BenchBot Robot

Safety and Installation Guide

Original Instructions

Agilent Technologies

Notices

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User Guide Part Number

G5486-90001

Edition

Revision 01, June 2011

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Safety Notices

⚠ A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Contents

Preface

This preface contains the following topics:

About this guide

Who should read this guide

This guide is for people with the following job roles:

Job role	Responsibilities
Installer	Unpacks, installs, and tests the Agilent BenchBot Robot before it is used.
Integrator	Configures hardware and writes software.
Lab manager, administrator, or technician	• Manages the automation system that contains the BenchBot Robot • Develops the applications that are run on the system • Develops training materials and standard operating procedures for operators
Operator	Performs the daily production work on the system that contains the BenchBot Robot and solves routine problems.

Installers, integrators, lab managers, and administrators are users who must have technical expertise. In addition, lab managers and administrators are individuals or groups responsible for the use and maintenance of the BenchBot Robot and for ensuring that operators are adequately trained.

What this guide covers

This guide describes the following:

- Potential safety hazards of the BenchBot Robot and how to avoid them.
- Specifications and site requirements for the BenchBot Robot. Use this information to plan the space for the BenchBot Robot. Make sure your site meets the requirements outlined in this guide before installing the robot.
- Installation instructions for the robot and, if applicable, the BenchBot integration plates.

Related guides

The *BenchBot Robot Safety and Installation Guide* should be used in conjunction with the following user documents:

- *BenchBot Robot Unpacking Guide*. Explains how to unpack and pack the robot.
- *BenchBot Robot User Guide*. Explains how to set up and operate the BenchBot Robot.
- *VWorks Automation Control Setup Guide*. Explains how to define labware, track labware, and manage users.
- *VWorks Automation Control User Guide*. Explains how to add devices, create protocols, and set task parameters for each device in the system.
- *VWorks Software Quick Start*. Provides an overview of how to use the VWorks Automation Control software.
- *Automation Solutions device user guides*. Explain how to set up and use the Automation Solutions devices.
- *Third-party device user documents*. Explain how to set up and use the third-party devices.

Accessing Agilent Technologies Automation Solutions user guides

You can search the online knowledge base or download the latest version of any PDF file from the Agilent Technologies website at www.agilent.com/lifesciences/automation.

Safety information for the Agilent Technologies devices appears in the corresponding device safety guide or user guide. You can also search the knowledge base or the PDF files for safety information.

Related information

For information about...	See...
Reporting problems	"Reporting problems" on page viii
Safety precautions	"Safety guidelines" on page 1
Site requirements and robot specifications	"Laboratory setup requirements" on page 11
Installation instructions	"Installing the robot" on page 27

Reporting problems

Contacting Automation Solutions Technical Support

If you find a problem with the BenchBot Robot, contact Automation Solutions Technical Support at one of the following:

Europe

Phone: +44 (0)1763850230

email: euroservice.automation@agilent.com

US and rest of world

Phone: 1.800.979.4811 (US only) or +1.408.345.8011

email: service.automation@agilent.com

Reporting hardware problems

When contacting Agilent Technologies, make sure you have the system ID and the serial number of the device ready.

Figure System ID label on the BenchBot Disable Hub

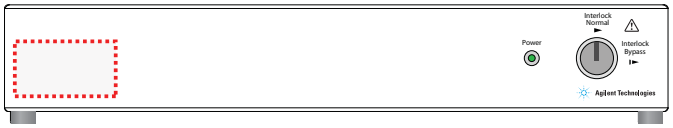
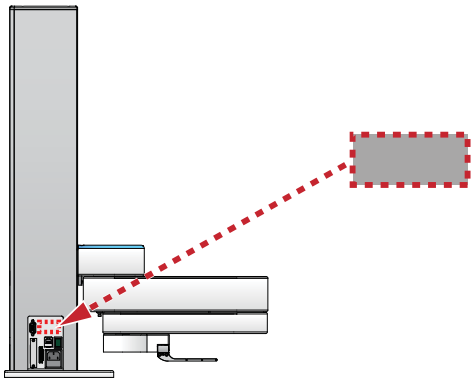


Figure BenchBot Robot serial number label location



Reporting software problems

When you contact Automation Solutions Technical Support, make sure you provide the following:

- Short description of the problem
- Relevant software version number (for example, automation control software, diagnostics software, ActiveX control software, and firmware)
- Error message text (or screen capture of the error message dialog box)
- Relevant files, such as log files

Reporting user guide problems

If you find a problem with this user guide or have suggestions for improvement, send your comments in an email to documentation.automation@agilent.com.

Related information

For information about...	See...
What this guide covers	“About this guide” on page vi
Safety precautions	“Safety guidelines” on page 1
Installation instructions	“Installing the robot” on page 27

1 Safety guidelines

This chapter contains the following topics:

General safety information

Before installing and using the Agilent BenchBot Robot

Before installing and using the BenchBot Robot, make sure you are aware of the potential hazards and understand how to avoid being exposed to them. You must be properly trained in the correct and safe installation and operation of the device.

EU installations only. Be aware that the G5487A BenchBot Robot (standalone/component configuration) is considered partly completed machinery that is required to be installed with other equipment such that the fully assembled machinery complies with the essential health and safety requirements (EHSRs) of the Machinery Directive 2006/42/EC.

Intended product use

WARNING **Do not remove the BenchBot Robot exterior covers or otherwise disassemble the robot. Doing so can expose you to hazards that could cause serious injury and damage the BenchBot Robot.**

WARNING **Using controls, making adjustments, or performing procedures other than those specified in the user guide can expose you to moving parts and hazardous voltage.**

Agilent Technologies products must only be used in the manner described in the Agilent Technologies product user guides. Any other use may result in damage to the product or personal injury. Agilent Technologies is not responsible for any damages caused, in whole or in part, by improper use of the products, unauthorized alterations, adjustments or modifications to the products, failure to comply with procedures in Agilent Technologies product user guides, or use of the products in violation of applicable laws, rules or regulations. Except as otherwise expressly provided in Agilent Technologies product user guides, any alteration, adjustment, or modification to the products will void the product warranty.

The BenchBot Robot is not intended or approved for diagnosis of disease in humans or animals. You assume full responsibility for obtaining any regulatory approvals required for such use and assume all liability in connection therewith.

Safety labels

Warnings in the user documentation or on the device must be observed during all phases of operation, service, and repair of this device. Failure to comply with these precautions violates safety standards of design and the intended use of the product. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

The following table lists the common symbols you might find on the device. The symbol on the label indicates the risk of danger. A description of the warning and information that will help you avoid the safety hazard are provided in this guide.

Symbol	Description
	Indicates that you must read the accompanying instructions (for example, the safety guide) for more information before proceeding.
	Indicates hazardous voltages.
	Indicates pinch, crush, and cut hazard.
	Indicates laser hazard.
	Indicates hot surface hazard.
	Indicates protective conductor terminal, which is bonded to conductive parts of an equipment for safety purposes.
	Indicates that you must not discard this electrical/ electronic product in domestic household waste.

Related information

For information about...	See...
Safety and regulatory certifications	“Safety and regulatory compliance” on page 4
Installing the safety equipment	“Installing the robot-disable hub” on page 48
How to stop the robot in an emergency	“Emergency stop” on page 6
Moving parts hazards	“Mechanical hazards” on page 7
Electrical hazards	“Electrical hazards” on page 9
Ergonomics	“Ergonomics” on page 10
Reporting problems	“Reporting problems” on page viii

Safety and regulatory compliance

The BenchBot Robot complies with the applicable EU Directives. See the Declaration of Conformity or Declaration of Incorporation, as applicable, for details. The BenchBot Robot is designed to comply with the standards listed in the following table.

Regulatory Compliance	Standard
EMC	
European Union	EMC Directive 2004/108/EC
	IEC 61326-1:2005 / EN 61326-1:2006
Canada	ICES/NMB-001:2004
Australia/New Zealand	AS/NZS CISPR 11:2004
Safety	
European Union	Machinery Directive 2006/42/EC
	Low Voltage Directive 2006/95/EC
	IEC 61010-1:2001 / EN61010-1:2001
Canada	CAN/CSA-C22.2 No. 61010-1-04
USA	ANSI/UL 61010-1:2004

Electromagnetic compatibility

If the BenchBot Robot causes interference with radio or television reception, which can be determined by turning the device off and on, try one or more of the following measures:

- Relocate the radio or television antenna.
- Move the device away from the radio or television.
- Plug the device into a different electrical outlet, so that the device and the radio or television are on separate electrical circuits.
- Make sure that all peripheral devices are also certified.
- Make sure that appropriate cables are used to connect the device to peripheral equipment.
- Consult your equipment dealer, Agilent Technologies, or an experienced technician for assistance.

Changes or modifications not expressly approved by Agilent Technologies could void the user's authority to operate the equipment.

Sound emission declaration

Sound pressure: Lp < 70 dB according to EN 27779:1991.

Schalldruckpegel: LP < 70 dB nach EN 27779:1991.

Related information

For information about...	See...
General safety information	“General safety information” on page 2
Emergency stop	“Emergency stop” on page 6
Mechanical hazards	“Mechanical hazards” on page 7
Electrical hazards	“Electrical hazards” on page 9
Ergonomics	“Ergonomics” on page 10

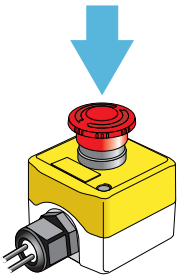
Emergency stop

Emergency-stop pendant

The BenchBot Robot is equipped with an emergency-stop pendant. Pressing the red button on the pendant decelerates and stops the robot during an emergency. The *z*-axis brake engages to prevent the robot arm from falling freely.

WARNING **After pressing the emergency-stop button, the robot arm might have momentum and continue to move until it comes to the end of its travel in the x-y plane, or until it bumps into an obstacle.**

Figure Emergency-stop pendant



G5486A BenchBot Robot (workstation configuration). For safe operation, make sure you install the safety equipment that is purchased with the BenchBot Robot workstation configuration. See "Safety equipment space requirements" on page 24.

G5487A BenchBot Robot (standalone/component configuration). When the robot is integrated with other devices in a third-party system, Agilent Technologies recommends that you install a main emergency-stop button to safely stop the robot and all devices simultaneously.

In addition, all operators should be instructed in the emergency stop procedure.

Related information

For information about...	See...
General safety information	"General safety information" on page 2
Safety and regulatory certification	"Safety and regulatory compliance" on page 4
Mechanical hazards	"Mechanical hazards" on page 7
Electrical hazards	"Electrical hazards" on page 9
Installing the safety equipment	"Installing the robot-disable hub" on page 48
Recovering from an emergency stop	*BenchBot Robot User Guide*

Mechanical hazards

Protecting users

The BenchBot Robot has relatively low inertia and is designed to stop its movement when it comes in contact with an obstacle. However, you can be injured if you obstruct the robot while it is in motion.

Agilent Technologies strongly recommends that you install the robot inside an enclosure. Safety-interlocked doors or light curtains that stop the robot when opened or interrupted can be used to further mitigate risk. Make sure the safety-interlocked enclosure complies with your country's safety regulations.

EU installations only. The enclosure and other safety recommendations are required so that the BenchBot Robot installation is compliant with the provisions of the Machinery Directive 2006/42/EC.

WARNING **To reduce the risk of injury from moving parts, make sure that the BenchBot Robot safety interlock circuit is connected to an enclosure or light curtain with an interlock switch or key.**

WARNING **To prevent potential damage or personal injury in unsupervised systems, you must install required warning devices.**

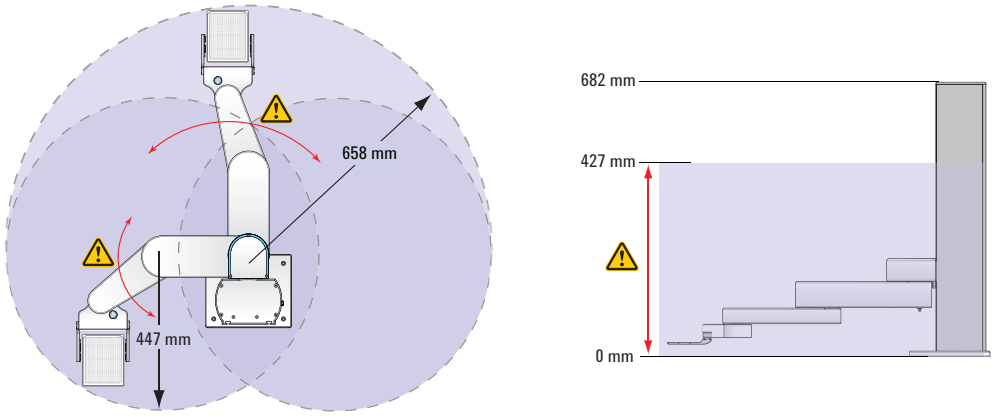
Moving-parts hazards

The following diagram shows the robot's maximum radial and vertical reach. Notice that the robot arm is able to reach behind the mast. For safety considerations, the maximum radial reach specification includes a standard labware held in the portrait orientation.

WARNING **Keep clear of the robot's reach when it is in motion. Keep your fingers, hair, clothing, and jewelry away from the robot while it is in motion.**

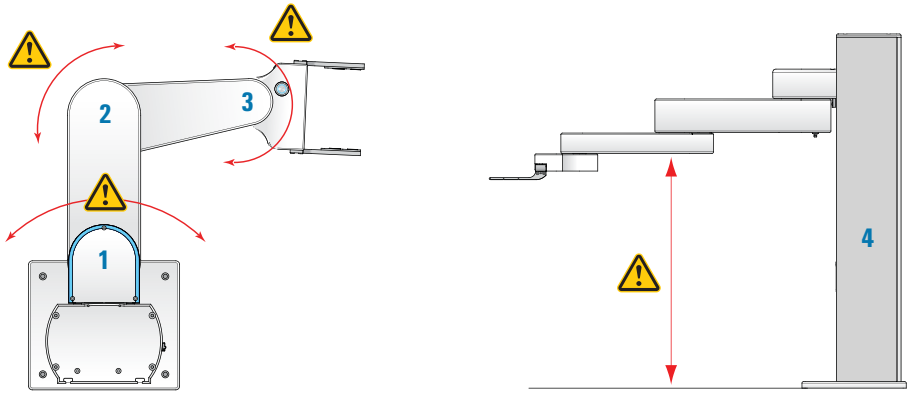
WARNING **The robot does not always move in a straight line between teachpoints. Do not try to predict the robot's movements and reach into the robot's travel space while it is in operation.**

Figure BenchBot Robot radial (top view) and vertical reach (side view).



Pinch hazards

The BenchBot Robot has four axes of motion:



Item	Axis	Description of robot movement
1	Shoulder	Robot arm rotates 186° about the shoulder.
2	Elbow	Robot forearm rotates 336° about the elbow.
3	Wrist	Robot hand rotates to any angle about the wrist.
4	Mast	Robot arm moves up and down along the mast.

WARNING **Keep clear of the robot while it is in motion. The robot could pinch or bruise you near the axes.**

Puncture hazards

The tapered robot grippers and the robot's low inertia are features that are designed to prevent puncture or other injuries. However, you might be injured if you obstruct the robot while it is in motion.

WARNING **Keep clear of the robot and its grippers while it is in motion.**

Related information

For information about...	See...
General safety information	"General safety information" on page 2
Safety and regulatory certification	"Safety and regulatory compliance" on page 4
Emergency stop	"Emergency stop" on page 6
Electrical hazards	"Electrical hazards" on page 9
Ergonomics	"Ergonomics" on page 10

Electrical hazards

Hazardous-voltage electronics

Hazardous-voltage electronics can be found within the BenchBot Robot. Under normal operating conditions, you are protected from exposure to the hazardous voltage.

WARNING **Do not try to gain access to the interior of the BenchBot Robot. Do not remove panels for any reason. Hazardous voltage inside of the robot can cause severe injury or death.**

Hazardous-voltage electronics can also be found in the computer. See the computer manufacturer documentation for the hazard warnings. Make sure you follow the instructions on the safe operation of the computer.

WARNING **Ensure that the power cord is in good condition and is not frayed. Use of a frayed or damaged power cord can cause injury. Use only the supplied power cable. Use of an incorrect power cord can cause damage to the robot.**

WARNING **Always turn off electrical power and disconnect the power cord before installing or servicing the robot.**

Related information

For information about...	See...
General safety information	“General safety information” on page 2
Safety and regulatory certification	“Safety and regulatory compliance” on page 4
Emergency stop	“Emergency stop” on page 6
Mechanical hazards	“Mechanical hazards” on page 7
Ergonomics	“Ergonomics” on page 10

Ergonomics

Lifting and moving the robot

WARNING **The BenchBot Robot weighs approximately 19 kg (42 lb). Attempting to move the BenchBot Robot without assistance could cause personal injury or damage the robot. Request assistance and use proper lifting techniques when moving the BenchBot Robot.**

CAUTION Never lift or move the robot by its arm. Doing so can damage the robot.

Positioning the computer

See the computer manufacturer documentation for instructions on the correct positioning of the computer, monitor, and keyboard.

Related information

For information about...	See...
General safety information	“General safety information” on page 2
Safety and regulatory certification	“Safety and regulatory compliance” on page 4
Emergency stop	“Emergency stop” on page 6
Mechanical hazards	“Mechanical hazards” on page 7
Electrical hazards	“Electrical hazards” on page 9

2 Laboratory setup requirements

This chapter contains the following topics:

General placement considerations

General considerations

When planning the placement of the robot and other devices:

- Make sure there is sufficient surface area for the robot, devices, accessories, and safety equipment.
- Note the proximity to power source, network drop, air source, and plumbing lines.
- Note the length of cords, cables, and tubing.
- If the workstation will use the Light Curtain:
  - Provide 8.9 cm (3.5 in) of clearance on all sides of the workstation table.
  - When mounting the Light Curtain posts on the integration plates, make sure the posts are contained within the area of the table surface.

  For more information about the Light Curtain, see "Safety equipment space requirements" on page 24.
- Because the robot power cord is 2.7 m (9 ft) long, locate the BenchBot Robot within 2.7 m (9 ft) of an electrical outlet.
- Be aware that the power, communication, and pendant connections are on the left side of the robot. Provide 7.6 cm (3.0 in) of clearance on the left side of the robot so that you can access the power switch and connections.
- Use the information in "Robot zone" on page 32 and "Teachpoint zone" on page 33 to plan the placement of devices surrounding the robot.

Fume hood considerations

If you plan to install the robot and workstation inside of a fume hood, be sure to note the following:

- Dimensions of the hood floor
- Height limitations inside of the hood
- Utility fixtures (such as gas turrets) that are inside of the hood
- Size of the user access area at the front of the hood

Doorways and hallways

Make sure you consider the width of doorways and hallways before selecting workstation tables. The table you select must be able to fit through hallways and the doorway to the laboratory.

Related information

For information about...	See...
Workstation table requirements	“Workstation table requirements” on page 14
Robot dimensions	“Robot dimensions” on page 17
Integration plate specifications	“BenchBot integration plate specifications” on page 18
Robot mounting specifications	“Robot mounting specifications” on page 22
Space requirements for the safety equipment	“Safety equipment space requirements” on page 24
Space requirements for the computer	“Computer placement requirements” on page 31

Workstation table requirements

Table surface area

The overall surface area of the workstation table depends on the following:

- The BenchBot Robot configuration you purchased
- The number of devices you are integrating

The following table lists the two BenchBot Robot configurations available. Use the remaining sections in this chapter to determine the space requirements for each component listed. Refer to the device user documentation to determine the space requirements of the device you want to integrate.

Product name	Product components
G5486A BenchBot Robot (workstation configuration)	BenchBot Robot (G5486-00001) Regrip station Integration plates Drip sheets Computer VWorks software Safety equipment: • BenchBot Disable Hub • Emergency-stop pendant • Light Curtain or shield
G5487A BenchBot Robot (standalone/component configuration)	BenchBot Robot (G5486-00001) Regrip station Computer VWorks software Emergency-stop pendant

EU installations only. Be aware that the G5487A BenchBot Robot (standalone/component configuration) is considered partly completed machinery that is required to be installed with other equipment such that the fully assembled machinery complies with the essential health and safety requirements (EHSRs) of the Machinery Directive 2006/42/EC. If you use third-party safety or other equipment with the G5487A BenchBot Robot, see the third-party equipment documentation for space-planning information.

Table height

Although the table surface dimensions can vary, the surface must be at least 86 cm (34 in) from the floor. The specified height helps prevent user access above the Light Curtain or shield.

Figure Minimum distance of the work surface from the floor

Table frame requirements

The table frame must meet the following requirements:

- The frame must have a leveling mechanism in the feet or castors.
- The frame and castors should have a minimum load rating of 680 kg (1500 lb). If you want to use a table with a lower load rating, contact Automation Solutions Customer Service.
- The frame must have cross members to prevent the table from swaying when the workstation is in operation.
- The frame must have some provisions for securing the table surface.
- Table legs must be a maximum of 152 cm (60 in) apart.

Table surface requirements

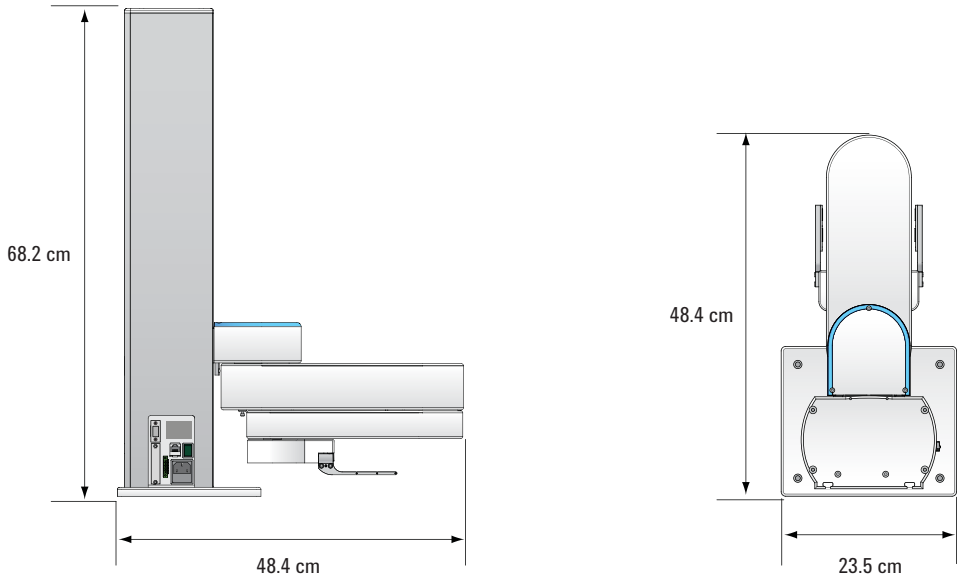
The table surface must meet the following requirements:

- The table surface must be chemical resistant. (For example, Trespa® TopLab^{PLUS}®, phenolic, or equivalent table surfaces have shown to meet this requirement.) Agilent Technologies does not recommend using laminated particle board, because the board might be exposed to liquids around the mounting holes.
- The table surface must be at least 19 mm (0.75 in) thick.
- The table surface should permit tapped holes for securing the BenchBot integration plates. For more information about the integration plates, see “BenchBot integration plate specifications” on page 18.
- The table surface should not overhang the frame by more than 51 mm (2 in) on each side.

Related information

For information about...	See...
Robot dimensions	“Robot dimensions” on page 17
Integration plate specifications	“BenchBot integration plate specifications” on page 18
Robot mounting specifications	“Robot mounting specifications” on page 22
Space requirements for the safety equipment	“Safety equipment space requirements” on page 24
Space requirements for the computer	“Computer placement requirements” on page 31
Electrical requirements	“Electrical requirements” on page 35
Environmental requirements	“Environmental requirements” on page 36
Computer requirements	“VWorks software requirements” on page 38

Robot dimensions



Dimension	Value
Height	68.2 cm (26.8 in)
Width	23.5 cm (9.3 in)
Depth	48.4 cm (19.0 in)
Weight	19 kg (42 lb)

Grippers: 4.1 mm thick, with replaceable gripping pads
Power cord: 2.7 m (9.0 ft)
Ethernet cable: 3.0 m (10 ft)

Related information

For information about...	See...
Robot workspace	“Workspace specifications” on page 32
Integration plate specifications	“BenchBot integration plate specifications” on page 18
Robot mounting specifications	“Robot mounting specifications” on page 22
Safety equipment space requirements	“Safety equipment space requirements” on page 24

BenchBot integration plate specifications

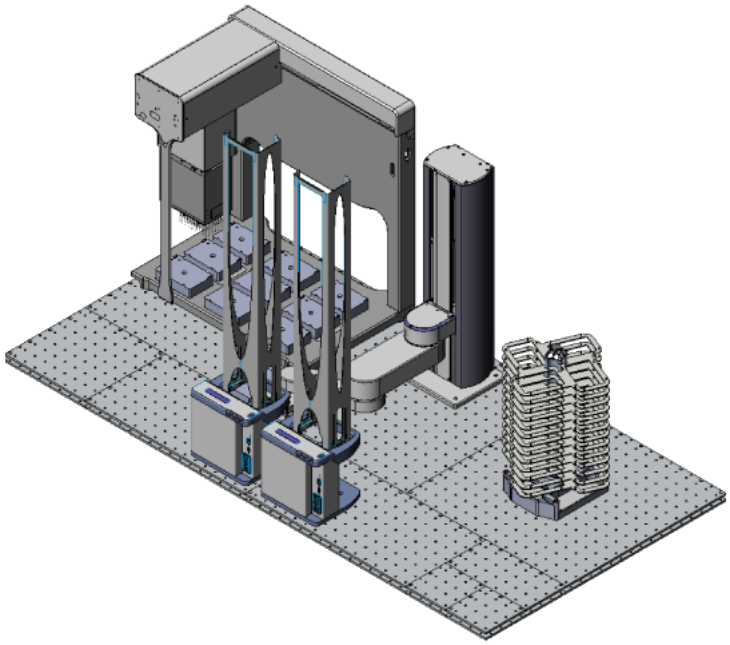
About the BenchBot integration plates

Note: The BenchBot integration plates are supplied with the G5486A BenchBot Robot (workstation configuration). The integration plates are optional and recommended for the G5487A BenchBot Robot (standalone/component configuration) to increase robot positioning stability and labware-handling accuracy. If you do not use the integration plates, you must use another method to secure the robot in position on the workstation table.

The BenchBot integration plates are flat, metal plates that can be assembled to provide a stable mounting surface for the BenchBot Robot. Available in different sizes, the integration plates can be combined to create custom-size mounting surfaces to meet the needs of your laboratory. The position and number of mounting holes in the plates can accommodate a variety of device configurations that can be changed easily for different application requirements.

In the following example, various plates are combined to accommodate a workstation consisting of a BenchBot Robot, a Bravo Platform, a MiniHub, and two Stackers.

Figure The BenchBot Robot and devices mounted on integration plates



Attachment surface

The integration plates must be installed on a flat surface that is capable of supporting the weight of the integration plates, the robot, and integrated devices. For more information, see "Workstation table requirements" on page 14.

Layout considerations

When planning the layout of the integration plates, consider the following:

- The assembled plates should be contained within the area of the table surface. None of the plates should hang over the edges of the table surface.
- If the plate assembly will straddle two surfaces, make sure the surfaces are at the same height so that the plate assembly remains even and level.

Plate dimensions

The following table lists the different sizes of integration plates available.

Plate type	Mounting surface	Total dimensions	Weight
24 x 12	610 mm x 305 mm (24 in x 12 in)	622 mm x 317 mm (24.5 in x 12.5 in)	6.3 kg (13.9 lb)
12 x 12	305 mm x 305 mm (12 in x 12 in)	317 mm x 317 mm (12.5 in x 12.5 in)	3.1 kg (6.9 lb)
12 x 6	305 mm x 152 mm (12 in x 6 in)	317 mm x 165 mm (12.5 in x 6.5 in)	1.5 kg (3.4 lb)
6 x 6	152 mm x 152 mm (6 in x 6 in)	165 mm x 165 mm (6.5 in x 6.5 in)	0.8 kg (1.7 lb)

Note the following:

- *Mounting surface column*. The mounting surface is the area on which robots and devices can be mounted (**1**).

  When calculating the total surface area available for mounting robots and devices, use the values in this column. For example, if you assemble two 12 x 12 plates, the area on which you can mount devices is 610 mm x 305 mm (24 in x 12 in).

- *Total dimensions column*. The dimensions value is the total measurement of the plate: the mounting surface plus the lip of the plate. The lip is the 12.7 mm (0.5 in) of ledge surrounding two sides of each plate (**2**). When it is between plates, the lip is part of the locking mechanism that keeps adjacent plates together. When it is on the edges of the plate assembly, it can be used to secure the plate assembly to the table surface or benchtop.

When calculating the total dimensions of the plate assembly, use the values in the Mounting surfaces column and add 12.7 mm (0.5 in) to account for the lip on two of the sides. For example, if you assemble two 12 x 12 plates, the total dimensions will be 622 mm x 317 mm (24.5 in x 12.5 in).

Figure The mounting surface and the lip

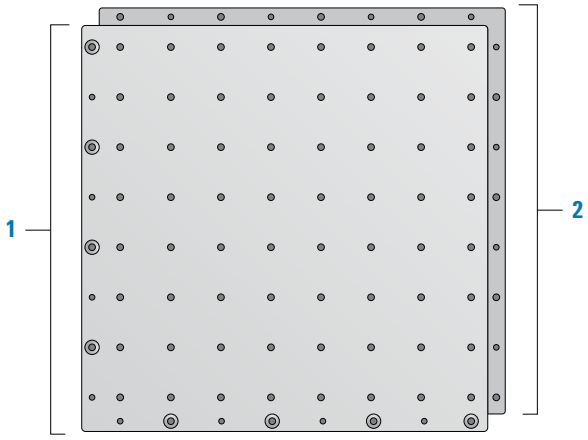


Plate assembly requirements

M5 x 12 flat-head socket-cap screws (FHSC screws, supplied) are required to lock adjacent plates together. Use only the counter-sink holes as shown in the diagram. For assembly instructions, see "Installing the robot" on page 27.

Figure Countersink holes for joining adjacent plates

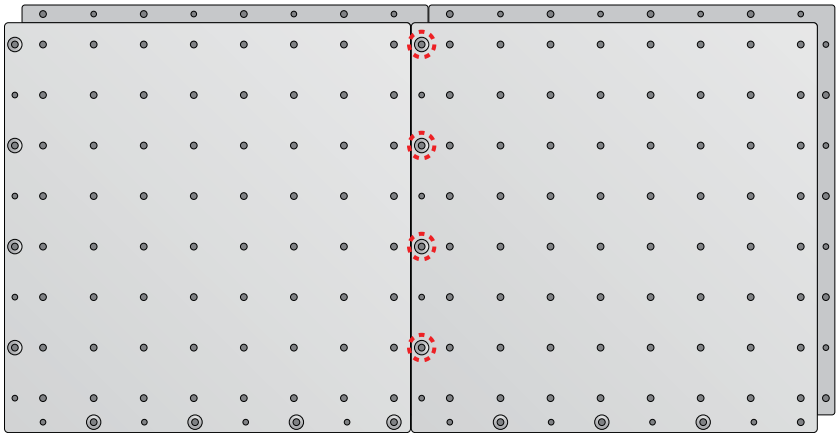


Plate mounting specifications

M5 FHSC screws (supplied) are required to secure the integration plates to the table surface. Use only the clearance holes on the edges for securing the plate assembly to the table surface.

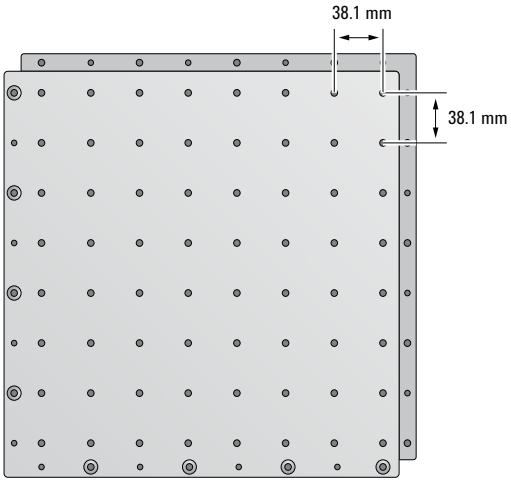
Mounting requirement	Measurement
Hole distance (center to center)	76 mm (3 in)
Screw type	M5 FHSC screw* * Length and type depends on the table surface material.

IMPORTANT Because the construction of the table surface can vary widely, you should work with your facilities personnel to secure the integration plates to the table surface. Agilent Technologies service personnel will not secure the integration plates to the table surface.

Device-mounting hole specifications

The following diagram shows the integration plates and the spacing of the holes for mounting the robot and devices. The spacing of the device-mounting holes are uniform across all plate types.

Figure Device-mounting hole specifications



Mounting requirement	Measurement
Hole distance (center to center)	38.1 mm (1.5 in)
Screw type	M5 x 12 FHSC screws (supplied)

Related information

For information about...	See...
Robot mounting specifications	“Robot mounting specifications” on page 22
Robot workspace	“Workspace specifications” on page 32
Robot dimensions	“Robot dimensions” on page 17

Robot mounting specifications

Attachment surface

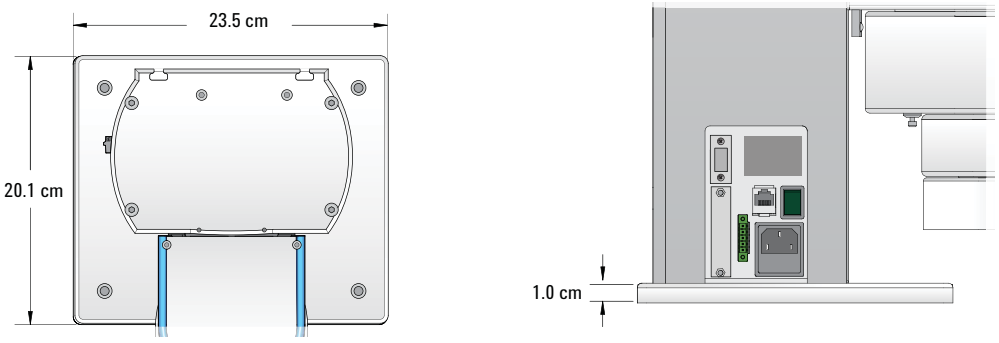
The BenchBot Robot must be mounted vertically on the integration plates or attachment surface. Be sure to plan the layout of the robot and other devices before installing them.

Layout considerations

When planning the layout of the robot and devices, be aware that the robot or any device can straddle two or more plates.

Robot base dimensions

Figure BenchBot Robot base top view (left) and side view (right)

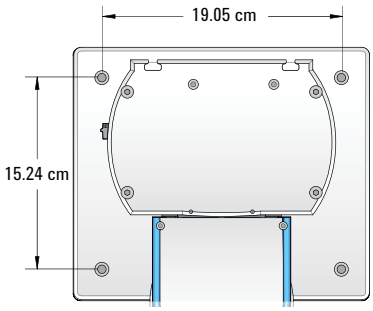


Dimension	Value
Width	23.5 cm (9.3 in)
Depth	20.1 cm (7.9 in)
Height	1.0 cm (0.4 in)

Robot base mounting specifications

Four M6 screws (supplied) are required to secure the BenchBot Robot to the integration plate. The following diagram shows the base of the robot and the spacing of the holes for the screws.

Figure BenchBot Robot base mounting holes



Mounting requirement	Measurement
Screw hole diameter	6.76 mm (0.266 in), through the base
Screw type	M6 socket-head cap screw
Number of screws	4
Hole distance (center to center)	19.05 cm (7.50 in) 15.24 cm (6.00 in)

CAUTION The BenchBot Robot must be bolted to the integration plates or attachment surface. Operating the robot without bolting it down can create excessive vibration, causing inaccurate pick-and-place performace. In addition, it can cause the robot to fall over and damage itself and other devices.

For the mounting specifications of the other devices, see the device user documentation.

Related information

For information about...	See...
Robot workspace	“Workspace specifications” on page 32
Space requirements for the safety equipment	“Safety equipment space requirements” on page 24
Space requirements for the computer	“Computer placement requirements” on page 31
Electrical requirements	“Electrical requirements” on page 35
Environmental requirements	“Environmental requirements” on page 36
Computer requirements	“VWorks software requirements” on page 38

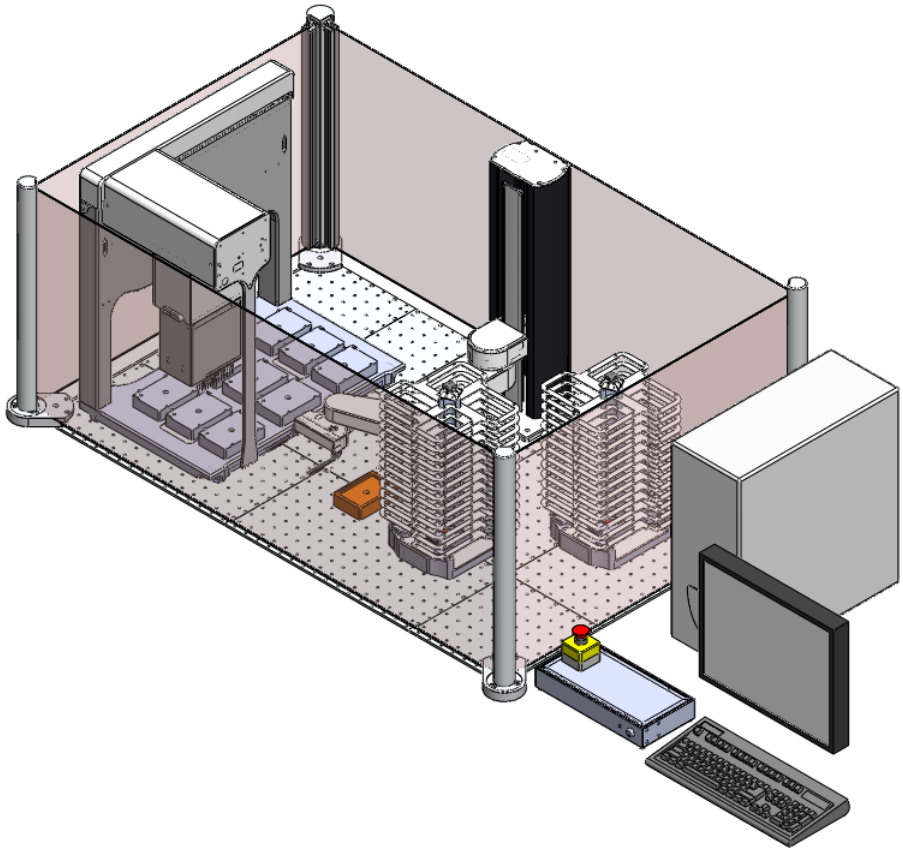
Safety equipment space requirements

Safety equipment is part of the G5486A BenchBot Robot (workstation configuration). The safety equipment consists of the following:

- BenchBot Disable Hub
- Emergency-stop pendant
- One of the following:
  - Light Curtain
  - Shields

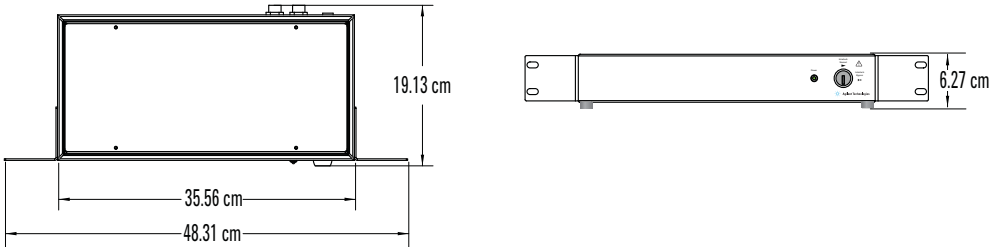
The following diagram shows an example workstation with the Light Curtain. The pink shield surrounding the workstation depicts light beams from the Light Curtain. The BenchBot Disable Hub is on the right side of the workstation, and the emergency-stop pendant is on the hub.

Figure The BenchBot Robot workstation with Light Curtain



BenchBot Disable Hub

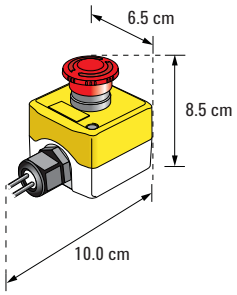
Figure BenchBot Disable Hub top view (left) and front view (right)



Dimension	Value
Width:	
Without mounting bracket	35.56 cm (14.00 in)
With mounting bracket	48.31 cm (19.02 in)
Depth	19.13 cm (7.53 in)
Height:	
With feet (table placement)	6.27 cm (2.47 in)
Without feet (rack mount)	5.71 cm (2.25 in)

The hub has two mounting brackets that are 1.5 rack units (or 1.5 RU) tall, and permit the hub to be mounted in a standard 19-inch rack. Mounting screws and washers are provided.

Emergency-stop pendant



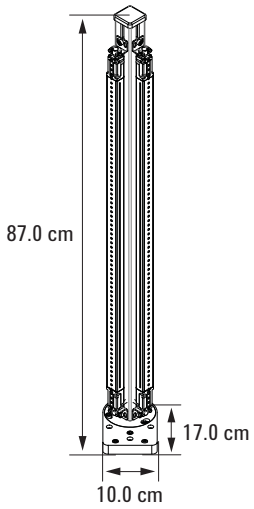
Dimension	Value
Width	8 cm (3 in)
Depth	13 cm (5 in)
Height	8 cm (3 in)

Pendant cable: 2 m (6 ft)

WARNING **Make sure you place the pendant outside of the danger zone.**

Light Curtain

The Light Curtain consists of up to two lightposts and up to three mirror posts. The following diagram and table show the dimensions of the posts.

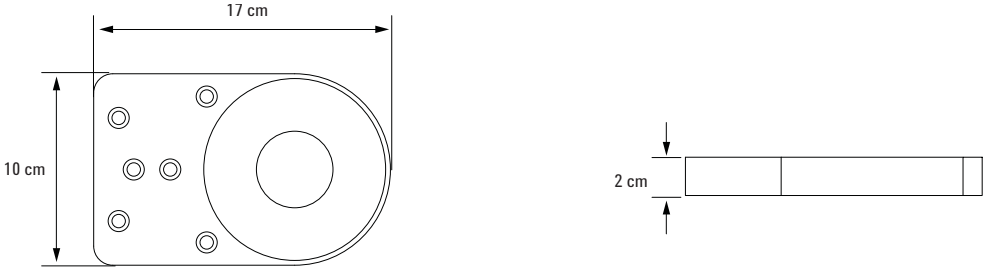


Dimension	Value
Width	10.0 cm (3.9 in)
Depth	17.0 cm (6.7 in)
Height	87.0 cm (34.2 in)

Transmitter and receiver cables: 5.0 m (16.4 ft)

The Light Curtain must be mounted vertically on the integration plates. The following diagram and table show the dimensions of the lightpost base.

Figure Lightpost base dimensions



Lightpost base dimension	Value
Width	17.0 cm (6.7 in)
Depth	10.0 cm (3.9 in)
Height	2.0 cm (0.8 in)

Three M6 screws (supplied) are required to hold each lightpost to the integration plates. The following diagrams and table show the spacing of the holes for the screws. The lightpost can be mounted at either the corner or side of the integration plates.

Figure Lightpost mounting holes for corner mount

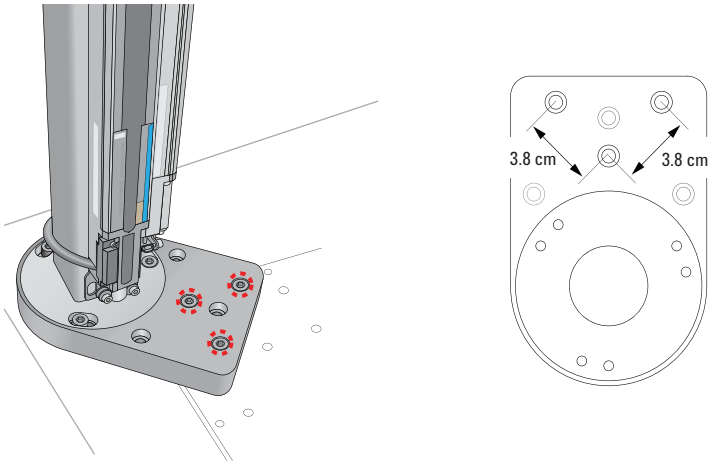
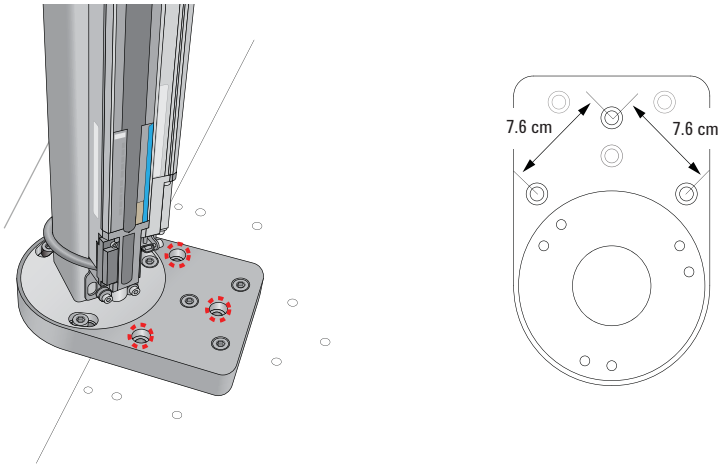


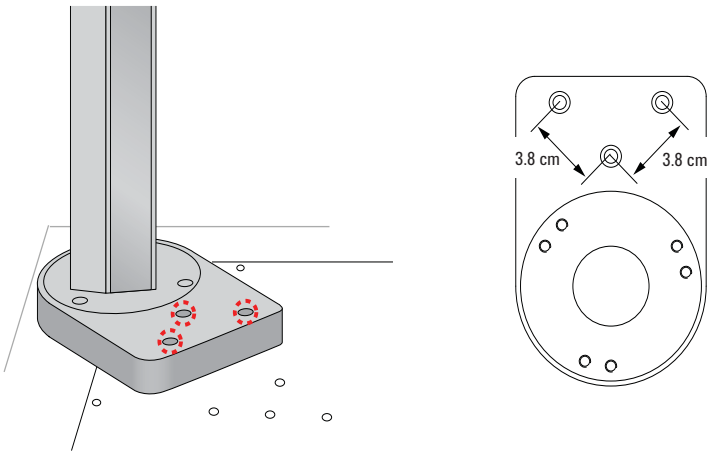
Figure Lightpost mounting holes for side mount



Mounting requirement	Measurement
Screw type	M6 socket-head cap screw
Number of screws	3 per lightpost
Hole distance (center to center)	3.8 cm (1.5 in) corner mount 7.6 cm (3.0 in) edge mount

The mirror posts are mounted at the corners of the integration plates only. The following diagram and table show the spacing of the holes for the screws.

Figure Mirror post mounting holes



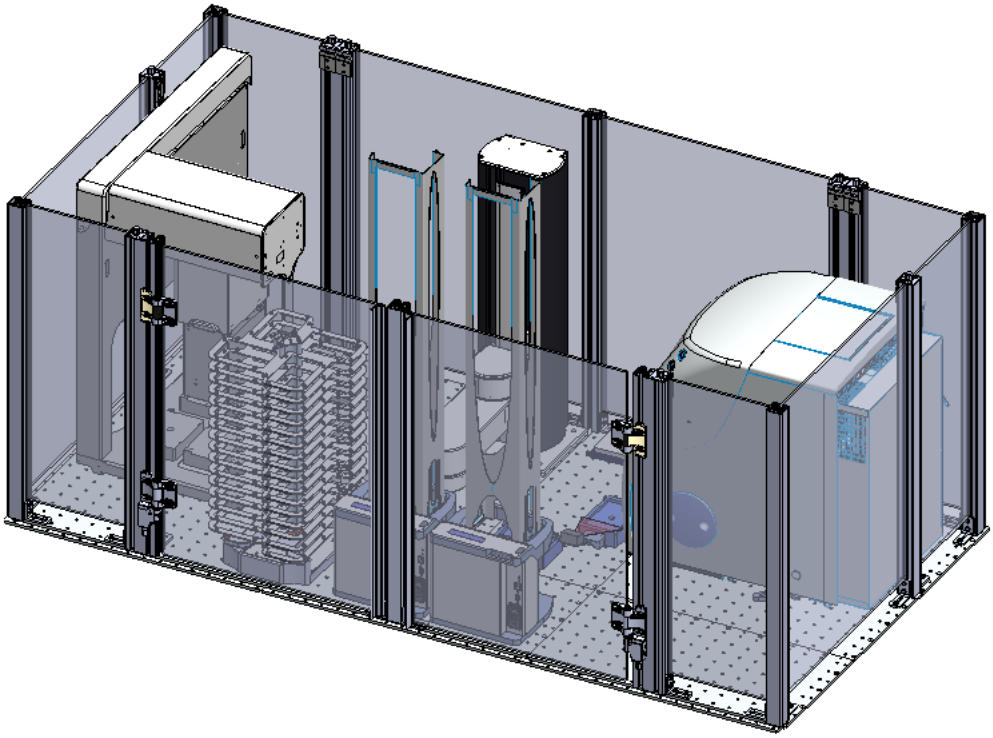
Mounting requirement	Measurement
Screw type	M6 socket-head cap screw
Number of screws	3 per mirror post
Hole distance (center to center)	3.8 cm (1.5 in) corner mount only

WARNING **The lightpost and mirror posts must be bolted down to the integration plates. Failure to do so can cause the light beams to become misaligned, rendering the Light Curtain useless. In addition, the posts can fall over and damage themselves and other devices.**

Shields

The shield consists of multiple polycarbonate panels that are held in place by metal frames installed around a workstation. The size of a workstation determines the size and number of panels used.

Figure The BenchBot Robot workstation with shield



L-shaped mounting brackets (supplied) and M6 x 12 screws (supplied) hold the metal frames to the integration plates. An interlock sensor is installed at each door to detect whether the door is open or closed.

For more information about the shield, contact Automation Solutions Customer Service.

Related information

For information about...	See...
Robot workspace	“Workspace specifications” on page 32
Robot dimensions	“Robot dimensions” on page 17
Integration plate specifications	“BenchBot integration plate specifications” on page 18
Robot mounting specifications	“Robot mounting specifications” on page 22
Space requirements for the computer	“Computer placement requirements” on page 31

Computer placement requirements

Be sure to plan for the placement of the supplied desktop computer. If you want to place the computer, monitor, and keyboard on the same surface as the workstation:

- Be sure to place the computer equipment outside of the Light Curtain or enclosure.
- Add approximately 61 cm (24 in) to the length of the table surface for the computer equipment.

For information about the supplied computer, contact Automation Solutions Customer Service.

Related information

For information about...	See...
Robot workspace	“Workspace specifications” on page 32
Safety equipment space requirements	“Safety equipment space requirements” on page 24
Electrical requirements	“Electrical requirements” on page 35
Environmental requirements	“Environmental requirements” on page 36
Labware and performance specifications	“Labware and performance specifications” on page 37
Computer requirements	“VWorks software requirements” on page 38

Workspace specifications

About this topic

This topic describes the three zones you should be aware of when planning the placement of devices and accessories around the robot:

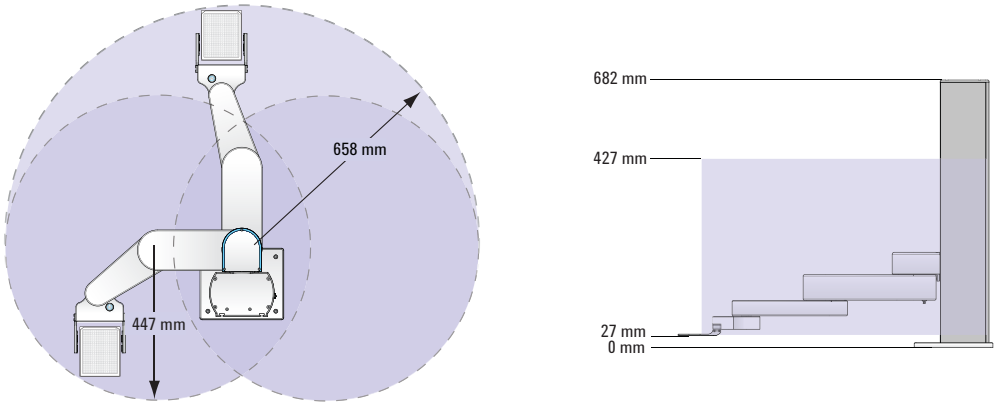
- Maximum reach
- Robot zone
- Teachpoint zone

Maximum reach

The following diagram shows the maximum robot reach. Notice the following:

- The robot arm is considered fully extended when the forearm is +/- 10° from the bicep.
- When the arm is fully extended, the maximum reach is 658 mm. This measurement includes a standard labware held in the portrait orientation.

Figure BenchBot Robot radial reach (left) and vertical reach (right)



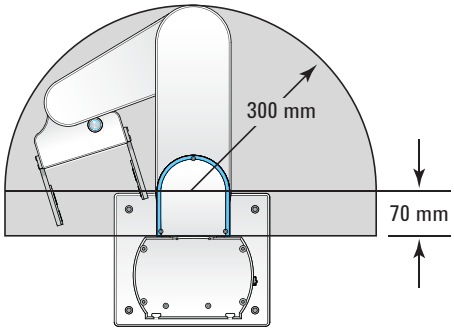
Robot zone

The robot zone is the region within which the BenchBot Robot is allowed to move without colliding with external devices. In general, the robot moves into the robot zone to change its arm orientation, rotate its wrist, or for other purposes after it completes a Move to, Pick from, Place to, or Transfer command.

IMPORTANT The robot software will not allow you to set teachpoints within the robot zone. An error message will display if you attempt to set a teachpoint within the robot zone.

The following diagram shows the top view of the robot zone. It is the shaded region within the elongated semi-circle.

Figure BenchBot Robot robot zone



Teachpoint zone

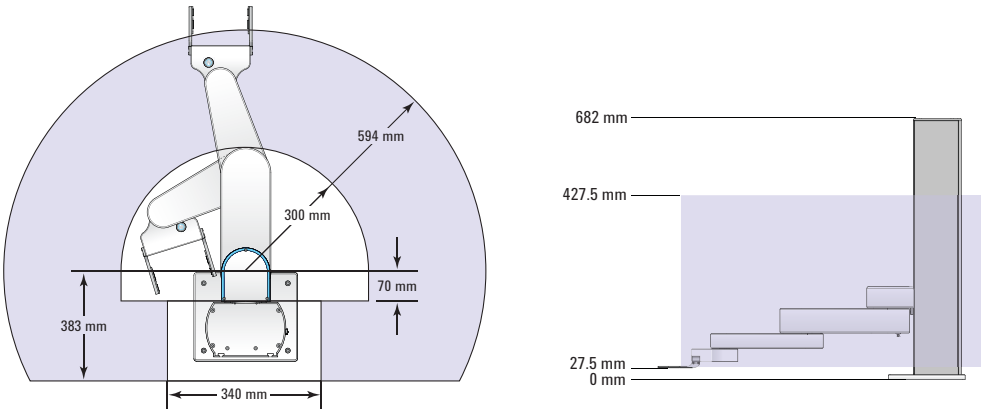
The teachpoint zone is the region within which you can set teachpoints. The following diagram shows the top and side views of the teachpoint zone. The outermost line shows the robot's maximum reach, through the center of the gripper and labware. The region within the inner line is the the robot zone. The teachpoint zone is between the two boundaries.

IMPORTANT To optimize performance results, teachpoints should be set within 30 mm to 415 mm along the *z*-axis.

IMPORTANT If you are planning a modular system where devices on docking tables can be added or removed frequently, make sure these device teachpoints are within the robot teachpoint zone.

Note: The robot cannot access the rectangular region enclosing the back half of the mast. Do not set teachpoints within this region.

Figure BenchBot Robot teachpoint zone top view (left) and side view (right)



Related information

For information about...	See...
Robot dimensions	“Robot dimensions” on page 17
Safety equipment space requirements	“Safety equipment space requirements” on page 24
Computer placement requirements	“Computer placement requirements” on page 31
Electrical requirements	“Electrical requirements” on page 35
Environmental requirements	“Environmental requirements” on page 36
Labware and performance specifications	“Labware and performance specifications” on page 37
Computer requirements	“VWorks software requirements” on page 38

Electrical requirements

Requirement	Value
Voltage	100–240 VAC
Frequency	50/60 Hz
Current	4 A
Power consumption	200 W typical
Fuses	6.3 A, 250 V, time delay, 5 mm x 20 mm
Chassis plug	IEC 60320 C14

Be sure to connect the BenchBot Robot to an AC circuit that is properly grounded.

Related information

For information about...	See...
General placement considerations	“General placement considerations” on page 12
Environmental requirements	“Environmental requirements” on page 36
Labware and performance specifications	“Labware and performance specifications” on page 37
Computer requirements	“VWorks software requirements” on page 38

Environmental requirements

Ambient environment

IMPORTANT The BenchBot Robot must operate within the temperature and humidity specifications stated in the following table.

Operating	Recommended range
Temperature	4–40 °C
Humidity	10–90% RH, non-condensing
Storage (non-operating)	**Recommended range**
Temperature	-20–50 °C
Humidity	0–90% RH, non-condensing

Related information

For information about...	See...
General placement considerations	"General placement considerations" on page 12
Electrical requirements	"Electrical requirements" on page 35
Labware and performance specifications	"Labware and performance specifications" on page 37
Computer requirements	"VWorks software requirements" on page 38

Labware and performance specifications

The BenchBot Robot can move all ANSI-compliant labware with or without lid.

Labware or performance parameter	Value
Distance between grippers	Maximum: 134 mm Minimum: 77 mm Homed: 130 mm
Payload	Maximum: 300 g
Repeatability	*x*, *y*, *z*: ±0.1 mm Yaw (xy plane): ±0.02°
Transfer time	Pick-and-place: 5 s average

Related information

For information about...	See...
General placement considerations	"General placement considerations" on page 12
Electrical requirements	"Electrical requirements" on page 35
Environmental requirements	"Environmental requirements" on page 36
Computer requirements	"VWorks software requirements" on page 38

VWorks software requirements

For VWorks software computer requirements, see the VWorks software release notes or the Automation Solutions Knowledge Base at www.agilent.com/lifesciences/automation.

Related information

For information about...	See...
Computer placement requirements	"Computer placement requirements" on page 31
Electrical requirements	"Electrical requirements" on page 35
Environmental requirements	"Environmental requirements" on page 36
Labware and performance specifications	"Labware and performance specifications" on page 37

3 Installing the BenchBot Robot workstation

This chapter contains the following topics:

Installation workflow

Before you start

Agilent Technologies strongly recommends that you install the BenchBot Robot inside an enclosure. Safety-interlocked doors or Light Curtain that stops the robot when opened or interrupted can be used to further mitigate risk. Make sure the safety-interlocked enclosure complies with your country's safety regulations.

EU installations only. The enclosure and other safety recommendations are required so that the BenchBot Robot installation is compliant with the provisions of the Machinery Directive 2006/42/EC.

WARNING **To reduce the risk of injury from moving parts, make sure that the BenchBot Robot safety interlock circuit is connected to an enclosure or Light Curtain with an interlock switch or key.**

Workflows

The following table presents the steps for installing the BenchBot Robot and safety equipment.

All equipment supplied with the G5486A BenchBot Robot (workstation configuration) will be installed for you. Changing the installed workstation might invalidate the safety compliance and lead to personal injury or equipment damage. For safe operation, you should become familiar with how the BenchBot Disable Hub works with the Light Curtain and the shield. See steps 8 and 9.

If you have the G5487A BenchBot Robot (standalone/component configuration), you can use the instructions in this chapter to install the robot and, if applicable, the recommended integration plates. See steps 1 through 7. Note that by building and installing your own workstation, you are assuming responsibility for providing appropriate safety protection and compliance.

Step	For this task...	See...
1	Verify that the installation location meets the site requirements.	“Laboratory setup requirements” on page 11
2	Unpack the robot.	*BenchBot Robot Unpacking Guide*
3	Assemble the integration plates.	“Assembling and disassembling the integration plates” on page 42
4	Secure the integration plates to the workstation table.	Laboratory facilities personnel
5	Install the robot.	“Installing and removing the robot” on page 45
6	Install other devices.	Device user guides
7	Install the computer.	“Installing the computer” on page 51

Step	For this task...	See...
8	*Workstation configuration.* Install the BenchBot Disable Hub.	"About the BenchBot Disable Hub" on page 52
9	*Workstation configuration.* Install the Light Curtain or shield.	One of the following: • "About the Light Curtain" on page 56 • "About the shield" on page 59
10	Install the VWorks software.	*VWorks Automation Control Setup Guide*

For startup, shutdown, setup, and operating instructions, see the *BenchBot Robot User Guide*.

Related information

For information about...	See...
Bench space requirements	"Workstation table requirements" on page 14
Computer space requirements	"Computer placement requirements" on page 31
Safety information	"Safety guidelines" on page 1
Startup, shutdown, setup, and operating instructions	*BenchBot Robot User Guide*

Assembling and disassembling the integration plates

About this topic

The integration plates are supplied with the G5486A BenchBot Robot (workstation configuration). The plates are optional and recommended for the G5487A BenchBot Robot (standalone/component configuration) to increase robot positioning stability and labware-handling accuracy. If you do not use integration plates, you must use another method to secure the robot in position on the workstation table.

This topic explains how to assemble the integration plates. See your facilities personnel for instructions on how to secure the assembled integration plates to your workstation table or attachment surface.

For a description of the integration plates and the specifications, see "BenchBot integration plate specifications" on page 18.

Materials and tools

Make sure you have the following materials and tools:

- Desired integration plates (types and number of vary with workstation)
- FHSC M5 x 12 screws (supplied)
- Drip sheets (supplied with the G5486A BenchBot Robot)
- 4-mm hex wrench

Before you start

Make sure you:

- Plan the layout of the integration plates.
- Plan the placement of the robot and other devices on the integration plates.
- Become familiar with the mounting specifications provided in "BenchBot integration plate specifications" on page 18.

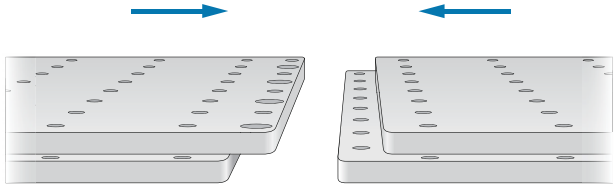
Assembling the integration plates

Note: Both the top and bottom sides of the plates are usable. When assembling the plates, if a plate does not fit, try turning it upside-down.

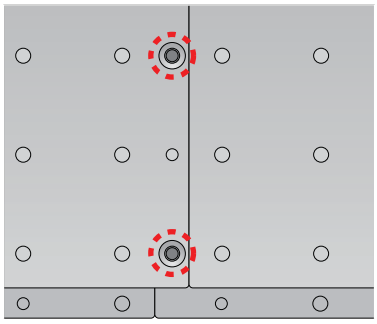
To assemble the integration plates:

1 On the attachment surface:

a Assemble the plates into the desired configuration, aligning adjacent plates as shown.

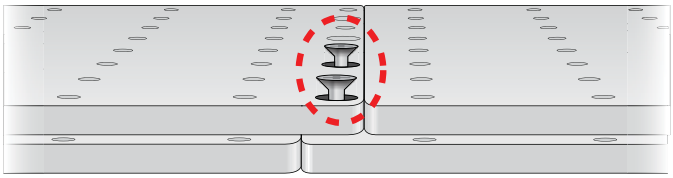


b Make sure that the counter-sink holes are aligned over the threaded holes on the lips of adjacent plates.



c Position the plate assembly so that the clearance holes in the plates align over the mounting holes in the attachment surface.

2 Lock the plates together. Insert the FHSC M5 x 12 screws in the counter-sink holes, and use the 4-mm hex wrench to tighten them until snug.



3 Secure the assembled plates to the attachment surface. See your facilities personnel for instructions.

4 Peel the protective paper from the back of the drip sheets, and then carefully place the sheets on the integration plates. The drip sheets prevent spills from leaking below the integration plates.

5 Mark the placement of robots and devices on the plate assembly. For example, you can use removable tape to mark the positions before mounting the robots and devices.

To attach the BenchBot Robot, see "Installing and removing the robot" on page 45. To attach other devices, see the device user guides.

Disassembling the integration plates

To disassemble the integration plates:

1 Remove the drip sheets from the integration plates.

2 Using the 4-mm hex wrench, loosen and remove the FHSC M5 x 12 screws in the counter-sink holes.

3 Consult your facilities personnel for instructions on removing the integration plates from the attachment surface.

4 Store the plates in the original shipping box.

5 Place the screws in a bag and store them with the plates.

Related information

For information about...	See...
Attaching the robot	"Installing and removing the robot" on page 45
Installing the computer	"Installing the computer" on page 51
Installing the VWorks software	*VWorks Automation Control Setup Guide*
Installing the safety equipment	• "About the Light Curtain" on page 56 • "About the shield" on page 59 • "About the BenchBot Disable Hub" on page 52

Installing and removing the robot

Materials and tools

Make sure you have the following materials and tools:

- BenchBot Robot
- Socket-head cap screws (SHCS) M6 x 16 (4, supplied)
- BenchBot Disable Hub (supplied with the G5486A BenchBot Robot), or equivalent third-party box that transmits and receives interlock circuit signals (G5487A BenchBot Robot)
- Emergency-stop pendant
- Power cord
- Ethernet cable
- Robot-hub cable
- 5-mm hex wrench

Installation workflow

Step	For this task...	See...
1	Install the robot.	"Attaching the robot" on page 45
2	Connect the power, communication, and BenchBot Disable Hub.	"Connecting the cables" on page 46

To remove the robot, see "Removing the BenchBot Robot" on page 48.

Before you start

Make sure you:

- Mount the integration plates to the workstation table.
- Review "Laboratory setup requirements" on page 11 when planning the following:
  - Position of the robot
  - Position of the devices
- Are aware of the robot's maximum reach and the region in which you can set teachpoints.

Attaching the robot

CAUTION The BenchBot Robot must be bolted to the integration plates or attachment surface. Operating the robot without bolting it down can create excessive vibration, causing inaccurate pick-and-place performance. In addition, it can cause the robot to fall over and damage itself and other devices.

To attach the robot to the integration plate or attachment surface:

1. Position the robot on the integration plate or attachment surface so that the base aligns over the mounting holes.
2. Insert the M6 screws in the four mounting holes and use the 5-mm hex wrench to tighten the screws until snug.

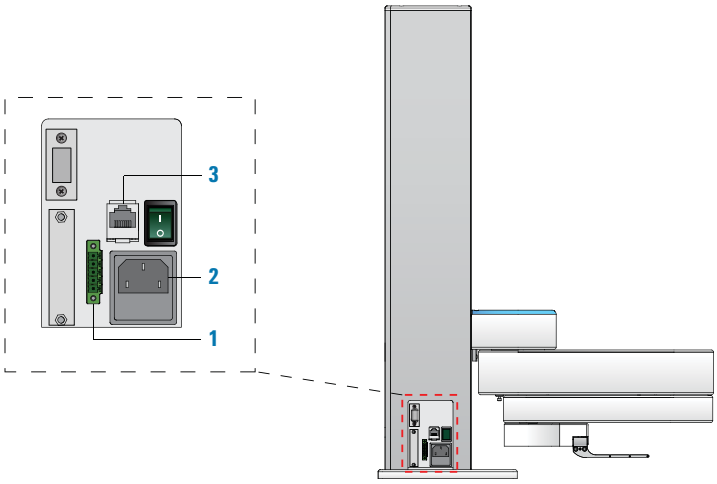
Connecting the cables

Before you start

- Make sure your laboratory meets the setup requirements. See "Laboratory setup requirements" on page 11.
- Follow the instructions included with the computer for setting up the computer. Make sure the computer and the BenchBot Robot are turned off.
- Make sure you have the supplied power cord, Ethernet cable, and robot-hub cable (the cable that connects the robot to the disable hub).

Connection panel

The power, Ethernet, and BenchBot Disable Hub connections are at the lower left side of the robot's mast.



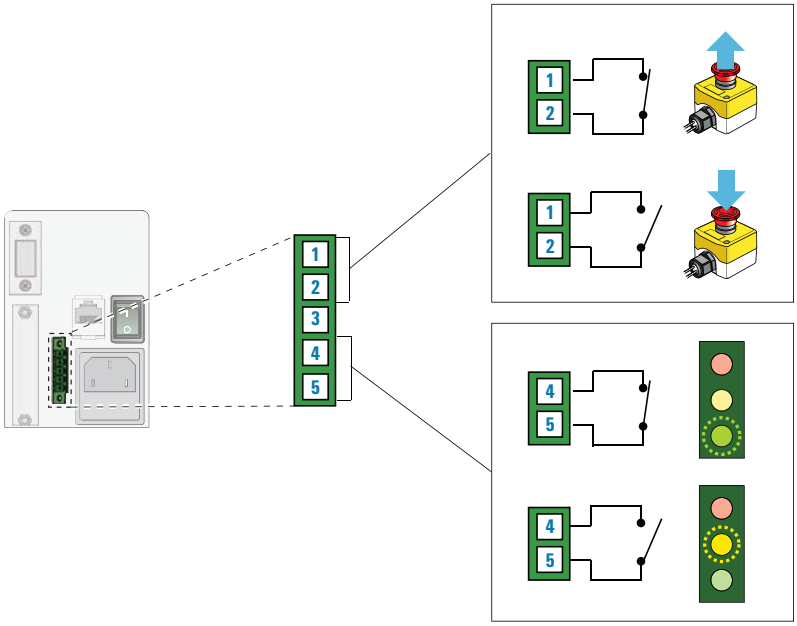
Item	Name	Description
1	Pendant port	Connects the BenchBot Robot to the BenchBot Disable Hub. *G5487A BenchBot Robot (standalone/component configuration).* Connects the emergency-stop pendant to the robot. If you want to connect a third-party box that transmits or receives interlock circuit signals, connect the box to the robot using this 5-pin pendant port on the robot. For more information, see "Pendant port connector pinout" on page 47.

Item	Name	Description
2	AC power entry	Connects the BenchBot Robot to an AC outlet with a safety earth grounding pin.
3	Ethernet port	Connects the BenchBot Robot to the controlling computer.

Pendant port connector pinout

If you have a G5487A BenchBot Robot (standalone/component configuration) and you want to use a third-party box that transmits or receives interlock circuit signals, connect the box to the 5-pin pendant port on the robot.

The pendant port is a 5-pin male connector (Phoenix Contact, part number 1803303). The following diagram and table show the connector pinout.



Pin	Connects to...	Purpose
1	Emergency-stop pendant and interlock circuit	+24 V output, from the robot to the pin.
2	Emergency-stop pendant and interlock circuit	Input, from the pin to the robot. Low state: 0 V, stop. High state: +24 V, run.
3	Not used	Not used
4	Third-party box	+24 V output, from the robot to the pin.
5	Third-party box	Input, from the pin to the robot. Low state: 0 V, reduced-speed mode. High state: +24 V, normal-speed mode.

Note: Pins 4 and 5 are only used if you connect a third-party box that transmits or receives interlock circuit signals.

The emergency-stop circuit (pins 1 and 2) is independent of the speed-mode circuit (pins 4 and 5). If the robot is in the reduced-speed mode, you can still press the emergency-stop button to stop the robot. However, if you press the emergency-stop button, you will not be able to move the robot until after recovery.

WARNING **To reduce the risk of injury from moving parts, make sure that the BenchBot Robot safety interlock circuit is connected to a Light Curtain or an enclosure with an interlock switch or key. For example, if you are using an third-party box that has an interlock switch or key, make sure you connect the Light Curtain or enclosure and the emergency-stop pendant to the box.**

Procedure

WARNING **Make sure the power cord is in good condition and is not frayed. Use of frayed or damaged power cords can cause injury.**

CAUTION **Use only the supplied power cord. Use of incorrect power cords can cause damage to the robot.**

To connect the cables:

1. At the pendant port:
   - *G5486A BenchBot Robot (workstation configuration).* Use the robot-hub cable to connect the BenchBot Disable Hub to the robot.
   - *G5487A BenchBot Robot (standalone/component configuration).* Connect the free end of the pendant cable to the robot. If you want to use a third-party box that transmits or receives the interlock circuit signals, connect the box to the robot using this 5-pin pendant port on the robot.
2. Use the supplied power cord to connect the robot to the power source.
3. Use the supplied Ethernet cable to connect the robot to the controlling computer. Connect the computer to the lab's wide area network.

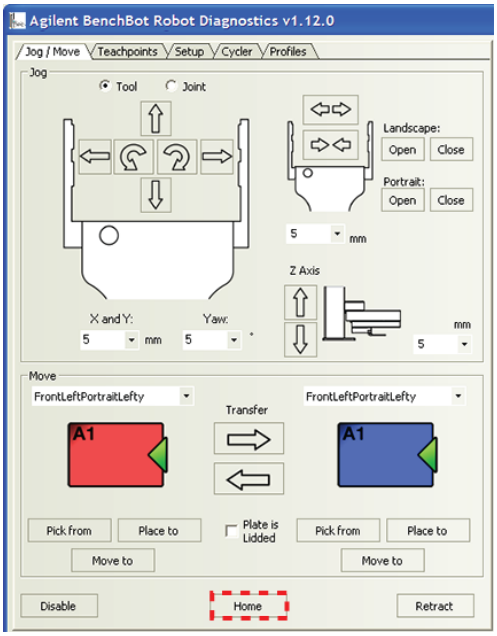
Removing the BenchBot Robot

Before you start

Before you remove the robot from the integration plates or attachment surface:

1. Move the robot arm to the home position. In **BenchBot Diagnostics Jog/Move** tab, click **Home**. The robot tucks its forearm and grippers under its bicep.

WARNING **Keep out of the workstation while the robot is moving.**



2 Turn off all devices in the workstation. For instructions, see the device user documentation.

3 Turn off the robot. See the *BenchBot Robot User Guide*.

Procedure

To disconnect the robot:

Disconnect and remove the following:

- Power cable
- Ethernet cable
- Robot-hub cable (G5486A BenchBot Robot), or pendant cable (G5487A BenchBot Robot)

To detach the robot:

1 Using the supplied 5-mm hex wrench, unscrew the four M6 screws that are holding the robot to the integration plate or attachment surface.

2 Place the robot on a flat, stable surface.

Related information

For information about...	See...
Installing the computer	"Installing the computer" on page 51
Installing the VWorks software	*VWorks Automation Control Setup Guide*

For information about...	See...
Installing the safety equipment	• "About the BenchBot Disable Hub" on page 52 • "About the Light Curtain" on page 56 • "About the Light Curtain" on page 56
Turning on and turning off the robot	*BenchBot Robot User Guide*
Setting up the robot in the software	*BenchBot Robot User Guide*
Setting teachpoints	*BenchBot Robot User Guide*
Packing the robot	*BenchBot Robot Unpacking Guide*

Installing the computer

See the manufacturer documentation for installation instructions. See also "Connecting the cables" on page 46 for instructions on connecting the computer to the BenchBot Robot.

WARNING **Where there is more than one control or operating position, including operators on remote computers, you must implement appropriate safety protocols to prevent the operators from hindering or putting each other into a hazardous situation.**

Related information

For information about...	See...
Installing the VWorks software	*VWorks Automation Control Setup Guide*
Turning on and turning off the robot	*BenchBot Robot User Guide*
Setting up the robot in the software	*BenchBot Robot User Guide*
Setting teachpoints	*BenchBot Robot User Guide*

About the BenchBot Disable Hub

About this topic

All safety equipment supplied with the G5486A BenchBot Robot (workstation configuration) will be installed for you. Changing the installed workstation might invalidate the safety compliance and lead to personal injury or equipment damage. For information on how to prepare for the installation, see "Laboratory setup requirements" on page 11. If you have questions about the safety equipment, contact Automation Solutions Technical Support.

This topic explains the function of the BenchBot Disable Hub and describes the two interlock key settings.

BenchBot Disable Hub description

The BenchBot Disable Hub is a central connection point for the BenchBot Robot and other devices. The hub:

- Provides the emergency-stop function for up to two BenchBot Robots and four devices that are equipped with emergency-stop circuitry.
- Receives interlock circuit signals from system doors or the Light Curtain, and transmits them to the robots and devices.
- Allows access for teaching the BenchBot Robot by muting, or overriding, the interlock circuit, placing the BenchBot Robot in the reduced speed mode and disabling other devices.

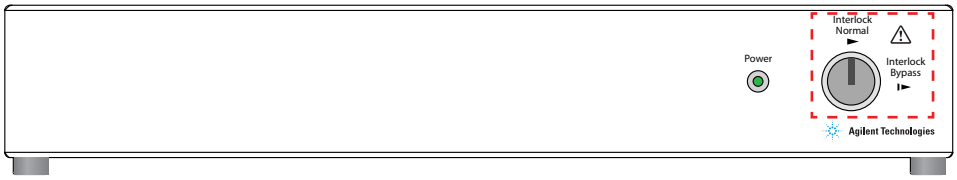
WARNING **Access to and use of the interlock key should be controlled. To avoid possible injury, the Interlock Bypass setting should be used only by personnel trained to teach the BenchBot Robot. The interlock key should be removed from the hub when not teaching the BenchBot Robot.**

Interlock key settings

An interlock key at the front of the hub can be set at:

- *Normal*. The interlock system is turned on. Under normal operating conditions, the key setting should be set at Normal.
- *Bypass*. The interlock system is muted, or overridden. When teaching the BenchBot Robot, use the Bypass key setting.

Figure BenchBot Disable Hub front view



The following sections describe the behavior of the robot and devices under each key setting.

IMPORTANT If the workstation is running a protocol, be sure to pause or finish the run before changing the key setting. If you are in BenchBot Robot Diagnostics and you have commanded the robot to move, make sure you stop the robot or allow it to finish moving before changing the key setting. Failure to pause the run or stop the robot before changing the key setting can cause an emergency stop condition and an error in the VWorks software. To recover from the emergency stop, see the *BenchBot Robot User Guide*. To recover from VWorks errors, see the *VWorks Automation Control User Guide*.

Normal setting

The following table shows the robot and device responses to the various Light Curtain or enclosure door states when the interlock key is set at Normal. Notice that whenever you press the emergency-stop button, interrupt the Light Curtain or open an enclosure door, the robot and devices connected to the hub will be disabled.

Table Normal interlock key setting

Key setting	Emergency stop	Light Curtain	Door	BenchBot Robot	Device
0 = Normal 1 = Bypass	0 = Normal 1 = Stopped	0 = Normal 1 = Tripped	0 = Closed 1 = Open	0 = Enabled 1 = Disable 3 = Slow	0 = Enabled 1 = Disabled
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	1	1
0	0	1	1	1	1
0	1	0 or 1	0 or 1	1	1

IMPORTANT You cannot always resume a protocol run after pressing the emergency stop button, interrupting the Light Curtain, or opening an enclosure door. You might need to rerun the protocol after restoring the system for normal operation. To restore the workstation for normal operation, see the *BenchBot Robot User Guide*.

Bypass setting

The following table shows the robot and device responses to the various Light Curtain or enclosure-door states when the interlock key is set at Bypass. Notice the following:

- The BenchBot Robot will always disregard operator-specified speed settings and move at a reduced speed. The reduced speed is 5% of the factory-set maximum speed.
- The devices connected to the hub will always be disabled.
- Whenever you press the emergency-stop button, regardless of the state of the Light Curtain or the enclosure door, the robot and connected devices will be disabled.

Figure Bypass interlock key setting

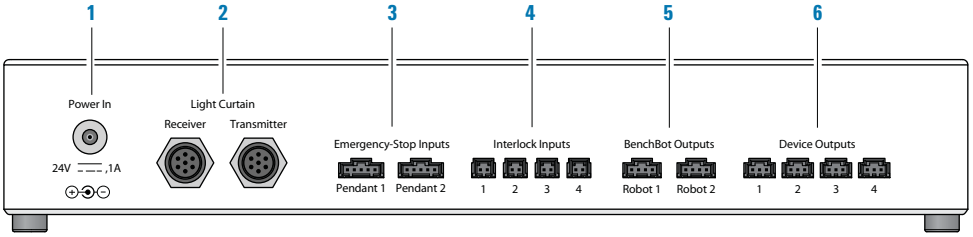
Key setting 0 = Normal 1 = Bypass	Emergency stop 0 = Normal 1 = Stopped	Light Curtain 0 = Normal 1 = Tripped	Door 0 = Closed 1 = Open	BenchBot Robot 0 = Enabled 1 = Disable 3 = Slow	Device 0 = Enabled 1 = Disabled
1	0	0 or 1	0 or 1	3	1
1	1	0 or 1	0 or 1	1	1

Connection panel

The following diagram and table show the connection panel on the back side of the BenchBot Disable Hub.

IMPORTANT Unused emergency-stop and interlock ports must have jumpers installed.

Figure BenchBot Disable Hub back view



Item	Name	Description
1	Power In	Connects the power supply to the hub. Make sure the power supply is connected to an AC outlet with a safety earth grounding pin.
2	Light Curtain	Connects the Light Curtain to the hub. • *Transmission*. The gray transmitter cable connects to the Transmitter port. • *Receiver*. The black receiver cable connects to the Receiver port. *Note:* If your workstation employs a shield, use the Interlock Inputs ports (4).
3	Emergency-Stop Inputs	Connects up to two BenchBot Robot emergency-stop pendants to the hub.

Item	Name	Description
4	Interlock Inputs	Connects up to four safety-interlocked doors to the hub. *Note:* If your workstation employs the Light Curtain, use the Light Curtain ports (2).
5	BenchBot Outputs	Connects up to two BenchBot Robots to the hub.
6	Device Outputs	Connects up to four devices that are equipped with emergency-stop circuitry.

Related information

For information about...	See...
Safety information	"Safety guidelines" on page 1
Planning for the safety equipment	"Safety equipment space requirements" on page 24
Installing the Light Curtain	"About the Light Curtain" on page 56
Installing the shield	"About the shield" on page 59
Installing the computer	"Installing the computer" on page 51
Installing the robot	"Installing and removing the robot" on page 45
Turning on and turning off the robot	*BenchBot Robot User Guide*
Setting up the robot in the software	*BenchBot Robot User Guide*

About the Light Curtain

About this topic

All safety equipment supplied with the G5486A BenchBot Robot (workstation configuration) will be installed for you. Changing the installed workstation might invalidate the safety compliance and lead to personal injury or equipment damage. For information on how to prepare for the installation, see "Laboratory setup requirements" on page 11. If you have questions about the safety equipment, contact Automation Solutions Technical Support.

This topic explains the function of the Light Curtain and describes how it works.

Light Curtain description

As part of the safety interlock circuit, the Light Curtain works in a similar manner to the emergency-stop pendant. Lightposts project and reflect light beams around the workstation. If an object disrupts the light beams, the safety interlock circuit stops the robot and devices that are connected to the BenchBot Disable Hub. Other devices that are not connected to the BenchBot Disable Hub might continue to move until they have completed the current tasks.

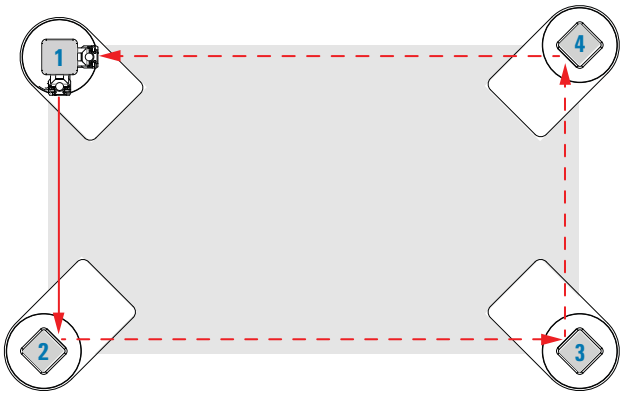
How the Light Curtain works

The Light Curtain consists of the following:

- *Lightpost*. Contains the light transmitter and light receiver components. In complex workstations, the transmitter and the receiver might be installed on different lightposts.
- *Mirror posts*. Consist of a mirror on one side of the post.

Light is transmitted from one side of the lightpost (**1**) and reflects off of the mirror posts (**2**, **3**, and **4**). The reflected light then returns to the receiver on another side of the lightpost (**1**).

Figure Lightpost and mirror posts (top view), and the transmission and reflection of light

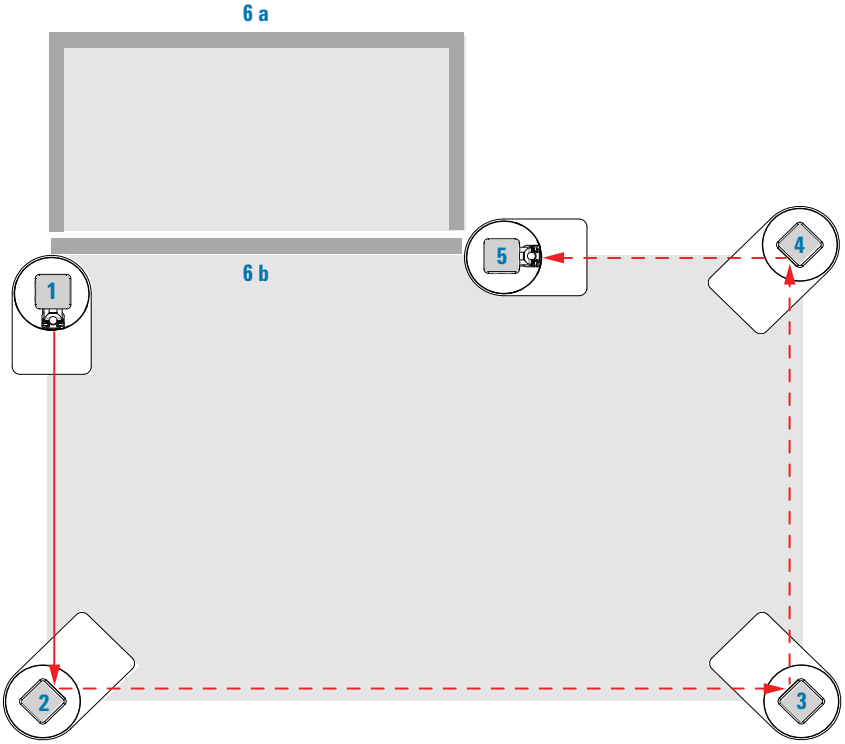


Depending on the workstation setup, the position and the number of posts can vary. In simple rectangular workstations, the lightpost typically hosts both the transmitter and the receiver. The lightpost and mirror posts are mounted at the corners of a workstation as shown in the previous figure.

In complex workstations, the light transmitter and the light receiver can be installed on different lightposts to accommodate flexible configurations. In the following example, the Light Curtain (1 through 5) surrounds the workstation table. Notice that the light transmitter is at lightpost 1 and the light receiver is at lightpost 5. In this flexible workstation, a docking table can be added between lightposts 1 and 5.

Note: A shield (6 a) can be installed on the docking table to prevent the operator from accidentally entering the danger zone. When the docking table is removed, another shield (6 b) can be added between lightposts 1 and 5 to protect the operator. Additional components are required to install these shields.

Figure Main light post and mirror posts (top view), and the emission and reflection of light



Related information

For information about...	See...
Safety information	“Safety guidelines” on page 1
Planning for the safety equipment	“Safety equipment space requirements” on page 24
Installing the BenchBot Disable Hub	“About the BenchBot Disable Hub” on page 52
Interlock key settings	“About the BenchBot Disable Hub” on page 52
Installing the shield	“About the shield” on page 59
Installing the computer	“Installing the computer” on page 51
Installing the robot	“Installing and removing the robot” on page 45
Turning on and turning off the robot	*BenchBot Robot User Guide*
Setting up the robot in the software	*BenchBot Robot User Guide*

About the shield

About this topic

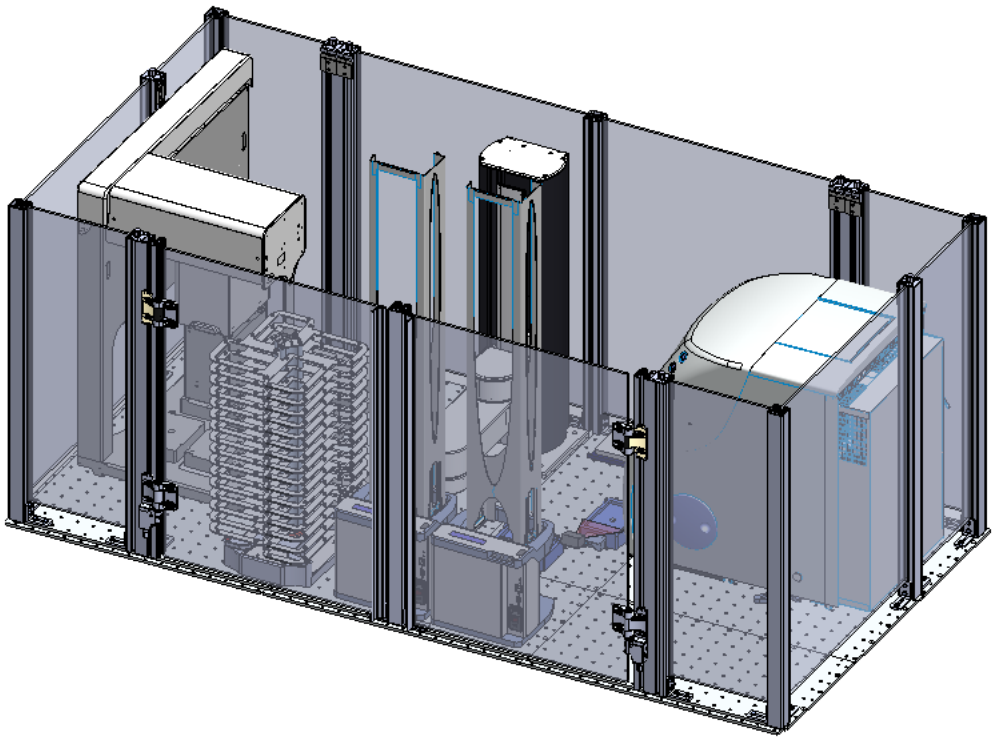
All safety equipment supplied with the G5486A BenchBot Robot (workstation configuration) will be installed for you. Changing the installed configuration might invalidate the safety compliance and lead to personal injury or equipment damage. For information on how to prepare for the installation, see "Laboratory setup requirements" on page 11. If you have questions about the safety equipment, contact Automation Solutions Technical Support.

This topic explains the function of the shield and describes how it works.

Shield description

The shield surrounding the workstation prevents the operator from entering the workspace. An interlock sensor is installed at each door to detect whether the door is open or closed. When the operator opens a safety-interlocked door, the safety interlock circuit stops the robot and devices that are connected to the BenchBot Disable Hub. Other devices that are not connected to the BenchBot Disable Hub might continue to move until they have completed the current tasks.

Figure Shield surrounding a workstation



Related information

For information about...	See...
Safety information	“Safety guidelines” on page 1
Planning for the safety equipment	“Safety equipment space requirements” on page 24
Installing the BenchBot Disable Hub	“About the BenchBot Disable Hub” on page 52
Interlock key settings	“About the BenchBot Disable Hub” on page 52
Installing the Light Curtain	“About the Light Curtain” on page 56
Installing the computer	“Installing the computer” on page 51
Installing the robot	“Installing and removing the robot” on page 45
Turning on and turning off the robot	*BenchBot Robot User Guide*
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Agilent Technologies

Safety and Installation Guide

G5486-90001

Revision 01, June 2011