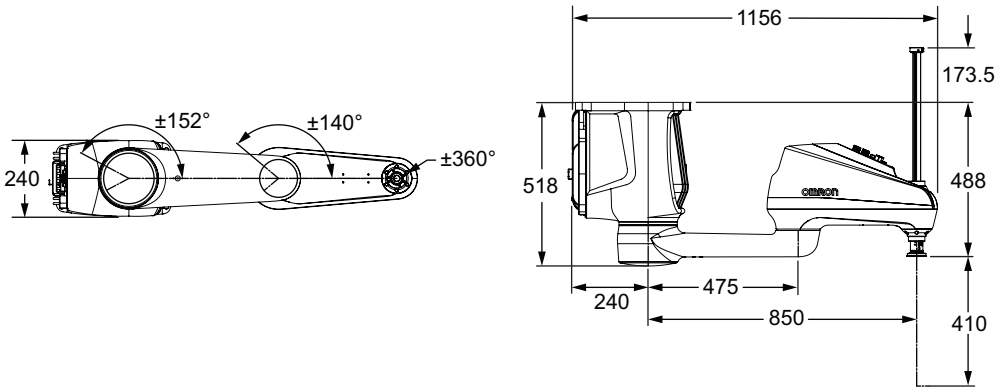
i4-850H Inverted Dimensions

Overall dimensions for the i4-850H Inverted are provided below.



i4-850H Inverted Long Quill Dimensions

Overall dimensions for the i4-850H Inverted Long Quill are provided below.

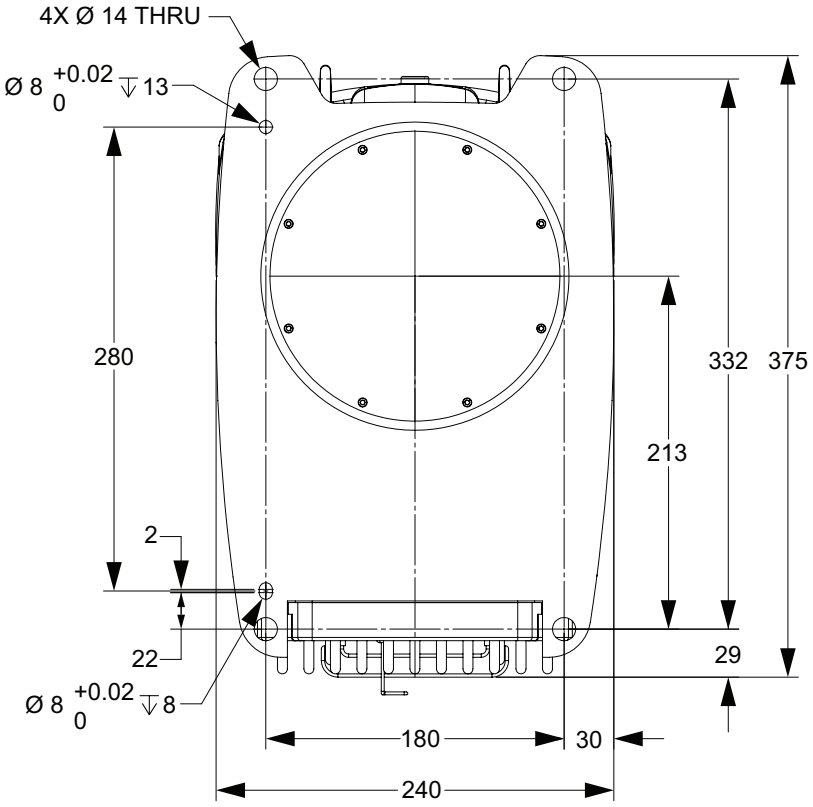


2-1-2 Mounting Flange Dimensions

The robot's mounting flange dimensions are provided below.

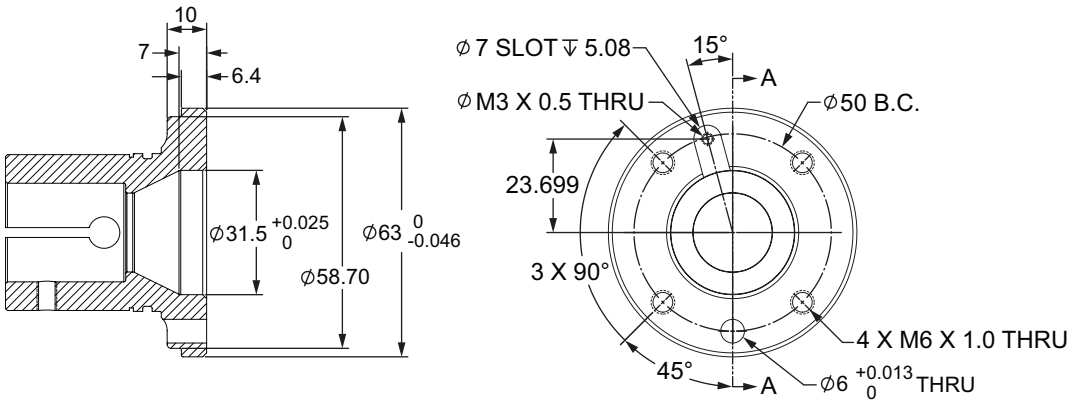
Additional Information

All hole locations are ± 0.12 mm.



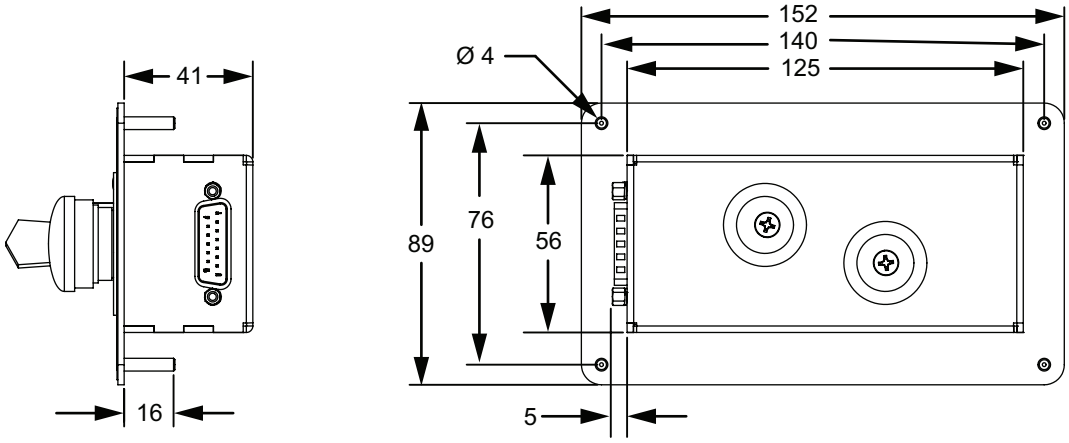
2-1-3 Tool Flange Dimensions

The robot's tool flange dimensions are provided below. Geometry and tolerances meet ISO-9409-1-50-4-M6 (2004) requirements for manipulating industrial robots.



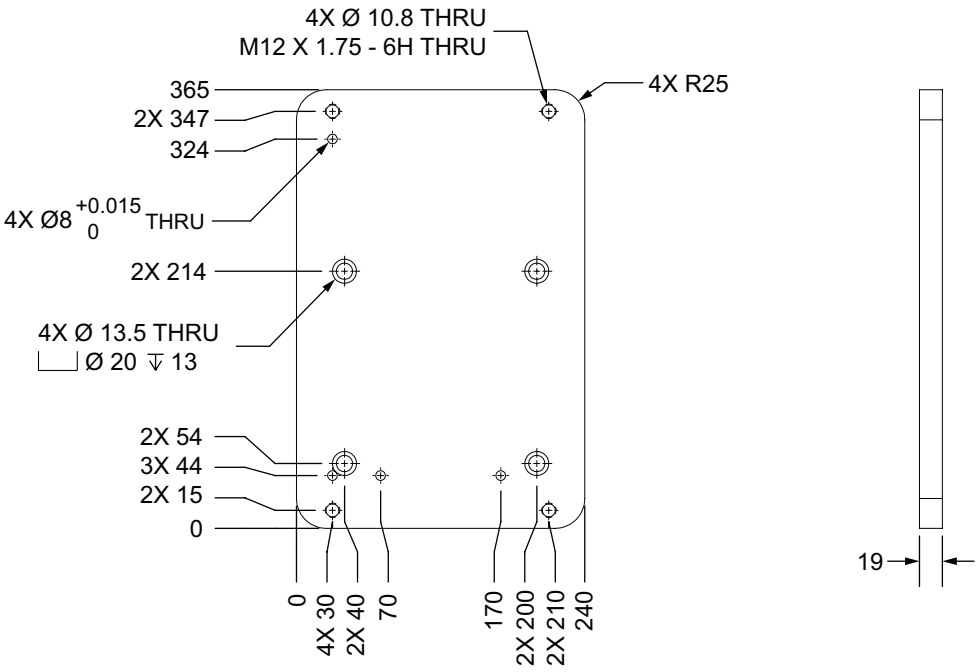
2-1-4 Front Panel Dimensions

The Front Panel dimensions are provided below.



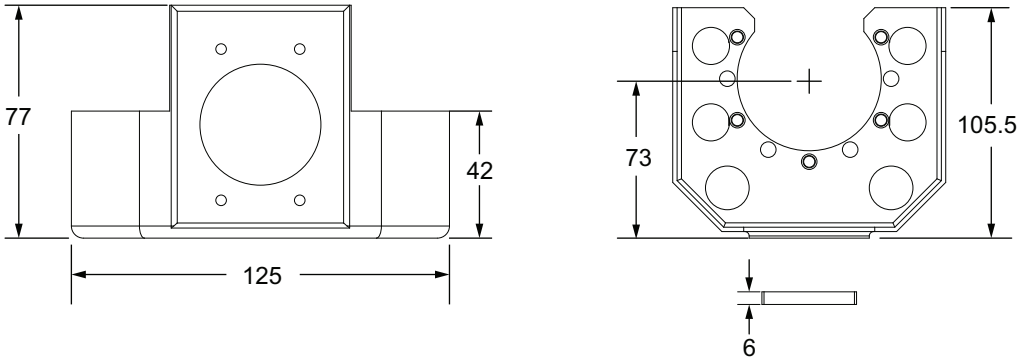
2-1-5 eCobra Mount Adapter Dimensions

The eCobra mount adapter dimensions are provided below.



2-1-6 Camera Mounting Bracket and Adapter Dimensions

The camera mounting bracket dimensions are provided below.



2-1-7 Robot Weights

Weights for the different robot models are provided in the following table.

Additional Information

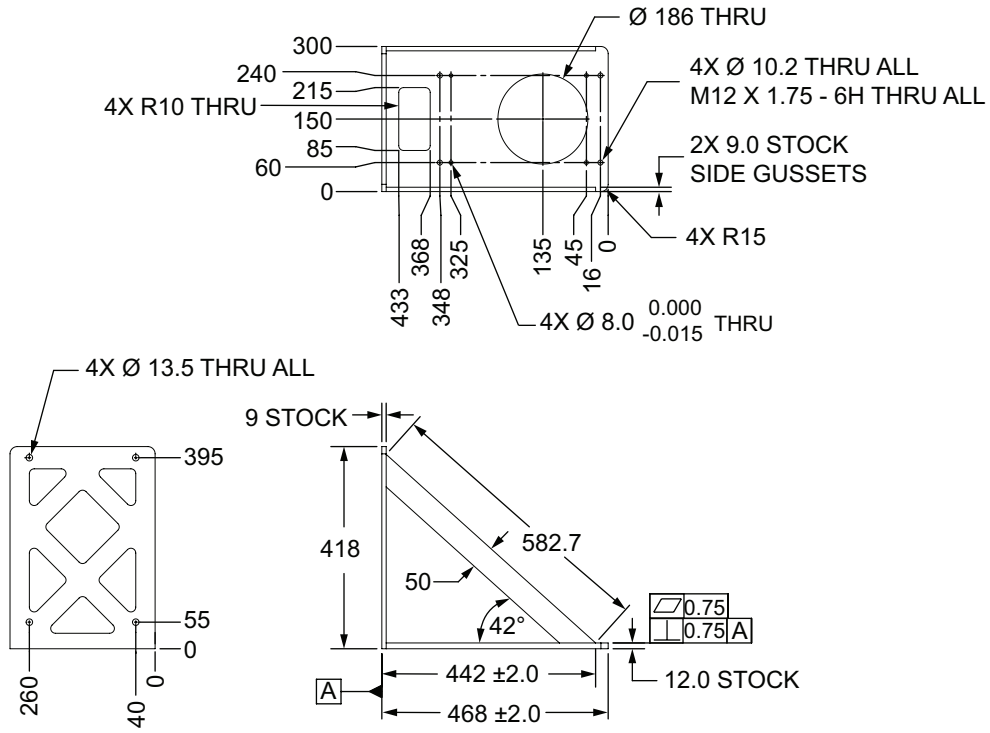
Add 2.0 kg to the weights below for robots with a Cable Seal and bellows present.

Robot Model	Weight
i4-650H Standard	50.4 kg
i4-650H Inverted	
i4-650H Long Quill	50.8 kg
i4-650H Inverted Long Quill	
i4-750H Standard	50.9 kg
i4-750H Inverted	

Robot Model	Weight
i4-750H Long Quill	51.3 kg
i4-750H Inverted Long Quill	
i4-850H Standard	51.6 kg
i4-850H Inverted	
i4-850H Long Quill	52.0 kg
i4-850H Inverted Long Quill	

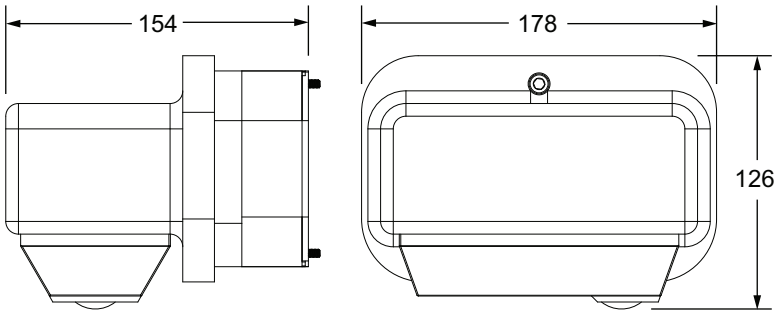
2-1-8 Wall Mount Bracket Dimensions

The wall mount bracket dimensions are provided below.



2-1-9 Cable Seal Dimensions

Cable Seal dimensions are provided below.



2-2 Performance Specifications

The following sections provide robot performance specifications.

2-2-1 General Performance Information

The following table provides general performance information for the robot.

Item		i4-650H	i4-750H	i4-850H
Maximum Payload*1		15 kg		
Reach		650 mm	750 mm	850 mm
Joint Range	Joint 1	±152°		
	Joint 2	±140°		
	Joint 3	• 210 mm • 410 mm (long quill model)		
	Joint 4	±360°		
Joint 4 Moment of Inertia		0.5 kg-m^2 maximum		
Downward Push Force burst with no load*2		588 N		
Cycle Time*3*4		0.45 s	0.46 s	0.50 s
Repeatability at 100% speed		• X, Y: ±0.015 mm • Joint 3: ±0.01 mm • Joint 4: ±0.005°		
Joint speeds (maximum)	Joint 1	450 deg/s		
	Joint 2	720 deg/s		
	Joint 3	1583 mm/s		
	Joint 4	2400 deg/s		

*1. Payload is considered as any object(s) attached to a robot link or tool flange including items such as end-effectors, tooling, valves, grippers, and objects being handled by the robot.

*2. At a duty cycle of 3 seconds pushing and then 2 seconds not pushing.

*3. Cycle time is defined as a continuous path with straight-line motion cycle in which the robot tool moves up 25 mm, over 305 mm, down 25 mm, and then back along the same path (not achievable over all paths in the robot working envelope). Values listed are for sustained motion, no joint 4 rotation, with a 2 kg payload at 20° C ambient temperature.

*4. Cycle times may increase by up to 15% when operating in ambient temperatures above 20° C.

Z-axis Quill Bending Moment

When the robot is operating at high payloads with high acceleration / deceleration, the z-axis quill is subject to excessive bending moments. Careful considerations must be made under these conditions. Refer to *4-2 Payload and Acceleration Considerations* on page 4-3 for more information.

2-2-2 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.

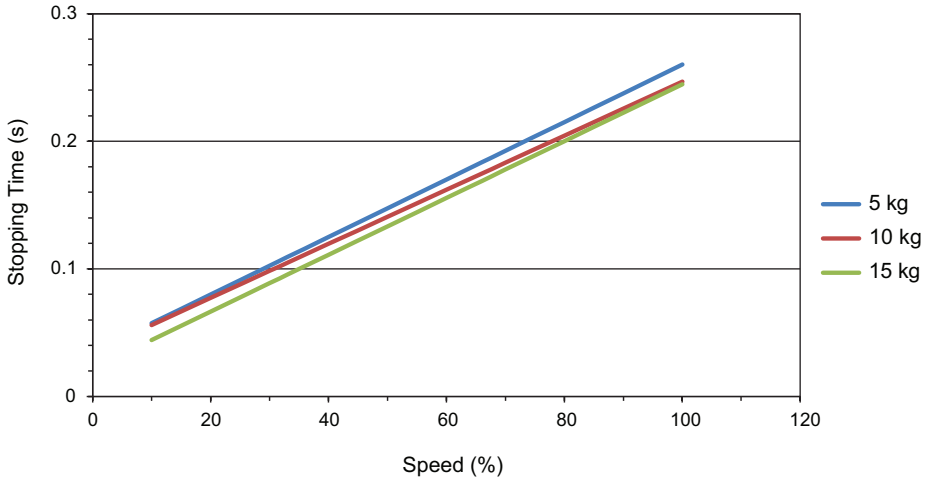
⚠ WARNING

The stopping time and distance, or angle, of a robot joint from initiation of a stop signal is not negligible and must be taken into account when designing and applying safeguarding devices.

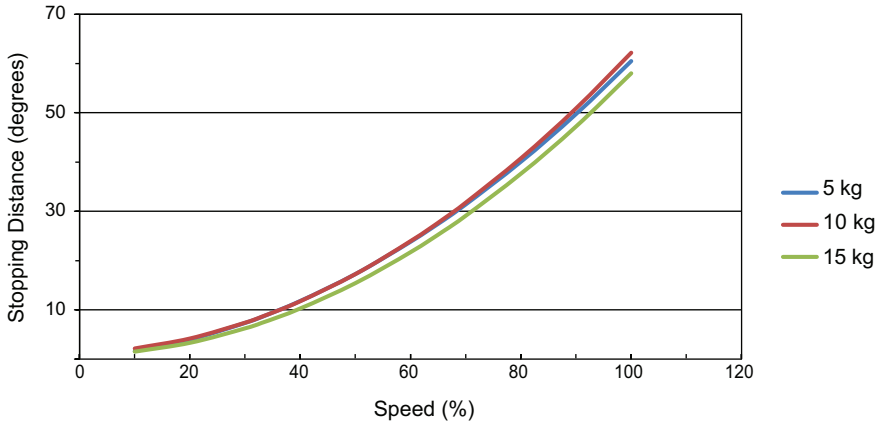
The graphs show the time elapsed and distances traveled between the initiation of a stop signal and the cessation of all robot motion.

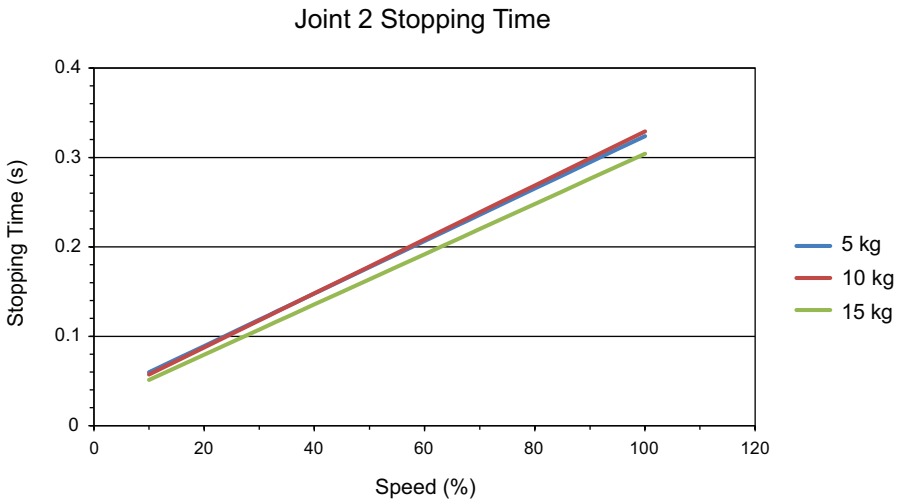
For stop category 1, the stopping time and distance values depend on the speed, load, and extension of the robot, stated for 33%, 66% and 100% of the maximum payload (15 kg). Data provided is for the three joints of greatest displacement (J1, J2, and J3).

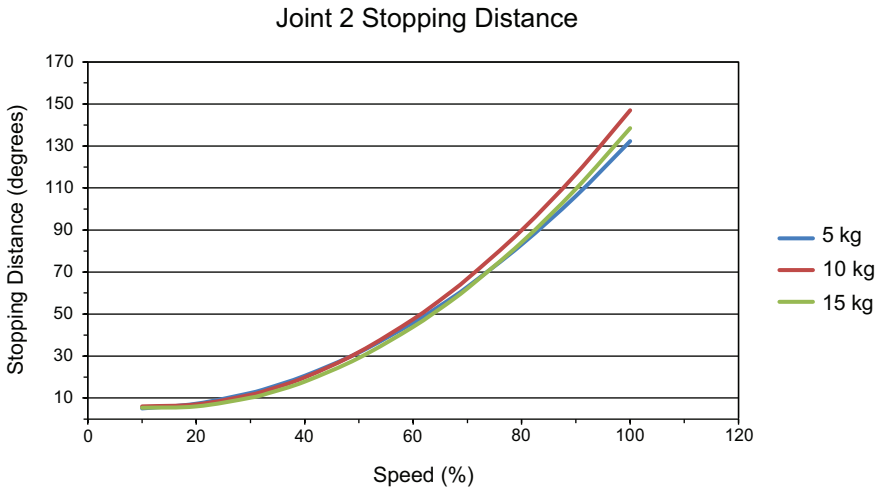
Joint 1 Stopping Time

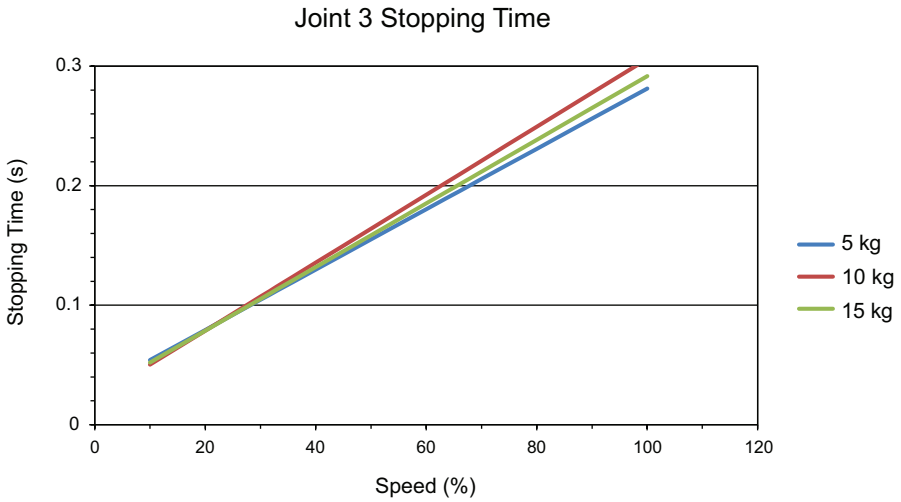


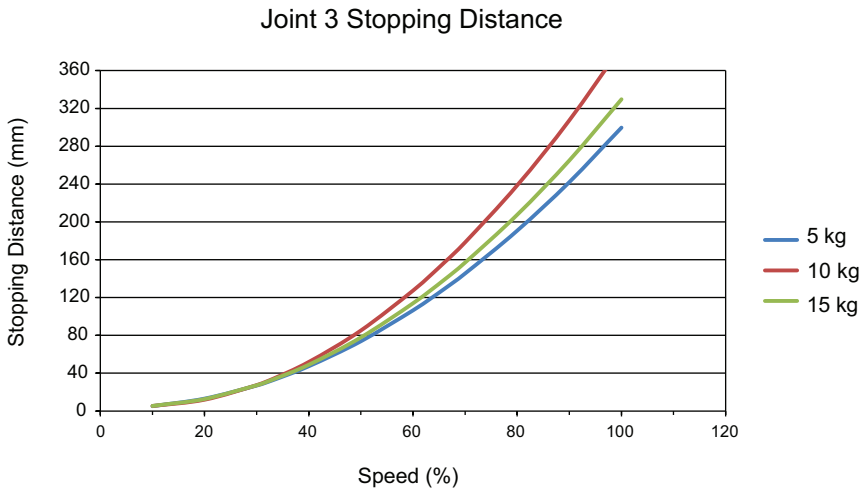
Joint 1 Stopping Distance




Joint 2 Stopping Time
Stopping Time (s)
0.4
0.3
0.2
0.1
0
0
20
40
60
80
100
120
Speed (%)
5 kg
10 kg
15 kg


Joint 2 Stopping Distance
Stopping Distance (degrees)
170
150
130
110
90
70
50
30
10
0
20
40
60
80
100
120
Speed (%)
5 kg
10 kg
15 kg


Joint 3 Stopping Time
Stopping Time (s)
0.3
0.2
0.1
0
0
20
40
60
80
100
120
Speed (%)
5 kg
10 kg
15 kg


Joint 3 Stopping Distance
Stopping Distance (mm)
360
320
280
240
200
160
120
80
40
0
0
20
40
60
80
100
120
Speed (%)
5 kg
10 kg
15 kg

2-3 Electrical Specifications

Electrical specifications are provided in the sections below.

2-3-1 Power Supply Specifications

Specifications for the 24 VDC and 200 to 240 VAC power supplies are provided below.

Power Supply	Item	Specification
24 VDC Control Power	Supply voltage range	24 VDC ±10%
	Current / power requirements	8 A / 190 W maximum
	Circuit protection	User-supplied 10 A, slow-blow fuse / breaker
	Wire size	0.75 mm^2 to 2.5 mm^2
	Shielding	User-supplied connection from power supply cable shield to robot ground point.
200 to 240 VAC High Power	Supply voltage range	200 to 240 VAC Minimum*1: 180 VAC Maximum: 264 VAC
	Supply frequency	50/60 Hz, single phase
	Current require-ments*2	12 A
	Circuit protection	User-supplied 15 A, slow-blow fuse / breaker
	Shielding	User-supplied connection from power supply cable shield to robot ground point.

*1. Specifications established at nominal line voltage. Low line voltage can affect robot performance.

*2. There is no inrush current beyond the specification provided.

Facility Overvoltages Protection

You must protect the robot from excessive overvoltages and voltage spikes. If your country requires a CE-certified installation or compliance with IEC 61131-2, 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.

Your equipment or transient suppressor must be capable of absorbing the energy in the transient. In the industrial environment, non-periodic overvoltage peaks may appear on mains power supply lines. These can come from power interruptions to high-energy equipment (such as a blown fuse on one branch in a 3-phase system), which will cause high current pulses at relatively low voltage levels. You must take the necessary steps to prevent damage to the robot.

2-3-2 XIO I/O Specifications

Specifications for the XIO input and output circuits are provided below.

Type	Item	Specification
Input circuits	Type	Sinking (NPN) / Sourcing (PNP)
	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	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 6 mA
	Typical threshold current	2.0 mA
	Impedance (V_{in} / I_{in})	3.9 kΩ
	Current at 24 VDC	< 6 mA
Output circuits	Type	Sourcing (PNP)
	Output voltage range	24 VDC ±10%
	Output current (single output)	0.7 A maximum
	Total current output for all XIO circuits	1.0 A maximum at 50°C ambient temperature 1.5 A maximum at 25°C ambient temperature
	ON state resistance at 0.5 A	0.14 Ω maximum at 85°C
	Output leakage current	5 µA maximum
	Short circuit current limit	0.7 to 2.5 A
	Output voltage at inductive load (turn OFF)	(+V - 52) ≤ V_{demag} ≤ (+V - 41) where I_{out} = 0.5 A and load ≥ 1 mH

2-3-3 TIO Specifications

Specifications for the TIO circuits are provided below.

Type	Item	Specification
Input circuits	Type	Sinking (NPN)
	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	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 6 mA
	Typical threshold current	2.0 mA
	Impedance (V_{in} / I_{in})	3.9 kΩ
	Current at 24 VDC	< 6 mA

Type	Item	Specification
Output circuits	Type	Sourcing (PNP)
	Output voltage range	24 VDC ±10%
	Total current output for all XIO circuits	1.0 A maximum at 50°C ambient temperature 1.5 A maximum at 25°C ambient temperature
	ON state resistance at 0.5 A	0.14 Ω maximum at 85°C
	Output leakage current	5 µA maximum
	Short circuit current limit	0.7 to 2.5 A
	Output voltage at inductive load (turn OFF)	(+V - 52) ≤ V_{demag} ≤ (+V - 41) where I_{out} = 0.5 A and load ≥ 1 mH

2-3-4 Belt Encoder Specifications

Specifications for the XBELTIO connections are provided below.

Item	Specification
Pulse input method	Line driver
Input signals	A, B, and Z
Counting unit	Pulses
Counter range	-8388607 to 8388608
ON voltage/current	2 to 5 VDC
OFF voltage/current	0 to 0.8 VDC
Input current	100 µA
5 VDC output rating	5 VDC ±10% 1 A max.

2-4 Environmental Specifications

Environmental specifications are provided below.

Item	Specification
Ambient operating temperature	0 to 40° C
Storage temperature	-25 to 55° C
Humidity	During operation: 5 to 90% (Non-condensing) During storage and transportation: 75% or less (non-condensing)
Altitude	2000 m max
Pollution degree	2
Rating	• IP20 model: NEMA Type 1 • Food Grade model: Food Grade Lubrication, NSF H1, ISO 21469 certified • IP65 model: NEMA Type 4, Food Grade Lubrication, NSF H1, ISO 21469 certified • Electrostatic Discharge Protection, Cleanroom model: ISO 4 / Class 10

2-5 Other Specifications

Other specifications are provided below.

2-5-1 Ethernet Communication Specifications

Ethernet communication specifications are provided below.

Item	Specification
Physical Layer	10BASE-T/100BASE-TX
Media access method	CSMA/CD
Modulation	Baseband
Topology	Star
Baud rate	100 Mbps (100Base-TX)
Transmission media	STP (shielded, twisted-pair) cable of Ethernet category 5, 5e, or higher
Maximum transmission distance between Ethernet switch and node	100 m

2-5-2 Connector and Port Specifications

Robot connector specifications are provided below.

Additional Information

Refer to *Section 3 Installation* on page 3-1 for more information about connector wiring and pin diagrams.

Connector	Specification
Pneumatic ports	6 mm push-connect type fittings Maximum air pressure of 0.55 MPa Internally mounted valves (optional): • Type: SMC VQZ1121-5MO1-C4-Q • Actuation: 2 position, single • Flow rate: 0.35 Cv • Operating pressure range: 0.15 to 0.55 Mpa • Response time: 12 ms (max.)
Vacuum ports	10 mm push-connect type fittings (2) 0.14 mm^3 / minute minimum flow rate 81 mm of water vacuum required
USER connectors	19-pin, M23, male Male-threaded Internal wire size: 0.25 mm^2 Internal wire voltage rating: 100 V Connector assembly consists of the following items: • Housing: Harting 09 15 100 0307 • Insert: Harting 09 15 119 3101 • Pins: Harting 09 15 100 6201(1 mm size) and 09 15 100 6211 (1.5 mm size)

Connector	Specification
Control Power connector	Molex 2-wire receptacle Part number: 43160-2102
High Power connector	IEC 60320 C15 type Part number: 04118-000
XSYSTEM connector	44 pin, D-sub HD, female
XBELTIO connector	26 pin, D-sub HD, male
XIO connector	26 pin, D-sub HD, female
Ethernet interface ports	RJ-45
Tool Ethernet connector port	4 pin, M12, female D-coded type Female-threaded
TIO connector	17-pin, M23, male Male threaded Connector assembly consists of the following items: • Housing: Harting 09 15 100 0307 • Insert: 09 15 117 3101 • Pins: Harting 09 15 100 6201(1 mm size) and 09 15 100 6211 (1.5 mm size)

2-5-3 Mounting Screws and Torques

The following screw type, washers, and torque is required for mounting the robot. These specifications also apply for securing a wall mount bracket to a vertical surface.

⚠ WARNING

The robot can fall over if it is not properly secured with mounting hardware.

Type	Quantity	Size	Class	Torque
Socket Head Cap Screw	4	• M12 x 1.75 mm • DIN 912 or ISO 4782	10.9 or 12.9	96 to 104 N-m
Hex Nuts (through hole mounting only)	4			
Flat Washer	4	• M12 • DIN 125 or ISO 7089	8.8	–-

3

Installation

This section provides information about installing the robot and other necessary equipment.

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3-1 Robot Installation Procedure

The basic installation steps are provided below.

⚠ WARNING

- Ensure that installation and post-installation checks of the product are performed by personnel in charge who possess a thorough understanding of the machinery to be installed.
- The robot must be installed to avoid interference with buildings, structures, utilities, other machines and equipment that may create trapping or pinch points. It must be installed in accordance with Standard for Robots and Robotic Devices – Safety Requirements for Industrial Robots – Part 2: Robot Systems and Integration, ISO 10218-2.

1 Mount the robot.
Refer to *3-2 Mounting the Robot* on page 3-4 for more information.

2 Install the end-of-arm tooling.
Refer to *3-3 Installing End-of-Arm Tooling* on page 3-6 for more information.

3 Install any optional equipment.
Refer to *3-4 Installing Optional Equipment* on page 3-7 for more information.

4 Connect any necessary pneumatic air lines using the ports.
Refer to *3-8 Connecting Pneumatic Equipment* on page 3-33 for more information.

5 Make any necessary adjustments to hardstops.
Refer to *3-5 Adjustable Hardstop Details* on page 3-20 for more information.

6 Connect all required system cables.
Refer to *3-6 System Cable Installation* on page 3-22 and *3-7 Connecting Digital I/O* on page 3-26 for more information.

7 Connect all required safety equipment.
Refer to *3-9 Installing Safety Equipment* on page 3-35 for more information.

8 Make power and ground connections.
Refer to *3-10 Supplying Power and Ground* on page 3-43 for more information.

9 Verify the robot installation.
Refer to *3-11 Verifying Installation* on page 3-46 for more information.

3-2 Mounting the Robot

Use the information in the following sections to mount the robot.
Before beginning the mounting procedure, have the following tools and resources available.

- A torque wrench for proper tightening of the mounting screws.
- Assistance to maneuver the robot into the mounting position.
- Four socket-head cap screws with flat washers and hex nuts (through hole mounting only). Refer to *2-5-3 Mounting Screws and Torques* on page 2-19 for more information.
- A lifting strap.

3-2-1 Robot Mounting Surface

The robot must be mounted on a smooth, level, and flat surface that is rigid enough to prevent vibration and flexing during operation. The mounting surface must be designed to support the weight of the robot with payload and also the reactionary forces that are caused by fast robot motion.
Mounting holes can be drilled and tapped or through type.

⚠ WARNING

If a robot is mounted to a surface with inadequate stiffness, damage to the z-axis quill or other mechanical components can result from excessive oscillation during operation.

Precautions for Correct Use

- It is recommended to use an 18 mm (minimum) thick steel plate with a maximum surface roughness of 25 µm that is properly secured to the floor or wall as a robot mounting surface. Mounting surface flatness must not exceed 5 mm.
- Keep a minimum of 300 mm clearance behind the robot to avoid unmounting of the robot in case of iCS amplifier chassis replacement and to allow for easy switch setting access.

Robot Mounting Structure

Use the following guidelines when designing a structure to support the robot.

- Structures designed for inverted robots require a typical stiffness of 40 Hz minimum. Applications with high payloads or aggressive moves at full link extensions may require higher stiffness.
- Structures designed for standard robots require a typical stiffness of 100 Hz minimum.

Precautions for Correct Use

If the robot mounting structure is not designed with adequate stiffness, robot performance will not meet the specified values.

3-2-2 Mounting Procedure

Use the following procedure to mount the robot to a horizontal surface.
If mounting the robot to a vertical surface using a wall mount bracket, fasten the wall mount bracket to the surface before attaching the robot. Refer to the following sections for more information.

- *2-5-3 Mounting Screws and Torques* on page 2-19
- *2-1-8 Wall Mount Bracket Dimensions* on page 2-9

⚠ WARNING

Do not remove the shipping brackets or move the robot links until the robot has been secured to its mounting surface. Failure to comply could result in the robot falling and causing either personnel injury or property damage.

⚠ WARNING

- Use a crane and straps to lift the robot by the inner arm and controller handle. Never lift the robot by the quill. Failure to comply could result in the robot falling and causing either personnel injury or equipment damage.
- The robot can fall over if it is not properly secured with mounting hardware.

Precautions for Correct Use

The mounting surface should be clean and prepared according to the information provided in *3-2-1 Robot Mounting Surface* on page 3-4 before attempting to mount the robot.

Additional Information

After mounting the robot, check the mounting screw torque after 72 hours of initial operation and then recheck every 3 months thereafter.

1 Using the dimensions provided in *2-1-2 Mounting Flange Dimensions* on page 2-6, prepare four holes in the mounting surface to accommodate the user-supplied machine screws. A slot and hole are provided in the mounting flange for locating purposes if necessary.

2 Maneuver the robot into position on the mounting surface.
Place lifting straps under the inner link and around the handle located near the rear of the robot when lifting.

3 Align the holes in the mounting flange with the prepared mounting holes in the mounting surface.

4 Insert all four screws with washers to secure the robot to the mounting surface.

5 Torque the mounting screws in a criss-cross sequence using a minimum of three passes until the required torque of 96 to 104 N-m is achieved.

6 After all four screws have been tightened to the specified torque, the mounting procedure is complete.

3-3 Installing End-of-Arm Tooling

You must provide, install, and ground (if necessary) end-of-arm tooling to the tool flange.
Use the following details when designing and installing end-of-arm tooling.

- Hole diameters and placement on the tool flange comply with ISO-9409-1-50-4-M6 (2004) requirements for manipulating industrial robots.
- End-of-arm tooling is attached to the tool flange using M6 x 1.0 (Class 10.9 or higher) screws with a minimum of 10 mm thread engagement into the tool flange.
- Apply Loctite 243 thread lock (or equivalent) to secure the fasteners.
- Apply a torque of 7.5 N-m when tightening tooling fasteners.

Additional Information

Refer to *2-1-3 Tool Flange Dimensions* on page 2-6 for more information.

If the end-of-arm tooling requires pneumatic or electrical connections, use the connectors on the Secondary Interface Panel. Refer to *1-2-5 Connectors and Ports* on page 1-8 for more information.

Precautions for Safe Use

The Joint 3 quill and the tool flange are not grounded to protective earth. 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.

⚠ DANGER

Failure to ground robot-mounted equipment or tooling that uses hazardous voltages could lead to injury or fatality of a person touching the end-effector during an electrical fault.

3-4 Installing Optional Equipment

This section provides information about installing the following optional equipment.

3-4-1 Mounting External Equipment to the Robot

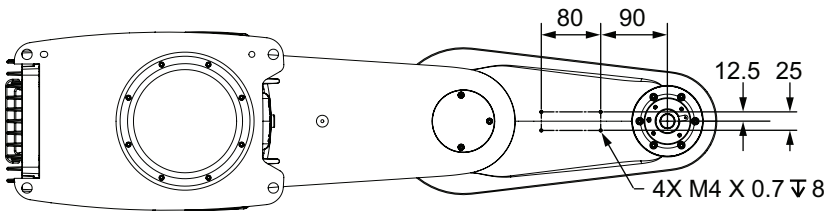
The robot body has accommodations to mount external equipment to the underside of the outer link.
Use the information below to understand how to mount external equipment to the robot.
The following considerations should be made when mounting external equipment to the robot.

- Do not mount equipment that will interfere with robot motion or other objects in the work cell.
- Do not mount equipment in a way that can induce excessive inertia to the outer link.

Precautions for Correct Use

Any externally mounted equipment is considered robot payload. Consideration to the payload attached to the Tool Flange should be made when mounting external equipment to the robot.

Apply a torque of 2.5 N-m to the user-supplied fasteners when mounting equipment to the 4 mounting holes between joint 2 and joint 4. Apply Loctite thread lock type 222 or equivalent.

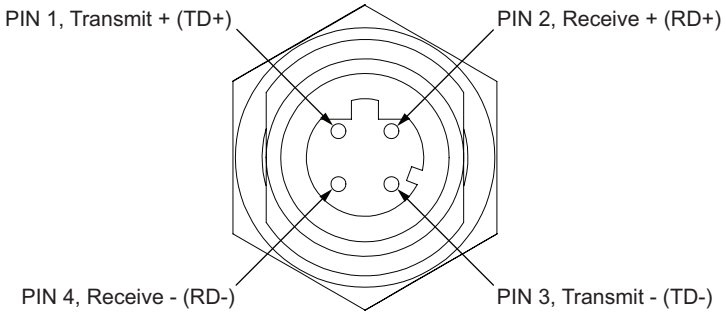


3-4-2 Tool Ethernet Connector Wiring

Use the information below to make an Ethernet network connection from the Tool Ethernet connector to user-supplied devices mounted on the outer link or end-of-arm tooling.

Additional Information

Refer to *2-5-2 Connector and Port Specifications* on page 2-18 for more information about the Tool Ethernet connector type.

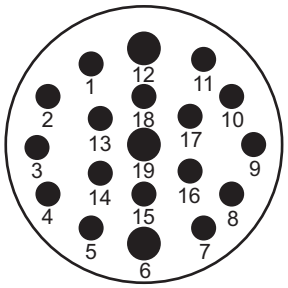


3-4-3 USER Connector Wiring

Use the information below to make connections to the USER connectors on the Primary Interface Panel and the Secondary Interface Panel.

Additional Information

Refer to *2-5-2 Connector and Port Specifications* on page 2-18 for more information about the USER connector type.



3-4-4 Bellows Installation Procedure

Use the following procedure to install bellows.

Precautions for Correct Use

Never loosen or remove the quill clamp collar while the z-axis brake is released.

Additional Information

Refer to *6-1-11 Bellows Replacement Procedure* on page 6-8 for more information.

The following items are required for this procedure.

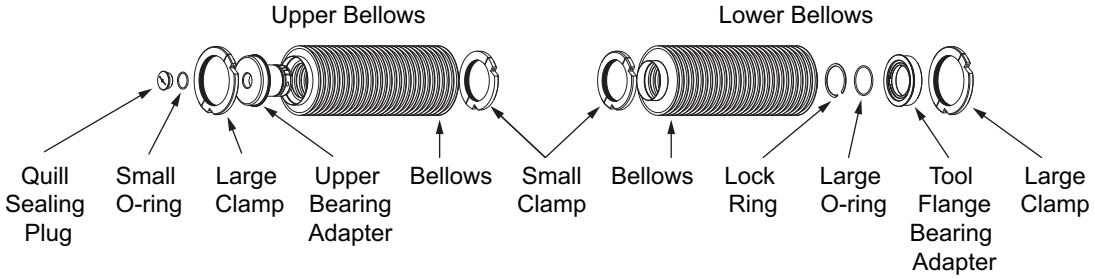
- If adding bellows, use one of the following bellows installation kits applicable to your robot.
  - Standard quill length (210 mm): 19464-003F
  - Long quill length (410 mm): 19464-004F
- If replacing bellows, use one of the following bellows replacement kits applicable to your robot.
  - Standard quill length (210 mm): 19464-103F
  - Long quill length (410 mm): 19464-104F
- Torque wrench
- Flathead screwdriver (optional)
- Loctite thread lock type 222 or equivalent
- 2.5 mm hex key
- 3 mm hex key

Make the following considerations before installing the bellows.

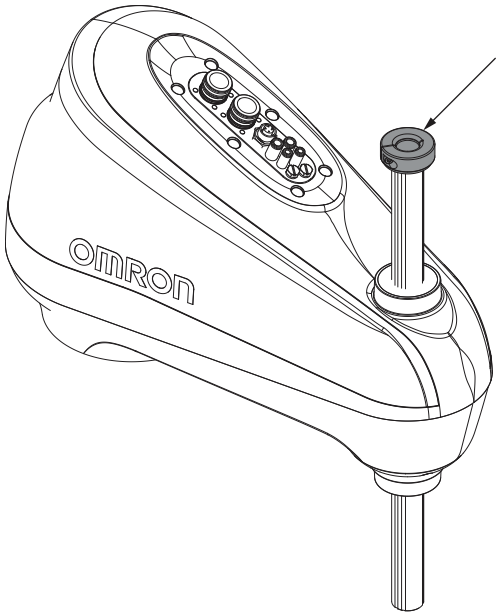
- If cables or tubing are routed through the center of the quill, they must be removed before beginning this procedure.
- The tool flange must be removed before beginning this procedure. Make all necessary preparations and considerations before removing the tool flange. Refer to *6-2-1 Replacing the Tool Flange* on page 6-12 for more information.
- The procedure below installs the upper bellows first and then the lower bellows next.

- To simplify installation, the Joint 3 quill should be positioned in approximately the middle position.
- The upper and lower bellows are identical and interchangeable.
- If routing cables or tubing through the center of the quill for use at the end-effector, user-supplied sealing plugs may be required for harsh environments. The top of the bellows accepts a plug with threads M20 X 13.5 mm. Refer to *2-1-3 Tool Flange Dimensions* on page 2-6 for information about a user-supplied sealing plug for the bottom of the tool flange.

The bellows installation kit includes the following components.

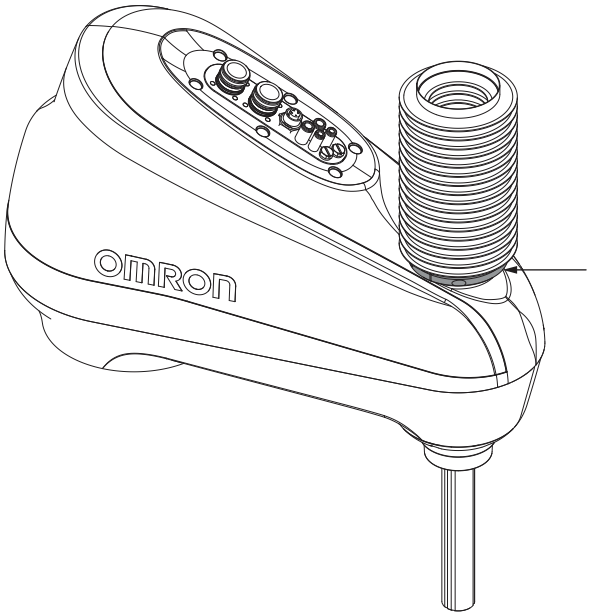


1 Begin the upper bellows installation by removing the quill clamp collar at the top of the Joint 3 quill using a 3 mm hex bit.
The quill clamp collar will be replaced by the upper bearing adapter provided in the bellows installation kit.



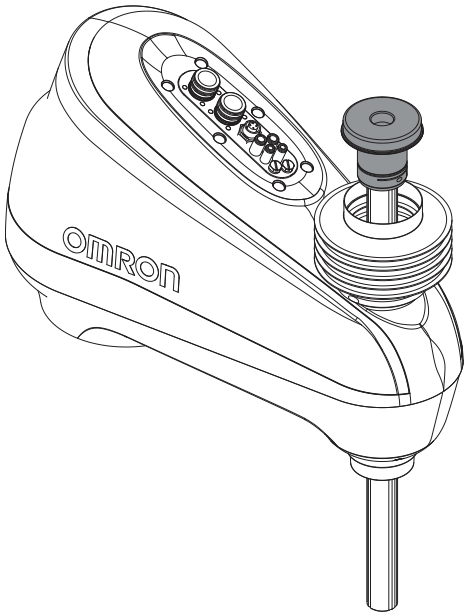
2 Slide the bellows down the quill and then wrap it around the exterior of the robot housing.
Orientation of the bellows is not required because it is symmetrical.
Take care to ensure the bellows is wrapped evenly and completely around the robot housing.

3 Place the two halves of the small clamp around the robot housing.
Orient the small clamp so that the fasteners can be inserted as shown in the image below.



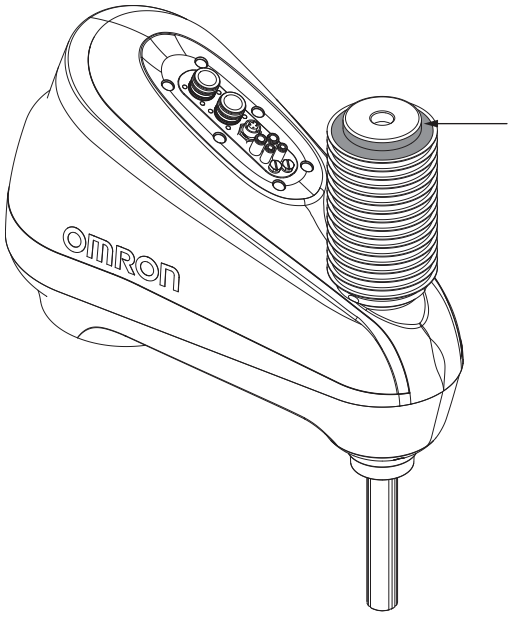
4 Apply thread lock to the small clamp fasteners, insert, and tighten using a 2.5 mm hex key while ensuring that the bellows are completely seated and positioned between the small clamp and the robot housing. Tighten to a torque of 0.6 N-m.

5 Place the upper bearing adapter on the top of the quill.
Ensure the upper bearing adapter is completely seated on top of the quill.

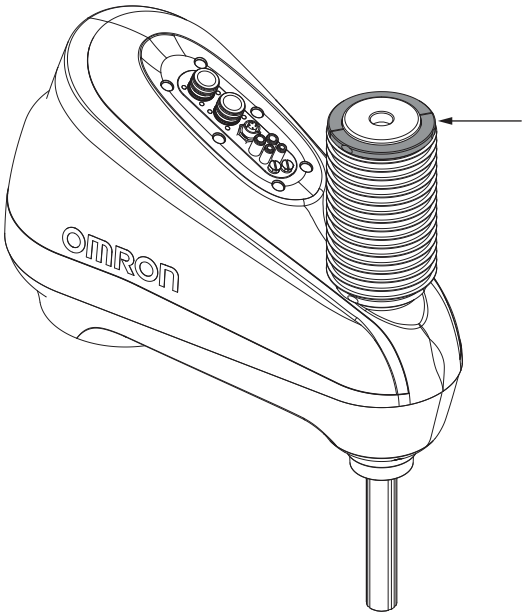


6 Apply thread lock to the upper bearing adapter clamp screw, insert, and tighten using a 3 mm hex key to a torque of 3.3 N-m.

7 Lift the bellows upward and wrap it over the outer circumference of the upper bearing adapter. This may require stretching the bellows slightly so it can be positioned over the upper bearing adapter lip.

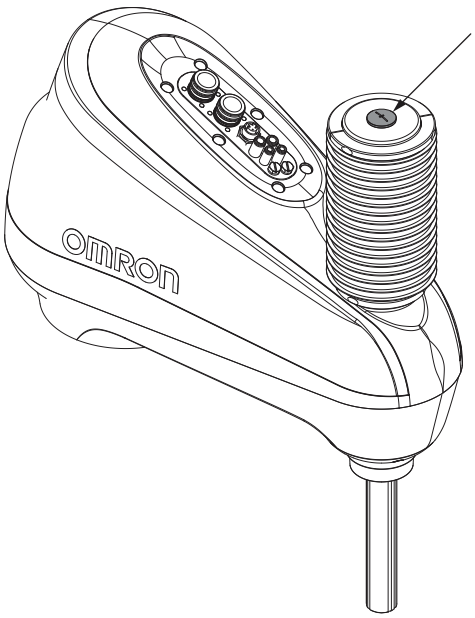


8 Place the two halves of the large clamp on the upper bearing adapter.
The bellows should be evenly positioned between the upper bearing adapter and the large clamp.

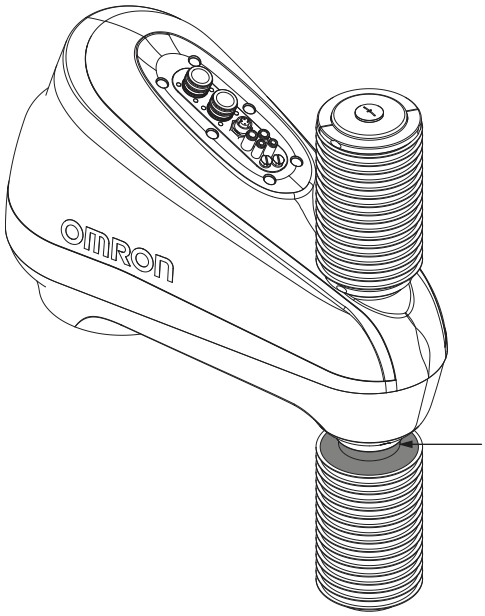


9 Apply thread lock to the large clamp fasteners, insert, and tighten using a 2.5 mm hex key while ensuring that the bellows are completely seated and positioned between the large clamp and the upper bearing adapter. Tighten to a torque of 0.6 N-m.

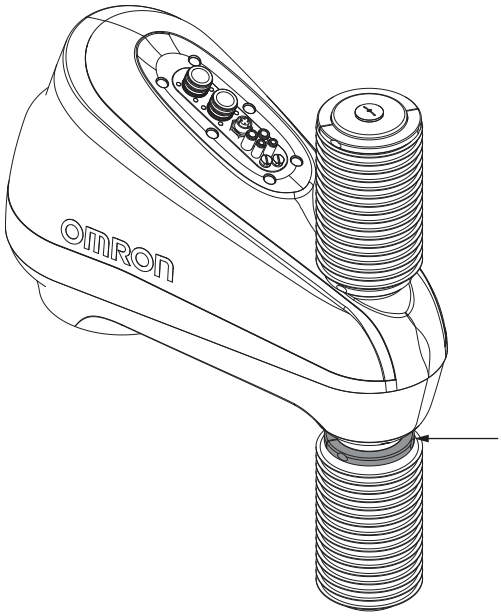
10 If routing cables or lines through the center of the quill is not required, insert the small o-ring and quill sealing plug into the upper bearing adapter to complete the installation of the upper bellows.



11 Begin the lower bellows installation by sliding the bellows up the quill and then wrap it around the exterior of the robot housing.
Orientation of the bellows is not required because it is symmetrical.
Take care to ensure the bellows is wrapped evenly and completely around the robot housing.

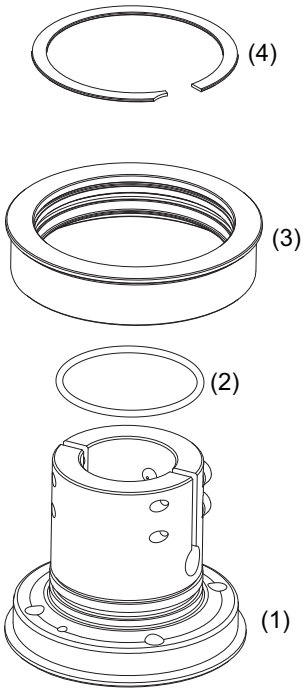


12 Place the two halves of the small clamp around the robot housing.



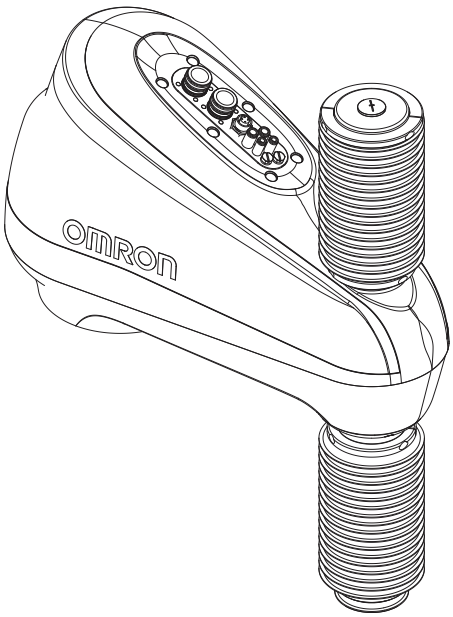
13 Apply thread lock to the small clamp fasteners, insert, and tighten using a 2.5 mm hex key while ensuring that the bellows are completely seated and positioned between the small clamp and the robot housing. Tighten to a torque of 0.6 N-m.

14 Place the large o-ring (2) on the tool flange (1), slide the tool flange bearing adapter (3) over the tool flange (1), and then secure the assembly with the lock ring (4).

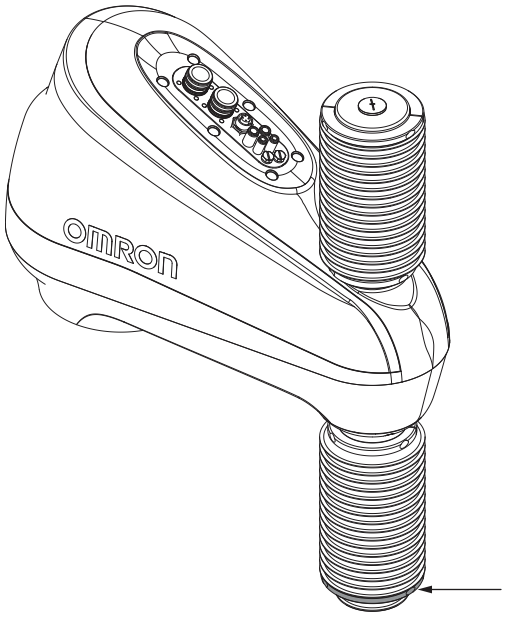


15 Place the assembled tool flange with adapter on the quill and secure it according to the information provided in *6-2-1 Replacing the Tool Flange* on page 6-12.

16 Wrap the bellows over the outer circumference of the tool flange bearing adapter.
This may require stretching the bellows slightly so it can be positioned over the tool flange bearing adapter lip.



17 Place the large clamp on the tool flange bearing adapter.
The bellows should be evenly positioned between the tool flange bearing adapter and the large clamp.



18 Apply thread lock to the large clamp fasteners, insert, and tighten using a 2.5 mm hex key while ensuring that the bellows are completely seated and positioned between the large clamp and the tool flange bearing adapter. Tighten to a torque of 0.6 N-m.
After the large clamp is secured, the bellows installation procedure is complete.

3-4-5 Pneumatic Valve Kit Installation Procedure

Use the following procedure to install an optional pneumatic valve kit.
Make the following considerations before installing the pneumatic valve kit.

- This installation procedure requires removal of the outer link cover and bellows hardware (if present). Make considerations for associated component removal before beginning this procedure.
- Illustrations in this procedure have been simplified for clarity and may differ from the appearance of the robot.

The following tools and resources are required for this procedure.

- Torque wrench.
- 3 mm hex bit.
- Flat head screwdriver.
- Cutters.

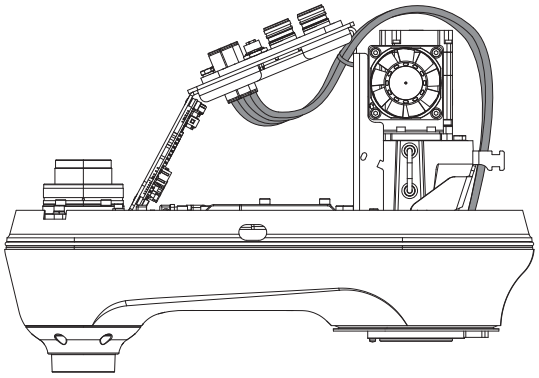
The pneumatic valve kit includes the following components.

Item	Quantity	Part Number
Pneumatic Valve Assembly	1	22776-000
Port Blocking Plug	1	22755-000
M4 x 30 Screws	2	04221191066-0030
M4 Lock Washers	2	18913-000
Loctite 545	1	87101-00545
Pneumatic Line Fittings	6	19107-002
Wire Harness	1	20005-000
Pneumatic Line	6	20013-000
Pneumatic Line Cap	1	22757-000
Cable Tie	5	27300-00023

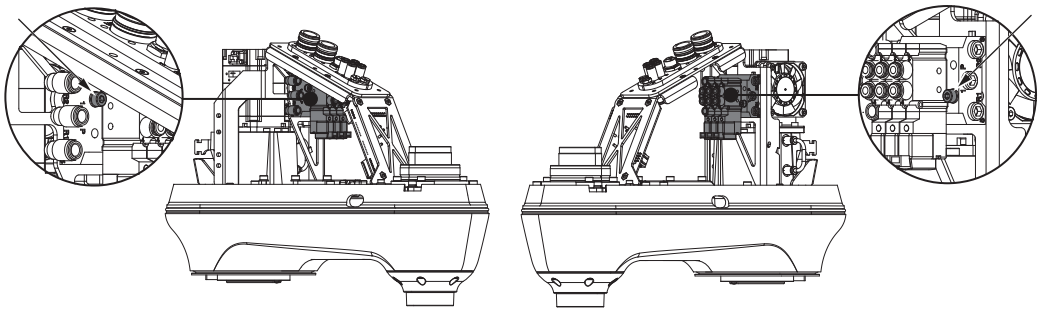
1 Insert the port blocking plug into port 4 on the Primary Interface Panel.

2 Remove the outer link cover.
Refer to *6-2-3 Replacing the Outer Link Cover* on page 6-17 for more information.

3 Inspect the existing pneumatic lines and take note of their routing and connections to the fittings under the Secondary Interface Panel.
Each pneumatic line is marked with a number (1 to 4) that corresponds with the port on the Secondary Interface Panel.

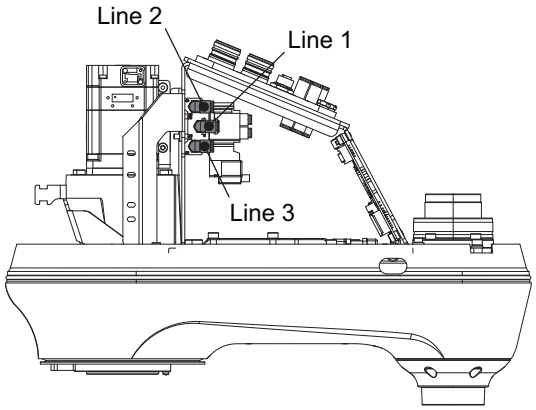


4 Place the pneumatic valve assembly at the mounting location shown below, and then insert two M4 x 30 screws with lock washers as shown in the following figure.
Apply Loctite 545 thread lock before inserting the screws. Tighten the screws to 3 N-m using a 3 mm hex bit.



5 Remove the four pre-connected 6 mm pneumatic lines from the fittings located under the Secondary Interface Panel.
Take note about the line number arrangement before removing. This will be used in the next step.

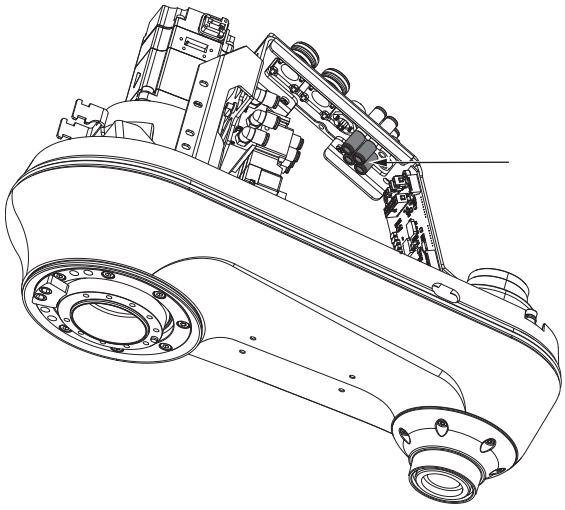
6 Insert the previously removed 6 mm pneumatic lines into the valve manifold ports as shown below.



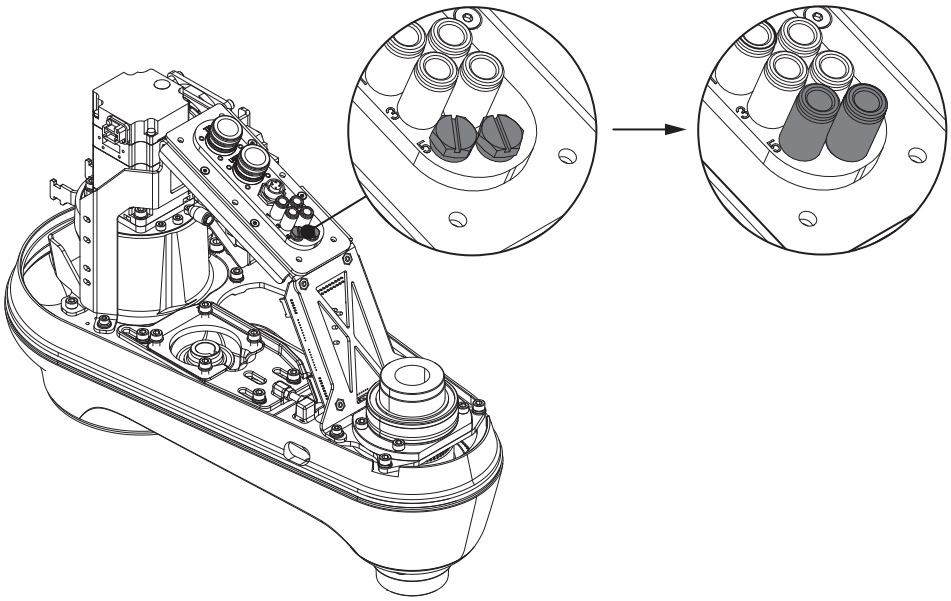
7 Place the pneumatic line cap on the unused pneumatic line 4.

8 Secure the unused pneumatic line 4 using supplied cable ties.
Secure the unused line to a rigid location that prevents it from interfering with moving parts such as a fan or belt.
Trim any excess cable tie material using cutters.

9 Remove the four existing 6 mm fittings under the Secondary Interface Panel.
Insert a 3 mm hex bit into the fitting to unscrew it.

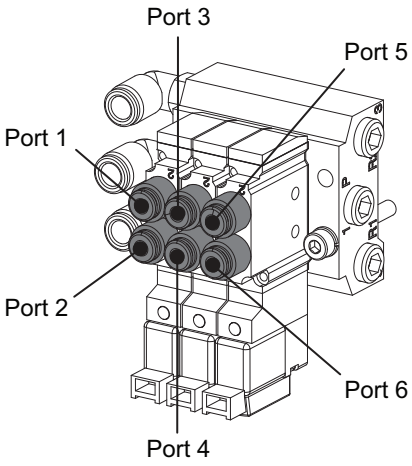


10 Replace the plugs on the top of the Primary Interface Panel(ports 5 and 6) with two of the 6 mm fittings that were removed in the previous step.
Insert a 3 mm hex bit into the fitting to tighten it.
Apply Loctite thread lock 545 before inserting the fittings. Tighten the fittings to 9 N-m using a 3 mm hex bit.

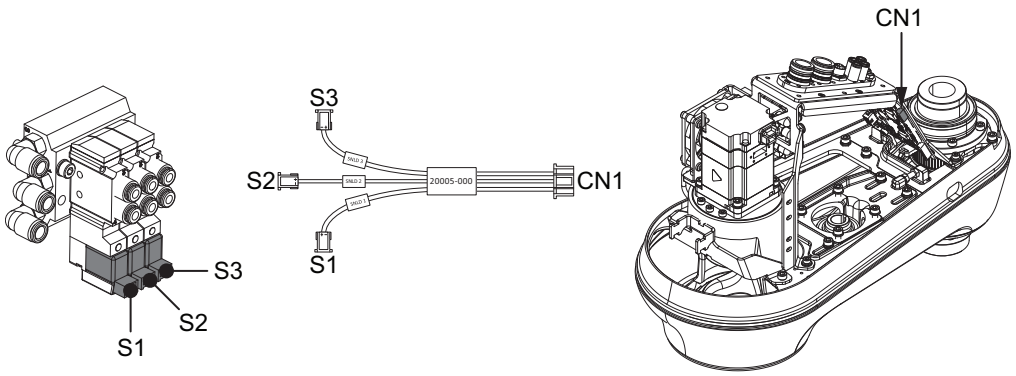


11 Install the pneumatic line fittings in the bottom of the Secondary Interface Panel.
Apply Loctite thread lock 545 before inserting the fittings. Tighten the fittings to 9 N-m using a 3 mm hex bit.

12 Connect the fittings on the pneumatic valve assembly to the installed fittings under the Secondary Interface Panel using the supplied pneumatic lines.
Connect the valve fittings to the corresponding ports on the Secondary Interface Panel as shown in the following figure.



13 Connect the pneumatic valve assembly solenoids to the outer link control board using the provided wiring harness.
Use the diagram below to understand the correct connections.
Position the wire harness in a location that prevents it from interfering with moving parts such as a fan or belt.



14 Secure the wire harness using supplied cable ties.

Secure the wire harness to a rigid location that prevents it from interfering with moving parts such as a fan or belt.

Trim any excess cable tie material using cutters.

15 Replace the outer link cover to complete this procedure.

3-5 Adjustable Hardstop Details

The robot is equipped with mechanical hardstop adjustment points for joint 1 as described in the following sections. Adjust this mechanical hardstop to restrict the robot's range of motion in order to prevent collisions within the workspace if necessary.

⚠ WARNING

The robot's physical hardstop devices are not intended to withstand repeated use. If this occurs, the hardstop may become damaged. Implement proper programming and configuration of joint range limits to prevent hardstop impacts.

Precautions for Correct Use

Always reduce joint motion limits with software settings in the robot configuration area when hardstops are used to restrict range of motion. Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information.

Additional Information

- Obstacles may be defined with software configuration to restrict the robot tool-tip from entering specified volumes of the work envelope. Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information.
- Refer to *2-1-1 Robot Overall Dimensions* on page 2-2 for full range of motion values.

3-5-1 Joint 1 Adjustable Hardstops

Joint 1 has adjustable hardstops that can be used to physically limit the range of travel. The full, default range of travel is ±152°.

User-supplied socket head cap screws are inserted into slots that limit the travel in the positive or negative directions. The slots are located under a cover for Joint 1 as described in the following procedure.

The following Joint 1 motion limits are available.

- ±107°
- ±62°
- ±17°
- +28° or -28°

The following tools and equipment are required for making adjustments to Joint 1 hardstop(s).

- M10 X 1.5 - 14 mm socket head cap screw(s), Class 12.9, alloy steel type.
- Torque wrench.
- 3 mm hex key.
- Loctite thread lock type 243 and 222 or equivalent.

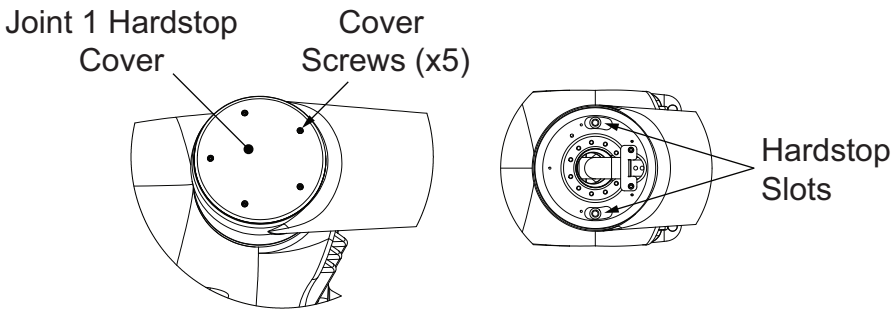
Joint 1 Hardstop Adjustment Procedure

Use the following procedure to make adjustments to the Joint 1 hardstops.

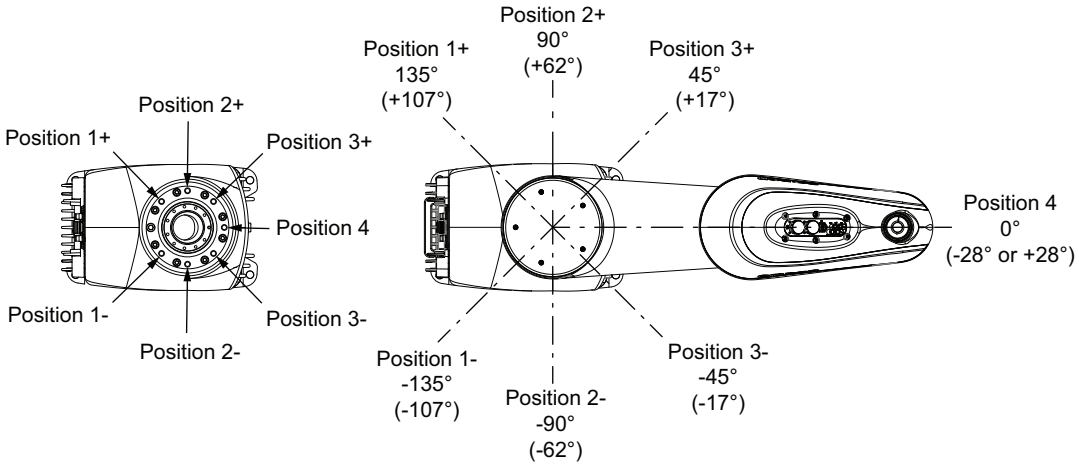
Precautions for Correct Use

Do not remove factory-installed Joint 1 hardstops.
When adjusting Joint 1 hardstops, do not let screws or other objects drop into the robot body.

1 Remove the 5 M4 screws that hold the Joint 1 hardstop cover in place. Then, remove the Joint 1 hardstop cover to expose the adjustment slots.



2 Move the inner arm to the desired position to expose the appropriate slot.
Use the following figure to determine the Joint 1 position required to expose a specific hard stop slot. Positions in parenthesis represent the hardstop limit value.



3 Apply Loctite thread lock type 243 to the M10 X 1.5 - 14 mm socket head screws and insert them into the appropriate slot(s). Apply a torque of 34 N-m.

4 Repeat steps 2 and 3 if a second hardstop is required.

5 Replace the Joint 1 hardstop cover. Apply Loctite 222 or equivalent to the fasteners, insert them, and tighten to a torque of 1.1 N-m to complete this procedure.

3-6 System Cable Installation

This section provides information about installing the robot system cables.

⚠ WARNING

- Never connect or disconnect system cables while power is applied to the robot. Failure to comply may cause unexpected behavior and can result in personnel injury and equipment damage.
- Provide appropriately-sized Branch Circuit Protection and Lockout / Tagout Capability in accordance with the National Electrical Code and any local codes.
- Ensure that interconnecting cables or pneumatic lines are routed away from the robot workspace.

3-6-1 System Cable Overview

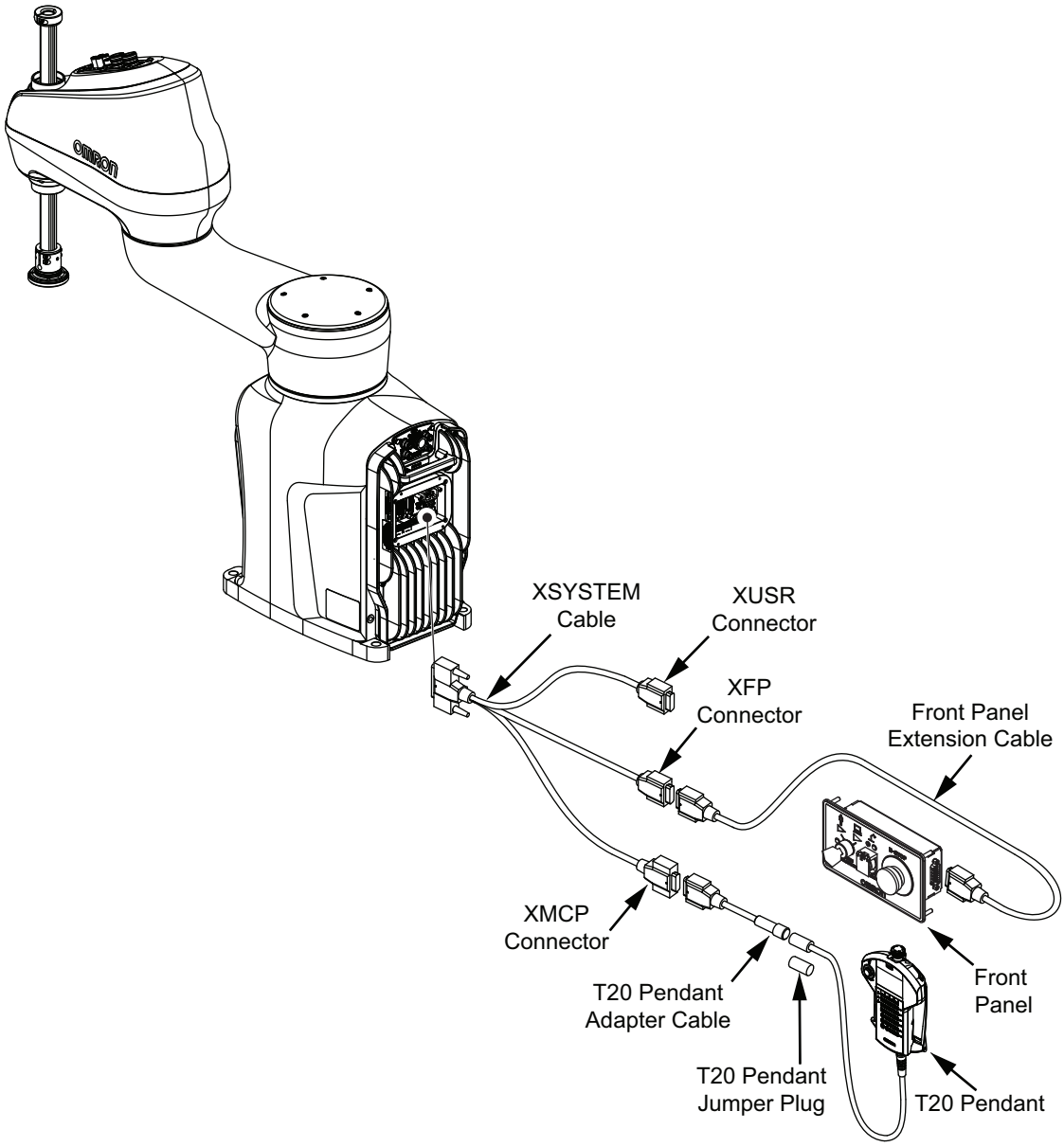
Standard and optional cable connections are provided below.

Standard Connections

The following figure shows standard connections with the XSYSTEM cable. This cable is supplied with the robot.

Additional Information

Refer to *3-9 Installing Safety Equipment* on page 3-35 for more information about XFP, XUSR, and XMCP connections.

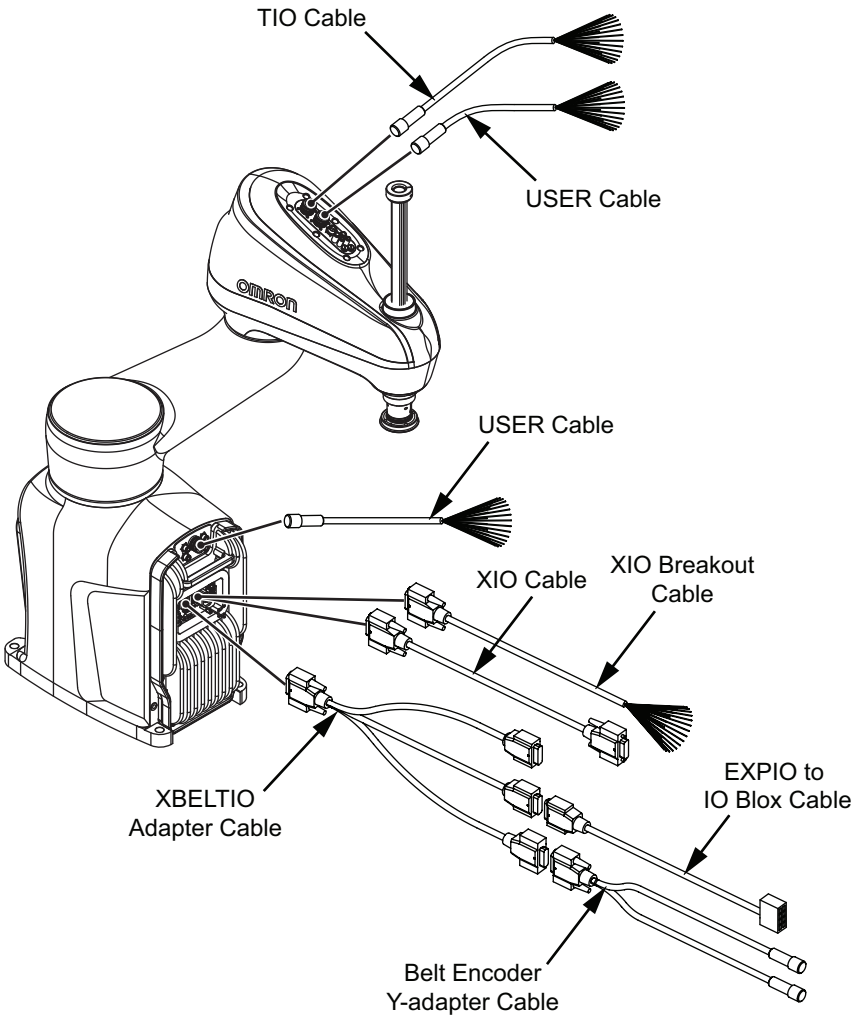


Optional Connections

The following figure shows optional connections to the robot.

Additional Information

Refer to *3-7 Connecting Digital I/O* on page 3-26 for more information about connecting I/O with IO Blox Units or with the XIO connector.



3-6-2 System Cable Installation Procedure

The following procedure provides details about system cable installation.
The robot must be mounted before following the steps below.
If installing system cables on an IP65 or Cleanroom rated robot, special considerations for the Cable Seal must be made. Refer to *A-1 Cable Seal Kit Installation Procedure* on page A-2 for more information before beginning this procedure.

1 Connect the XSYSTEM cable to the Primary Interface Panel XSYSTEM connector and route the XFP, XUSR, and XMCP connectors to their appropriate locations.

2 Connect any digital I/O.
Refer to *3-7 Connecting Digital I/O* on page 3-26 for more information.

3 Connect external equipment such as the Front Panel and Teach Pendant to the XSYSTEM cable XFP and XMCP connectors.
Refer to *3-6-1 System Cable Overview* on page 3-22 for more information.

4 Connect all user-supplied safety equipment to the XUSR connector on the XSYSTEM cable.
Refer to *3-9 Installing Safety Equipment* on page 3-35 for more information.

5 If applicable, connect devices to the XBELTIO connector and the USER connectors. Refer to *Optional Connections* on page 3-23 for more information.

6 Connect the robot to the Ethernet network.

3-7 Connecting Digital I/O

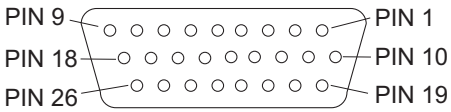
The following sections describe the various methods to connect digital I/O to the robot.

3-7-1 XIO Connector Signals and Wiring

The XIO connector on the Primary Interface Panel provides access to 12 built-in digital inputs and 8 built-in digital outputs.
The XIO connector pin assignments are provided in the table below.

Additional Information

Refer to the following sections for more information.
- Refer to o*2-3-2 XIO I/O Specifications* on page 2-14 for electrical specifications.
- Refer to *2-5-2 Connector and Port Specifications* on page 2-18 for connector specifications.
- Refer to *A-4 I/O Signal Numbering* on page A-6 for all V+ signal number assignments.



Pin Number	Designation	Signal Bank*1
1	Ground	---–
2	24 VDC	
3	Common 1	1
4	Input 1.1	
5	Input 2.1	
6	Input 3.1	
7	Input 4.1	
8	Input 5.1	
9	Input 6.1	
10	Ground	--
11	24 VDC	
12	Common 2	2
13	Input 1.2	
14	Input 2.2	
15	Input 3.2	
16	Input 4.2	
17	Input 5.2	
18	Input 6.2	

Pin Number	Designation	Signal Bank*1
19	Output 1	--
20	Output 2	
21	Output 3	
22	Output 4	
23	Output 5	
24	Output 6	
25	Output 7	
26	Output 8	

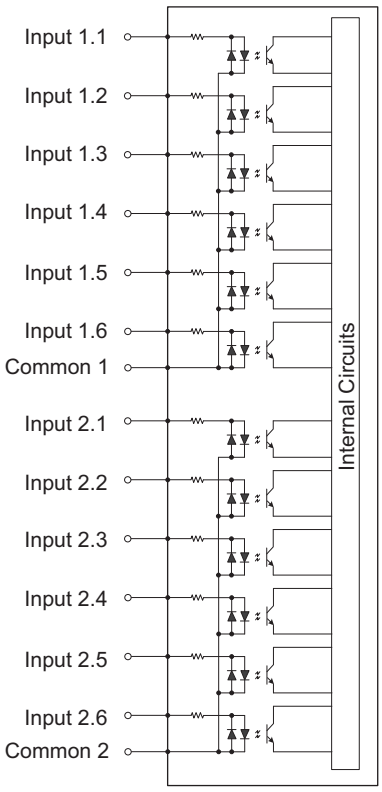
*1. Only applies when using an XIO Termination Block.

XIO Internal Circuits

Use the following information to understand the XIO internal circuits.

● XIO Input Signals

The twelve inputs are arranged in two banks of six. Each bank is electrically isolated from the other bank. Each input is optically isolated. The six inputs within each bank share a common source / sink line.



● XIO Output Signals

The eight outputs share a common, sourcing driver integrated circuit. The driver is designed to supply a load with one side connected to ground. Each channel is capable of switching up to 0.7 A of current. This driver has over-temperature protection, shorted load protection, and is current limiting. The driver draws power from the 24 VDC Control Power supplied to the robot through a self-resetting polyfuse.

Precautions for Safe Use

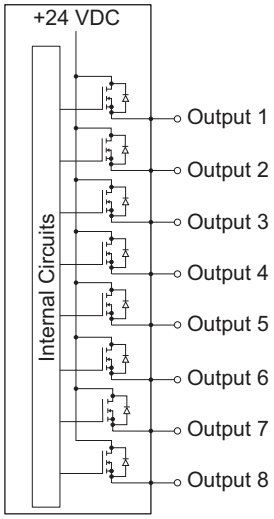
Output 8 can be assigned to indicate the robot's High Power state. When High Power is enabled, this output will turn ON. When High Power is not enabled, this output will be OFF. This is not a safety-rated means of indicating a High Power state and should only be used for monitoring the robot status. Use the ACE Software to make this configuration if needed.

Precautions for Correct Use

Use surge suppression when switching inductive loads such as relays to prevent damage to the output circuits.

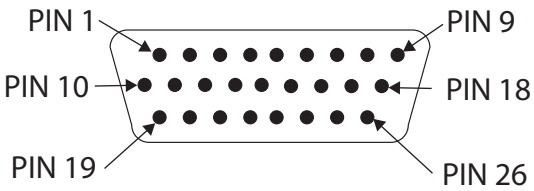
Additional Information

If there is an output short or other over-current condition, the affected output of the driver integrated circuit turns OFF until the condition is removed.



XIO Breakout Cable Pinouts

Use the following diagrams for XIO Breakout cable pinout information.



Pin Number	Signal	Wire Color
1	GND	White
2	24 VDC	White / Black
3	Common 1	Red
4	Input 1.1	Red / Black

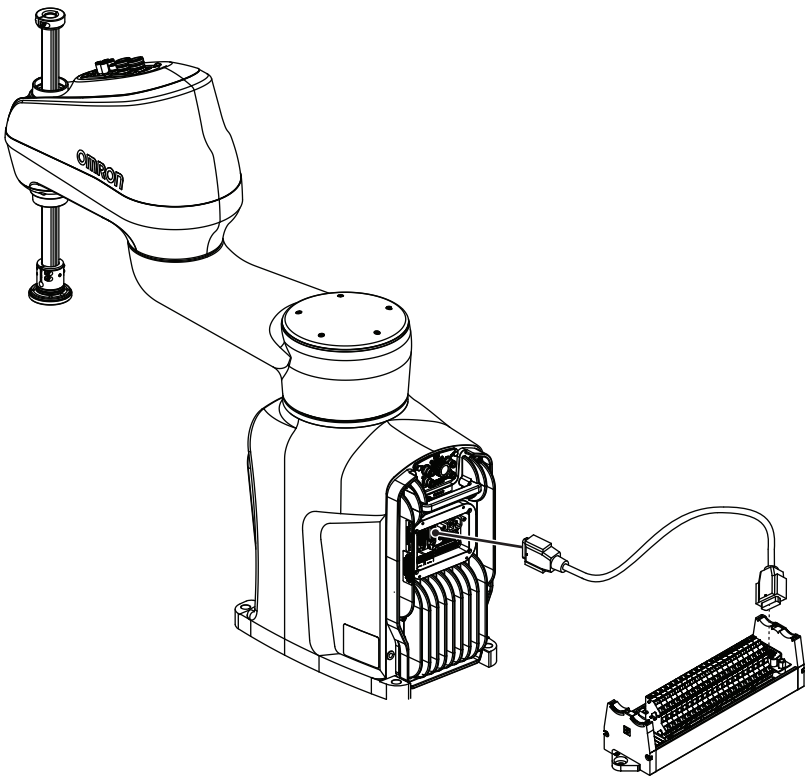
Pin Number	Signal	Wire Color
5	Input 2.1	Yellow
6	Input 3.1	Yellow / Black
7	Input 4.1	Green
8	Input 5.1	Green / Black
9	Input 6.1	Blue
10	GND	Blue / White
11	24 VDC	Brown
12	Common 2	Brown / White
13	Input 1.2	Orange
14	Input 2.2	Orange / Black
15	Input 3.2	Gray
16	Input 4.2	Gray / Black
17	Input 5.2	Violet
18	Input 6.2	Violet / White
19	Output 1	Pink
20	Output 2	Pink / Black
21	Output 3	Light blue
22	Output 4	Light blue / Black
23	Output 5	Light green
24	Output 6	Light green / Black
25	Output 7	White / Red
26	Output 8	White / Blue
Shell	Shield	

XIO Termination Block

An XIO termination block can be connected directly to the XIO connector to provide simple wiring and access to the built-in I/O.

Additional Information

Refer to the *Adept XIO Termination Block Installation Guide (00340-000)* for more information.



3-7-2 TIO Connector Signals and Wiring

The TIO connector on the Secondary Interface Panel provides access to built-in digital I/O.

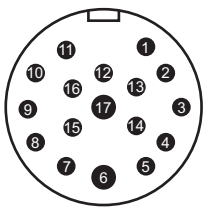
The 5 available inputs correspond to V+ signal numbers 1017 to 1021.

The 4 available outputs correspond to V+ signal numbers 17 to 20.

The TIO connector pin assignments are provided below.

Additional Information

- Refer to *2-3-3 TIO Specifications* on page 2-15 for more information.
- Refer to *2-5-2 Connector and Port Specifications* on page 2-18 for more information.
- Refer to *A-5-5 TIO Cable Pinouts* on page A-11 for more information.



Pin	Wire Color	Signal	V+ Signal Number
1	Black	24 VDC	---
2	White		
3	Red	Output 1	17
4	Green	Output 2	18
5	Yellow	Output 3	19
6	Brown	Output 4	20
7	Blue	Input 1	1017

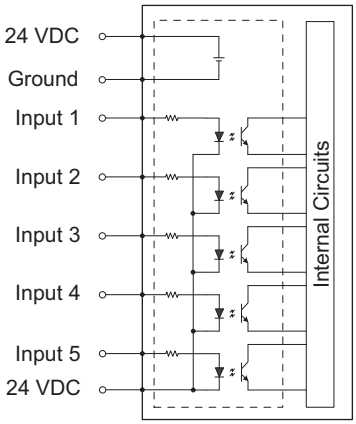
Pin	Wire Color	Signal	V+ Signal Number
8	Orange	Input 2	1018
9	Gray	Input 3	1019
10	Purple	Input 4	1020
11	Light Blue	Input 5	1021
12	Pink	0 VDC	---
13	White/Black		
14	Red/Black		
15	Green/Black		
16	Yellow/Black		
17	Brown/Black		

TIO Internal Circuits

Use the following diagram to understand the TIO internal circuits.

● TIO Input Signals

The 5 input channels are optically isolated and share a 24 VDC common.



● TIO Output Signals

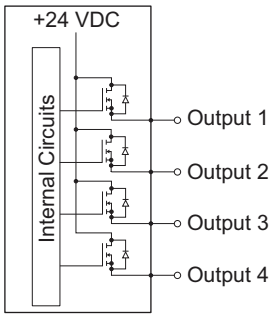
The 4 outputs share a common, sourcing driver integrated circuit. The driver is designed to supply a load with one side connected to ground. Each channel is capable of switching up to 0.7 A of current. This driver has over-temperature protection, shorted load protection, and is current limiting. The driver draws power from the primary 24 VDC input to the robot through a self-resetting polyfuse.

Precautions for Correct Use

Use surge suppression when switching inductive loads such as relays to prevent damage to the output circuits.

Additional Information

If there is an output short or other over-current condition, the affected output of the driver integrated circuit turns OFF until the condition is removed.

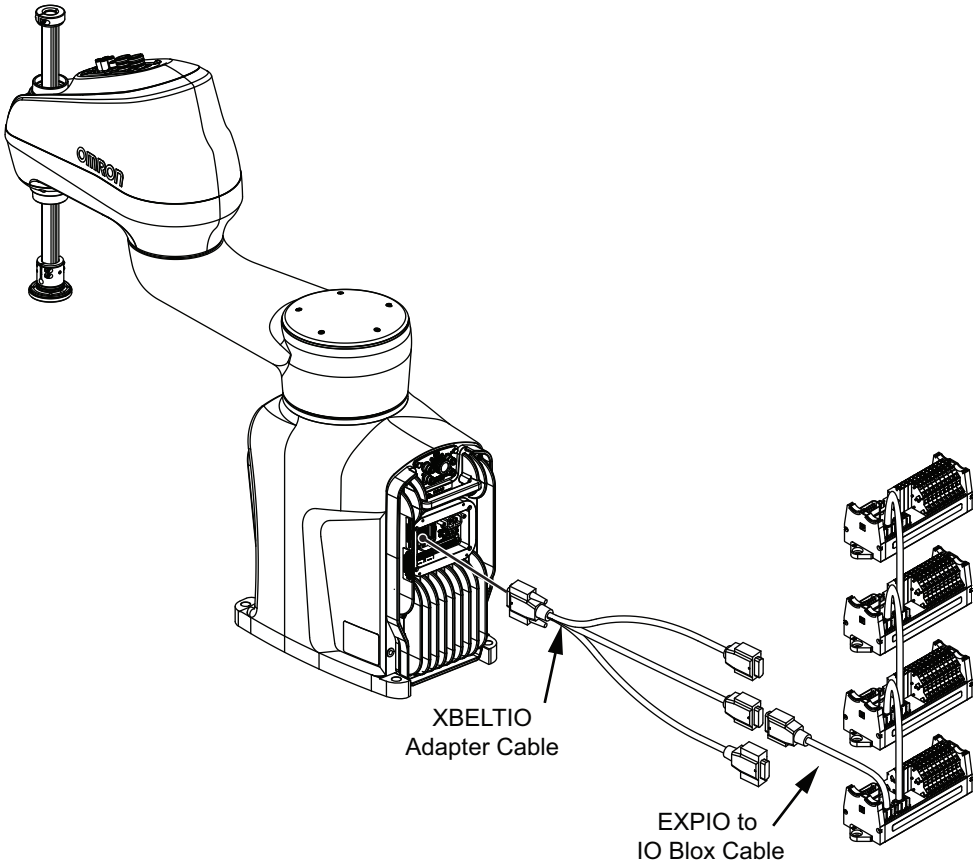


3-7-3 IO Blox Connections

IO Blox units can be connected to the XBELTIO connector using the XBELTIO adapter cable. Up to 4 IO Blox units can be connected as shown below.

Additional Information

Refer to the following areas for more information.
- *A-4 I/O Signal Numbering* on page A-6
- Omron Adept IO Blox User's Guide (04638-000)



3-8 Connecting Pneumatic Equipment

The following section describes the various methods to connect pneumatic equipment to the robot.

3-8-1 Pass-through Ports

Pneumatic ports on the Primary Interface Panel are internally connected to the Secondary Interface Panel.
Ports 1 to 4 on the Primary Interface Panelcorrespond to ports 1 to 4 on the Secondary Interface Panel.
Refer to *2-5-2 Connector and Port Specifications* on page 2-18 for more information.

Precautions for Correct Use

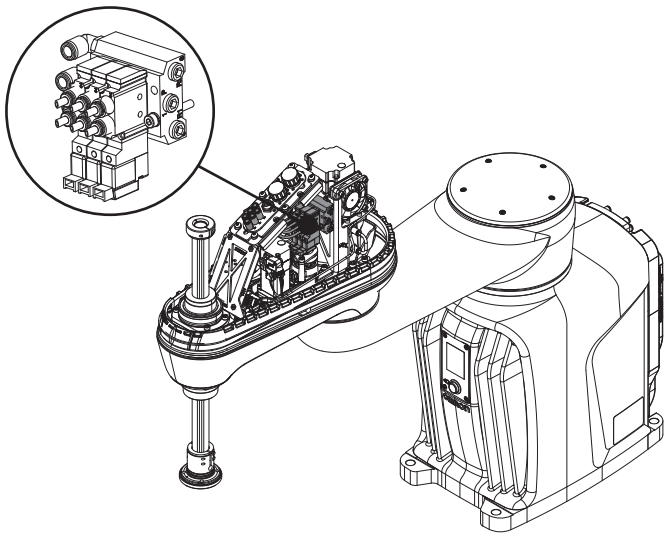
Pneumatic pass-through ports are re-purposed when the optional pneumatic valve kit is installed.

3-8-2 Pneumatic Valve Kit

An optional pneumatic valve kit may be installed to provide robot-controlled ports on the Secondary Interface Panel. When the pneumatic valve kit is installed, V+ signals can be used to control devices such as grippers or other pneumatic end-effectors.

Additional Information

Refer to the following sections for more information.
- *A-4 I/O Signal Numbering* on page A-6
- *3-4-5 Pneumatic Valve Kit Installation Procedure* on page 3-15



Use the information in the table below to understand port designations when a pneumatic valve kit is installed.

Port	Location	Description
1	Primary Interface Panel	High pressure input (all valves)
2		Exhaust (active valves)
3		Exhaust (non-active valves)
4		Unused
1	Secondary Interface Panel	Valve 1 • Signal ON: exhaust • Signal OFF: pressure
2		Valve 1 • Signal ON: pressure • Signal OFF: exhaust
3		Valve 2 • Signal ON: exhaust • Signal OFF: pressure
4		Valve 2 • Signal ON: pressure • Signal OFF: exhaust
5		Valve 3 • Signal ON: exhaust • Signal OFF: pressure
6		Valve 3 • Signal ON: pressure • Signal OFF: exhaust

3-9 Installing Safety Equipment

The user-supplied safety equipment connects to the system through the XMCP, XUSR and XFP connectors on the XSYSTEM cable. Refer to the following sections for safety equipment connection details.

⚠ DANGER

- The robot system must be installed with user-supplied interlock barriers. The interlocked barriers must open the E-Stop circuit in the event of personnel attempting to enter the work cell when High Power is enabled. Failure to install suitable guarding or interlocks could result in injury or death. We strictly prohibit installation, commissioning, or operation of any robot without adequate safeguards. These must be compliant with applicable local and national standards.
- The placement of safety controls shall avoid requiring a person to enter a hazardous area to actuate them.
- Controls shall be located outside of the safeguarded space, except for certain controls such as emergency stops or a teach pendant, where based on a risk assessment they may be located within the safeguarded space.

⚠ WARNING

Before starting the operation of equipment, always confirm that the safety equipment of the robot works properly. If a malfunction of the safety equipment is detected, follow the procedure for abnormal conditions.

⚠ CAUTION

The design and installation of the complete system must comply with the safety standards and regulations in the country of use. The integrators of the robot should understand the safety laws and regulations in their countries and prevent major hazards from occurring in the complete system.

Additional Information

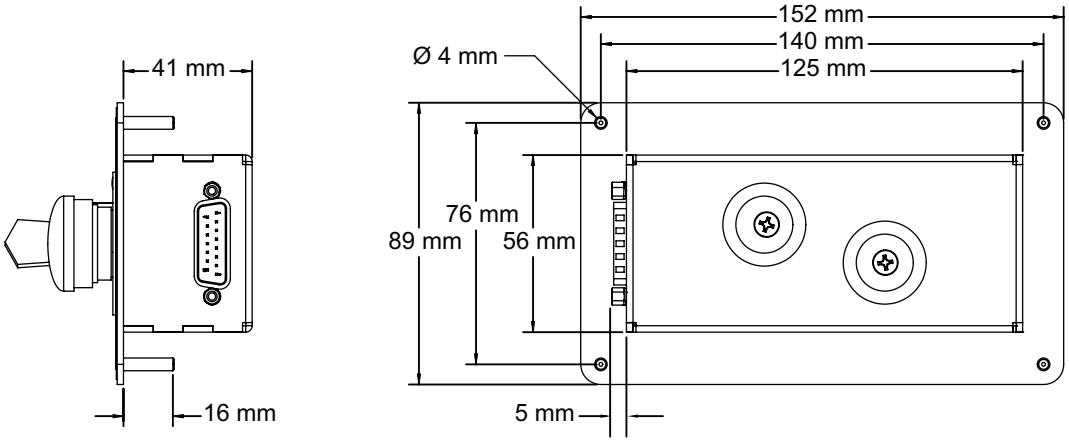
Refer to the *Robot Safety Guide (Cat. No. I590)* for more information.

3-9-1 Installing the Front Panel

Use the dimensions below to install the Front Panel in a suitable location outside of the robot's workspace where it can be easily accessed for emergency stops.
The length of the XSYSTEM cable (1.8 m) and the length of the Front Panel extension cable (3 m) should also be considered when choosing an installation location. If you need to extend the Front Panel beyond the supplied cable distance, contact your local OMRON representative for more information.

⚠ DANGER

Any High Power push-buttons must be installed outside of the robot's workspace.



Front Panel Connections

The Front Panel is connected directly to the XFP connector on the XSYSTEM cable with the 3 m extension cable supplied with the Front Panel.

- The part number of the extension cable is 10356-10500.
- The length of the extension cable is 3 m.

Additional Information

Refer to *XFP Connections* on page 3-38 for more information.

3-9-2 Safety Circuits

The XSYSTEM cable provides connections for all emergency stop circuits. All emergency stop circuits are dual-channel and voltage-free. 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.

The XUSR connector provides access to the following safety circuits.

- Dual channel emergency stop inputs.
- Dual channel emergency stop status outputs.
- Dual channel muted safety gate inputs.
- Dual channel Automatic / Manual mode status outputs.

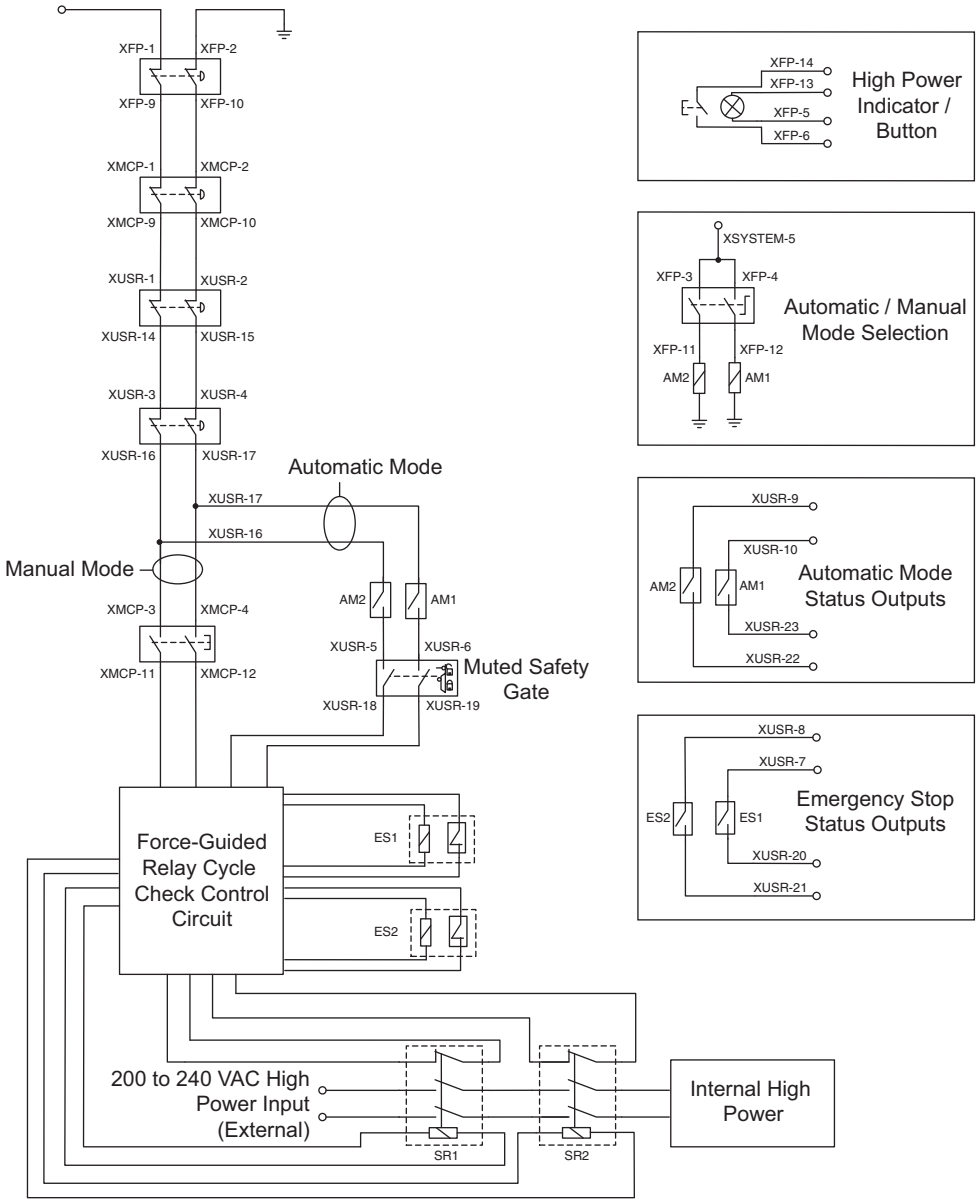
The XFP connector provides access to the following safety circuits that are typically used with the Front Panel.

- Dual channel emergency stop inputs.
- Dual channel Automatic / Manual mode selection inputs.
- High power indicator output.
- High power enable input.
- Control power indicator output.

The XMCP connector provides access to the following safety circuits that are use with a connected Teach Pendant.

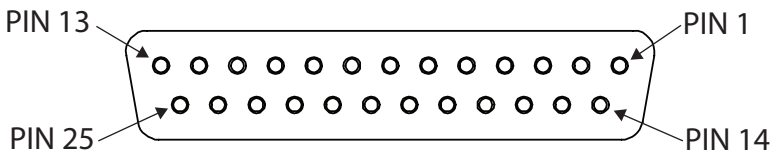
- Dual channel E-stop button inputs.
- Dual channel pendant enable switch inputs.

Use the diagram below to understand safety circuits.



XUSR Connections

Use the information in the following table to understand the signals provided on the XUSR connector.

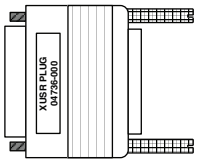


Pins	Description	Additional Information
1, 14	Emergency stop channel 1 input	Typically connected to normally closed contacts on user-supplied safety devices such as E-stop buttons, safety switches, or safety relays.
2, 15	Emergency stop channel 2 input	

Pins	Description	Additional Information
3, 16	Line emergency stop inputs	Normally closed contacts on user-supplied safety devices typically used for other robot or line emergency stop interconnection. This does not affect emergency stop indication signals on pins 7, 20.
4, 17		
5, 18	Muted safety gate channel 1 input	Causes emergency stop in Automatic mode only.
6, 19	Muted safety gate channel 2 input	
7, 20	Emergency stop status channel 1 output	Internal contacts are closed when Front Panel, Teach Pendant, and user-supplied safety devices are not enabled / activated.
8, 21	Emergency stop status channel 2 output	
9, 22	Automatic mode status channel 1	Internal contacts are closed when the robot is in automatic mode.
10, 23	Automatic mode status channel 2	
11, 12, 13, 24, 25	Reserved for future use.	

● XUSR Jumper Plug

The XUSR jumper plug is provided for safety equipment troubleshooting only.



⚠ WARNING

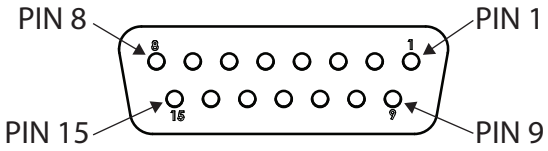
Never run a robot system with all jumpers installed. This would leave the system with no E-Stops.

Additional Information

The XUSR jumper plug is supplied with the robot.
The part number for the XUSR jumper plug is 04736-000.

XFP Connections

Use the information in the following table to understand the signals provided on the XFP connector.



Additional Information

Refer to *Front Panel Connections* on page 3-36 for more information.

Pins	Description	Additional Information
1, 9	Front panel E-stop button channel 1 input	Typically connected to normally closed contacts on the E-stop button used with the Front Panel.
2, 10	Front panel E-stop button channel 2 input	
3, 11	Automatic / Manual mode selection channel 1 input	Typically connected to the selector switch used with the front panel. An open circuit selects Manual mode. A closed circuit selects Automatic mode.
4, 12	Automatic / Manual mode selection channel 2 input	
5, 13	System-supplied 5 VDC output (pin 5) and common (pin 13) for High Power indicator lamp.	If lamp is user-supplied, it must draw between 10 mA to 500 mA to satisfy the internal High Power lamp monitoring function.*1
6, 14	High Power ON / OFF	Typically connected to a momentary push-button that enables High Power when all safety circuits are satisfied.
7, 15	System-supplied 5 VDC output (pin 7) and common (pin 15) for Control Power indicator.	If indicator is user-supplied, the recommended load is between 20 to 500 mA.
8	Reserved for future use	

*1. Lamps that illuminate with a low current (10 mA to 25 mA) may appear dim when the High Power is OFF due to leakage current. If this occurs, add additional resistance to ensure the lamp is OFF when High Power is not enabled.

● XFP Wiring Diagram

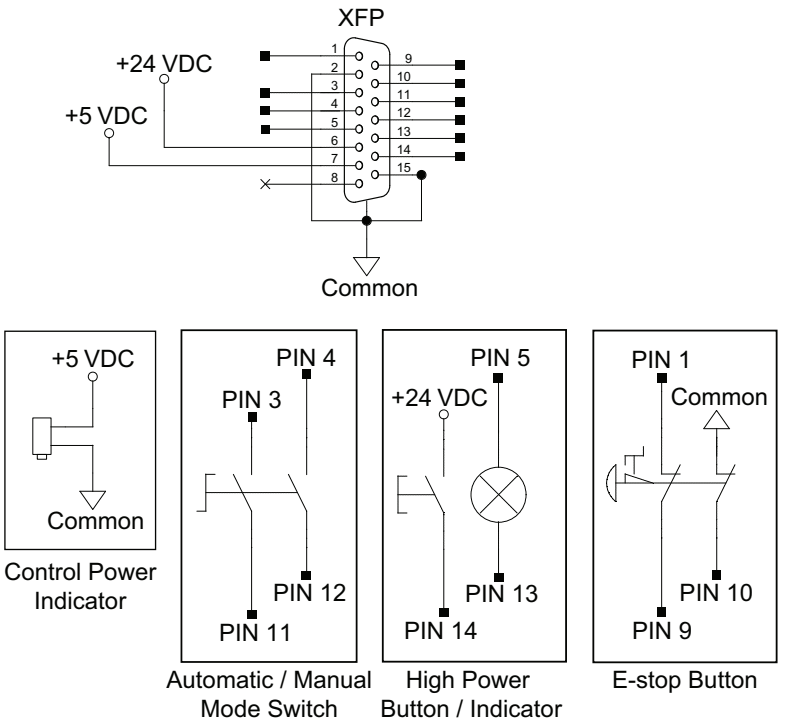
Use the following diagram to understand XFP electrical connections.

⚠ WARNING

If you supply your own Front Panel E-Stop, its design must comply with the requirements of IEC 60204-1 and ISO 13849. The E-Stop's push button must comply with ISO 13850.

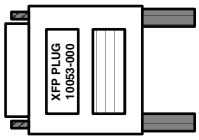
Precautions for Correct Use

Do not disable or bypass the High Power button. This will violate IEC 60204-1.



● XFP Jumper Plug

The XFP jumper plug is provided for safety equipment troubleshooting.



⚠ WARNING

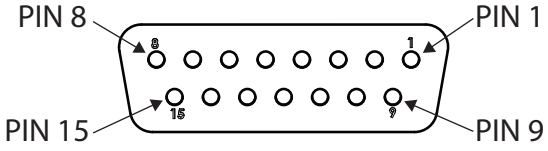
Never run a robot system with all jumpers installed. This would leave the system with no E-Stops.

Additional Information

- The XFP jumper plug is supplied with the robot.
- The part number for the XFP jumper plug is 10053-000.

XMCP Connections

Use the information in the following table to understand the signals provided on the XMCP connector.



Additional Information

Refer to the *T20 Pendant User's Manual (Cat. No. I601)* for additional information.

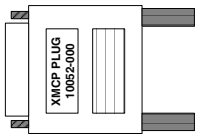
Precautions for Correct Use

If Teach Pendant cabling is installed, the jumper plug or the Teach Pendant must be connected to satisfy safety circuits and allow High Power to be enabled.

Pins	Description	Additional Information
1, 9	Pendant E-stop button channel 1	Connected to the pendant's integrated E-stop button.
2, 10	Pendant E-stop button channel 2	
3, 11	Pendant enable switch channel 1	Connected to the pendant's integrated enable switch.
4, 12	Pendant enable switch channel 2	
6	24 VDC pendant supply	
7	Serial communications TXD	Pendant serial communications transmit signal.
8	Serial communications RXD	Pendant serial communications receive signal.
13	Serial communications GND	Pendant serial communications ground signal.
Shield	Ground shield	
5, 14, 15	Reserved for future use.	

● XMCP Jumper Plug

The XMCP jumper plug is used when there is no T20 pendant adapter cable connected.



⚠ WARNING

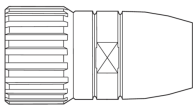
Never run a robot system with all jumpers installed. This would leave the system with no E-Stops.

Additional Information

- The XMCP jumper plug is supplied with the robot.
- The part number for the XMCP jumper plug is 10052-000.

● Teach Pendant Jumper Plug

The Teach Pendant jumper plug is provided to allow the system to operate when Teach Pendant cabling is installed, but the Teach Pendant is not connected. This plugs into the Teach Pendant adapter cable when the pendant is not in use.



Additional Information

- The jumper plug is supplied with the Teach Pendant kit.
- The part number for the Teach Pendant jumper plug is 10048-000.

3-10 Supplying Power and Ground

The robot requires separate 24 VDC and 200-240 VAC power supplies. The DC supply provides Control Power and the AC power supply provides power to the internal servo amplifiers for High Power. The end-user shall install a branch rated overcurrent protection. There must be a branch rated overcurrent protection on both the 200-240 VAC circuit, as well as the 24 VDC circuit.
A lockout tagout main disconnect device must be installed on the AC supply to the 24 VDC and also on the 200-240 VAC power supply. These devices are user-supplied. Disconnect devices shall be accessible and conveniently located to facilitate application of lockout devices during service and maintenance.
Use the information below to make all power supply connections to the robot.

Additional Information

Refer to *2-3-1 Power Supply Specifications* on page 2-14 for information about power supply requirements and other wiring details.

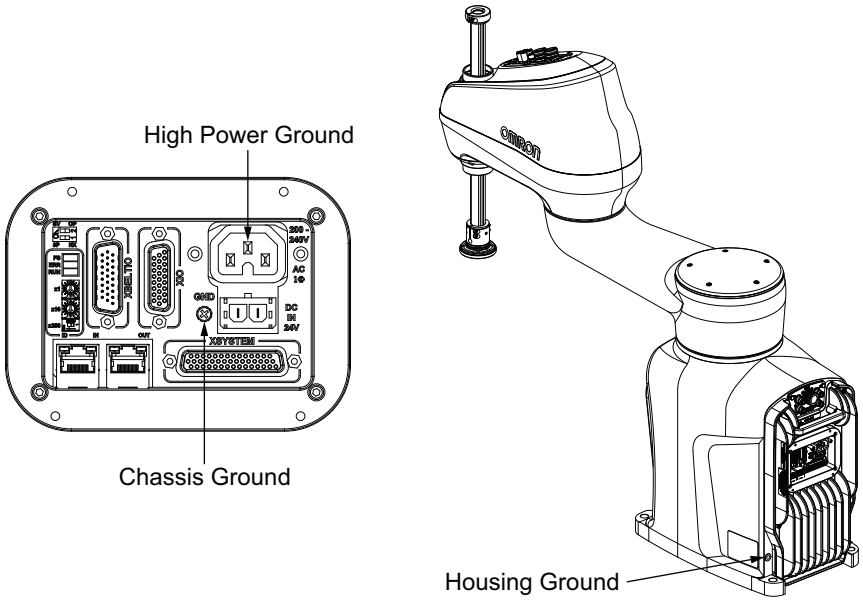
3-10-1 Grounding the System

The system should be grounded properly to avoid transient voltages or other electrical noise. There are three ground points on the system as described below.

- High Power ground
- Chassis ground
- Housing ground

Precautions for Safe Use

The Joint 3 quill and the tool flange are not grounded to protective earth. 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.

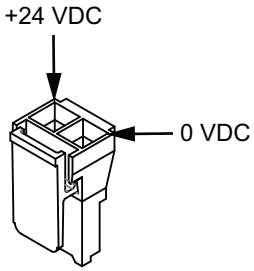


3-10-2 DC Connections

The 24 VDC Control Power connector is located on the Primary Interface Panel
Use the illustration below to understand the polarity of the mating connector.

Additional Information

A connector and pins are included with the robot. The part number for this assembly is 22822-200.

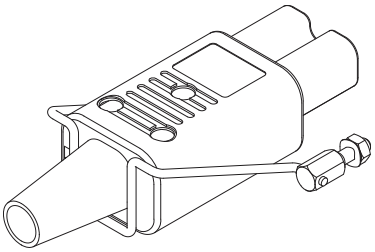


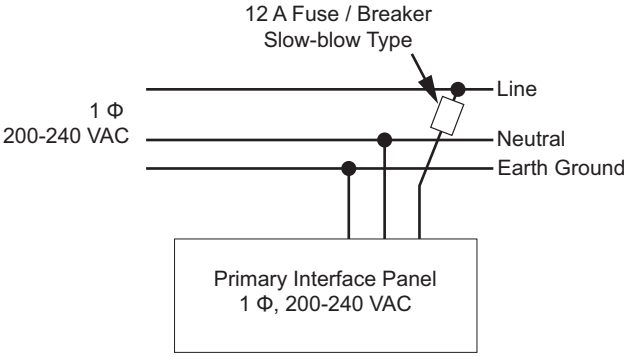
3-10-3 AC Connections

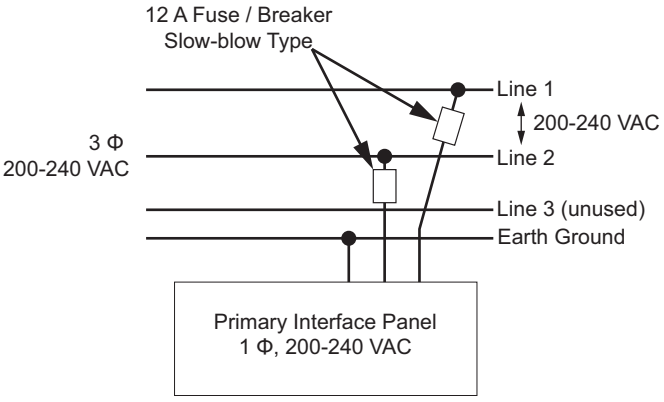
The 200-240 VAC High Power connector is located on the Primary Interface Panel.
Use the illustrations below to understand the AC connections for single and three-phase power sources.
A retaining clip is provided to secure the High Power connector to the Primary Interface Panel. To install this retaining clip, insert the posts into the Primary Interface Panel, align the holes horizontally, and then insert the retaining clip by squeezing it and then placing it into the post holes. Posts may need to be adjusted to ensure a tight High Power connector fit.

Additional Information

A connector, pins, and retaining clip are included with the robot. The part number for this assembly is 22822-100.







3-11 Verifying Installation

If any modifications have been made to the robot during installation or other actions, make the following checks before operation.

3-11-1 Mechanical Checks

Make the following mechanical checks after any hardware adjustments have been made to the system.

- Check that the robot mounting surface is secure and adequate.
- Check all mounting bolts and other fasteners for proper torque.
- Check the tool flange and end-of-arm tooling for correct installation and grounding (when necessary).
- Check any equipment that is mounted to the robot to make sure it is securely fastened.

3-11-2 System Cable Checks

Make the following system cable checks after any adjustments have been made to cable connections.

- Check all cables and connectors to ensure that they are securely fastened and free of damage.
- Check the system ground and power supply connections to make sure that they are connected properly.
- Check that all cables are adequately supported and not strained near the connectors.

3-11-3 Safety Equipment Checks

Make the following checks to all user-supplied safety equipment to ensure emergency stops are properly installed and other safety systems are functioning correctly.

When checking safety equipment, the following prerequisites are necessary.

- The ACE Software must be installed and available.
- The Front Panel operating mode switch must be in the Automatic position.
- All emergency stop devices must be able to be activated and deactivated easily.

Use the following utilities in ACE Software to confirm safety operations controlled by robot software.

Safety Setting Function	Description
Configure Teach Restrict	The objective of the Teach Restrict feature is to comply with safety regulations which require that the speed be limited while the robot is in Manual mode. This is hardware-based safety functionality to prevent rapid robot motion in Manual mode even in the unexpected event of software error attempting to move a robot faster than allowed. While jogging the robot in Manual mode, if any joint exceeds its configured speed limit, the system will disable High Power. Configuration will set predetermined speed limits for each robot motor. Verification will verify that Teach Restrict operations are functioning properly in Automatic and Manual modes.
Verify Teach Restrict Auto	
Verify Teach Restrict Manual	

Safety Setting Function	Description
Configure E-stop Hardware Delay	The objective of the ESTOP hardware delay feature is to comply with safety regulations which require the robot to have the capability of disabling High Power without software intervention in an emergency stop situation. Configuration will set the delay for the emergency stop timer circuit. Verification will verify that High Power is disabled without software intervention in an emergency stop situation.
Verify E-stop Hardware Delay	

Additional Information

Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information about using the Safety Setting functions.

Emergency Stop Check Procedure

Use the following procedure to check for correct emergency stop operation.

1. If a pendant is present in the system, connect it to the XSYSTEM cable.
2. Prepare all emergency stop devices for enabling the robot High Power.
3. Enable the robot High Power with one of the methods described in *4-4-1 Robot High Power Operations* on page 4-6.
4. Confirm that robot High Power is enabled using the High Power indicator. If robot High Power is not enabled, refer to *Section 5 Troubleshooting* on page 5-1 for more information.
5. If XUSR emergency stop status outputs are being monitored by other equipment, confirm that the signal state transition is detected properly.
6. Activate each and every emergency stop device connected to the system to check that High Power is disable for all safety equipment. This includes pendant safety devices, Front Panel safety devices, and any other safety equipment wired to the XUSR connector. After one safety device check is made, deactivate it, enable High Power again, and make a check for the next safety device. Repeat 2 to 5 until all safety device functionality is confirmed to be working properly to complete this procedure.

High Power Indicator Check

The robot monitors current used by the High Power indicator. This is to ensure that a High Power indicator device is connected and functioning properly to satisfy safety requirements.
If the robot does not detect a current between 10 mA to 500 mA when High Power is requested, an error condition (-924) *Front panel HIGH POWER lamp failure* will be present and High Power will not be enabled.
The High Power indicator needs to be periodically checked for correct functionality.
The following considerations should be made before beginning the High Power indicator check procedure.

- Control power and High Power supplies need to be available.

- All connected safety devices must be capable of providing signals for a safe state.
- The robot High Power needs to be disabled and robot motions will not execute during this procedure.
- High Power safety timeout must be enabled to allow the indicator to flash after a High Power request is made. The recommended setting is 10 seconds. Refer to *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information.

● High Power Indicator Check Procedure

Use the following procedure to verify that the High Power indicator is working correctly.

1 Apply Control Power to the robot and disable High Power.

2 Make a High Power request using one of the methods described in *High Power Control Methods* on page 4-7.

3 Check that the High Power indicator flashes. After the High Power request is made and the indicator is checked, the procedure is complete.

3-11-4 Switch Position Checks

Switch positions on the Primary Interface Panel are reserved for future use and do not impact functionality of the robot.

4

Operation

This section provides information necessary to operate the robot.

4-1 Connecting to the Robot 4-2
4-1-1 Initial Connection Procedure 4-2
4-2 Payload and Acceleration Considerations 4-3
4-3 Robot Control Modes 4-4
4-3-1 Manual Mode 4-4
4-3-2 Automatic Mode 4-4
4-4 Enabling and Disabling the Robot 4-6
4-4-1 Robot High Power Operations 4-6
4-5 LED Light Ring 4-8
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4-7 Brake Operation 4-10
4-7-1 Built-in Brake Release Button 4-10
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4-9-1 Joint Zero Position 4-13
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4-1 Connecting to the Robot

Use the information in this section to establish a connection to the robot with the ACE software. Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information.

The following conditions must be present before attempting to connect to the robot.

- ACE software must be installed on the PC.
- The robot must be completely installed with all safety equipment connected and verified.
- 24 VDC Control Power must be supplied to the robot.
- An Ethernet network must be available and connected to the robot and the PC.

4-1-1 Initial Connection Procedure

Use the procedure below to detect and connect to a robot controller.

1 After starting the ACE software, click the **Connect to Device** item. If the robot controller appears in the Detected Controller IP Address area, select it and click the **Connect** Button. This will initiate the online connection process. If no controller appears in this area, proceed to the next step.

2 To find a robot controller on the Ethernet network, click the **Detect and Configure Robotic Controller** Button. This will open the Controller IP Address Detection and Configuration Dialog Box.

In this area, a detected controller's properties can be modified to establish an online connection.

If a controller is detected but resides on a different LAN and does not have a gateway configured, an online connection is not possible until one of the following actions are taken.

- The detected controller's IP address and / or subnet is changed for compatibility with the PC's LAN connection. Select the detected controller and change the Desired Properties Address, Subnet, and Name accordingly.
- The PC's IP address and LAN connection are changed to be compatible with the controller's network settings. Adjust the PCs network adapter properties accordingly.

Precautions for Correct Use

If no controller(s) is detected, check the Ethernet network and cables and ensure that a network connection is available to the robot and the PC.

3 After the desired robot controller appears with the proper network settings, click the **Connect** Button to establish a connection and complete this procedure.

4-2 Payload and Acceleration Considerations

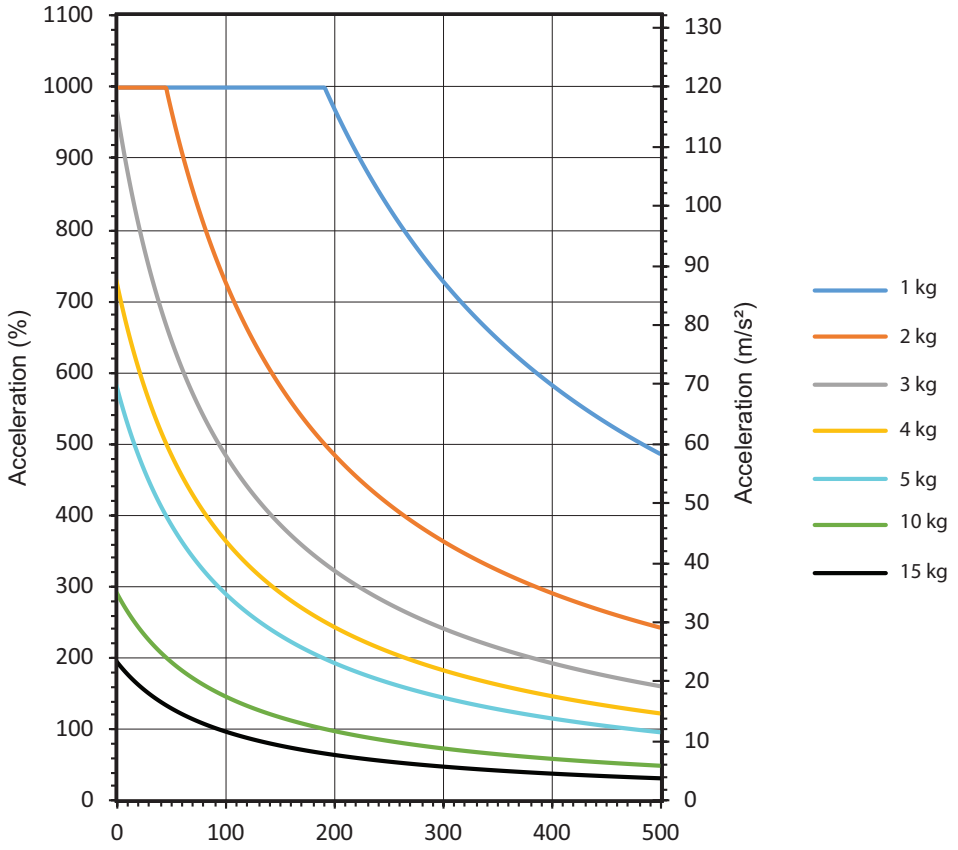
Careful considerations must be made when using high payloads, high accelerations, or a combination of both.

Use the following diagrams to understand the limitations to acceleration and payload.

Precautions for Correct Use

Operating the robot outside of the payload and speed constraints described in this document can damage the z-axis quill of the robot.

Payload Z-Location vs. Acceleration at 100% Speed
(Linear Moves Only)



Payload Z-Location (mm) = Joint 3 Position + Payload Center of Gravity

4-3 Robot Control Modes

The robot can operate in Automatic or Manual control modes. These modes are described in the following sections.

4-3-1 Manual Mode

Manual mode is typically used during functions of commissioning, position teaching, and other setup operations. In this mode, the robot will respond to the control signals issued by the connected pendant.
When the robot is placed in Manual mode, robot motion speed is limited to 250 mm/sec and servo torque is limited so an operator can safely work inside the cell. Programs can execute from the pendant in STEP mode.

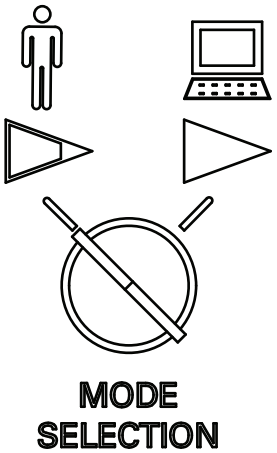
Precautions for Safe Use

- After the robot is placed in Manual mode using the Front Panel key switch, the key should be removed for safety purposes.
- During manual operation, ensure all persons are a safe distance away from the robot workspace.

Additional Information

Refer to the *T20 Pendant User's Manual (Cat. No. I601)* for more information.

To place the robot in Manual mode, use the Front Panel key switch and rotate it to the left position as indicated below. Changing the robot control mode will automatically disable High Power.



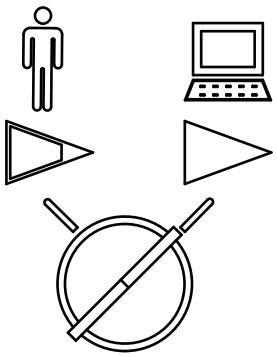
4-3-2 Automatic Mode

Automatic mode is used when the robot is operating under normal conditions.
When the robot is placed in Automatic mode, program execution will control the robot up to the maximum speed.

Precautions for Safe Use

Prior to placing the robot in Automatic Mode, all safeguards must be returned to their safe state.

To place the robot in Automatic mode, use the Front Panel key switch and rotate it to the right position as indicated below. Changing the robot control mode will automatically disable High Power.



⚠ WARNING

In Automatic mode, the robot can move unexpectedly. Ensure all personnel remain clear of the cell when Automatic mode is enabled.

4-4 Enabling and Disabling the Robot

Enabling the robot energizes all robot servo motors with the 48 VDC power supply. This is also referred to as enabling High Power. When the robot is enabled, it is capable of moving.
Program execution and I/O control functions are still operational when High Power is disabled. However, ATTACH or other motion commands may return errors or delay program execution if High Power is disabled. Refer to the *V+ Keyword Reference Manual (Cat. No. I672)* for more information.
Disabling the robot de-energizes all robot servo motors.

Additional Information

When High Power is enabled, the brake is automatically released. When High Power is disabled, the brake is automatically activated to prevent downward motion of the quill due to gravity.

Precautions for Safe Use

- The LED indicator does not reflect the robot's High Power status. To see the robot's High Power status, use the Front Panel indicator or a user-supplied indicator connected to the XFP connector.
- High Power cannot be enabled unless all safety circuits are satisfied.

4-4-1 Robot High Power Operations

Robot High Power operations are described below.

High Power Safety Timeout

If the safety timeout function is enabled in the robot configuration, the High Power indicator on the Front Panel will flash for a specified amount of time after a High Power request is made. If the High Power button is not pressed within the specified amount of time, a safety timeout occurs and High Power is not applied.
The safety timeout function is enabled by default and has a duration set for 10 seconds. The safety timeout function configuration settings are accessed with the ACE Software. Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information.

Precautions for Correct Use

If a Front Panel is not present, the High Power indicator and High Power button signals can be accessed with the XFP system cable connector. Refer to *XFP Connections* on page 3-38 for more information.

High Power and Faults

If a fault is present, the robot will not enter the High Power state.
The AUTO.POWER.OFF system switch controls if the robot prevents or disables High Power for specific errors. Refer to the *V+ Keyword Reference Manual (Cat. No. I672)* for more information.

High Power Control Methods

There are several methods to control robot High Power as described below.

● Front Panel

When a Front Panel is present in the system, the High Power button can be used to request High Power to the robot.

If High Power is enabled, pressing the button will disable High Power.

Additional Information

Refer to *Front Panel Connections* on page 3-36 for more information about connecting external devices to the High Power enable signal on the XFP connector.

● Connected PC

High Power can be controlled with the ACE software. Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* more information.

● User Program

High Power can be controlled with a user program through the use of the POWER system switch keyword. Refer to the *V+ Keyword Reference Manual (Cat. No. I672)* for more information.

● Pendant

If a pendant is connected to the robot, it can be used to control High Power. Refer to the *T20 Pendant User's Manual (Cat. No. I601)* for more information.

● Faults and Emergency Stops

Robot faults and E-stop open circuit detection will disable High Power.

4-5 LED Light Ring

The LED light ring indicator around Joint 1 of the robot provides a visual status of the robot. The LED indications and associated robot states are described below.

Precautions for Safe Use

The LED ring does not reflect the robot's High Power status. To see the robot's High Power status, use the Front Panel indicator or a user-supplied indicator connected to the XFP connector.

LED Indication	Robot State
OFF	Control Power is not present.
Solid White	The robot is initializing.
Solid Blue	The robot is booting.
Slow Flashing Blue (0.25 Hz)	The robot is in an idle state with no errors present.
Fast Flashing Green (1 Hz)	The robot is in a normal operating state while in Automatic mode.
Slow Flashing Green (0.25 Hz)	The robot is in a normal operating state while in Manual mode.
Fast Flashing Red (1 Hz)	The robot is in an error state from an emergency stop or other condition.
Solid Red	The robot has a system error.

4-6 LCD Display

The LCD display on the robot base provides messages for robot status and any error codes that may be present.

4-6-1 LCD Display Status Messages

The following messages can be shown on the LCD display when there are no errors present.
When an error is present, the LED light ring will flash red at 1 Hz and an error code will be shown on the LCD display. Refer to *5-3 Error Messages* on page 5-4 for more information about error codes.

Message	Description
OMRON logo	The robot is booting after Control Power is applied.
OK	The robot is in an idle state with no errors present.
ON	The robot is in a normal operating state while in Automatic mode.
MA	The robot is in a normal operating state while in Manual mode.

4-7 Brake Operation

The robot has a mechanical brake on joints 3 and 4. Releasing the brake is typically done when you need to manually position joint 3 or 4. The brake is controlled with the methods described below.
The mechanical brake is capable of preventing the z-axis quill from lowering more than 5 mm when up to 340 N of downward force is applied.

⚠ WARNING

Releasing a brake may cause the quill, tool flange, end-effector, and payload to drop. To prevent possible injury to personnel or damage to the equipment, make sure that the equipment is supported when releasing the brake and verify that the end-effector and payload are clear of all obstructions.

Precautions for Safe Use

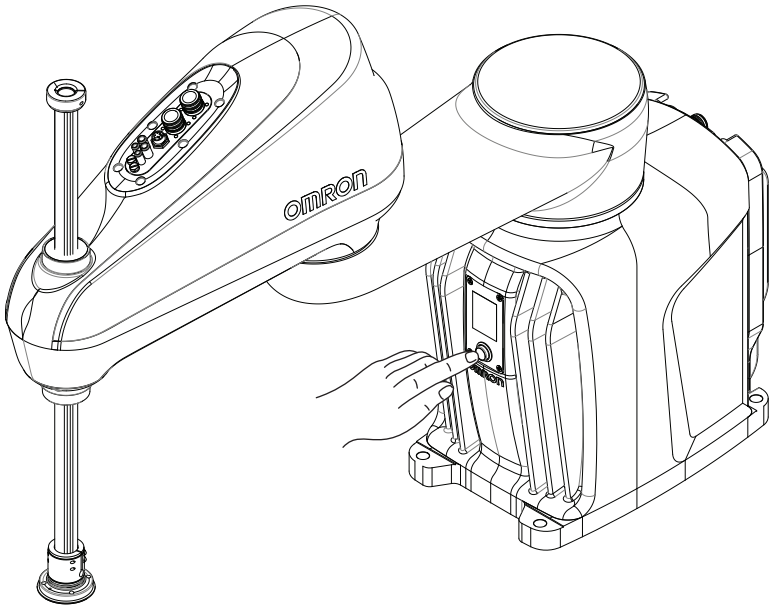
- The braking mechanism operates passively. If 24 VDC Control Power is removed from the system, the brake mechanism will automatically activate. 24 VDC Control Power must be supplied to release the brake. To prevent possible damage to the equipment, remove any payload from the end-of-arm tooling, make sure that Joint 3 is supported while releasing the brake, and verify that the end-of-arm tooling or other installed equipment is clear of all obstructions.
- In case of entrapment of a person by the robot or any other emergency or abnormal situation, you can manually move the inner and outer links to a safe position while High Power is disabled. A brake device prevents Joints 3 and 4 from moving when High Power is disabled and can only be released while 24 VDC Control Power is present.

Precautions for Correct Use

- Attempting to release the brake while High Power is ON will automatically disable High Power. If the robot is moving, this will cause it to stop abruptly.
- Robot joints 1 and 2 have no brake mechanism and can be manually moved when power is not present.
- Avoid rotating the quill / Joint 4 when the brake is released. This could result in an out-of-range condition and may prevent program execution.

4-7-1 Built-in Brake Release Button

The brake release button is located on the front of the base of the robot, near the LCD display. Pressing this button while the 24 VDC control power is ON and High Power is disabled will release the brake. The brake will remain released while the button is pressed. Releasing the button will re-enable the brake.



4-7-2 Remote Brake Release

The brake can be released with a signal connected to the XIO connector. This is typically used for remote control of the brake.

Use the ACE Software to configure the robot by selecting Enable Brake Release Input. This setting will change the XIO input 6.2 (pin 18) for use as a brake release signal from another device such as a remote pushbutton or an output from another control device. This setting does not affect the normal functionality of the brake release button.

Additional Information

Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information about the Enable Brake Release Input robot configuration item.

Precautions for Safe Use

To comply with ISO 10218-1 when using a remote brake release button, ensure the brake release button displays a warning label to indicate that the z-axis of the robot may fall due to gravity if the brake is released.

4-8 Manually Jogging the Robot

Manually jogging the robot is typically performed during setup or when teaching locations.

Precautions for Safe Use

During manual operation, ensure all persons are a safe distance away from the robot workspace.

The following considerations should be made when jogging the robot.

- The jog speed and accelerations of the robot are reduced from normal operating speeds and accelerations.
- The jog speed of the robot can be adjusted.
- Robot motion can be incremented by specified amounts when extra precision is needed.
- Jogging can be executed in world, tool, or joint modes.
- The robot can be manually jogged with software or a pendant. Refer to the *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* or the *T20 Pendant User's Manual (Cat. No. I601)* for more information.
  - The robot can be jogged with the pendant while in Automatic mode or in Manual mode.
  - The robot can be jogged with the software while in Automatic mode. If the pendant is connected, it must be set to COMP to allow the software to jog the robot.

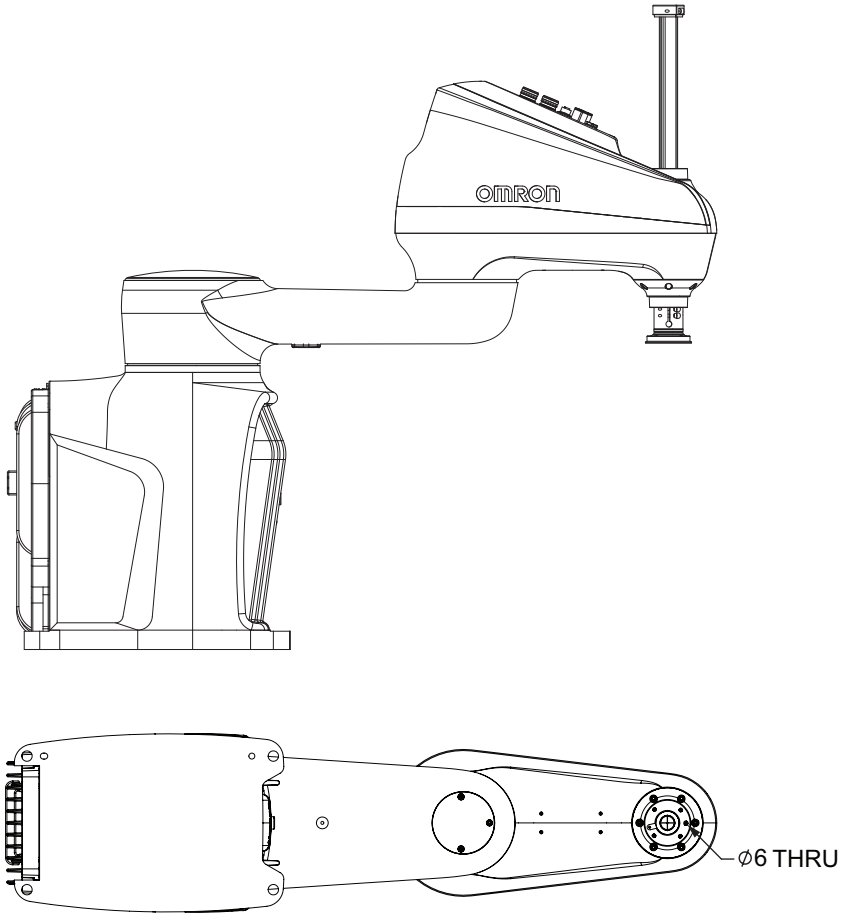
4-9 Robot Positioning

The information in this section describes important robot positions for typical operation.

4-9-1 Joint Zero Position

When the robot is properly calibrated and positioned at a precision point that consists of all zeros, the robot will have the following orientation.

- The inner link and outer link are fully extended.
- The quill is retracted in the up position.
- The 6 mm through hole on the tool flange is at the position shown below.



4-9-2 Ready Position

Use the READY keyword to place the robot in the ready position. Refer to the *V+ Keyword Reference Manual (Cat. No. I672)* for more information.

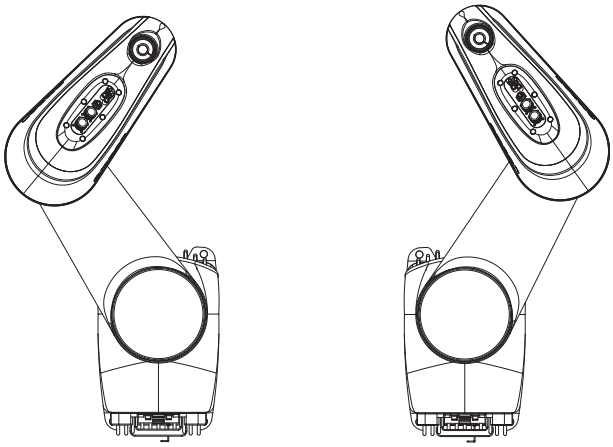
Ready positions provided below may vary slightly due to nulling tolerances.

Model	Joint 1 Position	Joint 2 Position	Joint 3 Position	Joint 4 Position
i4-650H	-32.86°	80.58°	10.00 mm	47.72°
i4-750H	-48.19°	96.38°	10.00 mm	48.19°
i4-850H	-45.15°	109.95°	10.00 mm	63.90°

4-9-3 Right-Left Arm Configurations

The robot can operate in a left-arm or right-arm configurations. Select an appropriate configuration for the work area based on your application requirements.

Use the RIGHTY/LEFTY keywords to set an arm configuration. Consider specifying the arm configuration before moving the robot to transformation locations. Moves to precision points are not affected by arm configurations because these points are unique joint positions. Refer to the *V+ Keyword Reference Manual (Cat. No. I672)* for more information.



Left Arm Configuration

Right Arm Configuration

5

Troubleshooting

This section provides robot troubleshooting information.

5-1 Fault Detection 5-2
5-2 Emergency Stop Troubleshooting 5-3
5-3 Error Messages 5-4

5-1 Fault Detection

Robot faults can be detected with the following methods.

- Create a V+ program to change the state of an output signal when a fault is present. Refer to the *V+ User's Manual (Cat. No. I671)* for more information.
- Use the LED light ring and LCD display to visually see when a fault is present.

5-2 Emergency Stop Troubleshooting

If the emergency stop circuit is not operating as expected, the following supplied jumper plugs can be used to troubleshoot the problem. These jumpers can be placed on the XSYSTEM cable to bypass and isolate safety devices. Refer to *3-6-1 System Cable Overview* on page 3-22 for jumper installation locations.

- XFP jumper plug (part number 10052-000)
- XUSR jumper plug (part number 04736-000)
- XMCP jumper plug (10052-000)

⚠ WARNING

Never run a robot system with all jumpers installed. This would leave the system with no E-Stops.

5-3 Error Messages

The following table lists robot error messages.

Additional Information

Other system messages may be present. Use the ACE Software to check for these messages. If errors persist, contact your local OMRON representative.

Error Message	Explanation	Corrective Action
24	24 VDC power fault. The 24 VDC input voltage is out of range.	Check connections and voltage level from the user-supplied 24 VDC power supply.
A#	Amplifier fault where # represents the associated joint number.	Check user motor power connections for shorts or opens. Turn High Power back on and restart the program.
AC	AC power fault.	Check connections and voltage level from the user-supplied AC power supply.
B#	IO Blox communication error where # represents the associated IO Blox unit.	Check IO Blox connections for shorts or opens. Check IO Blox address switches for proper configuration. Cycle power to the control system.
BA	The encoder backup battery voltage is low.	Replace the backup encoder batteries.
D#	Duty cycle exceeded where # represents the associated joint number.	Reduce the speed or acceleration for the motion that was in progress when the error occurred.
E#	Encoder fault where # represents the associated joint number.	Use the ACE Software to get the failure message for more information.
ES	Emergency stop detected by the robot.	Check safety devices connected to the robot for an emergency stop condition.
FM	Firmware mismatch.	Contact your local OMRON representative.
h#	Amplifier high temperature where # represents the associated joint number.	Try slowing the motion or insert pauses. Check for excessive ambient temperature, inadequate ventilation, and proper function of any cooling fans.
H#	Encoder high temperature where # represents the associated joint number.	Reduce robot speed, acceleration or deceleration, or introduce delays in the application cycle to reduce heat accumulation.
hV	High DC bus voltage fault. The high DC bus voltage is out of range.	This can be cause when AC power is abruptly removed. Check AC connections.
I#	Initialization state where # represents the step number.	If this code persists longer than 30 seconds, an initialization failure has occurred. Contact your local OMRON representative for support.
M#	Motor stalled where # represents the associated joint number.	Check for obstacles and free movement of all joints.
NV	Non-volatile memory fault.	Contact your local OMRON representative for support.
P#	Power system fault where # represents the code number.	Contact your local OMRON representative for support.

Error Message	Explanation	Corrective Action
PR	Processor overloaded. A servo task has overrun its allotted execution window.	Contact your local OMRON representative for support.
RC	RSC fault. There is a failure to communicate with the Robot Signature Card.	Contact your local OMRON representative for support.
SW	Watchdog timeout.	Contact your local OMRON representative for support.
S#	Safety system fault where # represents the code number.	Contact your local OMRON representative for support.
T#	Safety system fault where # represents the code 10 + #.	Contact your local OMRON representative for support.
TR	The safety system is not commissioned.	Commission and verify the Teach Restrict.
V#	Hard envelope error where # represents the associated joint number. The indicated motor was not tracking the commanded position with sufficient accuracy as set by the ACE Software.	Retry the motion at a slower speed. Ensure nothing is obstructing the robot motion.

6

Maintenance

This section provides information on the maintenance of the i4H robot.

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6-1-3 Checking Fastener Torques 6-4
6-1-4 Checking Safety and Warning Labels 6-4
6-1-5 Checking for Oil Leaks 6-4
6-1-6 Lubricating Joint 3 6-4
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6-1 Periodic Maintenance

This section lists when to perform periodic maintenance on your robots and the steps for checking each item to inspect.

⚠ WARNING

- Never connect or disconnect system cables while power is applied to the robot. Failure to comply may cause unexpected behavior and can result in personnel injury and equipment damage.
- You must perform the Lockout and Tagout procedure prior to servicing the robot.
- The procedures and replacement of the parts mentioned in this manual must be performed only by the skilled or instructed persons.
- The access covers on the robot are not interlocked. You should turn OFF and disconnect the power before the covers of the robot are removed.

6-1-1 Periodic Maintenance Overview

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

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

Item	Period	Reference
Check all installed safety equipment	6 months	*3-11-3 Safety Equipment Checks* on page 3-46
Check fastener torques	3 months	*6-1-3 Checking Fastener Torques* on page 6-4
Check safety labels	1 week	*6-1-4 Checking Safety and Warning Labels* on page 6-4
Check High Power indicator operation	1 week	*High Power Indicator Check* on page 3-47
Check for signs of oil around of harmonic drive area	3 months	*6-1-5 Checking for Oil Leaks* on page 6-4
Lubricate Joint 3 (Z-axis) ball screw	150 km of linear travel, or every 3 months (whichever comes first)*1	*6-1-6 Lubricating Joint 3* on page 6-4
Replace encoder backup batteries	2 years or as needed (whichever comes first)	*6-1-7 Replacing Encoder Batteries* on page 6-6
Harmonic Drive Oil Change (Joint 1 and Joint 2 Harmonic Drives)	12 months	*6-1-8 Harmonic Drive Oil Change* on page 6-7
Clean the exterior of the robot	as needed	*6-1-9 Cleaning the Robot* on page 6-8
Bellows inspection	1 week	*6-1-10 Bellows Inspection* on page 6-8

*1. 150 km of linear travel is approximately 2 weeks if a robot is operating 24 hours per day for 7 days per week.

6-1-2 Checking Safety Functions

All safety devices in the system should be checked regularly for proper functionality. Operating any of the following safety devices should disable robot high power.

- E-stop button(s) on the Front Panel or connected to the XSYSTEM cable.
- E-stop button and enabling switch on the pendant (if connected).
- Auto/manual switch on the Front Panel.
- All other safety devices connected to the XSYSTEM cable.

Precautions for Safe Use

The high power indicator must be operational to satisfy safety requirements.

Additional Information

Refer to *3-11-3 Safety Equipment Checks* on page 3-46 for more information.

High Power Indicator Check

The robot monitors current used by the High Power indicator. This is to ensure that a High Power indicator device is connected and functioning properly to satisfy safety requirements.
If the robot does not detect a current between 10 mA to 500 mA when High Power is requested, an error condition (-924) *Front panel HIGH POWER lamp failure* will be present and High Power will not be enabled.
The High Power indicator needs to be periodically checked for correct functionality.
The following considerations should be made before beginning the High Power indicator check procedure.

- Control power and High Power supplies need to be available.
- All connected safety devices must be capable of providing signals for a safe state.
- The robot High Power needs to be disabled and robot motions will not execute during this procedure.
- High Power safety timeout must be enabled to allow the indicator to flash after a High Power request is made. The recommended setting is 10 seconds. Refer to *Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)Automated Control Environment (ACE) Version 4 User's Manual (Cat. No. I633)* for more information.

● High Power Indicator Check Procedure

Use the following procedure to verify that the High Power indicator is working correctly.

1 Apply Control Power to the robot and disable High Power.

2 Make a High Power request using one of the methods described in *High Power Control Methods* on page 4-7.

3 Check that the High Power indicator flashes. After the High Power request is made and the indicator is checked, the procedure is complete.

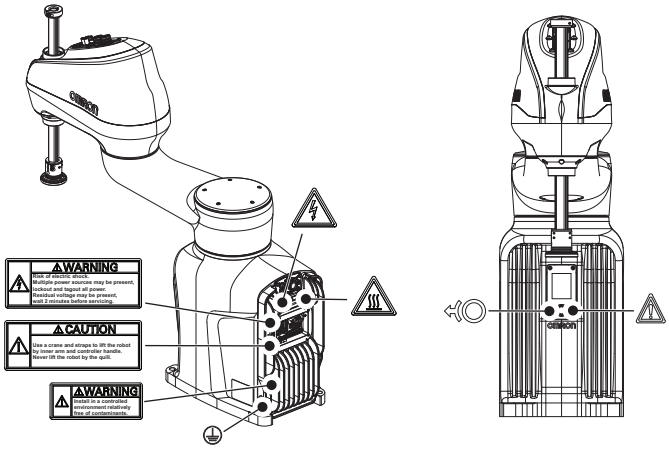
6-1-3 Checking Fastener Torques

The following fasteners must be periodically checked for proper torque.

- Mounting screws: 96 to 104 N-m
- External equipment mounting fasteners (if present): 2.5 N-m
- Cable D-sub connectors: finger tight
- Tool flange setscrew: 1.1 N-m
- Tool flange socket-head screws: 2.5 N-m
- Tool flange end-of-arm tooling mounting fasteners: 7.5 N-m
- Camera bracket mounting screws (if present): 2.5 N-m

6-1-4 Checking Safety and Warning Labels

This section lists the various safety and warning labels and their placement on the robot. Use this information to perform periodic checks to ensure the labels are not damaged and are legible.



Additional Information

The label indicates the operation of the joint 3 and joint 4 brake.

6-1-5 Checking for Oil Leaks

The robot uses oil in the harmonic drive components for lubrication. Periodically inspect the robot for any signs of oil in areas immediately outside of the harmonic drive. Check these locations:

- The area around Joint 1.
- The area around Joint 2.
- Inside the base of the robot. Refer to *Amplifier Chassis Replacement Procedure* on page 6-14 for information about about accessing the inside of the base of the robot.

6-1-6 Lubricating Joint 3

The joint 3 quill needs to be lubricated on a periodic basis of 3 months or 150 km of linear travel, whichever comes first. 150 km of linear travel is approximately 2 weeks if a robot is operating 24 hours per day for 7 days per week.

Precautions for Correct Use

Only use the recommended grease on the joint 3 quill. Refer to the provided Safety Data Sheet for proper handling.

Additional Information

If bellows are present, they must be removed before lubricating Joint 3. Refer to *3-4-4 Bellows Installation Procedure* on page 3-8 and *6-1-11 Bellows Replacement Procedure* on page 6-8 for more information.

Joint 3 Lubrication Procedure

Use the following procedure for standard grease application and food-based grease application on Joint 3 quill.

Precautions for Safe Use

The braking mechanism operates passively. If 24 VDC Control Power is removed from the system, the brake mechanism will automatically activate. 24 VDC Control Power must be supplied to release the brake. To prevent possible damage to the equipment, remove any payload from the end-of-arm tooling, make sure that Joint 3 is supported while releasing the brake, and verify that the end-of-arm tooling or other installed equipment is clear of all obstructions.

Precautions for Correct Use

Avoid rotating the quill / Joint 4 when the brake is released. This could result in an out-of-range condition and may prevent program execution.

Additional Information

- If bellows are present on the robot, they must be removed before this procedure to access the Joint 3 and then reinstalled after this procedure is complete. Refer to *6-1-11 Bellows Replacement Procedure* on page 6-8 for more information.
- Ensure there are no z-axis motion restrictions. The full operating stroke is required during this lubrication procedure.

1 Press the brake release button while moving the z-axis to the top of its stroke to expose the upper section of the quill.

2 Remove any existing grease or debris from the exposed quill with a clean, lint-free cloth.

3 Apply a small bead of grease to all grooves on the quill.

4 Press the brake release button while moving the z-axis to the bottom of its stroke to expose the lower section of the quill.

5 Remove any existing grease or debris from the newly exposed section of the quill with a clean, lint-free cloth.

6 Move the z-axis up and down to distribute the new grease. This can be accomplished manually with the brake release button or by jogging the z-axis. After this step is finished, the joint 3 lubrication procedure is complete.

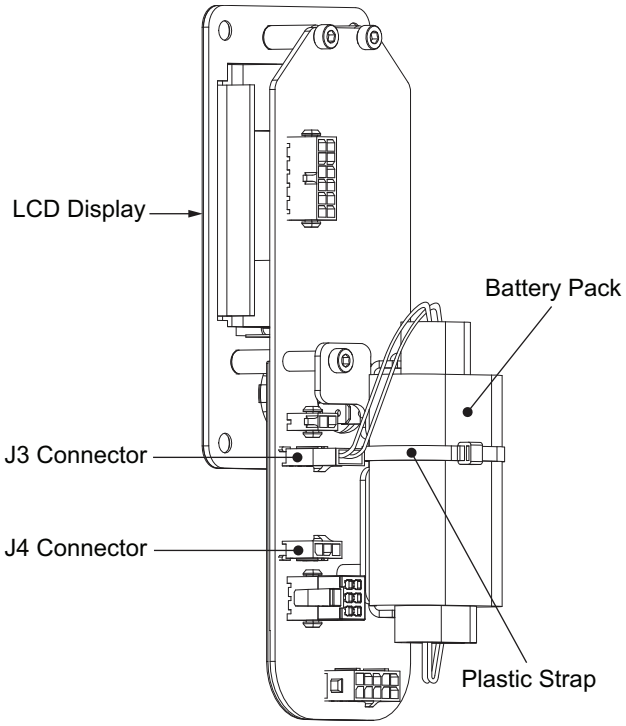
6-1-7 Replacing Encoder Batteries

Backup encoder batteries maintain joint position data stored by internal encoders. This data is protected by 3 lithium backup batteries located behind the LCD display assembly.
Encoder backup batteries need to be replaced on a periodic basis of 2 years or when a low battery error message is present.
Before beginning the replacement procedure, have the following items available.

- Cross-head screwdriver, point size #1.
- Cutter tool.
- Cable tie / plastic strap
- Loctite thread lock type 243 or equivalent.
- Replacement battery pack (part number 19238-000F).

Encoder Battery Replacement Procedure

Use the following procedure to replace encoder backup battery pack.
Voltage must be maintained during the encoder backup battery replacement procedure to preserve joint position data. There are two connectors near the battery pack. Ensure that at least one battery pack is connected at all times during this procedure.
Use the following diagram to identify items referenced during the replacement procedure.



Precautions for Safe Use

- Batteries may leak, rupture, heat, or ignite. Never short-circuit, charge, disassemble, heat, or incinerate a battery or subject it to strong shock.
- Dispose of any battery that has been dropped or otherwise subjected to excessive shock. Batteries that have been subjected to shock may leak if they are used.
- 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 designated collection facilities. For information about disposal of your old equipment, contact your local OMRON representative.

Precautions for Correct Use

Only replace items on the robot system with the parts supplied by OMRON.

1 Remove the four screws that fasten the LCD display assembly to the robot.

2 Tilt the LCD display assembly forward and carefully lift and move it away from the robot. Take care not to strain or damage the cables.

3 Plug in the new battery pack to one of the available J3 or J4 connectors.
Do not disconnect the existing battery pack until the new battery pack is plugged in.

4 Cut the plastic strap securing the old batteries to the bracket.

5 Disconnect the old battery pack from the connector.
Ensure the new battery pack is plugged in simultaneously before disconnecting the old battery pack.

6 Place the new batteries on the bracket and secure with a plastic strap / cable tie. Make sure that the excess cable is properly secured under the cable tie.

7 Re-install the LCD display assembly and secure it with the four screws that were removed in step 1 to complete this procedure.
Apply Loctite thread lock type 243 or equivalent to the screws before inserting.

6-1-8 Harmonic Drive Oil Change

The harmonic drive oil in Joint 1 and Joint 2 should be changed every 12 months. This will extend the life of the harmonic drives and ensure continued performance.

- The part number for the oil change kit is 12370-000F.
- Refer to *A-6 Parts List* on page A-12 for replacement oil part numbers.

Additional Information

Follow the procedure included with the oil change kit when changing the harmonic drive oil.

6-1-9 Cleaning the Robot

Clean the exterior of the robot as needed. Inspect the external surface of the robot frequently when used in a dirty environment.
Remove any dirt and debris from the exterior of the robot. Debris can accumulate around robot joints. Take extra effort to clean around these areas.

⚠ WARNING

Do not use organic solvents to clean any part of the robot. Organic solvents might damage electronics resulting in an unsafe operating state that could cause injury or damage to equipment.

6-1-10 Bellows Inspection

Check the bellows each week for cracks, wear, or damage and replace if necessary. Refer to the *6-1-11 Bellows Replacement Procedure* on page 6-8 for replacement and installation steps.

6-1-11 Bellows Replacement Procedure

Use the following procedure to replace bellows.

Precautions for Correct Use

Never release the z-axis brake while the quill clamp collar is loose or removed. This can allow the quill to fall out of the robot.

Additional Information

Refer to *3-4-4 Bellows Installation Procedure* on page 3-8 for more information.

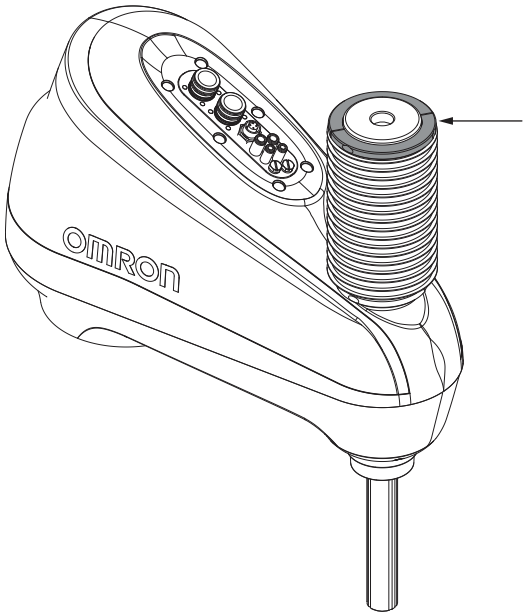
The following items are required for this procedure.

- One of the following bellows replacement kits applicable to your robot.
  - Standard quill length (210 mm): 19464-103F
  - Long quill length (410 mm): 19464-104F
- 2.5 mm hex key
- 3 mm hex key

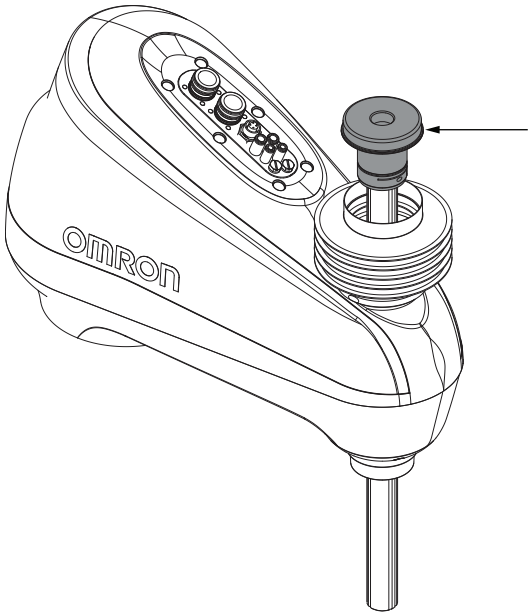
Make the following considerations before installing bellows.

- If cables or tubing are routed through the center of the quill, they must be removed before beginning this procedure.
- The tool flange must be removed if the lower bellows is being replaced. Make all necessary preparations and considerations before removing the tool flange. Refer to *6-2-1 Replacing the Tool Flange* on page 6-12 for more information.
- The procedure removes the upper bellows first and then the lower bellows next.
- To simplify installation, the Joint 3 quill should be positioned in approximately the middle position.
- The upper and lower bellows are identical and interchangeable.
- A bellows replacement kit includes the upper and lower bellows items.

1 Begin the upper bellows removal by removing the large clamp from the upper bearing adapter using a 2.5 mm hex bit.

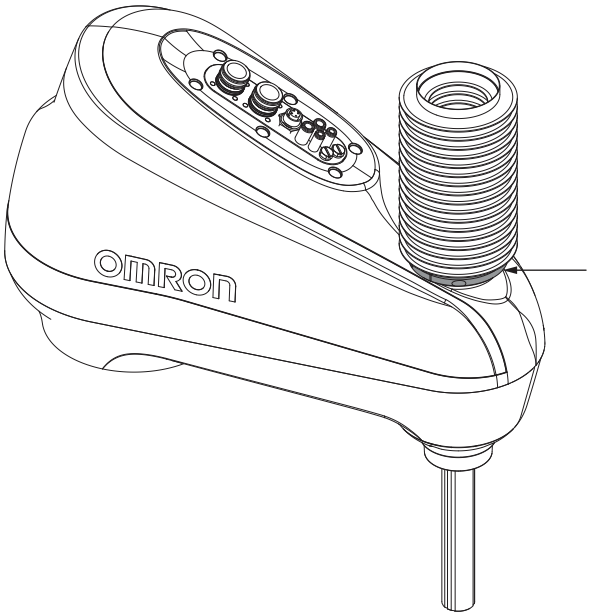


2 Remove the bellows from the upper bearing adapter by pulling it down and off of the lip.



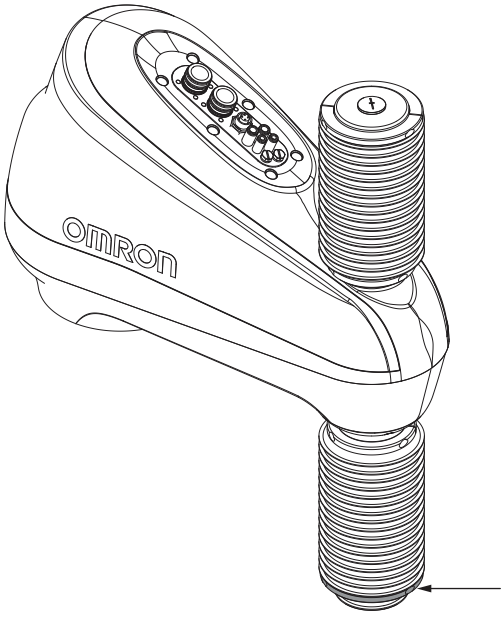
3 Loosen the upper bearing adapter clamp using a 3 mm hex bit and then remove it from the quill.

4 Remove the small clamp from the robot housing using a 2.5 mm hex bit.
Take note of the orientation of the small clamp before removal.



5 Remove the upper bellows by pulling it upward and off of the quill.

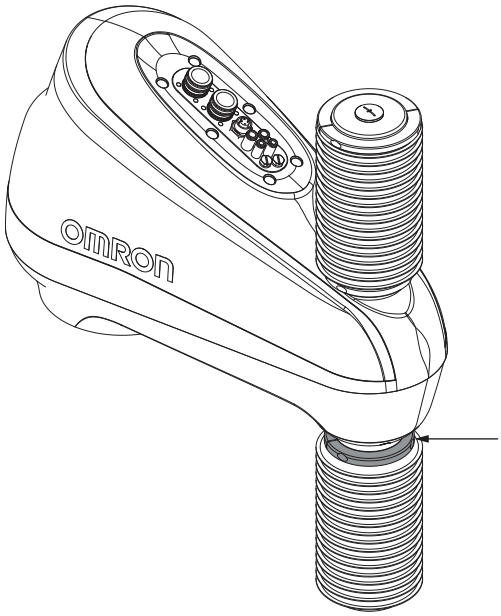
6 Begin the lower bellows replacement by removing the large clamp from the tool flange bearing adapter using a 2.5 mm hex bit.



7 Remove the lower bellows from the tool flange bearing adapter by pulling it up and off of the lip.

8 Remove the tool flange from the quill. Refer to *6-2-1 Replacing the Tool Flange* on page 6-12 for more information.
The tool flange includes a bearing adapter to accommodate the lower bellows. Disassembly of these components is not required.

9 Remove the small clamp from the robot housing using a 2.5 mm hex bit.



10 Remove the bellows by pulling them downward and off of the quill.

11 Refer to *3-4-4 Bellows Installation Procedure* on page 3-8 to install the replacement bellows and complete this procedure.

6-2 Non-periodic Maintenance

This section provides information and instructions for performing maintenance that does not occur at regular intervals.

⚠ WARNING

- Never connect or disconnect system cables while power is applied to the robot. Failure to comply may cause unexpected behavior and can result in personnel injury and equipment damage.
- You must perform the Lockout and Tagout procedure prior to servicing the robot.
- The procedures and replacement of the parts mentioned in this manual must be performed only by the skilled or instructed persons.
- The access covers on the robot are not interlocked. You should turn OFF and disconnect the power before the covers of the robot are removed.

6-2-1 Replacing the Tool Flange

Replace the tool flange if it gets damaged.

Before beginning the procedure, have the following tools available.

- 2.5 mm hex bit
- 3 mm hex bit
- Torque wrench
- Loctite thread lock type 243 or equivalent
- Loctite thread lock type 222MS or equivalent

⚠ DANGER

Failure to ground robot-mounted equipment or tooling that uses hazardous voltages could lead to injury or fatality of a person touching the end-effector during an electrical fault.

⚠ WARNING

If air pressure is present, disconnect it from the robot when servicing end-of-arm tooling or other pneumatic components to prevent unsecured pneumatic air lines from accidentally injuring personnel.

Precautions for Safe Use

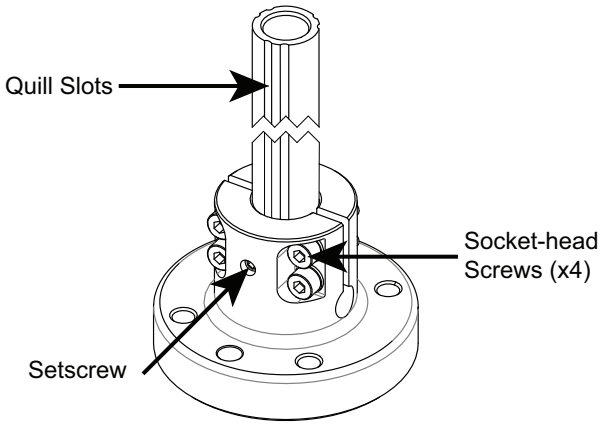
The Joint 3 quill and the tool flange are not grounded to protective earth. If hazardous voltages are present at any user-supplied robot-mounted equipment or tooling, you must install a ground connection from that equipment or tooling to the ground point on the robot base.

Precautions for Correct Use

When removing and replacing the tool flange, you must reinstall it in the same position to avoid losing the calibration for the robot.

Tool Flange Replacement Procedure

Use the following procedure to replace the tool flange on the z-axis quill if necessary.



1. Take note of the old tool flange position and orientation on the quill.
2. Loosen the setscrew and socket-head screws while holding the old tool flange in place. This prevents it from falling off the z-axis quill.
3. Slide the tool flange off the z-axis quill.
4. Align the setscrew with the proper groove in the z-axis quill.
5. When the orientation is correct, slide the new tool flange up on the z-axis quill until it stops.
6. Apply thread lock (Loctite 243 or equivalent) to the setscrew and tighten to a torque of 1.1 N-m.

Precautions for Correct Use

Do not over-tighten the tool flange setscrew. This will cause off-center alignment of the tool flange on the quill.

7. Apply thread lock (Loctite 222MS or equivalent) to the socket-head screws and then use a torque wrench to tighten one of the socket-head screws to 1 N-m. Then, apply the same torque to the other socket-head screws. Finally, tighten each socket-head screw to the full 2.5 N-m torque.
8. When all socket-head screws are tight and the new tool flange is verified to be in the correct orientation, the replacement procedure is complete.

6-2-2 Replacing the Amplifier Chassis

The amplifier chassis can be replaced in the event of repair or upgrade.

Precautions for Correct Use

Follow appropriate ESD procedures when removing or replacing the amplifier chassis.

Before beginning this procedure, have the following items available.

- Replacement amplifier chassis.
- 8 mm socket.
- Torque wrench.

Amplifier Chassis Replacement Procedure

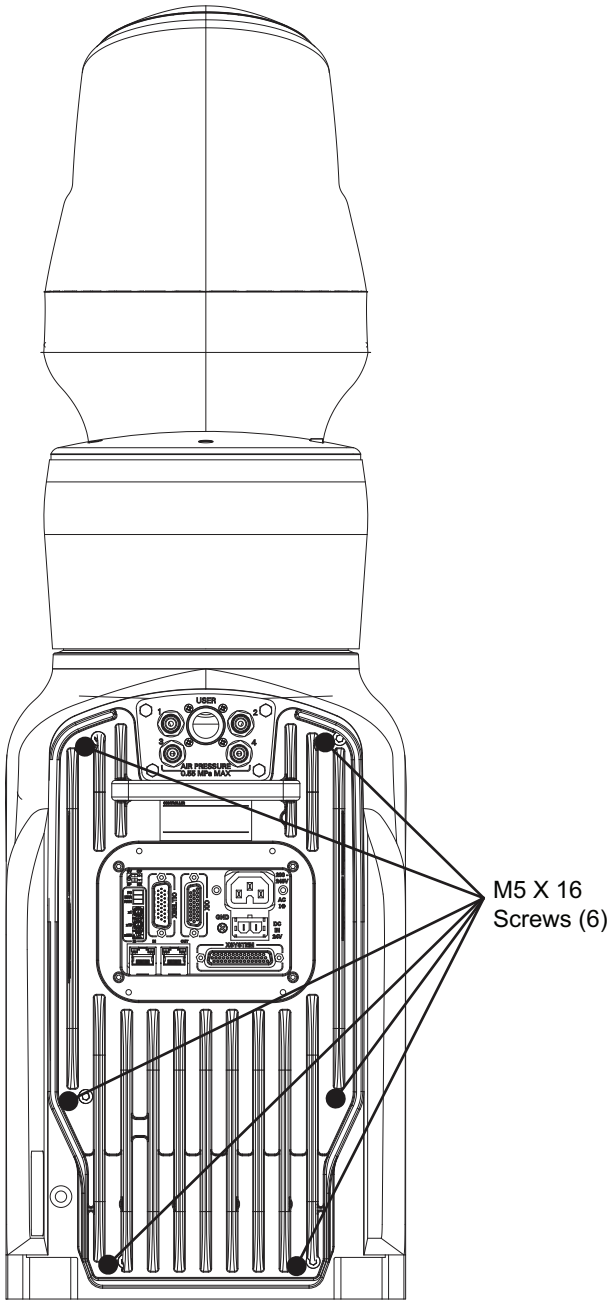
Use the following procedure to replace the amplifier chassis.

Additional Information

If you are installing a new into robot, you will need to run Teach Restrict and E-STOP Safety commissioning prior to operating the robot. Refer to *3-11-3 Safety Equipment Checks* on page 3-46 for more information.

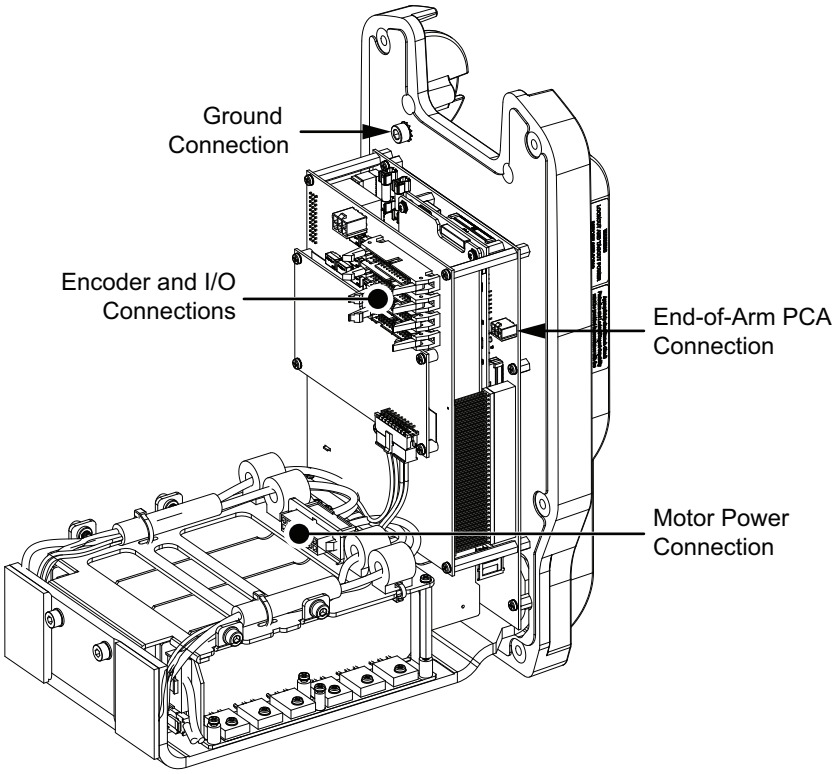
1 Disconnect all external cables connected to the Primary Interface Panel.

2 Remove the six M5 X 16 screws securing the amplifier chassis to the robot base.



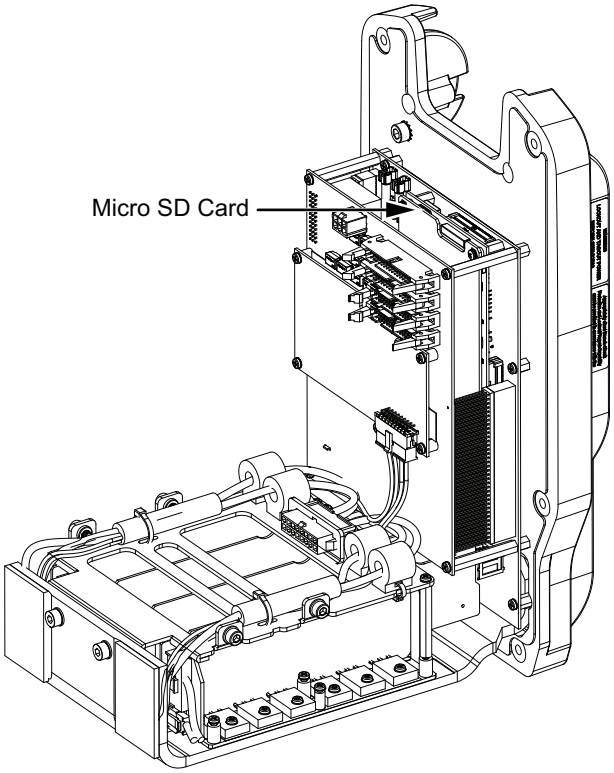
3 Carefully pull the amplifier chassis away from the robot base a small amount to expose internal harness connections. The assembly slides with guides in tracks.
Pulling the amplifier chassis too far from the robot base can damage the internal harness.
Take note of the internal harness and cable routing. Similar routing must be used when reassembling the components.

4 Disconnect the following items from the amplifier chassis:
- Ground connection
- Encoder and I/O connections
- Motor power connection
- End-of-arm PCA connection



5 After all internal connections have been removed, slide the amplifier chassis out of the robot base completely.

6 Remove the Micro SD card from the amplifier chassis.
Press the Micro SD card in and then release to eject it from the slot.



7 If the amplifier chassis is being replaced with an identical unit, insert the removed Micro SD card into the new amplifier chassis Micro SD card slot to transfer licensing and firmware.
If the amplifier chassis is not being replaced with an identical unit, this step can be skipped.

8 To install the replacement amplifier chassis, insert the first set of guides into the track in the base of the robot and then slide the chassis forward into the robot base until the second set of guides is reached.

9 Connect all items that were disconnected in step 5 above, while considering the cable routing that was observed in step 4.

10 After all internal connections are made, carefully push the amplifier chassis into the base of the robot while ensuring no cables are pinched and no connectors are strained.
Do not force the amplifier chassis into the base of the robot. Doing so may damage the unit. It may be necessary to pull the amplifier chassis out enough to correct the cable routing and retry.

11 After the amplifier chassis is in the original position, apply Loctite thread lock type 222 or equivalent to the six M5 X 16 screws and insert them . Apply a torque of 2.5 N-m to tighten them.

12 Make all necessary external cable connections to complete this procedure.

6-2-3 Replacing the Outer Link Cover

The outer link cover can be replaced if it becomes damaged.
The replacement outer link cover part numbers are provided below.

- i4-650H: 19211-002F
- i4-750H / i4-850H: 19227-002F

Before beginning this procedure, have the following items available.

- 3 mm hex bit.
- Loctite thread lock types 222 and 243 or equivalent.
- Torque wrench.

Outer Link Cover Replacement Procedure

Use the following procedure to replace the outer link cover.

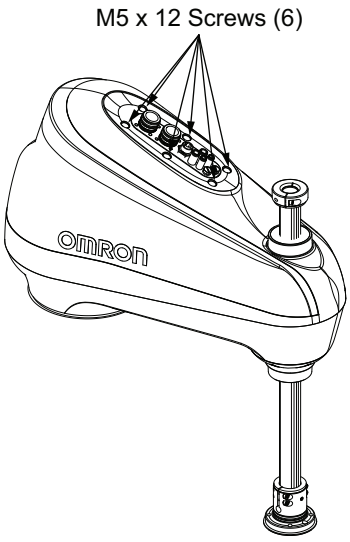
Precautions for Correct Use

Never release the z-axis brake while the quill clamp collar is loose or removed. This can allow the quill to fall out of the robot.

1 Disconnect all cables as well as any pneumatic tubing connected to the Secondary Interface Panel.

2 Remove the quill clamp collar from the top of the quill by loosening the socket-head capscrew and then slide the collar off of the quill.

3 Remove the six M5 x 12 screws that fasten the cover to the Secondary Interface Panel.



4 Carefully lift the cover off of the outer link.

5 Place the new cover on the outer link and align the lower edge and mounting screw holes.

6 Replace the six M5 x 12 screws that fasten the cover to the Secondary Interface Panel. Apply Loctite thread lock type 222 or equivalent and torque screws to 0.8 N-m.

7 Slide the quill clamp collar into position apply Loctite 243 or equivalent to the socket-head capscrew. Apply 2.8 N-m of torque to the socket-head capscrew to secure the clamp collar.

8 Connect all previously disconnected cables as well as any pneumatic tubing connected to the Secondary Interface Panel to complete this procedure.

A

Appendix

A-1 Cable Seal Kit Installation Procedure A-2

A-2 Repacking the Robot for Transport A-4

A-3 Transportation and Storage Considerations A-5

A-4 I/O Signal Numbering A-6

A-4-1 Input Signal Numbering A-6

A-4-2 Output Signal Numbering A-6

A-5 Cable Pinouts A-7

A-5-1 XSYSTEM Cable Pinouts A-7

A-5-2 XBELTIO Adapter Cable Pinouts A-9

A-5-3 Belt Encoder Y-adapter Cable Pinouts A-9

A-5-4 USER Cable Pinouts A-10

A-5-5 TIO Cable Pinouts A-11

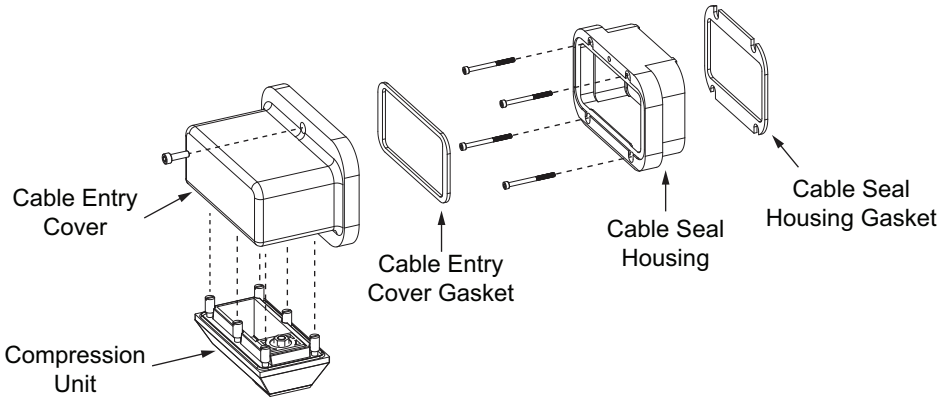
A-6 Parts List A-12

A-1 Cable Seal Kit Installation Procedure

Use the following procedure to install the Cable Seal Kit on the robot's Primary Interface Panel.
The following items are required for this procedure.

- One of the following Cable Seal Kits applicable to your robot
  - Cable Seal Kit for a standard robot (08765-000)
  - Cable Seal Kit for an inverted robot (08765-200)
- Torque wrench
- 13 mm socket
- Digital caliper
- Tape measure
- 5 mm hex key
- Loctite thread lock type 222 or equivalent

Make the following considerations before installing the Cable Seal Kit.
All cables that connect to the Primary Interface Panel must pass through the Cable Seal Kit and must be disconnected before beginning this procedure.
Roxtec modules are dense foam blocks surrounding pre-cut, half-sleeves that can be peeled away to match the diameter of the cable to be sealed. There are a total of eight Roxtec modules used in the Compression Unit.
The Cable Seal Kit includes the following components.



1 Apply the provided Roxtec lubricant to the inside surfaces of the Compression Unit.

2 Prepare the Cable Seal Kit by removing the adhesive seal from the Cable Seal Housing Gasket and bond the Cable Seal Housing Gasket to the Cable Seal Housing.
Ensure the orientation is correct and that the mounting holes are aligned properly before bonding the Cable Seal Housing Gasket to the Cable Seal Housing.

3 Remove the adhesive seal from the Cable Entry Cover Gasket and bond it to the Cable Seal Housing.

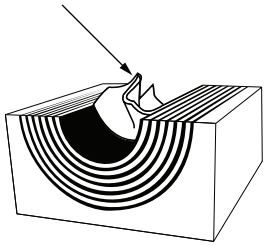
4 Apply thread lock to the four M4 X 50 mm screws, insert, and tighten using a 3 mm hex key to fasten the Cable Seal Housing to the robot. Tighten to a torque of 2.4 N-m.
Ensure that the gasket is seated between Primary Interface Panel surface and the Cable Seal Housing.

5 Assemble the Compression Unit to the Cable Entry Cover using the supplied hex screws (6) and a 5 mm hex key. Tighten to a torque of 4.5 N-m.

6 Insert the cables through the compression unit and Cable Entry Cover.

7 Measure the diameter of each cable with a digital caliper and use that measurement to approximate the number of layers that you must peel from the Roxtec modules.

8 Peel away layers until a gap of 0.1 to 1.0 mm is achieved when the cable is inserted into each Roxtex module. The number of layers removed from each half should not differ.
Up to eight cables may be routed through the Compression Unit. Take care to ensure that you measure the diameter of each cable accurately with the digital caliper and then peel off the Roxtec module layer corresponding to the cable diameter.
Only peel away layers for Roxtec modules in use.



9 Apply the provided Roxtec lubricant to all surfaces of the prepared Roxtex modules.

10 Place each cable into its corresponding Roxtec module and then insert each module into the Compression Unit.
Ensure that the Roxtec modules are properly seated on the Compression Unit lip.
Take care to ensure that all cables measure a distance of 250 to 300 mm from the cable ends to the Roxtec module.

11 After all Roxtec modules have been inserted in the Compression Unit, use a 13 mm socket to tighten the compression unit to 5.6 N-m.
Ensure all Roxtec modules are in place and aligned during this sealing process.

12 Connect all the cables to the Primary Interface Panel.

13 Align the Cable Entry Cover and gasket to the Cable Seal Housing.
Ensure that the gasket between the Cable Top Entry Cover and the Cable Seal Housing is seated, and all cables are contained within the Cable Entry Top Cover.

14 Apply thread lock to the M6 mm screws, insert, and tighten using a 5 mm hex key while ensuring that the Cable Entry Cover is completely secured to the Cable Seal Housing. Tighten to a torque of 7.3 N-m.
After Cable Entry Cover is attached to the Cable Seal Housing, this installation procedure is complete.

A-2 Repacking the Robot for Transport

The robot must be carefully packed if it needs to be transported. Reuse all original packing containers and materials and follow all safety guidelines detailed in the installation section of this manual. Reverse the installation instructions to repack the robot for transport.

A-3 Transportation and Storage Considerations

This section provides details about transporting and storing your robot.

Precautions for Correct Use

- This equipment must be shipped and stored in a temperature-controlled environment, within the range –25 to +55° C. The recommended humidity range must be 5 to 90%, non-condensing. It should be shipped and stored in the supplied packaging, which is designed to prevent damage from normal shock and vibration.
- Do not expose the shipping container to excessive shock and vibration. Do not lay the crate on its side or any other non-upright position. This could damage the robot.

Use a forklift or pallet jack to transport the packaged equipment in an upright position.

Always keep the ISO double-arrows on the sides of the crate oriented up.

A-4 I/O Signal Numbering

Digital I/O for the V+ programming language uses numeric signal numbers in the ranges provided below based on the I/O configuration of the system.

A-4-1 Input Signal Numbering

Use the table below to understand the digital input signal numbers.

Input Type	Switch Position	V+ Signal Numbers
XIO	--	1001 to 1012
TIO		1017 to 1021
IO Blox 1	OFF, OFF	1065 to 1072
IO Blox 2	ON, OFF	1073 to 1080
IO Blox 3	OFF, ON	1081 to 1088
IO Blox 4	ON, ON	1089 to 1096

A-4-2 Output Signal Numbering

Use the table below to understand the digital output signal numbers.

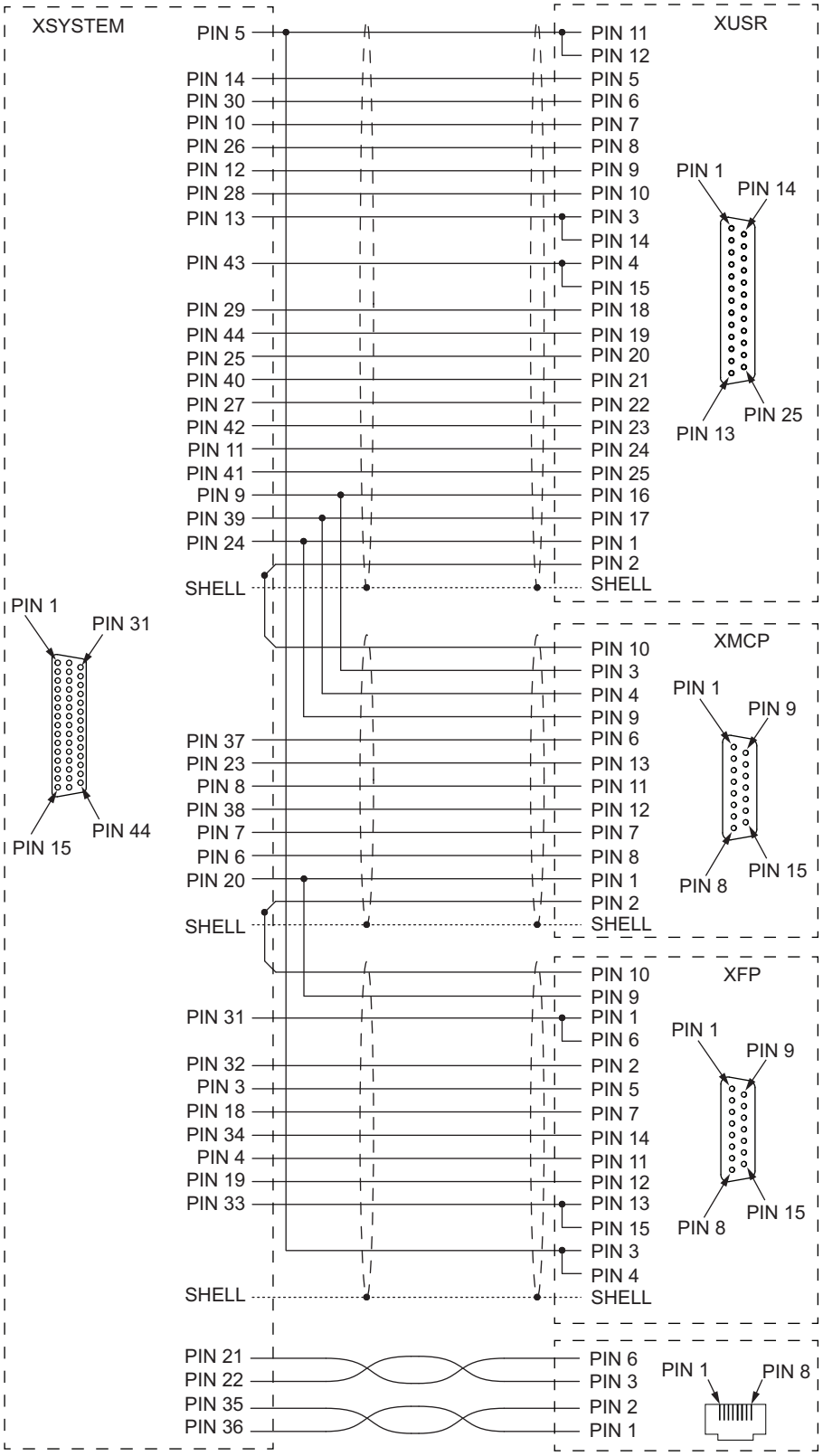
Output Type	Switch Position	V+ Signal Numbers
XIO	--	1 to 8
TIO		17 to 20
Pneumatic Valves (optional)		3001 to 3003
IO Blox 1	OFF, OFF	65 to 72
IO Blox 2	ON, OFF	73 to 80
IO Blox 3	OFF, ON	81 to 88
IO Blox 4	ON, ON	89 to 96

A-5 Cable Pinouts

Cable pinout information is provided below.

A-5-1 XSYSTEM Cable Pinouts

Use the following diagrams for XSYSTEM cable pinout information.


XSYSTEM
PIN 5
PIN 14
PIN 30
PIN 10
PIN 26
PIN 12
PIN 28
PIN 13
PIN 43
PIN 29
PIN 44
PIN 25
PIN 40
PIN 27
PIN 42
PIN 11
PIN 41
PIN 9
PIN 39
PIN 24
SHELL
PIN 1
PIN 31
PIN 15
PIN 44
PIN 37
PIN 23
PIN 8
PIN 38
PIN 7
PIN 6
PIN 20
SHELL
PIN 31
PIN 32
PIN 3
PIN 18
PIN 34
PIN 4
PIN 19
PIN 33
SHELL
PIN 21
PIN 22
PIN 35
PIN 36
XUSR
PIN 11
PIN 12
PIN 5
PIN 6
PIN 7
PIN 8
PIN 9
PIN 10
PIN 3
PIN 14
PIN 4
PIN 15
PIN 18
PIN 19
PIN 20
PIN 21
PIN 22
PIN 23
PIN 24
PIN 25
PIN 16
PIN 17
PIN 1
PIN 2
SHELL
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PIN 13
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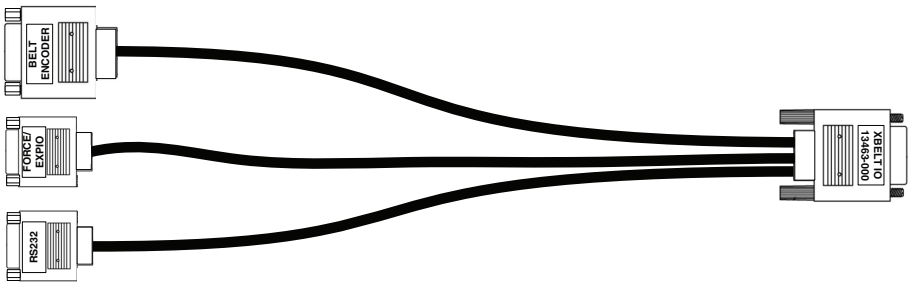
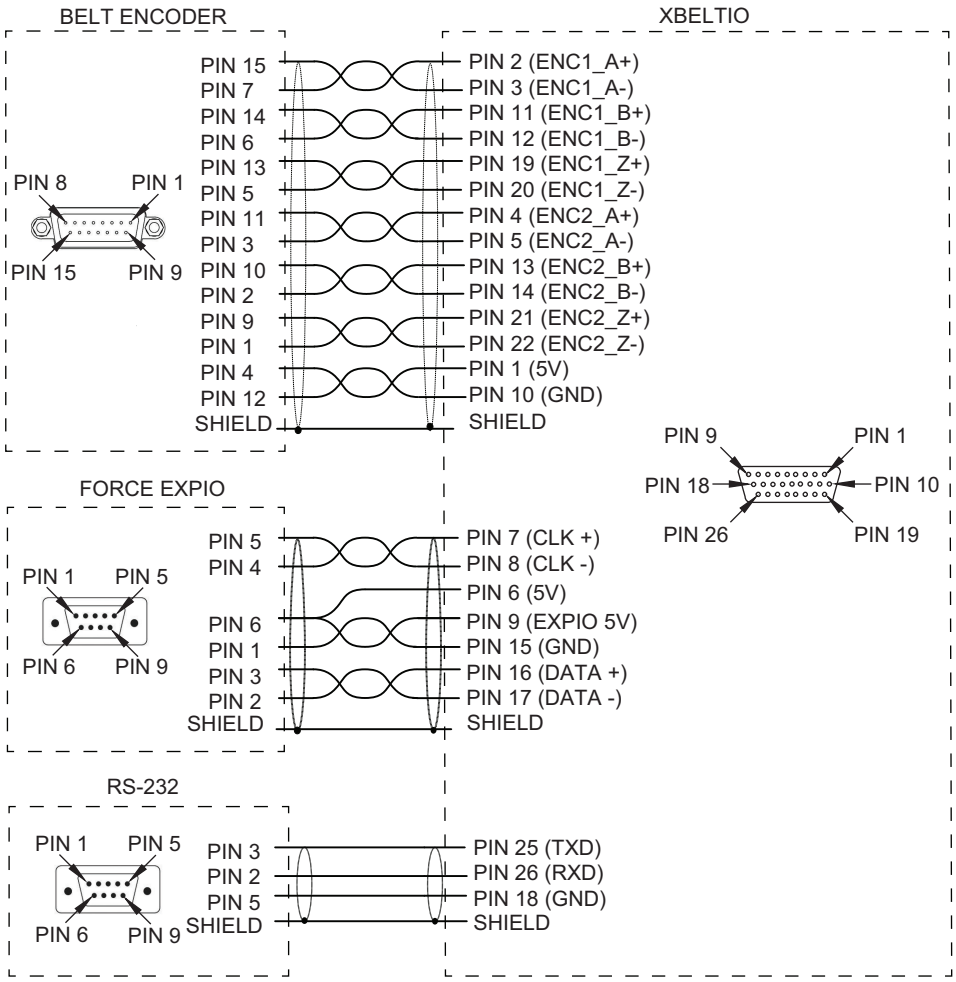
PIN 4
PIN 9
PIN 6
PIN 13
PIN 11
PIN 12
PIN 7
PIN 8
PIN 1
PIN 2
SHELL
PIN 1
PIN 9
PIN 8
PIN 15
XFP
PIN 10
PIN 9
PIN 1
PIN 6
PIN 2
PIN 5
PIN 7
PIN 14
PIN 11
PIN 12
PIN 13
PIN 15
PIN 3
PIN 4
SHELL
PIN 1
PIN 9
PIN 8
PIN 15
PIN 6
PIN 3
PIN 2
PIN 1
PIN 1
PIN 8

A-5-2 XBELTIO Adapter Cable Pinouts

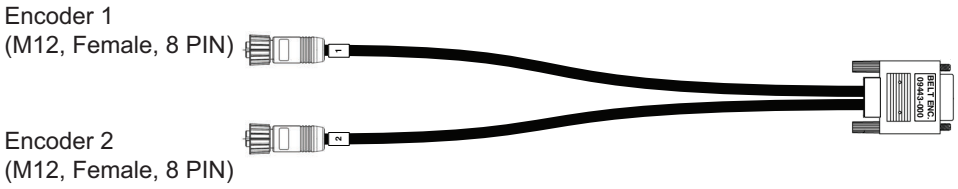
Use the following diagrams for XBELTIO adapter cable pinout information.

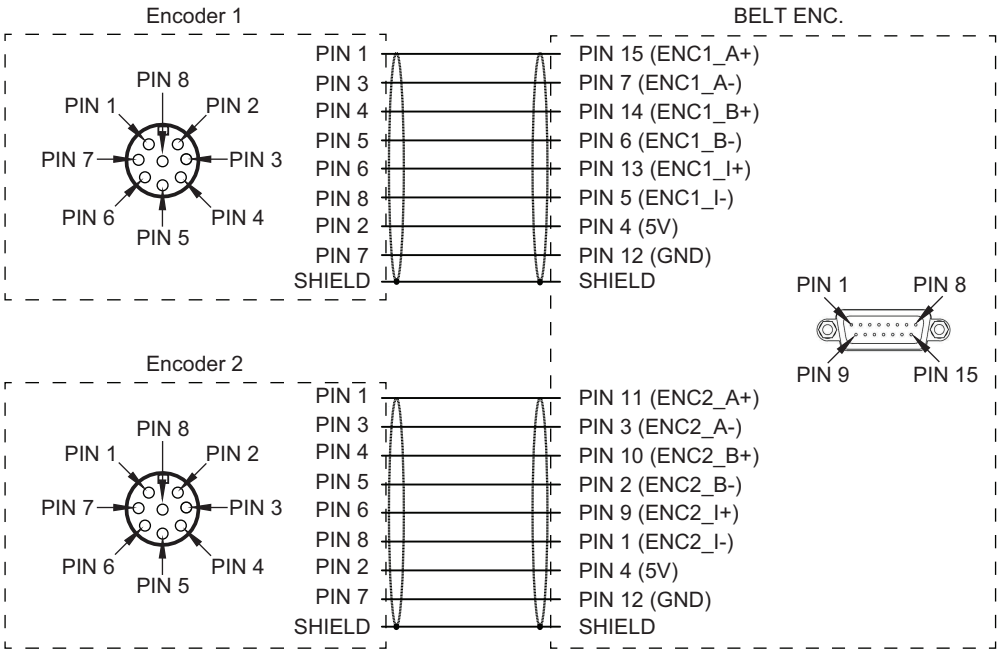




A-5-3 Belt Encoder Y-adapter Cable Pinouts

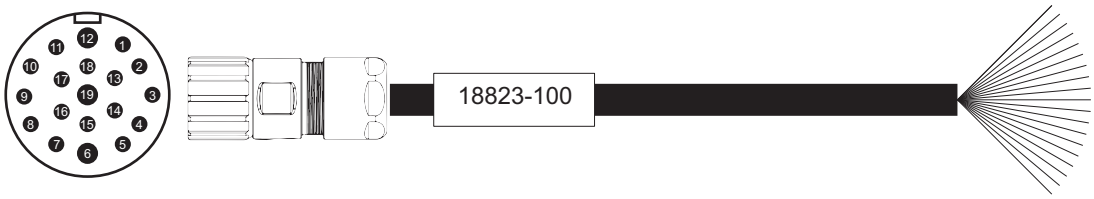
Use the following diagrams for Belt Encoder Y-adapter cable pinout information.





A-5-4 USER Cable Pinouts

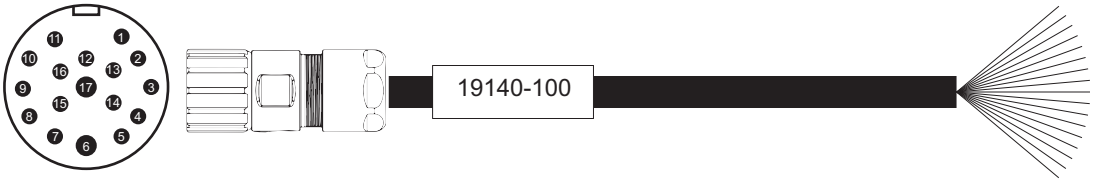
Use the following information to understand the USER cable pinout.



Pin	Wire Color	Pin	Wire Color
1	Black	11	Light blue
2	White	12	Pink
3	Red	13	White / Black
4	Green	14	Red / Black
5	Yellow	15	Green / Black
6	Brown	16	Yellow / Black
7	Blue	17	Brown / Black
8	Orange	18	Blue / Black
9	Gray	19	Orange / Black
10	Purple		

A-5-5 TIO Cable Pinouts

Use the following diagrams for TIO cable pinout information.



Pin	Wire Color	Signal
1	Black	24 VDC
2	White	
3	Red	Output 1
4	Green	Output 2
5	Yellow	Output 3
6	Brown	Output 4
7	Blue	Input 1
8	Orange	Input 2
9	Gray	Input 3
10	Purple	Input 4
11	Light Blue	Input 5
12	Pink	0 VDC
13	White/Black	
14	Red/Black	
15	Green/Black	
16	Yellow/Black	
17	Brown/Black	

A-6 Parts List

Standard robot parts and accessories are provided in the following table.

Item		Part Number	Details	Included	Optional
Cables	XSYSTEM cable	13322-100	The length of this cable is 1.8 m.	X	
	XBELTIO Cable	13463-000	The length of this cable is 600 mm.		X
	XIO Breakout Cable	04465-000	The length of this cable is 5 m.		X
	IO Blox Extension Cable (to robot)	04677-030	Extends the connection between the IO Blox and the robot up to 3 m.		X
	IO Blox Extension Cable (between units)	04679-030	Extends the connection between IO Blox units up to 3 m.		X
	Encoder Extension Cable	09446-050	Replaces or extends encoder cable up to 5 m.		X
	Belt Encoder Y-adapter Cable	09443-000	The length of this cable is 3 m.		X
	USER Connector Cable, Primary/Secondary Interface Panel	18823-100	IP65, 1700 mm, M23 19 pin flying lead		X
	TIO Connector Cable	19140-100	IP65, 1800 mm, M23 17 pin flying lead		X
	T20 Pendant Adapter Cable	10051-003	M23 to DB15, 3m		X
Connectors / Jumpers	High Power Connector	22822-100	Includes connector, pins, and retaining clip.	X	
	Control Power Connector	22822-200	Includes connector and pins.	X	
	XFP Jumper Plug	10053-000		X	
	XUSR Jumper Plug	04736-000		X	
	XMCP Jumper Plug	10052-000		X	
	T20 Pendant Jumper Plug	10048-000			X

Item		Part Number	Details	Included	Optional
Other Items	Encoder Backup Battery Pack	19238-000F		X	
	Camera Mounting Bracket	18908-000			X
	Camera Mounting Adapter	22295-000			X
	Front Panel Kit	92546-10358	Kit includes front panel and 3 m cable.	X	
	Tool Flange	19106-000F		X	
	eCobra Mount Adapter	21636-000			X
	Outer Link Cover (i4-650H)	19211-002F		X	
	Outer Link Cover (i4-750H, i4-850H)	19227-002F		X	
	Amplifier Chassis (standard robot type)	29900-000F		X	
	Amplifier Chassis (inverted robot type)	29910-000F		X	
	XIO Termination Block and Cable	90356-40100			X
	T20 Pendant Kit	10046-010	Kit includes the pendant with a 10 m cable, 3 m adapter cable, and a jumper plug.		X
	T20 Pendant	10054-010	Includes the pendant with a 10 m cable.		X
	T20 Pendant Wall Bracket	10079-000			X
	IPC Application Controller	AC1-152000	Includes ACE software pre-installed.		X
	eCobra Tool Flange	19106-100F			X
	IO Blox Kit (robot connection)	90356-30200	Includes 300 mm cable to connect directly to the robot.		X
	IO Blox Kit (IO Blox connection)	90356-30100	Includes 200 mm cable to connect to another IO Blox unit.		X

Item		Part Number	Details	Included	Optional
Other Items	Joint 3 Quill Standard Grease*1	90401-04029	NSK Grease, LG 2 type.		X
	Joint 3 Quill Food-grade Grease*2	21294-000	Dow Corning Molykote 111 Grease		X
	i4H Wall Mount Bracket	20089-000			X
	Harmonic Drive Oil, Standard Type*1	21947-100F	Mobilgear 600 XP 68, 100 ml (Joint 1)		X
		21947-170F	Mobilgear 600 XP 68, 170 ml (Joint 2)		X
	Harmonic Drive Oil, Food Grade type*2	20165-100F	Mobil SHC Cibus 68, 100 ml (Joint 1)		X
		20165-170F	Mobil SHC Cibus 68, 170 ml (Joint 2)		X
	Harmonic Drive Oil Change Kit	12370-000F	Kit includes funnel, separator bottle, vacuum pump, reducer, tubing, and instructions.		X
	Encoder Kit	09742-001	Includes encoder, mounting bracket, and 5 m cable.		X
	NJ501-R Series Machine Automation Controller	NJ501-R[ ][ ][ ]	Contact your local Omron representative for complete part number.		
	Bellows Installation Kit, Standard	19464-003F	All components for installing bellows on a standard robot with a Joint 3 quill length of 210 mm are included.	X*3	X
	Bellows Installation Kit, Long Quill	19464-004F	All components for installing bellows on a standard robot with a Joint 3 quill length of 410 mm are included.	X*3	X

Item		Part Number	Details	Included	Optional
Other Items	Bellows Replacement Kit, Standard	19464-103F	All components for replacing bellows on a standard robot with a Joint 3 quill length of 210 mm are included.	X*3	X
	Bellows Replacement Kit, Long Quill	19464-104F	All components for replacing bellows on a standard robot with a Joint 3 quill length of 410 mm are included.	X*3	X
	Cable Seal Kit, Standard Robot	08765-000	All components for replacing the Cable Seal for a standard robot are included.	X*4	X
	Cable Seal Kit, Inverted Robot	08765-200	All components for replacing the Cable Seal for a inverted robot are included.	X*4	X
	Pneumatic Valve Kit	19165-000	All components for adding robot-controlled pneumatic valves.		X

*1. Use with IP20 (standard) models only.
*2. Use with IP20 (Food Grade) or IP65 models only. Not for use with IP20 (standard) or Cleanroom models.
*3. IP65 and Cleanroom / ESD models only.
*4. IP65 models only.

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OMRON Corporation **Industrial Automation Company**
Kyoto, JAPAN **Contact: www.ia.omron.com**

Regional Headquarters

OMRON EUROPE B.V.
Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ASIA PACIFIC PTE. LTD.
No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON ROBOTICS AND SAFETY TECHNOLOGIES, INC.
4225 Hacienda Drive, Pleasanton, CA 94588
U.S.A.

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

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