BenchCel Microplate Handling Workstation R-Series

BenchCel Diagnostics version 17.0.3 (2007)
for BenchWorks Automation Control software

User Guide and Addenda

Agilent Technologies

Notices

User Guide Part Number

G5400-90001

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June 2008 Labware Rack guide,
November 2007 BenchCel Workstation user guide addendum,
May 2007 BenchCel Workstation user guide

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Agilent Technologies

Letter to our Customers

Dear Customer,

The Agilent Technologies acquisition of Velocity11 resulted in the following changes:

- Creation of Agilent Technologies Automation Solutions, formerly Velocity11
- Renaming of some Velocity11 products
- New Customer Service and Technical Support contact information
- New website address for product information

Please make a note of the following changes as they impact this user guide.

Velocity11 product name changes

Velocity11 product name	Changes to ...
Access2 Automated Microplate Loader	Automated Centrifuge Loader
Element Automation System	BioCel 900 System
IWorks Device Driver Programming Interface	VWorks Device Driver Interface
PlatePierce Seal Piercing Station	Microplate Seal Piercer
VCode Barcode Print and Apply Station	Microplate Barcode Labeler
Velocity11 Robot	3-Axis Robot
VHooks Integration Interface	VWorks Hooks Interface
VPrep Pipetting System	Vertical Pipetting Station
VSpin Microplate Centrifuge	Microplate Centrifuge
VStack Labware Stacker	Labware Stacker

New contact information

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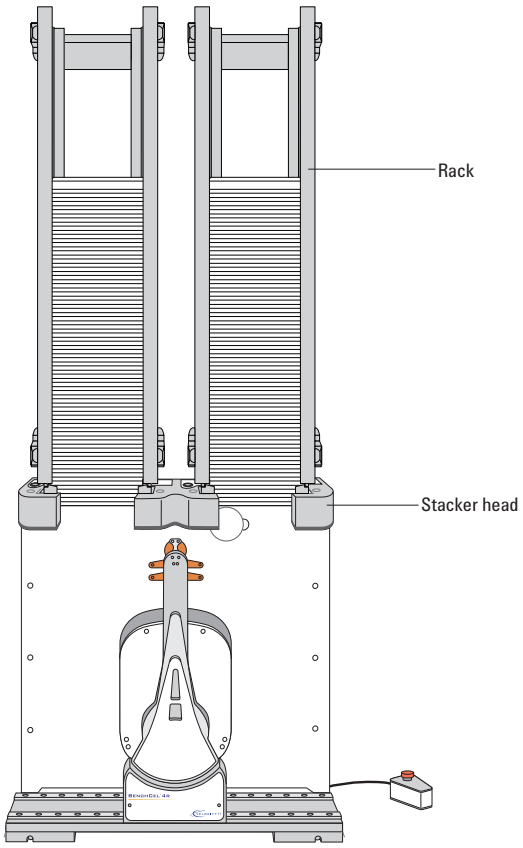
Labware Rack Handling Guide

This guide explains how to handle the labware racks safely. The topics are:

About the labware racks

The BenchCel® Microplate Handling Workstation and the VStack® Labware Stacker use labware racks to store the stacks of labware (microplates, tipboxes, and tube racks) that are processed during a protocol run.

Figure BenchCel Workstation with front-load labware racks



For a description of the BenchCel device or VStack device, see the *BenchCel User Guide* or *VStack User Guide*.

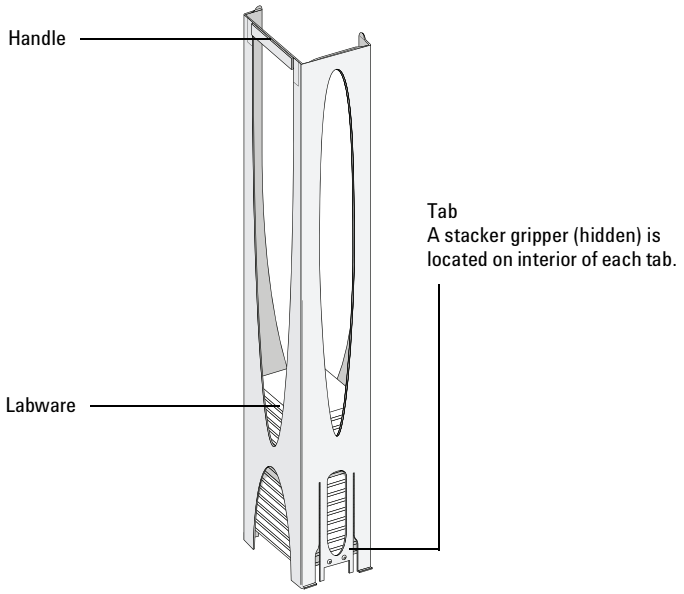
The labware racks are available in three models: standard rack, top-load rack, and front-load rack.

Figure Three models of labware racks

All the rack models have the following basic parts:

- *Carrying handle*. The standard rack has a polished top bar that can be used as a carrying handle. The top-load and front-load racks have fold-down carrying handles.
- *Tabs*. A pair of vertical tabs are located at the bottom sides of the rack. The tabs insert into slots on the device when you mount the rack.
- *Stacker grippers*. A gripper is located on the interior bottom of each tab. The pair of grippers hold a microplate during the labware loading, unloading, downstacking, and upstacking processes. A clamp in the device opens and closes the grippers.

Figure Standard rack containing labware



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Carrying the racks

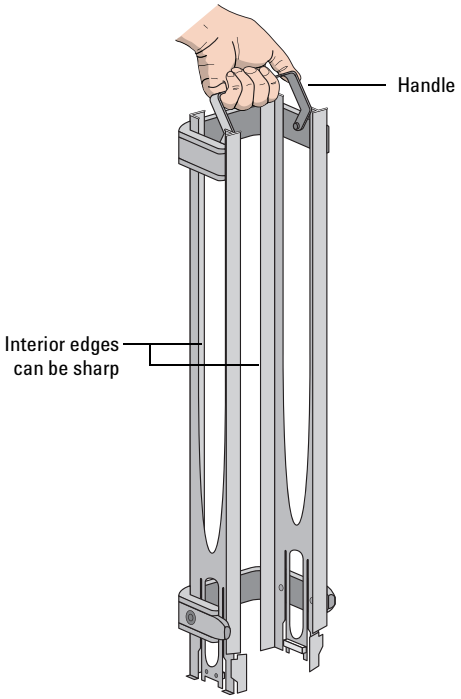
WARNING **Do not hold a rack by the interior edges. The interior edges can have sharp surfaces that can cause cuts if handled improperly.**

CAUTION A rack that is fully loaded with labware can be heavy. Grasp the rack handle firmly to prevent the rack from slipping or tilting.

To carry a rack:

Firmly grasp the rack by the handle.

Figure Carrying a front-load rack



Lifting the racks

Make sure to use the proper lifting technique when mounting a rack on a device or removing a rack from a device.

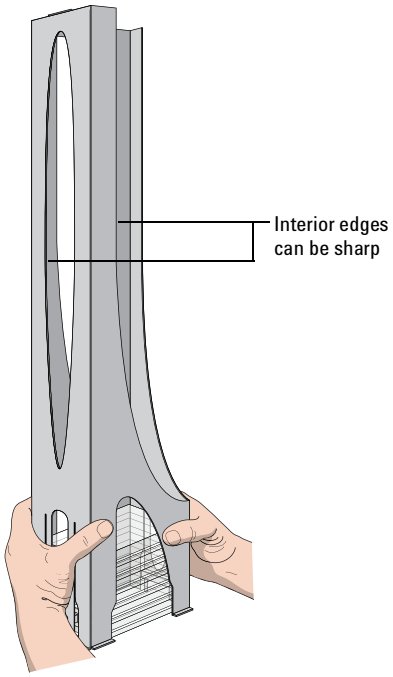
WARNING **Avoid touching the interior edges of a rack when lifting the rack. The interior edges can have sharp surfaces.**

IMPORTANT See your *BenchCel User Guide* or *VStack User Guide* for the procedure to mount a rack on the device or to release a rack from the device.

To lift a rack:

Use both hands to grasp the rack securely around the four corners near the base, as the following figure shows.

Figure Lifting a standard rack



Loading labware into the racks

Before loading the labware into a rack:

- Position the rack so that the opening is facing you.
- Determine how the microplates should be oriented in the rack.

  For example, if the BenchCel orientation-sensing feature is enabled, make sure the A1 wells are oriented in the rack as specified.

Loading labware in standard and top-load racks

IMPORTANT See your *BenchCel User Guide* or *VStack User Guide* for the details on how to release a rack for removal or to prepare for loading a mounted rack.

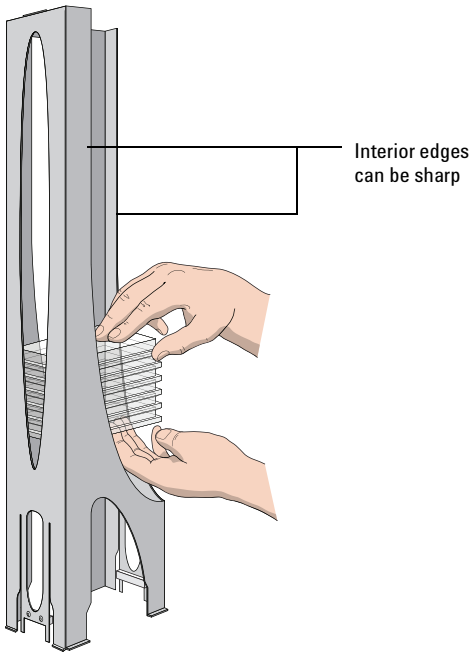
To load labware into a standard or top-load rack:

1. If possible, remove the rack from the device, and place the rack on a flat, level surface.
2. Using both hands, carefully slide a small stack of labware down through the top of the rack.

   You can use one hand to support underneath the labware stack, while the other hand holds the top of the labware to keep it level. See the following figure.

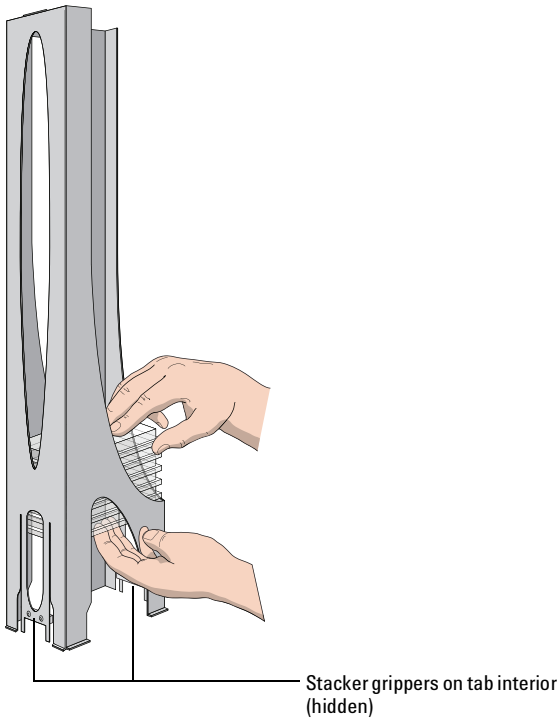
WARNING **Use care to avoid sliding your hand on the interior edges in the rack. The edges can have sharp surfaces.**

Figure Loading a standard rack



3 (Standard racks only) When you reach the bottom of the open slot, transfer your hand positions so that you continue supporting the labware through the bottom slot.

Figure Supporting labware through the bottom slot



4 Ensure that the bottom labware in the stack rests on the rack stacker grippers.

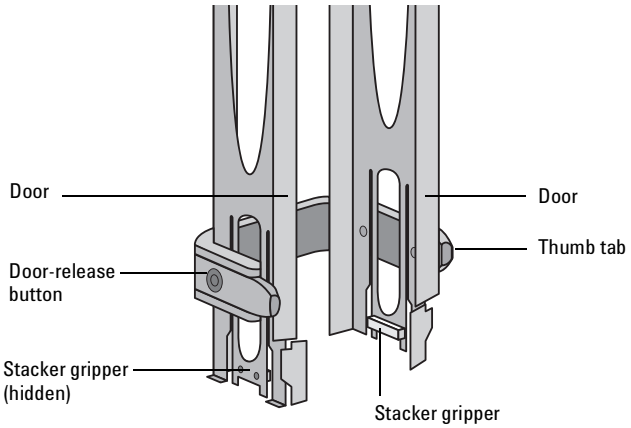
To unload labware from a standard or top-load rack:

With your hands positioned as shown in the previous figures, carefully slide the labware in small stacks up and out of the top of the rack.

Loading labware in a front-load rack

The doors on the front-load rack provide easy access for loading labware into the front of a rack that is mounted on a device.

Figure Door mechanism on the front-load rack

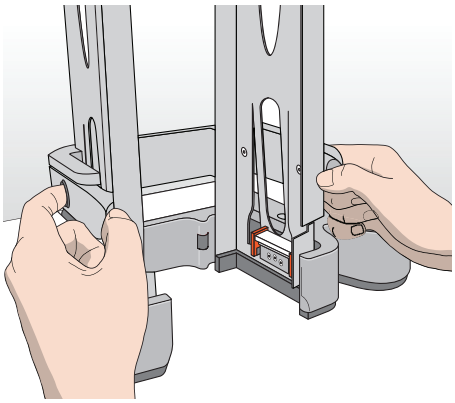


To load labware in a front-load rack:

IMPORTANT Before you attempt to load the labware in a mounted rack, ensure the device is ready for loading. For example, the clamps in the BenchCel stacker head must be closed (extended). See your device user guide for details.

1 On each side of the rack, slide the Door-release (black) buttons forward, while pushing outward on the thumb tabs. The rack doors open.

Figure Opening the front-load rack



2 Place the labware directly through the open rack doors so that the bottom labware rests on the rack stacker grippers. Ensure the labware is level and securely in the rack.

3 To close the doors, press the thumb tabs inward until the doors snap shut.

To unload labware from a front-load rack:

IMPORTANT Before you attempt to unload the labware from a mounted rack, ensure the device is ready for unloading. For details, see your device user guide.

1 To open the rack doors, slide the black Door-release buttons forward on each side of the rack, while pressing outward on the thumb tabs.

2 Carefully, lift the labware out through the front of the rack.

Accessing product user documentation

Velocity11 product user documentation is available in the following formats:

- Online help available within the software
- PDF files on the software CD
- Printed books

You can also search the online help or download the latest version of any PDF file from the Velocity11 website at:

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BenchCel Microplate Handling Workstation
R-Series User Guide Addendum

November 2007

BenchCel Diagnostics version 17.0.3

19770.00.01.00_BenchCelR-SeriesUG_May07

About this addendum

This addendum explains how to set the sensor thresholds for optimum operation and provides additional troubleshooting information. The addendum contains the following sections:

This addendum documents the following:

❑ BenchCel Diagnostics version 17.0.3 or later

❑ BenchCel firmware version 3.2.8 or later

❑ BenchWorks Automation Control version 43.0.1 or later

This addendum complements the labware setup instructions in the *BenchWorks Automation Control Software User Guide* and replaces the sensor adjustment topic in the *BenchCel Microplate Handling Workstation R-Series User Guide*.

Setting sensor thresholds

About this topic

To ensure optimum operation, you should set the Plate-presence and Orientation thresholds correctly for the type of microplate you are using. You must do so before you start a run with the type of microplate.

This topic explains how to set the Plate-presence and Orientation thresholds.

Workflow

The workflow for setting the Plate-presence and Orientation sensor thresholds is:

Step	For this task...	See...
1	Calculate the Plate-presence threshold using the following: ❑ Highest Plate-presence reading among all the stacks when no microplate is loaded ❑ Lowest Plate-presence reading among all the stacks when the first microplate is loaded in each stack	"Calculating the Plate-presence threshold" on page 2
2	Determine the optimum sensor offset at each stack.	"Determining the optimum Orientation sensor offset" on page 5
3	Calculate the Orientation threshold based on the observed Notch Sensor readings.	"Calculating the Orientation threshold" on page 8

Before you start

Make sure you have three spare microplates for each BenchCel Workstation stacker head. For example, if the BenchCel Workstation has six stacker heads, you will need 18 microplates.

Make a copy of the provided "Worksheet for setting sensor thresholds" on page 11. You can use it to record sensor readings and facilitate threshold calculations.

Calculating the Plate-presence threshold

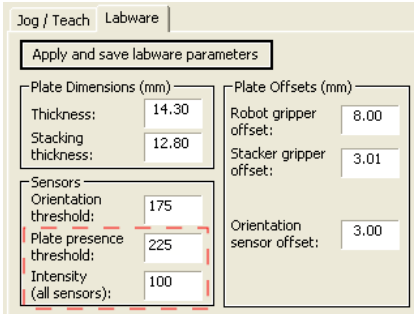
To calculate the Plate-presence threshold:

1. Install a stacker rack at each stacker head, and then physically load three microplates in each rack. (For instructions, see the *BenchCel Microplate Handling Workstation R-Series User Guide*.) The microplates should rest on top of the stacker grippers.

   Do not click Load plates in BenchCel Diagnostics.

2. In the **BenchCel Diagnostics Controls** tab, click the **Labware** tab. In the **Sensors** area:

   - Set the **Plate presence** threshold at 225 units.
   - Set the **Intensity** at 100%.



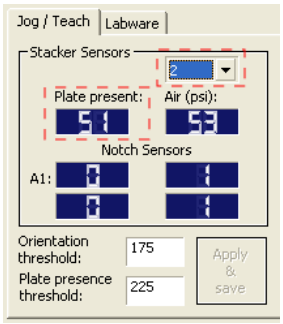
3. Click the **Jog/Teach** tab. In the **Stacker Sensors** area:

   a. Select the first stack.

   b. Record the **Plate present** reading.

   c. Repeat steps a and b for each of the remaining BenchCel Workstation stacks.

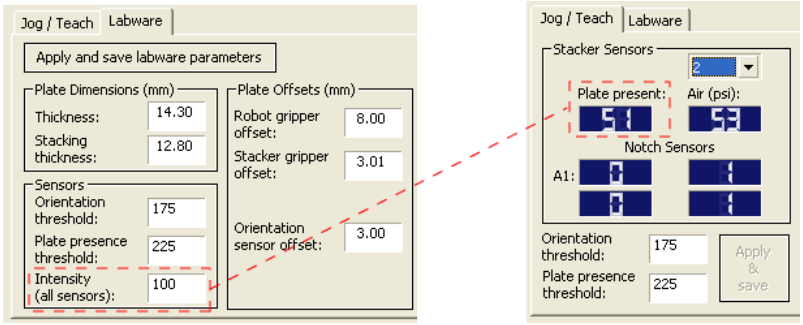
   d. Select the stack that has the highest Plate present reading.



4. Click the **Labware** tab. In the **Sensors** area, reduce the **Intensity** so that the highest **Plate present** reading (Jog/Teach tab) is less than or equal to 175.

   If the Plate present reading is very low, increase the Intensity to 100%. If the Plate present reading is greater than 175, decrease the Intensity slightly so that the reading is reduced to 175.

   For example, a dark-colored microplate has a Plate present reading of 10. Increasing the Intensity to 100% increases the reading to 51 (shown in the example below). A light-colored microplate has a Plate present reading of 200. Decreasing the Intensity to 20 reduces the reading to 175.



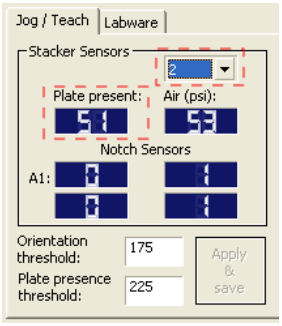
5. In the **Jog/Teach** tab, find the highest **plate present** reading ($P_{unloaded}$) among all the stacks. To do this:

   a. Select the first stack.

   b. Record the **Plate present** reading.

   c. Repeat steps a and b for each of the remaining BenchCel Workstation stacks.

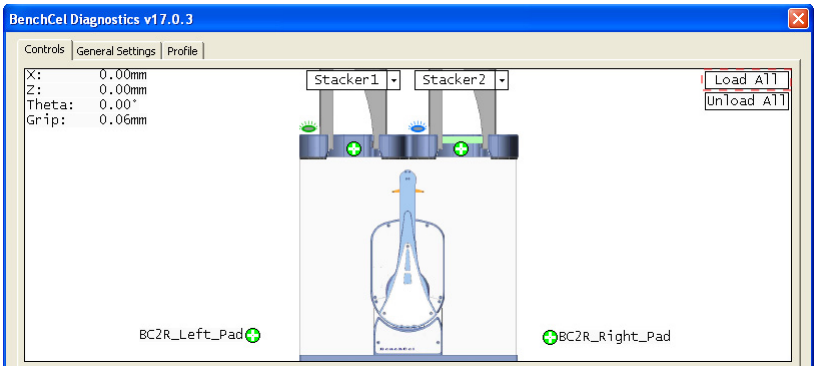
   d. Assign the highest Plate present reading to $P_{unloaded}$, the highest Plate presence threshold when no microplate is loaded. The value will be used to calculate the Plate presence threshold.



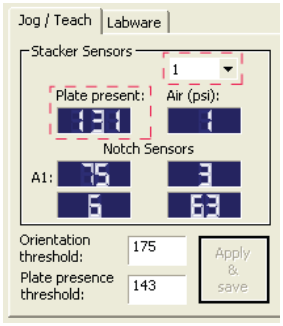
In the following example, the highest reading is 51 (stack 2).

Stack 1	Stack 2	Stack 3	Stack 4
48	51	50	45

6. In BenchCel Diagnostics, click **Load All.**



7. In the **Jog/Teach** tab:
   a. Select the first stack.
   b. Record the **Plate present** reading.
   c. Repeat steps a and b for each of the remaining BenchCel Workstation stacks.
   d. Assign the lowest Plate present reading to P_{loaded}, the lowest Plate presence threshold when microplates are loaded. The value will be used to calculate the Plate presence threshold.



In the following example, the lowest reading is 131 (stack 1).

Stack 1	Stack 2	Stack 3	Stack 4
131	139	140	135

8. Calculate the Plate presence threshold as follows:

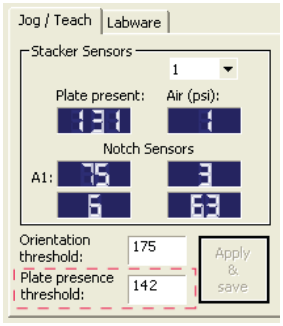
   Plate presence threshold = $P_{unloaded} + ((P_{loaded} - P_{unloaded})/2)$

   In the following example, the calculated threshold is 142.

$P_{unloaded}$	51
P_{loaded}	131
Plate presence threshold	142

   If the calculated Plate presence threshold is less than 50, make sure you are using the stacker grippers to hold the stack (Stack Holding Method in the Labware Editor), and then repeat the procedure in this section.

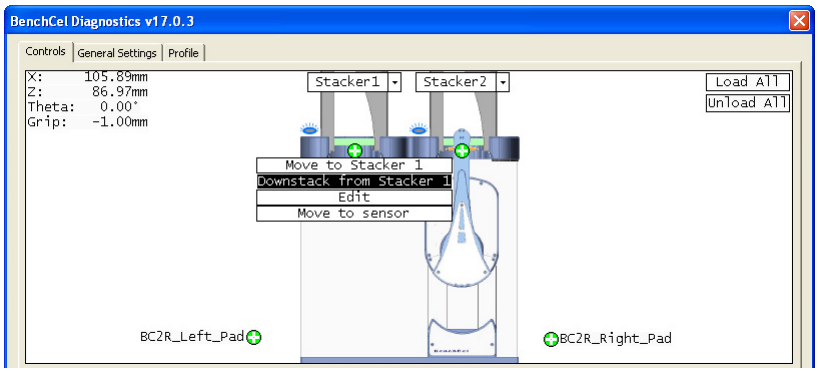
9. In the **Jog/Teach** tab, type the calculated **Plate presence threshold.**



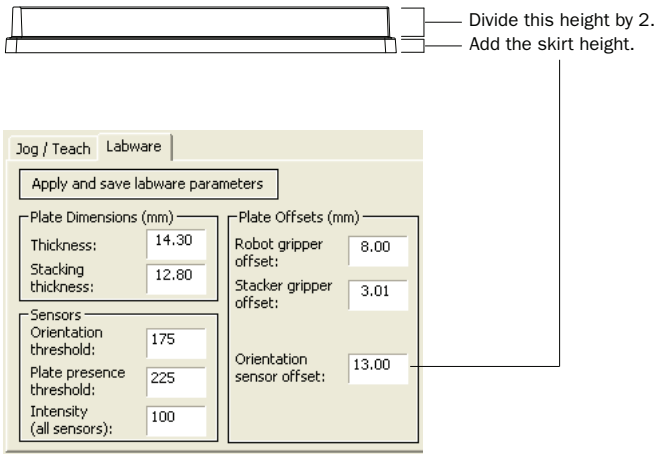
Determining the optimum Orientation sensor offset

To determine the optimum Orientation sensor offset:

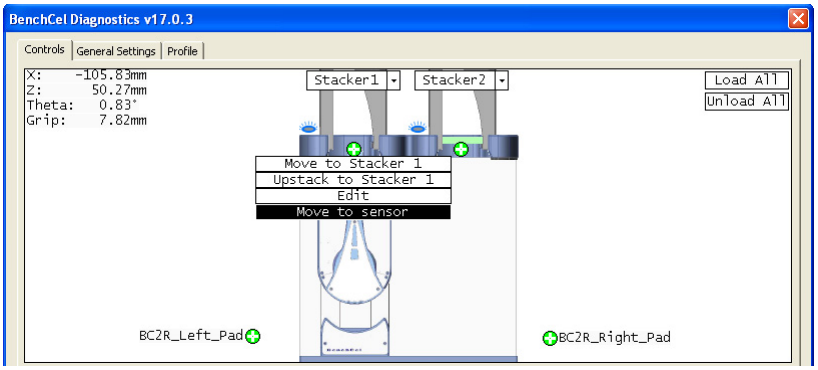
1. In BenchCel Diagnostics, click **Downstack** at the first stack.



2. In the **Controls** tab, click the **Labware** tab.
3. In the **Orientation sensor offset** box, type the initial offset value you want to use. To determine the initial value:
   a. Determine the halfway distance (in millimeters) between the top of the microplate and the top of the skirt.
   b. Determine the height of the microplate skirt (in millimeters).
   c. Add the values from step a and step b.

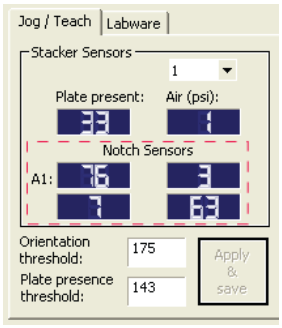


4. Click **Move to Sensor.** The robot moves the first microplate into the line of notch sensors.



5. Click the **Jog/Teach** tab and check the **Notch Sensor** readings. The notches should have much lower readings than the corners. In addition, the difference between the notch readings and corner readings should be at a maximum.

   In the following example, the Notch Sensor values indicate that the microplate has two notches (3 and 7) and two corners (76 and 63).

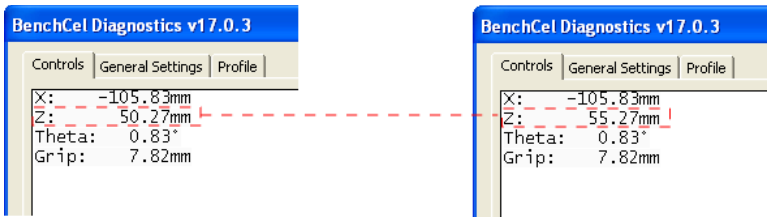


6. To find the maximum difference between the notch readings and corner readings:
   a. Record the initial *z*-axis position ($Z_{initial}$) in the upper left corner of the BenchCel Diagnostics screen.
   b. Jog the robot up or down, and then check the **Notch Sensor** readings. You can repeat this step until you find the maximum difference between the notch readings and the corner readings.
   c. Record the adjusted *z*-axis position ($Z_{adjusted}$).

7. Calculate the jog distance:

   Jog distance = $Z_{initial} - Z_{adjusted}$

   In the following example, the jog distance is –5.00 mm.



$Z_{initial}$	50.27 mm
$Z_{adjusted}$	55.27 mm
Jog distance	–5.00 mm

8. Calculate the adjusted Orientation sensor offset:

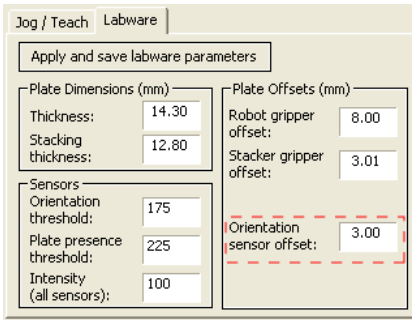
   Adjusted Orientation sensor offset =

   Initial Orientation sensor offset + Jog distance

   In the following example, the adjusted orientation sensor offset is 3.00 mm.

Initial Orientation sensor offset	8.00 mm
Jog distance	–5.00 mm
Adjusted Orientation sensor offset	3.00 mm

9. Type the adjusted orientation sensor offset in the **Labware** tab.

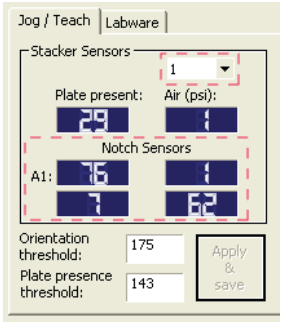


10. Select the next stack, and then click **Move to Sensor.** Check the Notch Sensor readings. The notches should have much lower readings than the corners. In addition, the difference between the notch readings and corner readings should be at a maximum.
11. Repeat step 10 for the remaining stacks.

Calculating the Orientation threshold

To calculate the Orientation threshold:

1. Click the **Jog/Teach** tab. In the **Stacker Sensors** area:
   a. Select the first stack.
   b. Record the highest reading for the notch and lowest reading for the corner. (In the example below, the highest notch reading is 7, and the lowest corner reading is 62.)
   c. Repeat steps a and b for the remaining stacks.



2. Find the highest notch reading (Notch) among all the stacks. In the following example, the highest reading is 35 (stack 3).

Stack 1	Stack 2	Stack 3	Stack 4
0	25	35	15

3. Find the lowest corner reading (Corner) among all the stacks. In the following example, the lowest reading is 235 (stack 4).

Stack 1	Stack 2	Stack 3	Stack 4
244	238	245	235

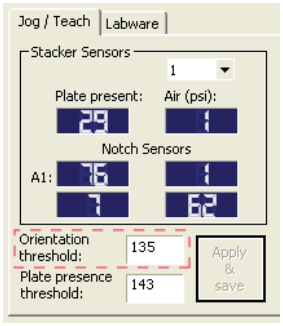
4. Calculate the Orientation threshold as follows:

   Orientation threshold = Notch + ((Corner - Notch)/2)

   In the following example, the calculated threshold is 100.

Highest notch reading among all stacks	35
Lowest corner reading among all stacks	235
Orientation threshold (midpoint)	135

5. In the **Jog/Teach** tab, type the calculated **Orientation threshold.**



Hardware problems and software errors

About this topic

This topic supplements the troubleshooting chapter in the *BenchCel Microplate Handling Workstation User Guide*. If you are still experiencing problems with the BenchCel Workstation after trying the solutions, contact Velocity11 Technical Support.

Hardware problems

Problem	Cause	Solution
More than one microplate was downstacked.	The Plate present reading is below the Plate presence threshold.	Use the procedure in "Setting sensor thresholds" on page 1 to adjust the threshold values.
The stack of microplates is dropped onto the shelf during the downstacking procedure.	In the shelf stack-holding method, the stacker gripper offset is too low. So the distance between the grippers and shelves is large.	Increase the stacker gripper offset.

Software problems

Error message	Cause	Solution
Deadlock	The microplate is assigned to the wrong labware class.	Check that the labware belongs to the correct labware class in the Labware Editor. Most microplates should belong to the Uses Standard Plate Pad class. If you created a special class for a particular microplate, make sure it belongs to the special class. For more information about setting up labware classes, see the *BenchWorks Automation Control User Guide*.
No plate in grippers	The Orientation threshold was used to detect microplate presence, and the sensor readings from all four corners are below the threshold. *Note:* The software always uses the Orientation threshold as a secondary check, even if the Check Orientation option is not selected.	Reduce the Orientation threshold value.
	The Robot gripper offset parameter value is incorrect.	Correct the Robot gripper offset value in the Labware Editor or in BenchCel Diagnostics. Velocity11 recommends an 8 mm offset for most labware.
	No microplate is available at the pickup location.	Make sure you load or place labware at the target location.
	The Orientation sensor offset parameter value is incorrect.	Adjust the Orientation sensor offset value in BenchCel Diagnostics. See “Setting sensor thresholds” on page 1 for detailed instructions.
	The sensor intensity and threshold need adjusting.	See “Setting sensor thresholds” on page 1 for detailed instructions.

Worksheet for setting sensor thresholds

Plate-presence threshold

Initial Plate present readings

Set the thresholds as follows:

- ❑ Plate presence threshold = 225 units
- ❑ Intensity = 100%,

Record the **Plate present** reading for each stack.

Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6

Plate present readings when microplates are unloaded

After adjusting the Intensity so that the highest Plate present reading is less than or equal to 175, record the **Plate present** readings for each stack.

Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6

Highest reading among all the stacks ($P_{unloaded}$): _____

Plate present readings when the microplates are loaded

After loading the microplates at each stack (**Load All** in BenchCel Diagnostics), record the **Plate present** readings for each stack.

Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6

Lowest reading among all the stacks (P_{loaded}): _____

Plate presence threshold

Plate presence threshold = $P_{unloaded} + ((P_{loaded} - P_{unloaded})/2)$ = _____

Optimum Orientation sensor threshold

Initial Orientation sensor offset

Measure A and B of your microplate.

Initial Orientation sensor offset = (A/2) + B = _____ mm

Jog distance

Jog distance = $Z_{initial} - Z_{adjusted}$ = _____ mm

Adjusted Orientation sensor offset

Adjusted Orientation sensor offset =

Initial Orientation sensor offset + Jog distance = _____ mm

Orientation threshold

After you calculate the adjusted Orientation sensor offset, in BenchCel Diagnostics, click **Move to Sensor** at each stack. In the **Notch Sensor** area, the notches have lower readings than corners.

Highest Notch Sensor readings

Record the highest notch reading for each stack.

Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6

Highest reading among all stacks (Notch): _____

Lowest Corner readings

Record the lowest corner reading for each stack.

Stack 1	Stack 2	Stack 3	Stack 4	Stack 5	Stack 6

Lowest reading among all stacks (Corner): _____

Orientation threshold

Orientation threshold = Notch + ((Corner – Notch)/2) = _____

BenchCel Microplate Handling Workstation
R-Series User Guide

May 2007

BenchCel Diagnostics version 15.0.22

19770.00.00.00_BenchCelR-SeriesUG_May07

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Contents

Preface

This preface contains the following topics:

Who this guide is for

About this topic

This topic describes the target audience of this user guide.

Job roles

This user guide is for people with the following job roles:

Job role	Responsibilities
Integrator	Someone who configures software and hardware to allow integration of the BenchCel System into a larger lab automation system.
Installer	Someone who unpacks, puts together, and tests the BenchCel System before it is used.
Lab manager, administrator, or technician	Someone who is responsible for: ❑ Managing the BenchCel System ❑ Developing the applications that are run on it ❑ Solving the more challenging problems that might arise ❑ Developing training materials and standard operating procedures for operators
Operator	Someone who performs the daily production work on the BenchCel System and solves routine problems. Your organization may choose to create its own procedures for operators including the procedures in this guide.

Related topics

For more information about...	See...
What this guide covers	“What this guide covers” on page v
How to access different formats of this user guide	“Accessing Velocity11 user information” on page vi

What this guide covers

What is covered

This guide covers the description, installation, setup, and operation of the BenchCel® Microplate Handling Workstation R-Series.

What is not covered

This guide does not provide instructions for the following:

- ❑ BenchWorks™ Automation Control software or third-party software
- ❑ Velocity11 devices, such as the PlateLoc® Thermal Plate Sealer, the VCode® Barcode Print and Apply Station, and the VPrep® Pipetting System
- ❑ Third-party devices

For more information about these topics, see the relevant user guides for these products.

Software version

This guide documents BenchCel Diagnostics version 15.0.22 or later.

Related guides

The *BenchCel User Guide* should be used in conjunction with the following user documents:

- ❑ Velocity11® lab automation system software user guides, such as the *BenchWorks Automation Control User Guide*. These user guides explain how to define labware, create protocols, and set task parameters for each device in the system.
- ❑ Third-party device user documents. These documents explain how to set up and use the third-party lab device.

Related topics

For more information about...	See...
Reporting problems	“Reporting problems” on page 135
Who should read this guide	“Who this guide is for” on page iv
How to access different formats of this user guide	“Accessing Velocity11 user information” on page vi

Accessing Velocity11 user information

About this topic

This topic describes the different formats of Velocity11 user information and explains how to access the user information.

Formats available

Velocity11 user information is provided to you as:

- ❑ Online help
- ❑ A PDF file
- ❑ A printed book

The information in each format is the same but each format has different benefits.

Where to find user information

Online help

The online help is added to your computer with the Velocity11 lab automation system software installation.

PDF file

The PDF file of the user guide is on the software CD that is supplied with the product.

Velocity11 website

You can search the online help or download the latest version of any PDF file from the Velocity11 website at www.velocity11.com.

Note: All Velocity11 user information can be searched from the website at www.velocity11.com.

Online help

The online help is the best format to use when you are working at the computer and when you want to perform fast or advanced searches for information.

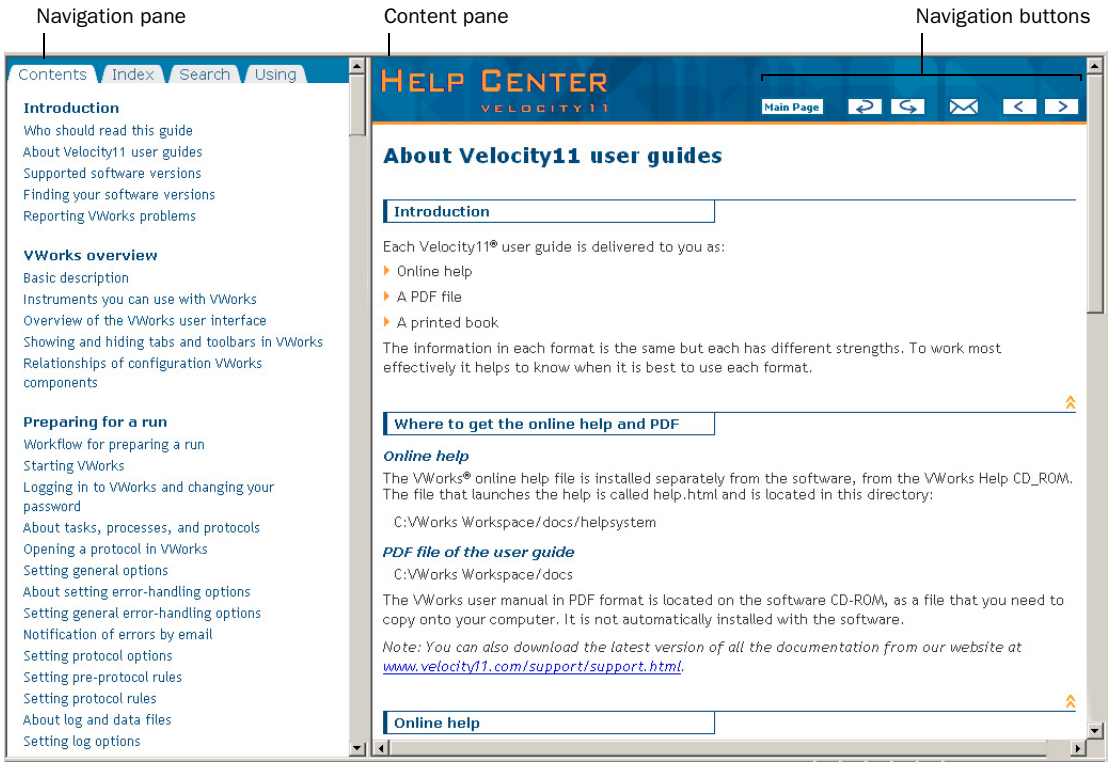
To open the online help:

In the Velocity11 lab automation software, press F1. The online help window opens.

Main features

The online help window contains the following:

- ❑ *Navigation pane*. Consists of four tabs. The Contents, Index, and Search tabs provide different ways to locate information. The Using tab contains information about using the help system.
- ❑ *Content pane*. Displays the online help topics.
- ❑ *Navigation buttons*. Enables you to navigate through the pages.The online help includes a navigation pane, content pane, and navigation buttons.



PDF user guides

Computer requirements

To open a user guide in PDF format, you need a PDF viewer. You can download a free PDF viewer from the internet.

Printing and searching

The user guides in PDF format are mainly for printing additional copies. You can perform simple searches in the PDF file, although these searches are much slower than online help searches.

More information

For more information about using PDF documents, see the user documentation for the PDF viewer.

Related topics

For more information about...	See...
Who should read this guide	“Who this guide is for” on page iv
What this guide covers	“What this guide covers” on page v

Introduction

1

This chapter contains the following topics:

BenchCel Workstation description

About this topic

This topic describes the BenchCel Microplate Handling Workstation R-Series and explains its uses.

Description

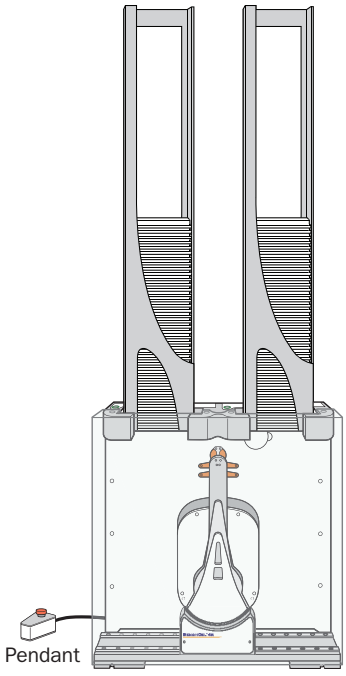
The BenchCel Microplate Handling Workstation R-Series (or the BenchCel Workstation) is a microplate-processing automation system that:

- ❑ Stores stacks of labware (microplates, tip boxes, and tube racks) that will be processed during a protocol run.
- ❑ Moves labware to and from external devices such as the PlateLoc Thermal Microplate Sealer and the VCode Barcode Print and Apply Station for processing.

Components

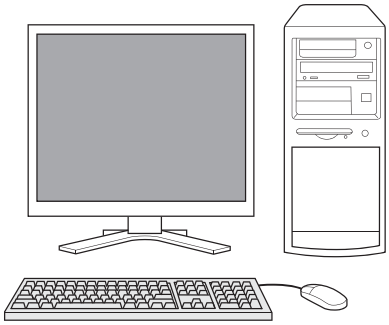
The BenchCel Workstation consists of the following components:

- ❑ BenchCel device that can load two, four, or six stacks of labware
- ❑ Two, four, or six stacker racks
- ❑ Safety shield
- ❑ BenchWorks Automation Control software
- ❑ Computer
- ❑ Pendant



BenchCel Microplate Handling device with safety shield and two stacker racks (microplates not included)

BenchWorks Automation Control software



Computer

Related topics

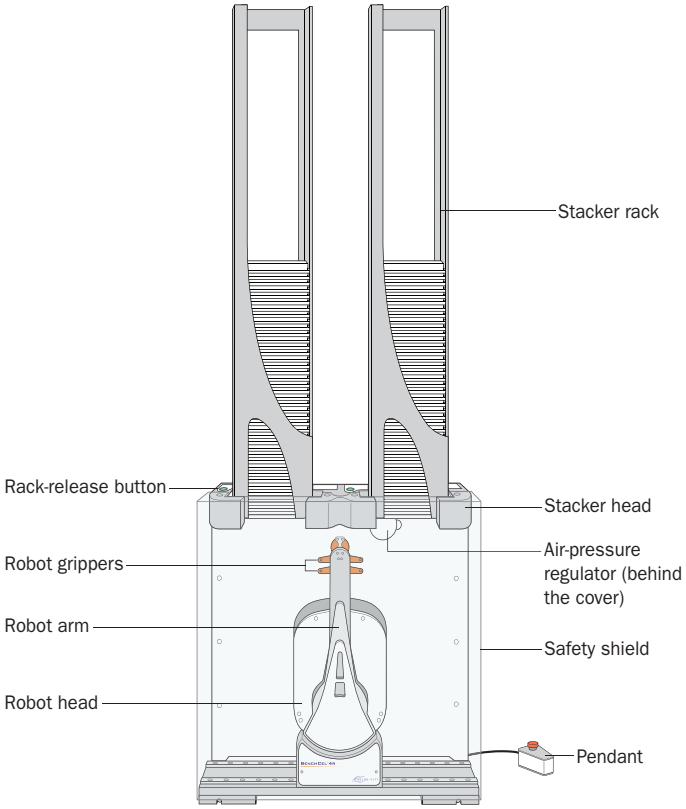
For more information about...	See...
Hardware overview	“Hardware overview” on page 4
Accessories	“Accessories” on page 12
Integration options	“Integration options” on page 14
Automation-ready labware	“Labware considerations” on page 16
Software that controls the BenchCel Workstation	“Software description” on page 18
Safety information	“Safety information” on page 22
Installation requirements	“Verifying laboratory requirements” on page 29

Hardware overview

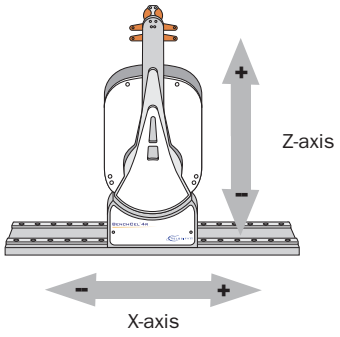
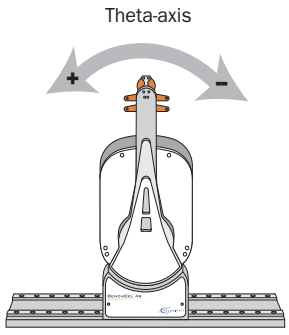
About this topic

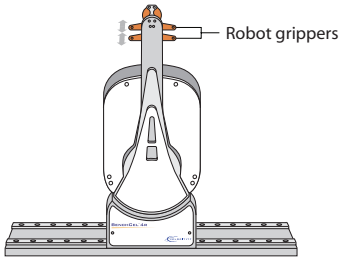
This topic describes the hardware features of the BenchCel device. Note that the diagrams in this topic show a BenchCel device with two stacker racks only. All the major components and functions are the same for devices with four and six stacker racks.

Front view

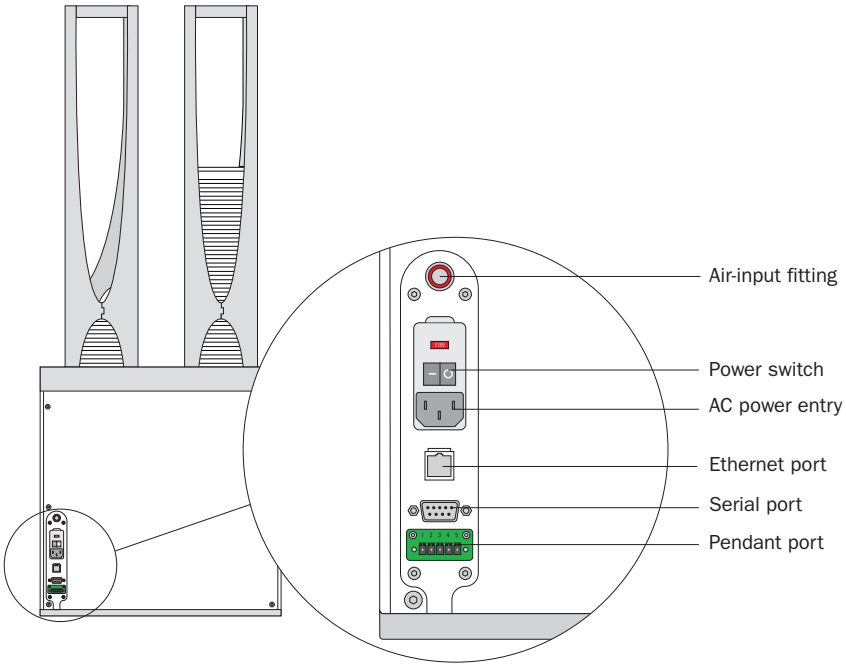


Feature	Description
Stacker rack	The accessory that stores labware to be processed in a run.
Stacker head	The structure at which: ❑ A stacker rack is loaded. Two sensors inside of each stacker head detect the presence of the racks. ❑ A microplate is checked for type and orientation using a plate-presence sensor and four plate-orientation sensors. ❑ A microplate is lowered into the robot grippers for a run. See “Stacker head” on page 7 for the location and detailed descriptions of the sensors.

Feature	Description
Safety shield	The clear acrylic panel that is installed on the front of the BenchCel device to restrict access while it is in operation. **!! INJURY HAZARD !! Do not operate the workstation without the safety shield.**
Rack-release button	The button that unlocks the rack for removal. The rack-release button at the top of each stacker head displays different colors to indicate the state of the stacker head: ❑ *Solid green*. The stacker rack is installed correctly on the BenchCel device and the microplates are unloaded. The stack of microplates are ready for processing or you can unlock and remove the stacker rack. ❑ *Flashing green*. The stacker rack is unlocked and can be removed. ❑ *Solid blue*. The stack of microplates is loaded. You cannot unlock and remove the stacker rack.
Robot head	The component that moves horizontally along the *x*-axis and vertically along the *z*-axis. 
Robot arms	Two parallel structures that are attached to and rotate about the robot head along the *theta*-axis. 

Feature	Description
Robot grippers	The structures inside the robot arms that close and open to hold and release a microplate. Using the provided software, you can adjust the distance between the grippers to hold a microplate loosely or tightly. 
Air pressure regulator	The knob that you turn to adjust the air pressure inside the device. Compressed air is used to move components inside the stacker heads. Each regulator controls the air pressure to the two adjacent stacker heads. To access the regulator, remove the circular cover.
Pendant	The component that is part of the safety interlock circuit that must be closed for the BenchCel device to operate. Pressing the raised button on the pendant breaks the safety circuit and disables the robot motors. Use this method for emergencies only.

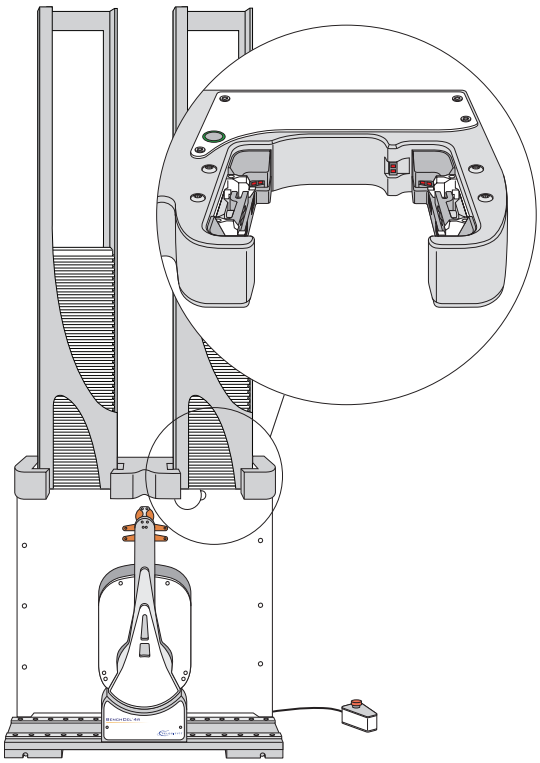
Back view



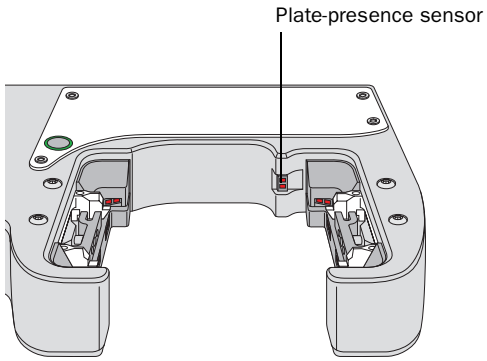
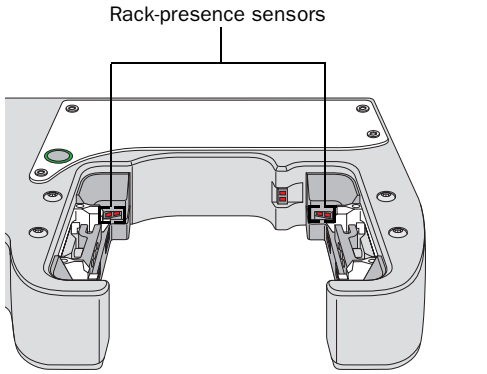
Feature	Description
Air-input fitting	Connects the air tubing to the BenchCel device. Compressed air is used to actuate components inside the stacker head.
Power switch	Turns on or off the power to the BenchCel device.
AC power entry	Connects the power cord to the BenchCel device.
Ethernet port	Connects the Ethernet cable from the controlling computer to the BenchCel device to allow communication between the computer and the device. Use this port as an alternative to the serial connection.
Serial port	Connects the serial cable from the controlling computer to the BenchCel device to allow communication between the computer and the device. Use this port as an alternative to the Ethernet connection.
Pendant port	Connects the pendant to the safety interlock circuit. The BenchCel device is equipped with a safety interlock circuit that must be closed for the device to operate. Pressing the raised button on the pendant breaks the safety circuit and disables the robot motors.

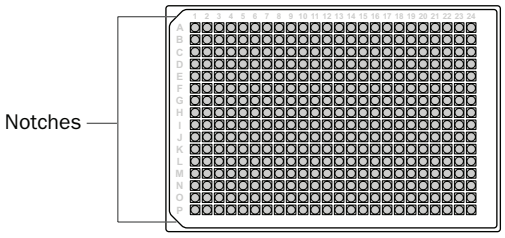
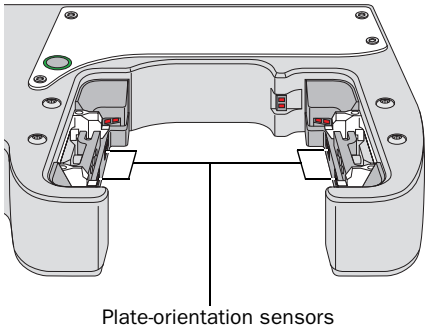
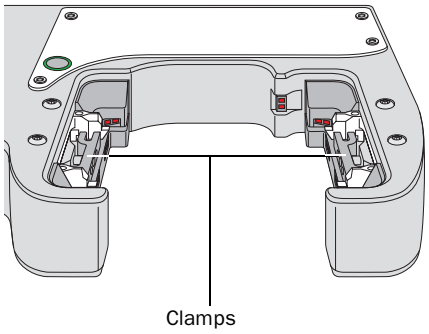
Stacker head

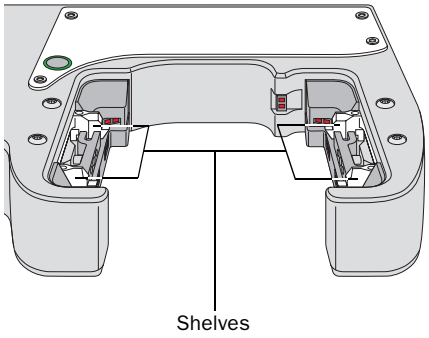
At the top of the BenchCel device are stacker heads that contain infrared sensors and mechanical components that load and unload microplates during operation.



The following table lists and describes the various components inside the stacker head.

Feature	Description
Plate-presence sensor	Detects the presence of a microplate in the stack. One plate-presence sensor is on the back wall of each stacker head. 
Rack-presence sensors	Detect the presence of stacker racks. Two rack sensors are on the back wall of each stacker head. 

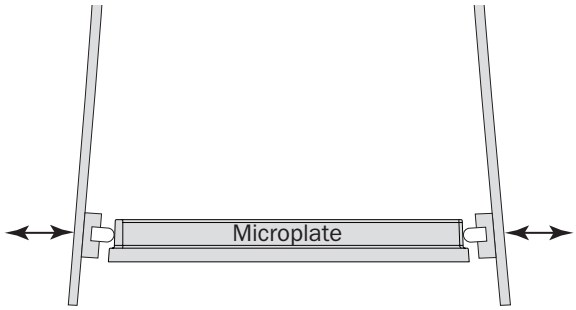
Feature	Description
Plate-orientation sensors	Detect the presence of notches in microplates. Four sensors are in the inside corners of each stacker head. For details of how the sensors work, see “Adjusting the plate-orientation sensors” on page 124.  
Clamps	Close and open the grippers at the bottom of the stacker rack to hold and release microplates during loading, unloading, downstacking, and upstacking processes. Two clamps are inside each stacker head. Compressed air is used to open and close the clamps. 

Feature	Description
Shelves	Provide leveling surfaces for the microplates, thus ensuring accurate robot gripping, during the downstacking process. Two shelves (four leveling surfaces) are inside each stacker head. Compressed air is used to extend and retract the shelves. 

Stacker rack

At the bottom of each stacker rack is a pair of grippers that hold a microplate during the loading, unloading, downstacking, and upstacking processes. The grippers are closed and opened by the clamps in the stacker head. For the description of the clamps, see “Stacker head” on page 7.

The following conceptual diagram shows the side view of the stacker rack, with the stacker grippers holding a microplate. The front wall of the rack is not shown to reveal the stacker grippers that are hidden from view.



Related topics

For more information about...	See...
BenchCel Workstation description	“BenchCel Workstation description” on page 2
Accessories	“Accessories” on page 12
Integration options	“Integration options” on page 14
Automation-ready labware	“Labware considerations” on page 16
Software that controls the BenchCel Workstation	“Software description” on page 18
Safety information	“Safety information” on page 22
Installation requirements	“Verifying laboratory requirements” on page 29

Accessories

About this topic

Accessories provide a function without performing tasks themselves. For example, you can temporarily place a microplate on a platepad accessory.

This topic lists the accessories that are compatible with the BenchCel Workstation.

Compatible accessories

The following table lists some accessories available for the BenchCel Workstation. For the latest list of accessories, see the Velocity11 website at www.velocity11.com.

Accessory	Description
Stacker racks	The structures that store microplates to be processed in a run. In addition to the standard racks that are supplied with the BenchCel Workstation, you can order additional standard stacker racks. Other types of stacker racks are available, including unique racks for microtube plates and racks that offer alternative ways to load microplates. See the Velocity11 website at www.velocity11.com or contact your regional Velocity11 representative for details.
Laptop computer	The computer that has a smaller footprint than the standard desktop computer for use with the BenchCel Workstation.
Platepad	A parking place for a microplate.
Plate hotel	Multiple platepads that are stacked vertically and configured as shelves in the operating software.
Auxiliary barcode reader	The barcode reader assembly that can be attached to the side of the VCode Microplate Labeler. The assembly consists of a platepad with a barcode reader sensor head attached.
Integration plate	A metal base on which you mount a Velocity11 or a third-party device. The base contains built-in clamps that lock the adjacent integration plate and mounted device in position for maintaining teachpoints. Note that the integration plates for third-party devices might include footpad depressions to facilitate placement of devices with feet.

Related topics

For more information about...	See...
Integration options	“Integration options” on page 14
Automation-ready labware	“Labware considerations” on page 16
Safety information	“Safety information” on page 22
Installation requirements	“Verifying laboratory requirements” on page 29

Integration options

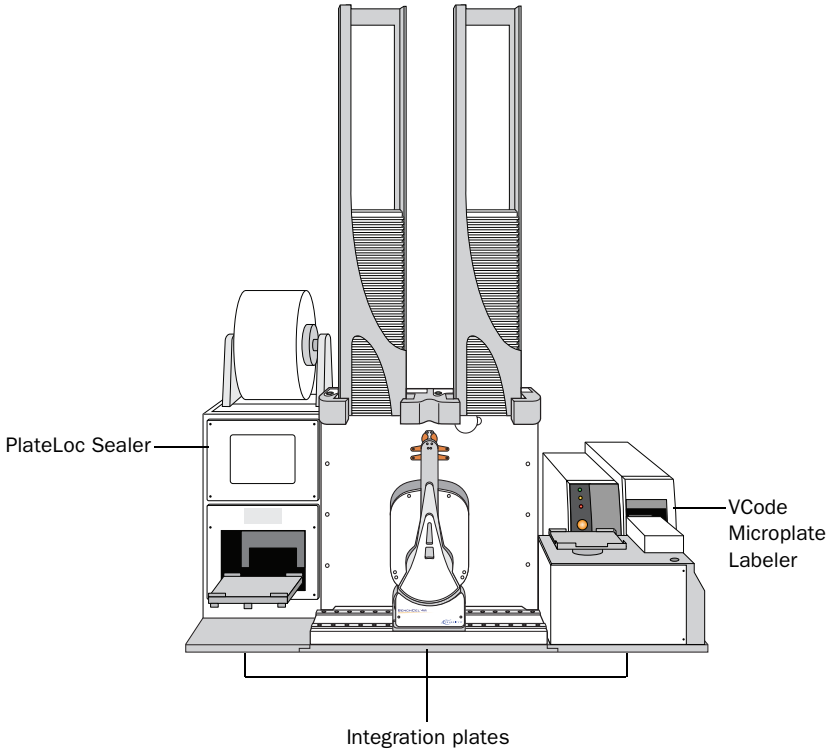
About this topic

You can integrate Velocity11 and some third-party devices with the BenchCel device to create a BenchCel Workstation. The BenchCel robot can move microplates to and from these devices as specified by the protocol you create.

This topic lists some of the devices that can be integrated in the BenchCel Workstation.

Velocity11 devices

You can integrate Velocity11 devices in the BenchCel Workstation. The following diagram shows an example of a BenchCel Workstation that consists of the BenchCel device, the PlateLoc Thermal Plate Sealer, and the VCode Barcode Print and Apply Station.



The following Velocity11 devices can be integrated with the BenchCel device:

Device	Description
PlateLoc Thermal Microplate Sealer	Applies seal on microplates.
VCode Barcode Print and Apply Station	Prints barcodes and applies the barcode labels to microplates.
VPrep Pipetting System	Dispenses liquids.

Device	Description
VSpin Access2 Auto Loading Microplate Centrifuge	Centrifuges microplates.
Bravo Automated Liquid Handling Platform	Dispenses liquids.

Note: Because the PlatePierce Seal Piercing Station does not extend microplates all the way out of the piercing chamber, it cannot be integrated with the BenchCel device.

Third-party devices

You can integrate a number of third-party devices in the BenchCel Workstation. For the complete list of compatible devices, go to the Velocity11 website at www.velocity11.com.

Note: Before purchasing a third-party device, contact Velocity11 Technical Support about integration requirements.

Related topics

For more information about...	See...
BenchCel Workstation features	“Hardware overview” on page 4
Safety information	“Safety information” on page 22
Installation requirements	“Unpacking and installing the workstation” on page 27

Labware considerations

About this topic

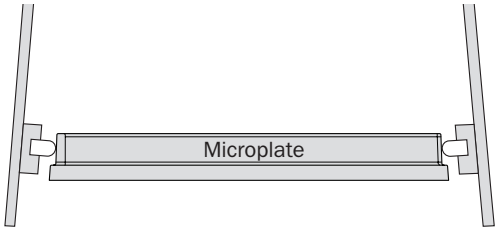
This topic provides guidelines for selecting automation-ready labware for use in the BenchCel Workstation.

Acceptable microplates

Use only labware that meet the American National Standards Institute (ANSI) standards. For the latest labware standards, go to www.sbsonline.org. You can also contact the labware manufacturer to inquire about ANSI-compliant labware.

The BenchCel Workstation uses gripping mechanisms to hold microplates securely and repeatably in the stacker rack and in the robot arms. The BenchCel Workstation typically holds the microplates halfway between the top of the microplate and the top of the microplate skirt.

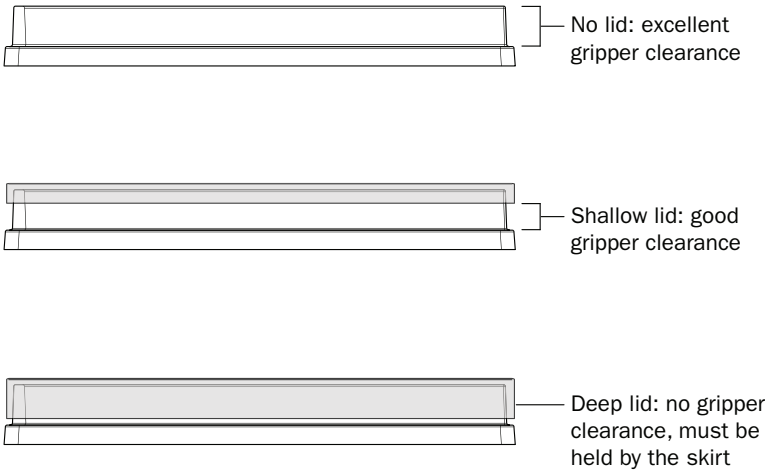
The following diagram shows the BenchCel stacker grippers holding a microplate in the stacker rack. Notice the gripper-microplate contact point.



Lidded microplates

Microplates that do not have lids or have shallow lids (lids that do not reach the microplate skirt) provide enough clearance to allow secure and repeatable gripping. Microplates with deeper lids can be more challenging, because the microplate must be held by the skirt. If the skirt is too flexible, the stacker grippers will bend the skirt. The bent skirt can grip the microplate lid stacked beneath, inadvertently removing the lid.

Note: Some labware vendors might offer alternative lids that are shallower. Contact the vendor for details.



Challenging microplate characteristics

Microplates that have the following characteristics might require additional setup time to ensure repeatable performance for the BenchCel Workstation:

- *Microplate material*. Although you can adjust the robot grip distance to compensate for a microplate's flexibility, some microplates are too soft and tend to bend in the robot grippers (for example, low-profile polypropylene PCR microplates).
- *Manufacturing variance*. Slight variations in microplate dimensions can reduce repeatability of secure gripping. In addition, because the BenchCel Workstation uses reflected light to sense microplate presence and orientation, variations in the reflective properties of the microplates can affect optimal operation.
- *Microplate design*. Microplates that have very small notches might be hard to detect by the orientation sensors. In addition, some microplates have special features specifically designed for particular instruments but are not optimized for the BenchCel Workstation.
- *Thermal cycling effects*. Microplates that have been through thermal cycling might become warped.
- *Tall labware*. Especially tall tube racks and tip boxes that are taller than 65 mm might pose challenges in the BenchCel Workstation. Contact Velocity Technical Support about acceptable tall labware.
- *Extra long lid*. Some microplates that have lids that extend past the microplate skirt tend to pose challenges for the BenchCel Workstation.

Related topics

For more information about...	See...
Defining labware in the software	*BenchWorks Automation Control User Guide*
Location of plate-orientation sensors	"Stacker head" on page 7
How the plate-orientation sensors work	"Adjusting the plate-orientation sensors" on page 124
BenchCel Workstation features	"Hardware overview" on page 4
Safety information	"Safety information" on page 22
Installation requirements	"Unpacking and installing the workstation" on page 27

Software description

About this topic

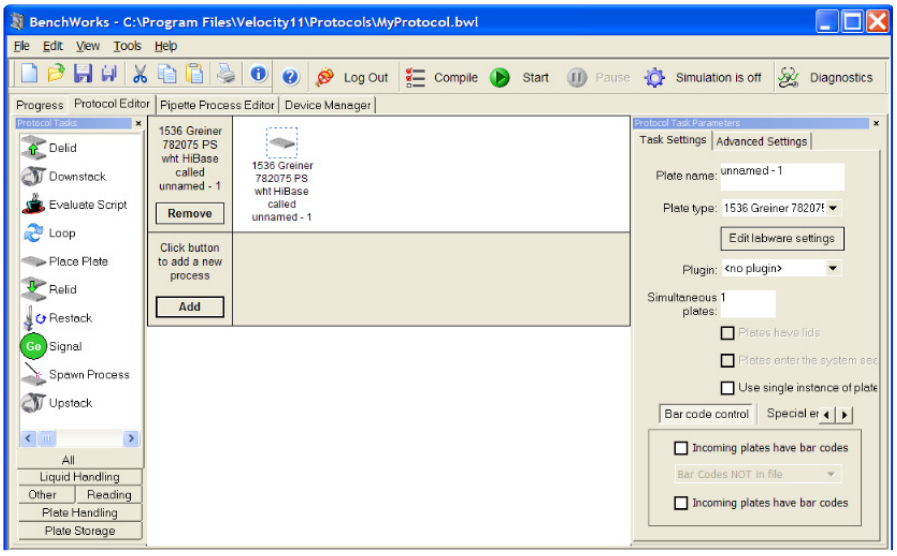
This topic describes the software you use to set up, control, and troubleshoot the BenchCel Workstation.

BenchWorks Automation Control software

The BenchWorks Automation Control software (or BenchWorks software) allows you to:

- *Set up the BenchCel Workstation*. During setup, you need to create device files for the BenchCel device and external devices. You create device files when you set up the BenchCel device and external devices. For setup information, see “Setup Workflow” on page 50.
- *Set up user accounts and privileges*. You can set up different user accounts to enforce access policies. For instructions, see the *BenchWorks Automation Control User Guide*.
- *Define labware*. Labware definitions describe the labware you will use during protocol runs. For instructions, see the *BenchWorks Automation Control User Guide*.
- *Create protocols*. Protocols determine the sequence of tasks you want to automate in a run. For example, you can use a protocol to apply barcode labels to 100 microplates. For protocol-writing instructions, see the *BenchWorks Automation Control User Guide*.
- *Run, pause, monitor, and stop protocols*. You can start, pause, monitor, and stop a protocol run from the controlling computer.

For a full description and instructions on how to use the BenchWorks software, see the *BenchWorks Automation Control User Guide*.



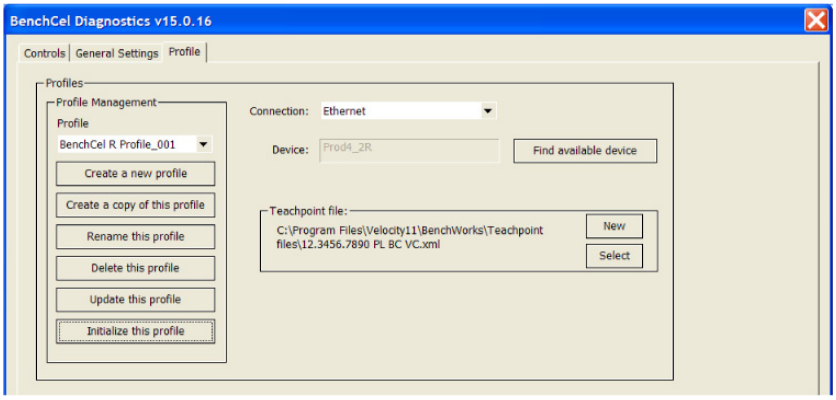
BenchCel ActiveX control

Included with the BenchWorks software is the BenchCel ActiveX control that allows the BenchCel Workstation to interact with any Velocity11 or third-party lab automation system. For information about the BenchCel ActiveX control, see “BenchCel ActiveX control” on page 137.

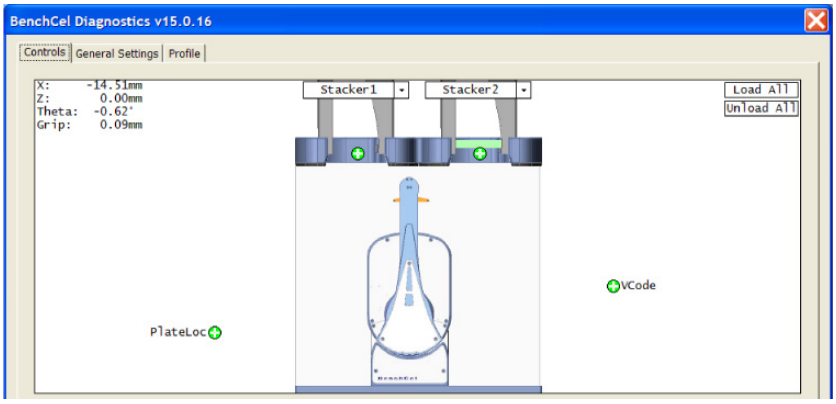
BenchCel Diagnostics software

BenchCel Diagnostics is a component of the supplied BenchCel ActiveX software. Accessed through the BenchWorks software, the BenchCel Diagnostics software allows you to:

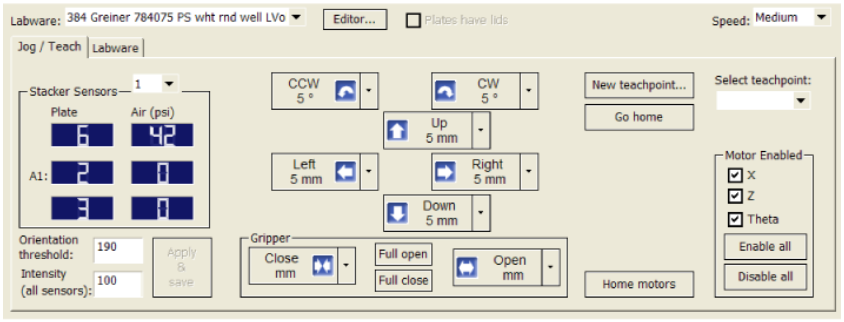
- *Create and manage profiles*. Profiles allow you to set up communication between the selected BenchCel Workstation and the controlling computer. You create profiles when you set up the BenchCel Workstation. For setup information, see “Setup Workflow” on page 50.



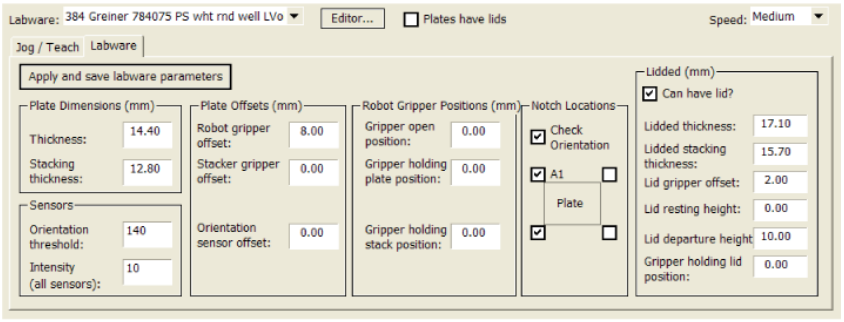
- *Set and edit teachpoints*. Teachpoints are locations that the BenchCel robot will go to and from during a protocol run. You set teachpoints when you set up the BenchCel Workstation. For setup information, see “Setup Workflow” on page 50.



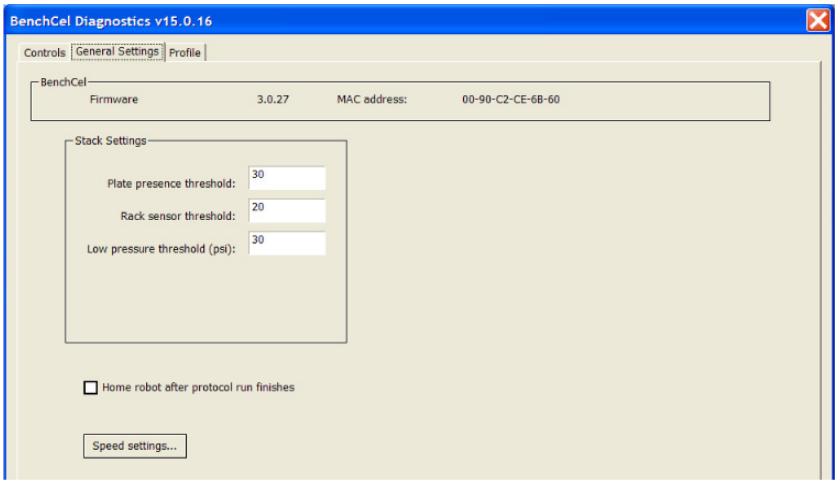
- *Diagnose problems*. Moving and adjusting individual hardware components allow you to diagnose and troubleshoot problems. For information on diagnosing and troubleshooting problems, see “Diagnostic tools” on page 105.



While testing new or troubleshooting labware definitions, you can change parameters to refine the labware definition. For information on changing labware parameters, see “Diagnostic tools” on page 105.



- *Change general device settings*. After diagnosing problems, you can change some of the device settings to repair problems or to optimize operation.



Related topics

For more information about...	See...
BenchWorks software instructions	*BenchWorks Automation Control User Guide*
Software installation instructions	*BenchWorks Automation Control User Guide*
Workstation setup procedure	“Setup Workflow” on page 50
BenchCel ActiveX control	“BenchCel ActiveX control” on page 137

Safety information

Introduction

This topic provides information for the safe operation of the BenchCel Workstation.

Before using the BenchCel Workstation

Before using a BenchCel Workstation, your organization should make sure that you are properly trained in:

- ❑ General laboratory safety
- ❑ The correct and safe operation of the BenchCel Workstation
- ❑ The correct and safe operation of other lab automation systems or components used in combination with the BenchCel Workstation

If you are the person in your organization responsible for training others on the BenchCel Workstation and you have a safety question, contact Velocity11 Technical Support.

Safety standards

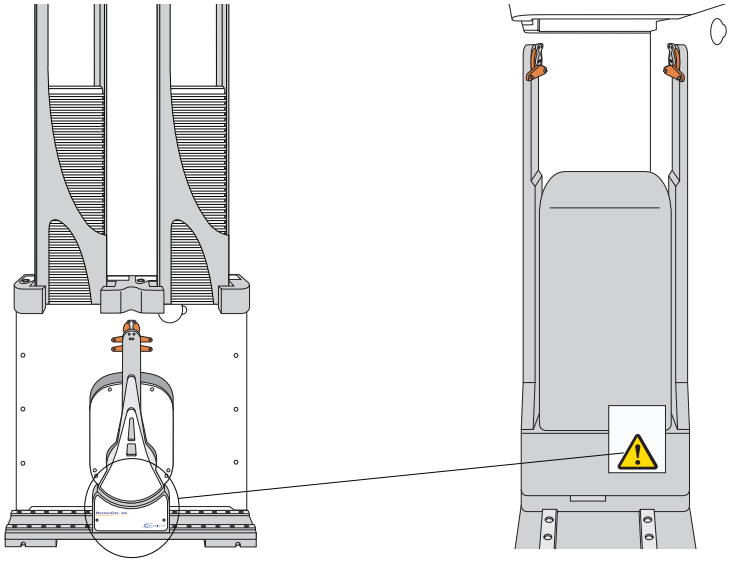
The BenchCel device is CE certified and complies with the following CE safety directives:

- ❑ EN61326:1997, including Amendment 1:1998 (EMC)
- ❑ EN61010-1:1993, including Amendment 2:1995 (Safety)

Safety labels

Pay attention to safety labels printed on your product. A safety label consists of a warning symbol. A description of the warning and information that will help you to avoid the safety hazard are located in the user guide.

The following diagram shows an example of a warning label that indicates risk of danger. It is located on the lower left and right sides of the robot head.



Front view Side view

General precautions

!! INJURY HAZARD !! Do not remove the BenchCel device covers or otherwise disassemble the device. Doing so can cause injuries and damage the device.

!! INJURY HAZARD !! Using controls, making adjustments, or performing procedures other than those specified in this user guide can expose you to high pressure gases and moving parts. Exposure to these hazards can cause severe injury.

The BenchCel device is designed for safe operation. Under normal operating conditions, you are protected from high pressure gas and moving parts. However, you should be aware of these hazards and understand how to avoid being exposed to them.

Removed safety shield injury hazard

!! INJURY HAZARD !! Operating the BenchCel Workstation without safety shields or enclosure covers increases risk of injury.

Velocity11 recommends that you enclose the BenchCel Workstation in the supplied safety shield. Using the safety shield restricts access to the BenchCel Workstation while it is operating.

Moving parts injury hazard

!! INJURY HAZARD !! Do not attempt to touch any of the moving parts or attempt to remove microplates while the BenchCel Workstation is in operation. The robot head moves with considerable force and can cause pinching, piercing, or bruising injury if you are in the path of the robot head or grippers.

!! INJURY HAZARD !! Keep your fingers, hair, clothing, and jewelry away from the device and the path of the robot head while it is in motion.

!! INJURY HAZARD !! Do not touch the BenchCel Workstation as you start the software. The robot head moves when the device initializes.

To minimize potential injury, the BenchCel Workstation is designed to stop immediately if the robot head hits an obstacle while it is in operation. However, be aware that the robot moves with considerable force in the vertical or *z* direction and could pierce your skin with one of its grippers.

Not all circumstances can be foreseen and serious injury is possible. It is the responsibility of every operator to follow warnings and safety labels and keep out of the robot's workspace whenever it is likely to move.

Safety interlock override hazard

!! INJURY HAZARD !! Do not disable or override the BenchCel Workstation safety interlock.

The BenchCel Workstation has a safety interlock circuit that must be closed for the system to operate. Do not defeat the safety interlock. Always connect the safety interlock to the supplied safety shield.

Infrared LED injury hazard

!! INJURY HAZARD !! Looking directly at the light-emitting diodes (LEDs) inside the stacker heads can cause eye injury.

Each BenchCel device stacker head contains seven infrared LEDs that detect the presence of a stacker rack, microplates, and microplate notches. (See “Stacker head” on page 7 for the location of the LEDs.) The LEDs are capable of dissipating 100 mW of power. Do not look directly at the LEDs when the BenchCel device is turned on.

User account passwords damage hazard

!! DAMAGE HAZARD !! Only fully trained BenchCel Workstation administrators should have access to, and use of, the user account passwords.

Improper use of the robot by untrained operator can lead to damage to the device. For example, the robot grippers could collide with a stacker if a teachpoint is not defined properly.

Improper cleaning hazard

!! DAMAGE HAZARD !! Do not use harsh abrasives, corrosive cleaning agents, or metal brushes to clean any BenchCel Workstation components or accessories. Do not use any concentration of bleach (sodium hypoclorite). Do not allow cleaning agents to contact any electrical or sensitive mechanical components.

Chemical hazards

Some chemicals used when working with the BenchCel Workstation can be hazardous. Make sure you follow your local, state, and federal safety regulations when using and disposing of the chemicals.

Read the recommendations in the MSDS (Material Safety Data Sheet) for every chemical that you plan to use. The manufacturer of the chemical should provide you with the MSDS.

Gas cylinders and pressure regulators

Compressed air is used to move components inside the BenchCel Workstation.

Follow the local, state, and federal safety codes for the placement and mounting of gas cylinders. For example, you might have to attach a standard cylinder bracket to a solid permanent structure to meet or exceed all local seismic and safety requirements.

Always use good lab practices when handling high-pressure cylinders. Make sure you follow any instructions provided with the cylinders.

Product use

Velocity11’s products must only be used in the manner described in the user guides. Any other use can damage the product or injure you. Velocity11 is not responsible for damages caused, in whole or part, by unauthorized modifications, or by procedures that are not explicitly described in the product user guides. Any modifications or changes to products not expressly described in Velocity11 user guides are not covered under the warranty.

The BenchCel Workstation is not intended or approved for diagnosis of disease in humans or animals.

Related topics

For more information about...	See...
BenchCel Workstation hardware description	“Hardware overview” on page 4
Connection panel location and description	“Hardware overview” on page 4
Turning on and turning off the BenchCel Workstation	“Starting up and shutting down the BenchCel Workstation” on page 52
Stopping the BenchCel device in an emergency	“Stopping the BenchCel device in an emergency” on page 88

Unpacking and installing the workstation

2

This chapter describes how to unpack and set up the BenchCel Workstation. All of the procedures in this chapter can be performed by someone with operator privileges.

This chapter contains the following topics:

Installation workflow

About this topic

This topic presents the workflow for unpacking the BenchCel device and installing the BenchCel Workstation.

Workflow

The following table presents the steps for unpacking and installing the BenchCel Workstation.

Step	For this task...	See...
1	Verify laboratory requirements.	"Verifying laboratory requirements" on page 29
2	Unpack and inspect the BenchCel Workstation.	"Unpacking and inspecting the BenchCel device" on page 32
3	Integrate external devices.	"Integrating the devices" on page 35
4	Connect the power.	"Connecting the power source" on page 39
5	Connect the pendant.	"Connecting the pendant" on page 40
6	Connect the air supply.	"Connecting and disconnecting the air source" on page 41
7	Connect the computer.	"Connecting the computer" on page 44
8	Install the safety shield.	"Installing the safety shield" on page 47
9	Install the BenchWorks software.	*BenchWorks Automation Control User Guide*

Related topics

For information about...	See...
Installing external devices	External device user documentation
Setting up the BenchCel Workstation	"Setting up the BenchCel Workstation" on page 49
BenchWorks software	*BenchWorks Automation Control User Guide*
Writing protocols	*BenchWorks Automation Control User Guide*

Verifying laboratory requirements

Laboratory space

General bench requirements

Make sure the bench for the BenchCel Workstation has the following:

- ❑ Proximity to power and air sources
- ❑ Enough space to accommodate the complete configuration of your BenchCel Workstation, which includes the number and size of stacks, computer, and external devices
- ❑ Sufficient clearance on the back side of the BenchCel Workstation to access power, communication, and air tubing connections
- ❑ Enough strength to support the BenchCel Workstation and devices without excessive shaking or movement
- ❑ A fixed position (no wheels)
- ❑ Proper height for any operator to comfortably operate the BenchCel Workstation

Space requirements

The minimum space requirements for your BenchCel device depends on its configuration and stacker rack size. The following table lists dimensions for a BenchCel device in a two-, four-, or six-stack configuration.

Dimension	Two stacks	Four stacks	Six stacks
Height with x-short rack with short rack with medium rack with tall rack	46.3 cm 68.0 cm 88.3 cm 111.2 cm 128.9 cm	46.3 cm 68.0 cm 88.3 cm 111.2 cm 128.9 cm	46.3 cm 68.0 cm 88.3 cm 111.2 cm 128.9 cm
Width	43.2 cm	86.4 cm	129.5 cm
Depth	20.3 cm	20.3 cm	20.3 cm
Weight without rack with tallest rack	 21.8 kg 25.2 kg	 28.1 kg 38.7 kg	 32.7 kg 52.2 kg

Note: The racks listed are the standard racks supplied with the system. In addition, the weight of the rack is of the rack alone and does not include liquid-filled microplates. The height and weight are slightly different with different rack types. See the Velcity11 website at www.velocity11.com for the height and weight information of various rack types.

Addition of devices

If you are integrating a Velocity11 device or third-party device in your BenchCel Workstation, make sure you include adequate space to accommodate these devices. See the device user documentation for space requirement information.

Electrical

The BenchCel device has the following power requirements. For power requirements of other devices in the workstation, see the device user documentation.

Utility	Requirement
Electrical	100–240~, 50/60 Hz, 5 A
Fuse	5 A, 250 V, 5 × 20 mm, fast acting

Compressed air

The BenchCel device requires the use of clean, dry, compressed air to move pneumatic components inside the device. The compressed air can be from the following sources:

- ❑ Centralized source (house)
- ❑ Compressed-air cylinders
- ❑ Portable pumps

!! DAMAGE HAZARD !! Using oil compressors can cause oil to leak into the BenchCel device and void your warranty.

To maintain the desired air supply in the device, the BenchCel device requires a source of air as follows:

Requirement	Value
Quality	Clean, dry, compressed
Flow rate	340 Lpm (1.2 cfm)
Pressure	0.65–0.69 MPa (95–100 psi)

!! DAMAGE HAZARD !! Air pressure greater than 0.69 MPa (100 psi) can damage the BenchCel Workstation.

Environment

The lab must meet the following environmental requirements.

Requirement	Value
Ambient temperature	5–40 °C
Humidity condition	10–90% RH, non-condensing
Elevation	1–2000 m

Velocity11 recommends that you do the following:

- ❑ Place the BenchCel Workstation away from heat and air conditioning ducts.
- ❑ Place the BenchCel Workstation away from direct sunlight.

Computer

The BenchCel device is shipped with a computer that controls the BenchCel Workstation operations. The computer has all the necessary software and is configured to operate the BenchCel Workstation.

!! IMPORTANT !! Velocity11 recommends that you use the supplied computer, because it is set up and tested for BenchCel Workstation operations.

If your organization does not allow you to use the supplied computer, you can purchase your own computer. Make sure the computer meets the following minimum requirements:

- ❑ PC system
  - ◆ Pentium 4, 2 GHz or faster
  - ◆ 256 MB RAM
  - ◆ Windows 2000 or Windows XP
  - ◆ 50 GB free hard disk space
- ❑ Communications interface
  - ◆ Dedicated 10BaseT Ethernet card (two network cards if connecting to your local area network)
  - ◆ RS-232 DB9 serial port

To facilitate the setup process, a software installation CD is supplied. You can use the CD to install the necessary software and setup configurations.

Networking considerations

The supplied computer comes with a serial port and two Ethernet ports. You can connect the computer to the BenchCel device using either the serial port or one of the Ethernet ports. You can use the second Ethernet port to connect the computer to your local area network (LAN). You must provide an Ethernet cable for the LAN connection and make sure the lab has the proper network hookups for the connection.

If you are supplying your own computer, consider whether you will:

- ❑ Connect the computer to the BenchCel device using a serial or Ethernet connection.
- ❑ Connect the computer to your LAN.

The computer might need two Ethernet cards if you plan to connect it to the BenchCel device and to your company's LAN. Doing so allows the BenchCel Workstation to operate on an isolated network.

Related topics

For information about...	See...
External device lab requirements	External device user documentation

Unpacking and inspecting the BenchCel device

About this topic

This topic explains how to unpack the BenchCel device and lists the items that are included with the device.

Unpacking precautions

When unpacking the BenchCel device, be sure to:

- ❑ Note the dimensions of the shipping container before moving it to make sure you have adequate clearance through doorways and passages.
- ❑ Make sure the final location is nearby and easily accessible.
- ❑ Use care when lifting the BenchCel device to prevent personal injury and damage to the device. Depending on the configuration, the BenchCel device weighs 21.8 kg (48.1 lb) to 32.7 kg (72.1 lb) and requires two people to lift it.

Unpacking the BenchCel Workstation

To unpack the BenchCel device:

1. Open the BenchCel device shipping container.
2. Lift the contents out of the container and set each item carefully on the lab bench or final location where you want to install the device.
3. Remove packing foams from the device.
4. Remove components from the plastic bags or other packing material.

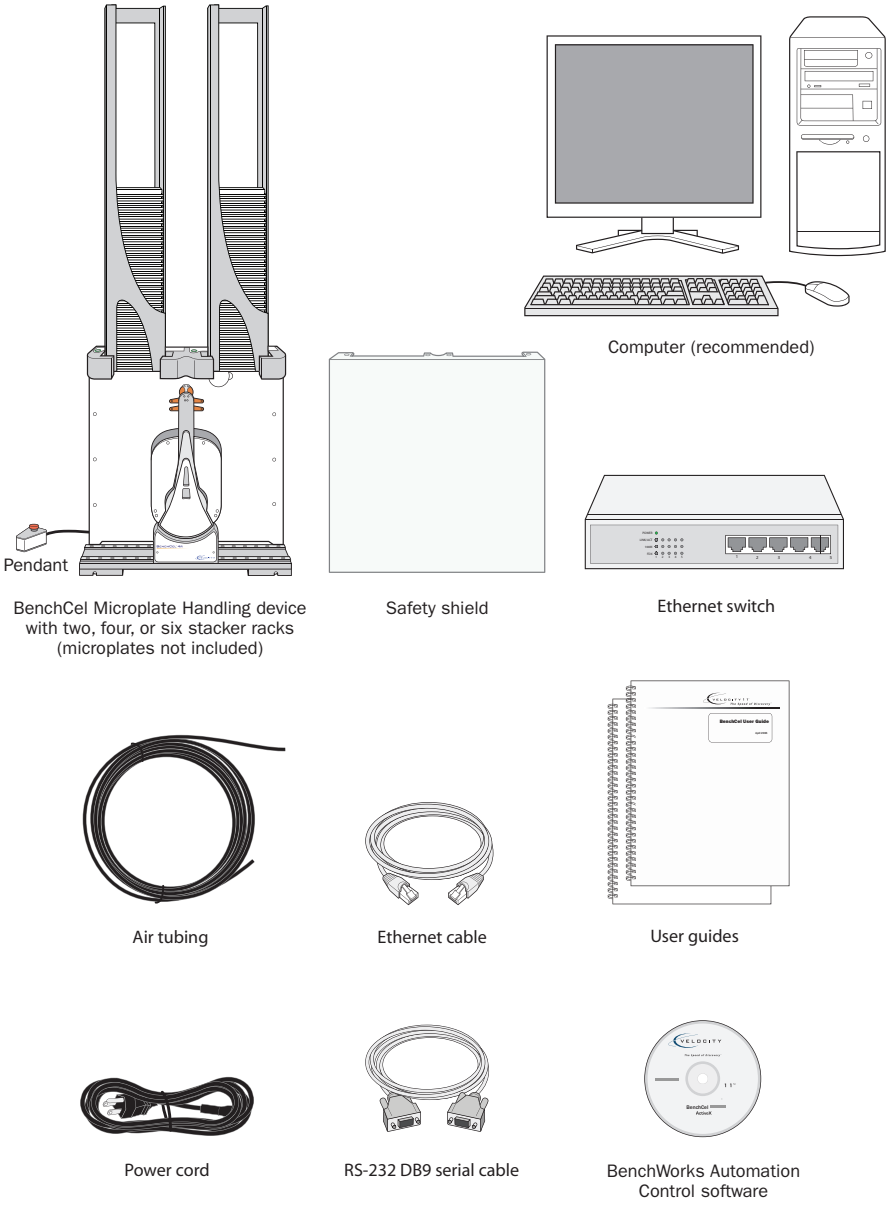
!! DAMAGE HAZARD !! Save the packing materials and shipping container in case you need to move or ship the BenchCel device.

!! DAMAGE HAZARD !! The packing materials and shipping container were designed to protect the device. Packing the BenchCel device using other materials might damage the device and void your warranty.

Inspecting the contents

After you unpack the BenchCel device, check that you have the items in the following diagram. Inspect the items to make sure you have everything shown. If any of the items are missing or damaged, contact Velocity11 Technical Support.

Note: The stacker racks might vary, depending on the type you ordered.



Related topics

For more information about...	See...
Installation requirements	"Verifying laboratory requirements" on page 29
Installing the BenchCel Workstation	❑ "Integrating the devices" on page 35 ❑ "Connecting the power source" on page 39 ❑ "Connecting the pendant" on page 40 ❑ "Connecting and disconnecting the air source" on page 41 ❑ "Connecting the computer" on page 44 ❑ "Installing the safety shield" on page 47

Integrating the devices

About this topic

After you unpack the system components, you can arrange the BenchCel and external devices on the benchtop in preparation for integration. The layout and integration procedures can vary, depending on the combination of devices you are integrating and the desired configuration. Simple configurations might include one external device and the installation and alignment of basic integrations plates under the devices. Complex configurations might include several devices and require custom tables, custom integration plates, plate stage modifications, and so on.

This topic provides basic integration concepts: how integration plates are used and how to adjust device positions. Always contact Velocity11 Technical Support when you want to integrate a new device. For the list of compatible devices, see “Integration options” on page 14.

Before you start

Make sure you have the following:

- ❑ The external devices you want to integrate
- ❑ Two integration plates for the BenchCel device
- ❑ Integration plate for each external device
- ❑ 4-mm hex wrench
- ❑ 3-mm hex wrench

Installing the BenchCel device integration plate

The BenchCel device integration plates have locking mechanisms that keep the BenchCel device and any external device in position during a run. The integration plates must be installed under the BenchCel device.

To install the BenchCel device integration plate:

1. Position the integration plates on the benchtop.
2. If risers are required in the integration, install the risers on the integration plates.
3. Place the BenchCel device on the integration plates or risers.
4. Tighten the screws to secure the device on the integration plates.

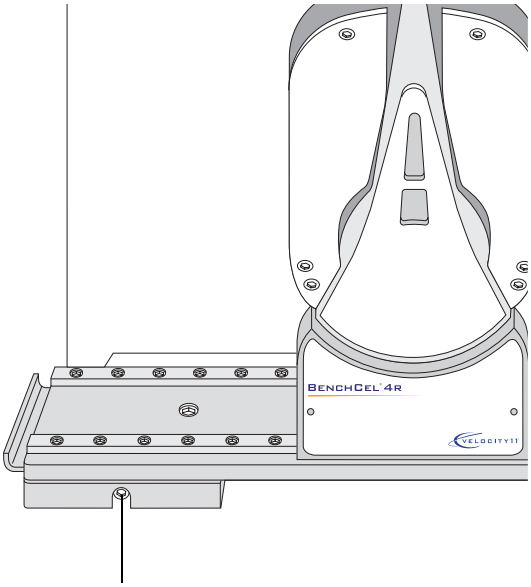
Installing the external device integration plate

You can integrate an external device on the left or right side of the BenchCel device. For each external device, you must install the integration plate that is specific to that device.

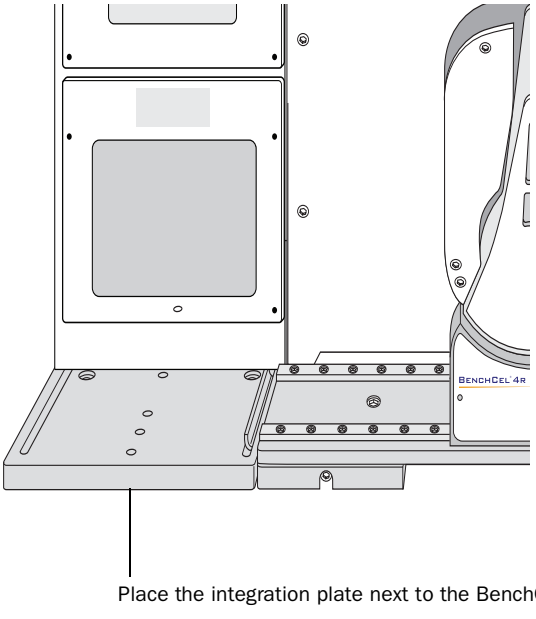
To install the external device and integration plate:

1. Depending on whether you are integrating a device to the left or right of the BenchCel device, loosen the left or right clamp screw using the 3-mm hex wrench. As you loosen the screw, the left or right clamp opens.

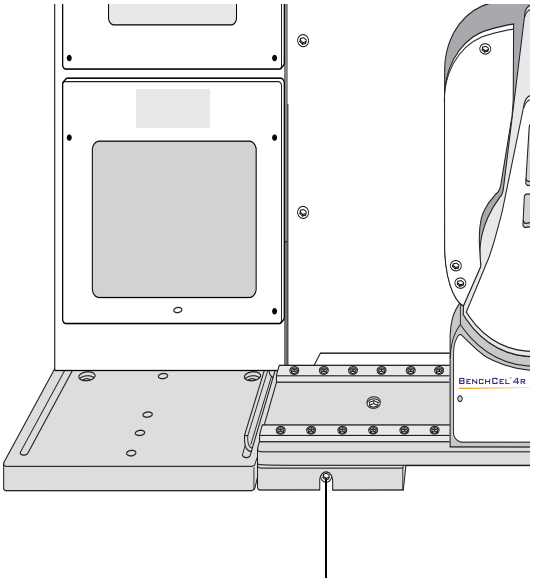
The following diagram shows the location of the left clamp screw. An identical screw is located on the right side of the device.



2. Mount the external device on its integration plate. Tighten the bolts or screws to secure the device on the integration plate.
3. Place the external device and integration plate next to the BenchCel device as shown in the following diagram.



4. Slightly tighten the BenchCel device integration plate clamp screw using the 3-mm hex wrench. You will not tighten the screw all the way until the devices are correctly aligned.



5. Visually inspect the position of the device relative to the BenchCel device. The two devices should be aligned along the *y*-axis (front-to-back direction) so that the BenchCel robot will be able to place a microplate on the plate stage accurately. If the devices are not properly aligned, slide the devices along the y-axis until they appear to be correctly aligned.

   Note: You will verify and refine the alignment when you set up the teachpoints for the external devices (see “Setup Workflow” on page 50).

6. Repeat the procedure for each external device.

Related topics

For more information about...	See...
Integration options	“Integration options” on page 14
BenchCel Workstation installation requirements	“Verifying laboratory requirements” on page 29
External device installation requirements	External device user documentation

For more information about...	See...
Installing the BenchCel Workstation	❑ "Installation workflow" on page 28 ❑ "Connecting the power source" on page 39 ❑ "Connecting the pendant" on page 40 ❑ "Connecting and disconnecting the air source" on page 41 ❑ "Connecting the computer" on page 44 ❑ "Installing the safety shield" on page 47

Connecting the power source

About this topic

This topic explains how to connect the BenchCel device to a grounded power source.

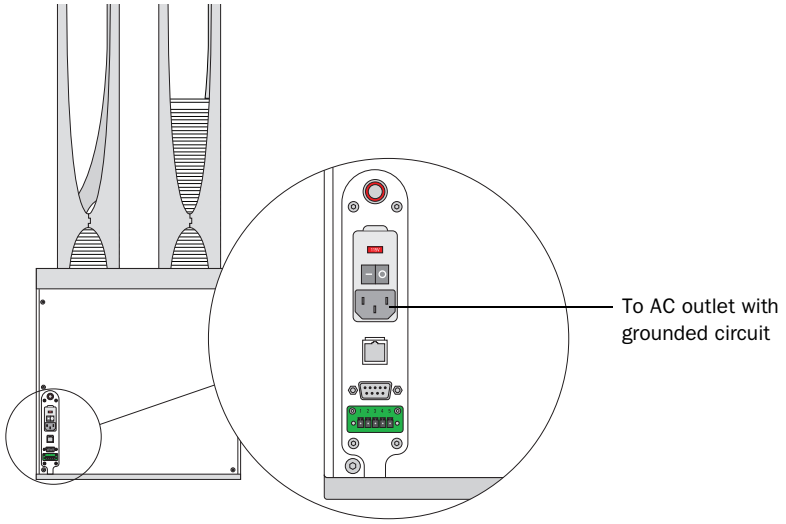
Before you start

Make sure you have the supplied power cord.

Connecting the power source

To connect the BenchCel device to a grounded power source:

1. Plug one end of the power cord into the AC power entry located on the back of the BenchCel Workstation.



2. Plug the other end of the cord into an AC outlet with grounded circuit.

Related topics

For more information about...	See...
Electrical requirements	“Verifying laboratory requirements” on page 29
How to set up the BenchCel Workstation	“Setup Workflow” on page 50
How to operate the BenchCel Workstation	“Workflow for performing a run” on page 82

Connecting the pendant

About this topic

Designed to protect you from moving-part hazards while the BenchCel Workstation is in operation, the pendant is part of the safety interlock circuit that must be closed for the BenchCel Workstation to operate. Pressing the raised button on the pendant breaks the safety circuit and disables the robot motors.

This topic explain how to connect the pendant to the BenchCel device.

Before you start

Make sure you have the supplied pendant.

Connecting the pendant

To connect the pendant to the BenchCel device:

Connect the pendant cable to the pendant port on the back of the BenchCel device.

Related topics

For more information about...	See...
The pendant and its use	“Hardware overview” on page 4
Electrical requirements	“Verifying laboratory requirements” on page 29
How to set up the BenchCel Workstation	“Setup Workflow” on page 50
How to operate the BenchCel Workstation	“Workflow for performing a run” on page 82

Connecting and disconnecting the air source

About this topic

Compressed air is used to move parts inside the BenchCel device. This topic explains how to connect the BenchCel device to the air source and check the connections for leaks before use.

Before you start

Make sure you have the supplied air tubing.

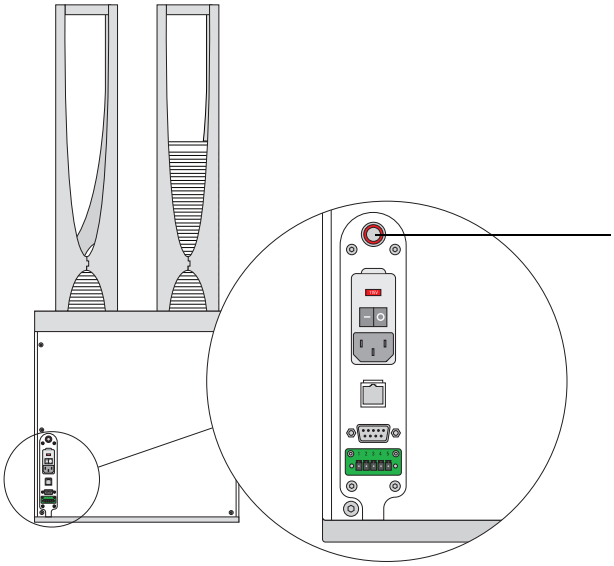
Connecting the air source

To connect the BenchCel device to the air source:

1. Turn off the air at the source (house, cylinder, or pump).
2. Connect one end of the air tubing to the air source (house, cylinder, or pump), and then connect the free end of the tubing to the quick disconnect fitting at the air-input port.

   To connect the tubing, push the end of the tubing into the quick disconnect fitting at the air source and on the back of the BenchCel device.

   The following diagram shows the air tubing connection on the back of the BenchCel device.



Checking the air connections

To check the air connections:

1. With the air source turned off, gently tug the air tubing at each connection.

   If you feel resistance at the connection, the tubing has been properly installed.

2. Turn on the air at the source (house, cylinder, or pump).
3. Listen near each connection for hissing sounds that might indicate a leak.

   If you hear hissing sounds, turn off the air at the source, check and tighten the connections, and then turn on the air again. If the problem persists, contact your facilities department or Velocity11 Technical Support.

Disconnecting the air source

You might need to disconnect the air tubing before moving or shipping the BenchCel device and before performing maintenance or cleaning.

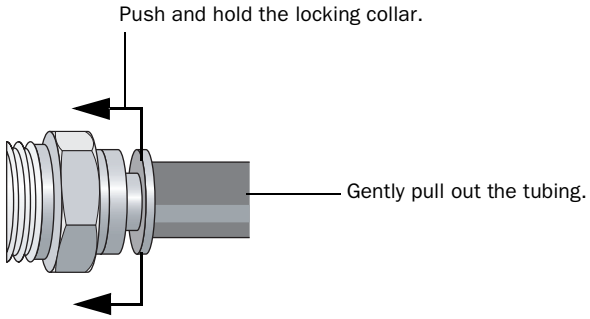
!! DAMAGE HAZARD !! Do not pull the tubing out of the orange quick disconnect fitting. Doing so can damage the fitting.

To disconnect the air tubing from the BenchCel device:

1. Turn off the air at the source (house, cylinder, or pump).
2. Push and hold the locking collar against the fitting, and then gently pull the air tubing out.

   Note: Alternatively, you can use the SMC Pneumatics tool (TG-2) to aid in this task. See the manufacturer's documentation for use instructions. Contact your local SMC parts supplier for ordering details.

   The following diagram shows a close-up view of the quick disconnect fitting.



Related topics

For more information about...	See...
Air source requirements	“Verifying laboratory requirements” on page 29
How to set up the BenchCel Workstation	“Setup Workflow” on page 50
How to operate the BenchCel Workstation	“Workflow for performing a run” on page 82

Connecting the computer

About this topic

You need a computer to operate the BenchCel Workstation and external devices. This topic explains how to connect the controlling computer to the BenchCel device.

Before you start

Make sure you have the following:

- ❑ RS-232 DB9 serial cable or Ethernet cable (supplied)
- ❑ Ethernet switch (supplied) for Ethernet connections only

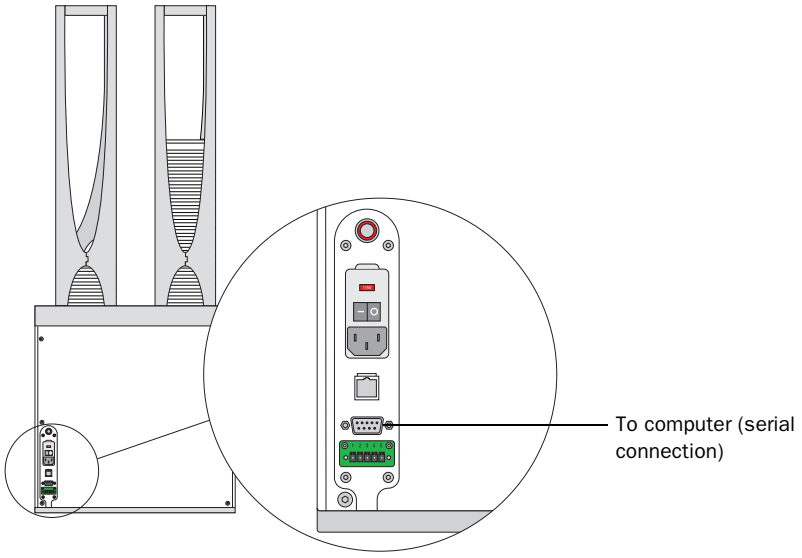
Connecting the controlling computer

You can connect the computer to the BenchCel device in one of two ways:

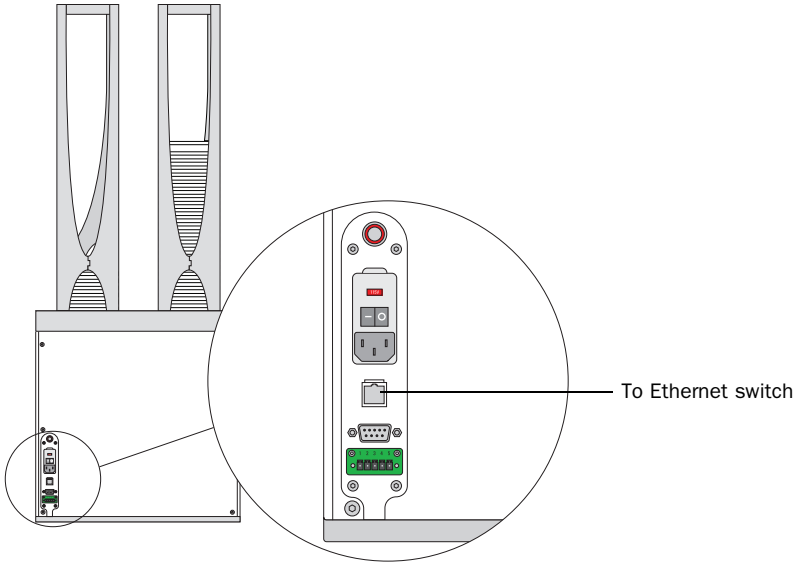
- ❑ *Serial connection.* You can use the supplied RS-232 DB9 serial cable to connect the computer to the BenchCel device.
- ❑ *Ethernet connection.* You can use the supplied Ethernet cable to connect the computer to the BenchCel device. The computer from Velocity11 has two Ethernet ports. You can use one to connect to the BenchCel device. You can use the other to connect to your local area network (LAN).

To connect the controlling computer to the BenchCel Workstation:

1. Turn off the computer.
2. *Serial connection only.* Do the following:
   a. Connect the female end of the serial cable to a COM port on the controlling computer. Note the number of the COM port. You will need to provide this number in the software.
   b. Connect the male end of the serial cable to the serial port on the back of the BenchCel device.



3. *Ethernet connection only.* Do the following:
   a. Connect one end of the Ethernet cable to the back of the BenchCel device.
   b. Connect the free end of the Ethernet cable to any available port on the Ethernet switch.



Configuring the computer's network card (Ethernet connection only)

The computer you purchased from Velocity11 is already configured to communicate with the BenchCel Workstation. You do not need to change the network card's IP address.

If you are using your own computer, make sure the value of the network card's IP address and subnet mask are as follows:

- ❑ IP address: 192.168.0.1
- ❑ Subnet mask: 255.255.255.0

!! INJURY HAZARD !! Do not connect multiple BenchCel Workstations on a general network. Remote computer operators might accidently initiate an operation that causes the robot to move unexpectedly, possibly injuring nearby lab personnel.

If your computer will be connected to your LAN, make sure the computer has a second network card. The second network card can have a dynamic IP address.

Connecting the computer to external devices (Ethernet connection only)

To connect the external devices to the controlling computer:

1. Connect one end of the Ethernet cable to the Ethernet port on the external device. See the device user documentation for details.
2. Connect the free end of the Ethernet cable to any available port on the Ethernet switch.

Related topics

For more information about...	See...
The controlling computer requirements	“Verifying laboratory requirements” on page 29
The Ethernet switch	See the Ethernet switch user documentation
How to set up the BenchCel Workstation	“Setup Workflow” on page 50
How to operate the BenchCel Workstation	“Workflow for performing a run” on page 82

Installing the safety shield

About this topic

This topic explains how to install the safety shield on the front of the BenchCel device.

Before you start

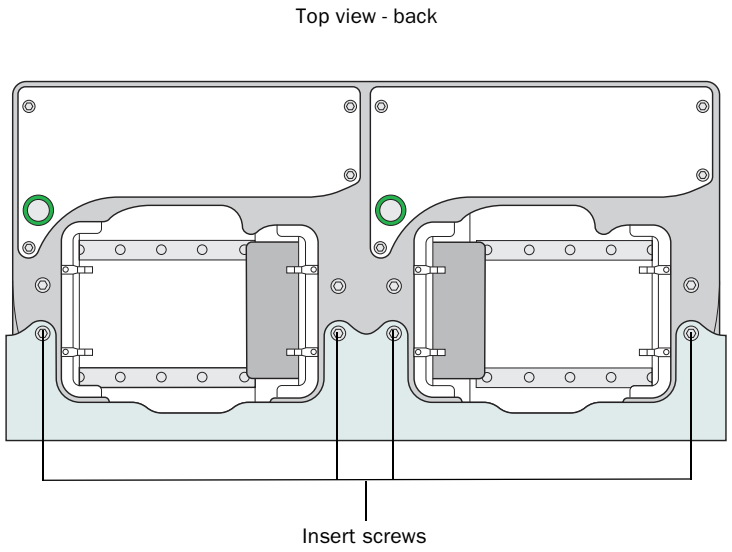
Make sure you have the following:

- ❑ M3 hex wrench
- ❑ Low-head M5 screws (supplied)

Procedure

To install the safety shield:

1. Place the safety shield on the front of the BenchCel device. The ledge of the shield should sit on the top of the device.
2. Insert the four M5 screws into the shield.



3. Tighten the screws using the M3 hex wrench.

Related topics

For more information about...	See...
Safety shield description	“Hardware overview” on page 4
Safety information	“Safety information” on page 22
How to set up the BenchCel Workstation	“Setup Workflow” on page 50
How to operate the BenchCel Workstation	“Workflow for performing a run” on page 82

Setting up the BenchCel Workstation

3

This chapter explains how to set up the BenchCel Workstation for operation. This chapter contains the following topics:

Setup Workflow

About this topic

This topic presents the workflow for setting up the BenchCel Workstation for operation.

Workflow

The following table presents the steps for setting up the BenchCel Workstation. After setting up the BenchCel Workstation for the first time, you will not likely change any of the settings in the procedure unless you add a device, replace a device, or move the BenchCel Workstation.

!! IMPORTANT !! Before proceeding to step 6 (setting teachpoints), you should already have definitions for the labware you want to use. Although you can define labware at any time before step 6, Velocity11 recommends that you define labware before setting up the BenchCel Workstation. For instructions on how to define labware in the BenchWorks software, see the *BenchWorks Automation Control User Guide*.

Step	For this task...	See...
1	Start up the workstation.	"Starting up and shutting down the BenchCel Workstation" on page 52
2	Create a device file and add the BenchCel device in BenchWorks.	"Creating and deleting a BenchCel device in BenchWorks" on page 54
3	Create a profile.	"Creating and managing profiles" on page 60
4	Add external devices to the device file.	User documentation for the Velocity11 device or the *Device Driver Guide* for third-party devices
5	Create a profile for each external device. Add another device to the device file? Yes No	User documentation for the Velocity11 device or the *Device Driver Guide* for third-party devices
6	Set and edit teachpoints for external devices.	"Setting and managing teachpoints" on page 66
7	Write protocols.	*BenchWorks Automation Control User Guide*

Related topics

For more information about...	See...
Installation procedure	“Installation workflow” on page 28
Operating the BenchCel Workstation	“Workflow for performing a run” on page 82
Troubleshooting problems	“Maintenance and troubleshooting” on page 91

Starting up and shutting down the BenchCel Workstation

About this topic

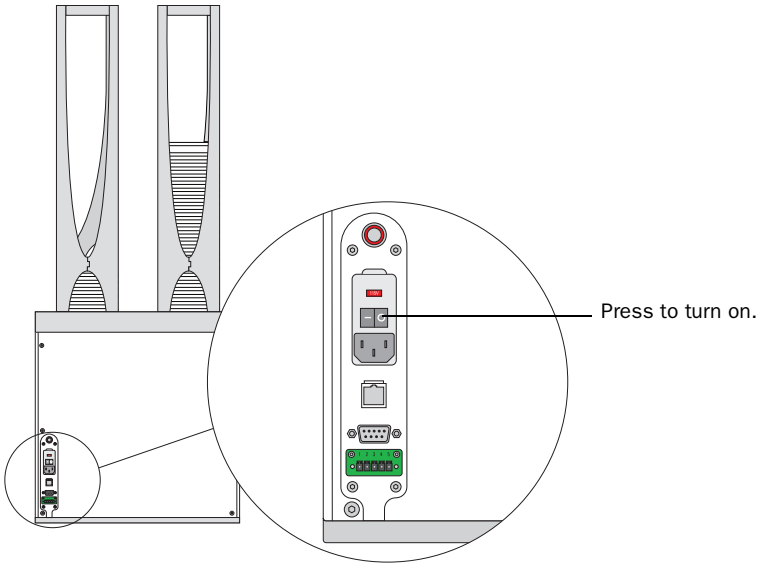
This topic explains how to start up and shutdown the BenchCel Workstation.

Starting up the BenchCel Workstation

!! INJURY HAZARD !! Keep your fingers, hair, clothing, and jewelry away from the BenchCel Workstation while it is in motion.

To start up the BenchCel Workstation:

1. Turn on the BenchCel device. To do this, on the back of the device, press the power switch to the on (**I**) position.



   Every time you turn on the BenchCel device, the robot homes (the robot is sent to the factory-defined home position for each axis of motion). If the BenchCel robot does not home, make sure power to the robot has been restored (see “Recovering from an emergency stop” on page 103 to reset the Robot Disable button). If the button has been reset and the robot still does not home, turn off the device, check the connections, and turn it on again.

2. Turn on all other devices integrated in the BenchCel Workstation. See the device user documentation for instructions.
3. Turn on the compressed air supply to the BenchCel device.
4. Turn on the controlling computer. See the user documentation from the computer manufacturer.
5. Start the BenchWorks software. To do this, on the Windows desktop, double-click the **BenchWorks shortcut icon.** Alternatively, click **Start > Programs > Velocity11 > BenchWorks.**

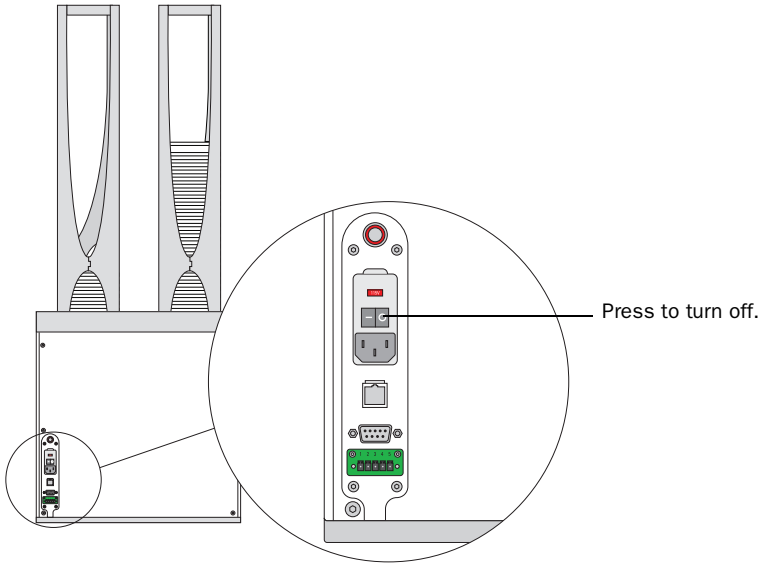
Shutting down the BenchCel Workstation

Shut down the BenchCel Workstation if you intend to:

- ❑ Leave it unused for a long period of time.
- ❑ Service the device.
- ❑ Move it to another location.

To shut down the BenchCel Workstation:

1. Follow the post-run clean-up procedure after the last protocol run. See “Cleaning up after a protocol run” on page 89.
2. In BenchWorks, select **File** > **Exit** to quit the software.
3. If you use devices that require a vacuum pump, turn off power at the pump if the pump module has an on/off switch.
4. Turn off the compressed air to the BenchCel device and other devices.
5. Turn off the BenchCel device. To do this, on the back of the device, press the power switch to the off (**O**) position.



6. Turn off other devices in the BenchCel Workstation.

Related topics

For information about...	See...
Electrical requirements	“Verifying laboratory requirements” on page 29
Cleaning up after a protocol run	“Cleaning up after a protocol run” on page 89
Troubleshooting startup or shutdown problems	“Maintenance and troubleshooting” on page 91

Creating and deleting a BenchCel device in BenchWorks

About this topic

The computer you purchased from Velocity11 is set up with the correct device configuration to communicate with the BenchCel Workstation. You do not need to create new BenchCel devices unless you want to reference different profiles or use a different teachpoint file.

If you purchased your own computer, you will need to add BenchCel devices in BenchWorks. This topic describes how to add and delete new BenchCel devices in BenchWorks.

You will also need to add devices that are integrated with the BenchCel Workstation later in the setup process (see "Setup Workflow" on page 50). For instructions on how to add Velocity11 devices, see the device user documentation. For instructions on how to add third-party devices, see the *Device Driver User Guide*.

Devices defined

A device is an item in your lab automation system that has an entry in the BenchWorks Device Manager. A device can be a robot, an instrument, or a location on the lab automation system that can hold a piece of labware. The following are some examples of devices:

- ❑ BenchCel device
- ❑ BenchCel stacker rack
- ❑ PlateLoc Thermal Microplate Sealer
- ❑ VCode Barcode Print and Apply Station
- ❑ VPrep Pipetting System shelf
- ❑ Platepad
- ❑ A third-party device integrated in the BenchCel Workstation

Device file defined

To communicate with and to control external devices, the BenchWorks software uses a device file that contains the following information for all the devices in the integrated system:

- ❑ Type of device (for example, BenchCel robot, BenchCel stacker rack, PlateLoc Thermal Microplate Sealer, and any external device)
- ❑ Device configuration information (for example, approach height, allowed or prohibited labware, barcode access, and so on)
- ❑ Profile to use (see "Creating and managing profiles" on page 60)

You provide the device information in the BenchWorks Device Manager. The device information is stored in a device (.dev) file that is located in a folder you specify when saving the file.

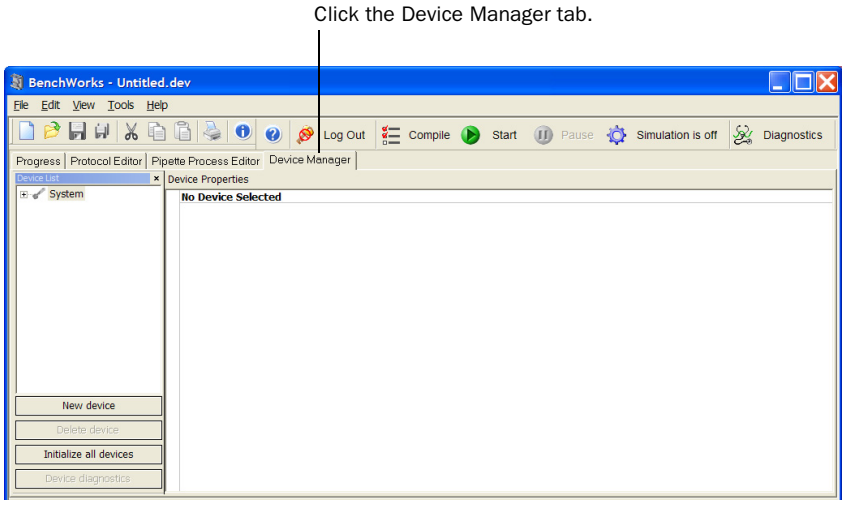
For detailed information about device files and associations with profiles, teachpoint files, and labware definitions, see the *BenchWorks Automation Control User Guide*.

Creating a device file

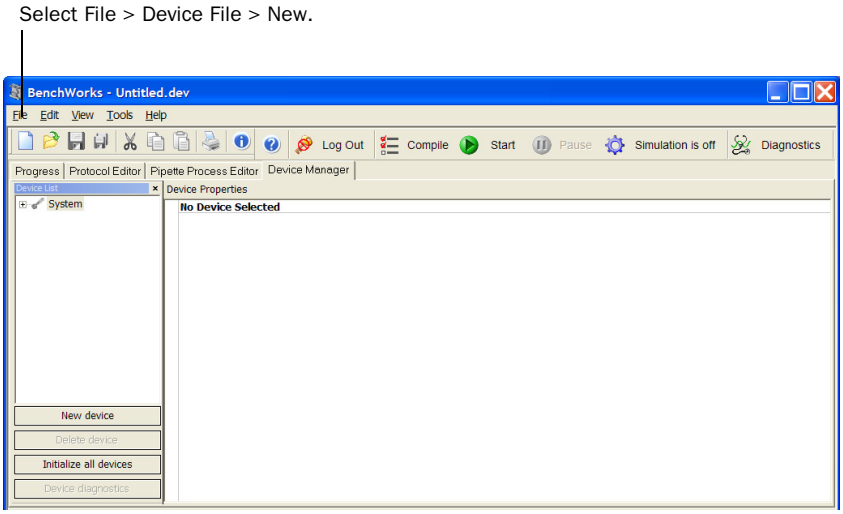
If you are setting up the BenchCel Workstation for the first time, you will need to create a new device file, and then add the BenchCel device and other devices to this file.

To create a new device file:

1. Start the BenchWorks software and log in. See the *BenchWorks Automation Control User Guide* for instructions.
2. Click the **Device Manager** tab.



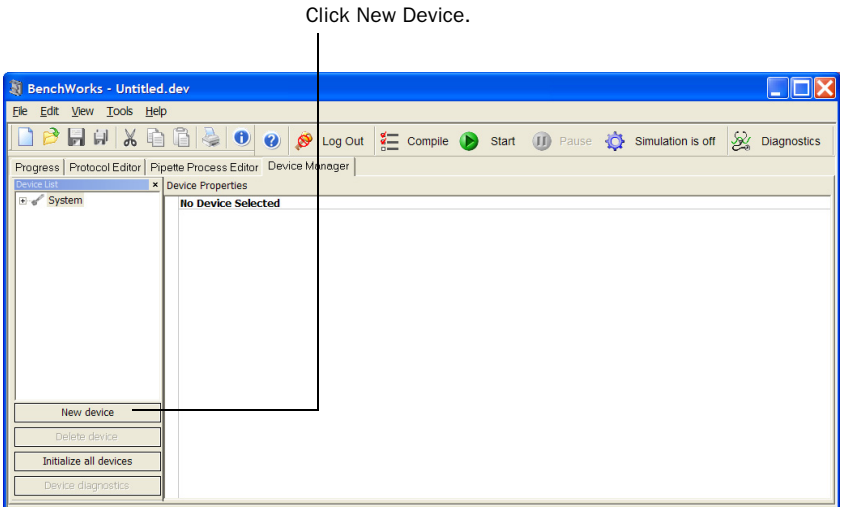
3. In the BenchWorks window, select **File > Device File > New.** In the Log area at the bottom of the BenchWorks window, the last message indicates that you have created the new device file.



Adding a BenchCel device

To add a BenchCel device:

1. In the **Device Manager Device List** area, click **New Device.**



The New Device dialog box opens.

2. Type a name for the BenchCel device.

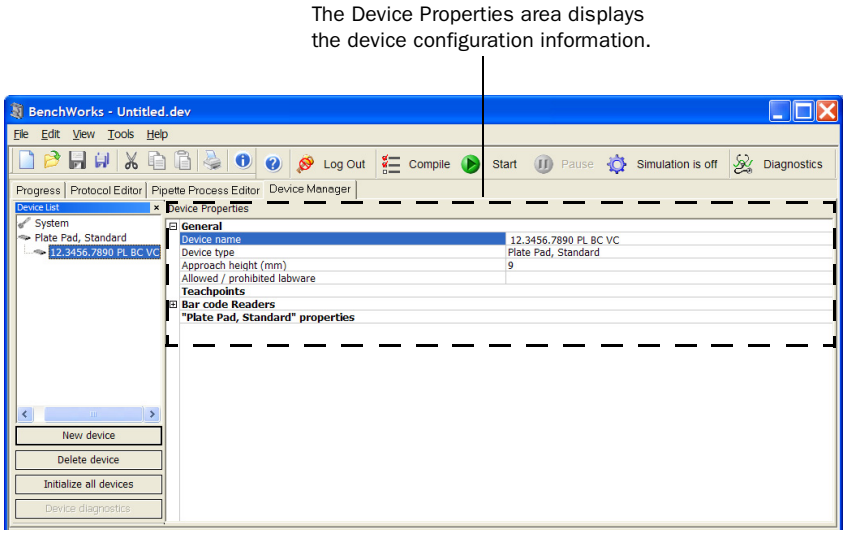
   Velocity11 recommends that the device name consists of the following, in the order shown:

   - BenchCel device serial number
   - BenchCel Workstation configuration (left-to-right, top-to-bottom)

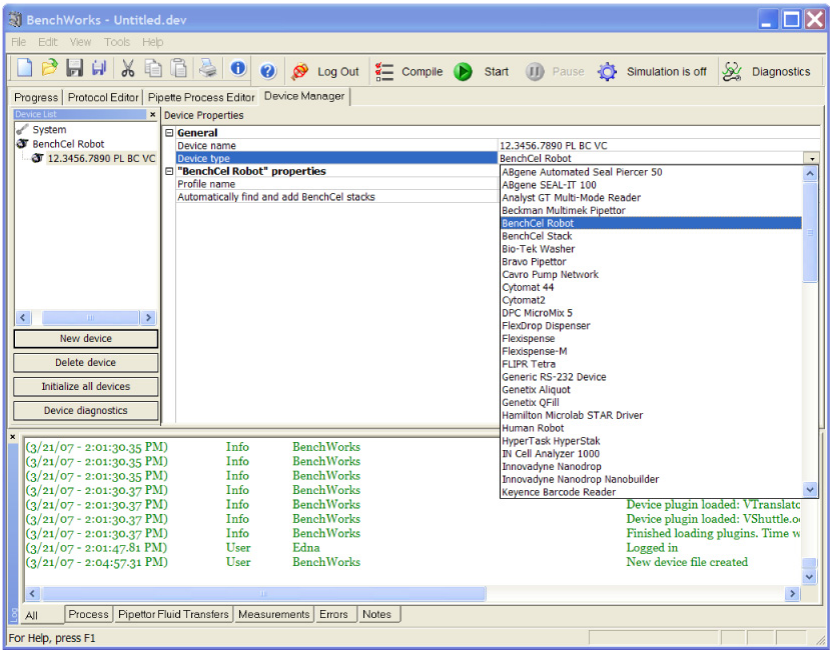
   For example, if the BenchCel device has a serial number of 12.3456.7890, and the BenchCel Workstation consists of a PlateLoc Sealer on the left side of the BenchCel device and a VCode Microplate Labeler on the right side of the BenchCel device, the recommended device name is: 12.3456.7890 PL BC VC.

   To locate the device serial number, see “Reporting problems” on page 135.

3. Click **OK** to return to the BenchWorks window. The device configuration information appears in the Device Properties area.

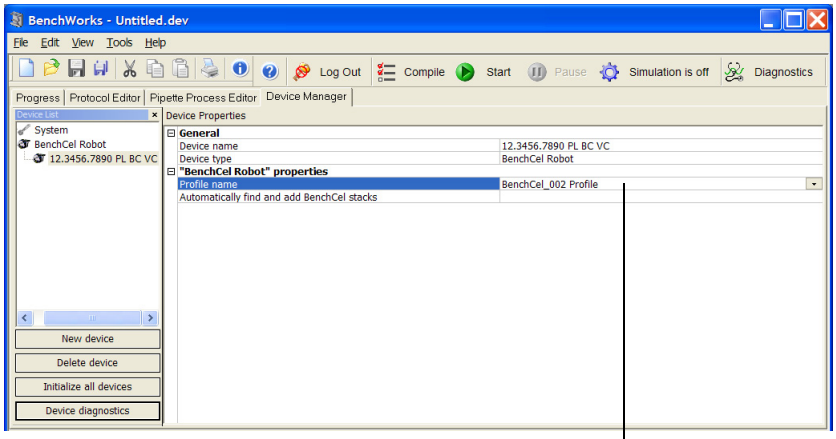


4. In the **Device Properties** area, click **Device type,** and then select **BenchCel Robot.**



5. In the **Device Properties** area, click **Profile name,** and then select the profile you want to use.

   If this is the first time you are setting up the BenchCel Workstation, or if no profile appears in the list, see “Creating and managing profiles” on page 60 to create a new profile, and then return to this step to select a profile. Without the profile, you will not be able to establish communication with the BenchCel device in step 6 and add the stacks in step 7.



Click to select profile.

6. In the **Device List** area, click **Initialize all devices** to establish communication with the selected devices.
7. In the **Device Properties** area, click **Automatically find and add BenchCel Workstation stacks,** and then click [...]. Wait a few seconds while the software finds the stacks.

   Note: The BenchCel device must be connected to the controlling computer for the BenchWorks software to automatically find the stacks.

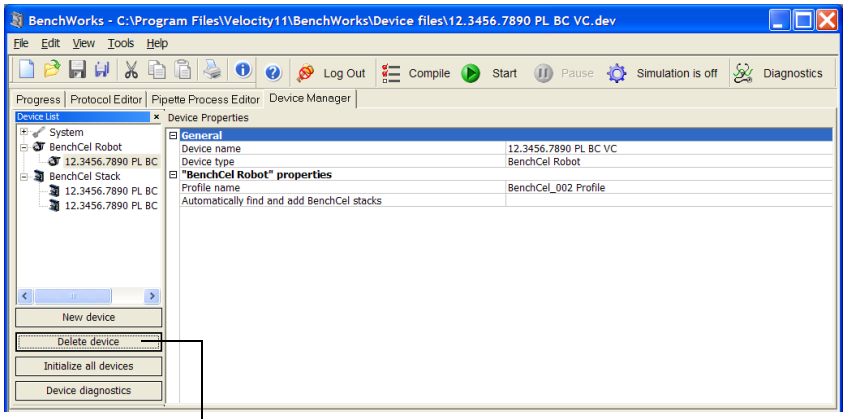
   The list of stacks appears under the BenchCel Robot in the Device List area. To see the stack list, In the **Device List** area, expand **BenchCel Stack.**
8. Select **File > Device File > Save As.** The Save As dialog box opens.
9. Type a name for the device file, select a location where you want to save the file, and click **Save.**

   Velocity11 recommends that the device file name matches the device name you provided in step 2 on page 56.

Deleting a device

To delete a BenchCel device in the BenchWorks software:

1. In the BenchWorks window, click the **Device Manager** tab.
2. In the **Device List** area, select the device you want to delete.
3. Click **Delete device.**



Click to delete a selected device file.

Related topics

For information about...	See...
BenchWorks software	*BenchWorks Automation Control User Guide*
Protocol files	“Creating and managing profiles” on page 60
Teachpoints	“Setting and managing teachpoints” on page 66

Creating and managing profiles

About this topic

The computer you purchased from Velocity11 is set up with the correct profile to communicate with the BenchCel Workstation. You do not need to create new BenchCel profiles unless you want to set up unique communication settings or use a different teachpoint file.

If you purchased your own computer, you will need to create a BenchCel profile. This topic describes how to create new BenchCel profiles and how to manage existing profiles.

You will also need to create profiles for devices that are integrated with the BenchCel Workstation. For instructions on how to create the profiles for Velocity11 devices, see the device's user documentation. For instructions on how to create profiles for third-party devices, see the *Device Driver User Guide*.

Profiles

!! IMPORTANT !! Each BenchCel device you install requires a unique profile.

A profile is a collection of settings, stored in the Windows registry, that manages how you connect to devices. A BenchCel profile:

- Specifies the port used to establish communication between the BenchCel Workstation and the controlling computer.
- References a teachpoint file. For a description of teachpoint files, see "Setting and managing teachpoints" on page 66.

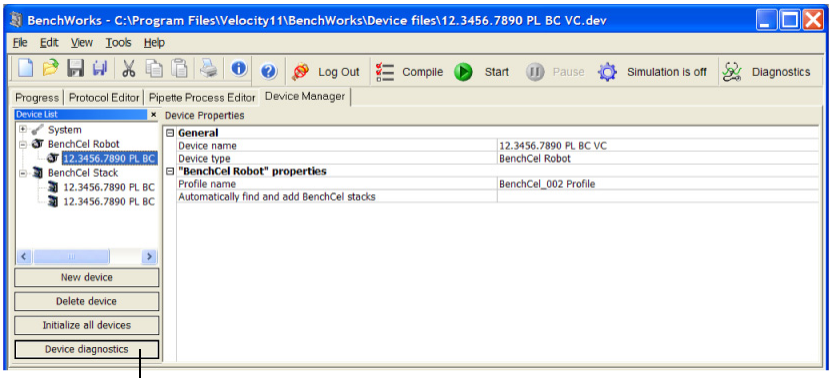
You use the BenchCel Diagnostics software to create and manage profiles.

Note: The profile is referenced by a device file. For information about device files, see "Creating and deleting a BenchCel device in BenchWorks" on page 54. For a detailed description of the relationships between the device file, profile, and teachpoint file, see the *BenchWorks Automation Control User Guide*.

Creating BenchCel Workstation profiles

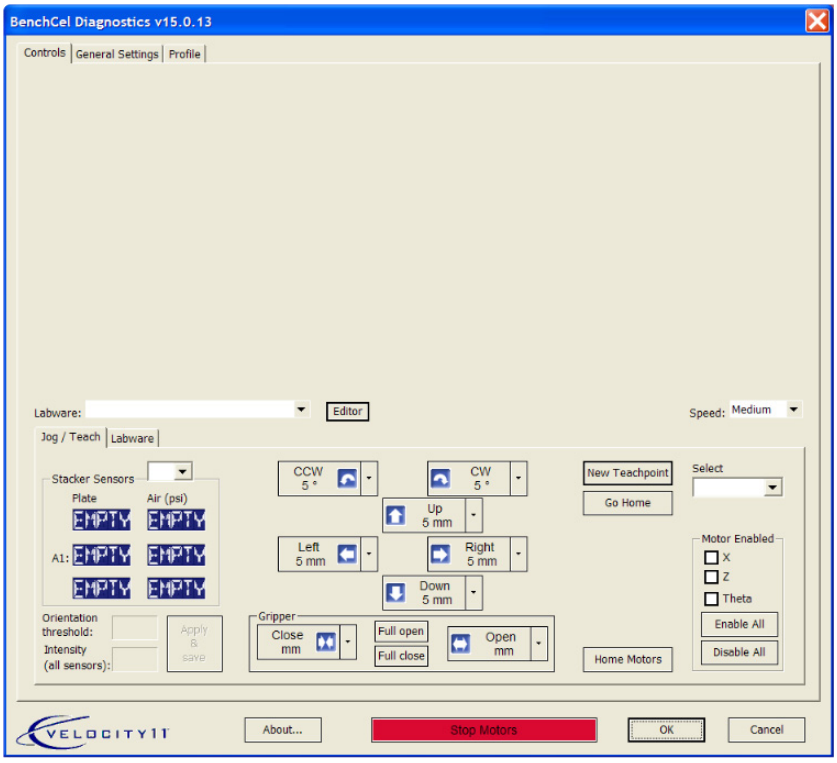
To create a BenchCel profile:

1. In the **Device Manager Device List** area, select a BenchCel device.
2. Click **Device diagnostics.**

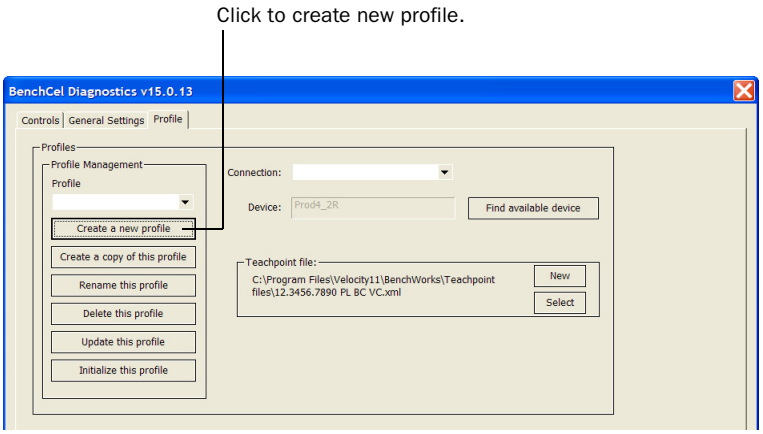


Click to open BenchCel Diagnostics.

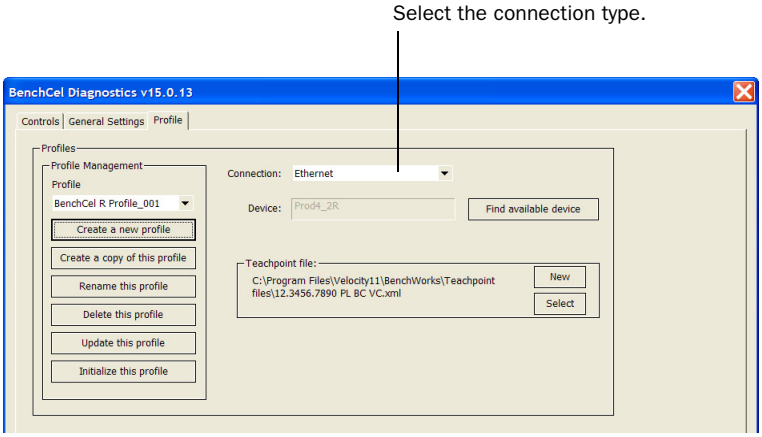
The BenchCel Diagnostics dialog box opens and displays the Controls tab.



3. Click the **Profiles** tab.
4. Click **Create a new Profile**. The Create Profile dialog box opens.

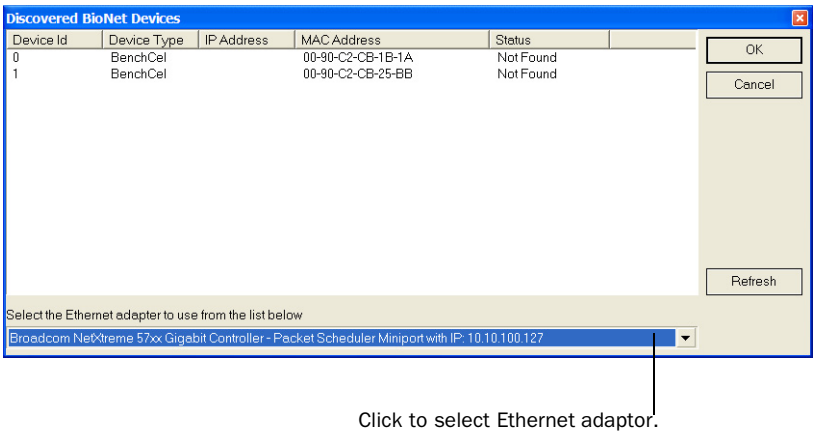


5. Type a name, and click **OK**.
6. In the **Connection** list, select one of the following:
   - **Ethernet.** If the BenchCel device is connected to the computer using an Ethernet port.
   - **COM.** If the BenchCel device is connected to the computer using a serial port.



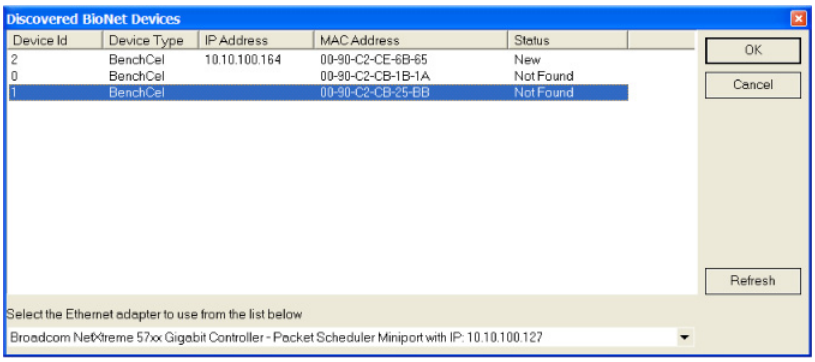
7. If you selected an Ethernet connection, click **Find available device** to select the device to associate with the profile. In the **Discovered BioNet Devices** dialog box that opens:

   a. Select the correct Ethernet adaptor for the device connection. A list of devices appear.



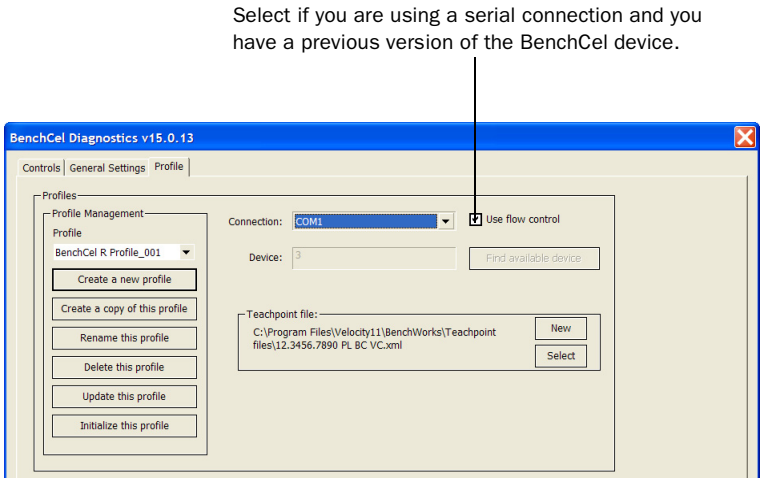
   b. In the list of devices that appear, select the BenchCel device. If you have multiple BenchCel Workstations on the network, use the **MAC Address** to identify the BenchCel device you want. To successfully communicate with the BenchCel device, the device must show **New** or **Matched** in the **Status** column.

      Note: To determine the MAC address, you can turn off all other BenchCel devices so that only one is shown in the Discovered BioNet Devices dialog box.



   c. When you are finished, click **OK** to return to the BenchCel Diagnostics dialog box.

8. If you selected a serial (COM) connection, select **Use flow control** to stop the flow of data from the computer before it overruns the device communication buffer. Velocity11 recommends that you select this option to optimize communication over the serial connection.



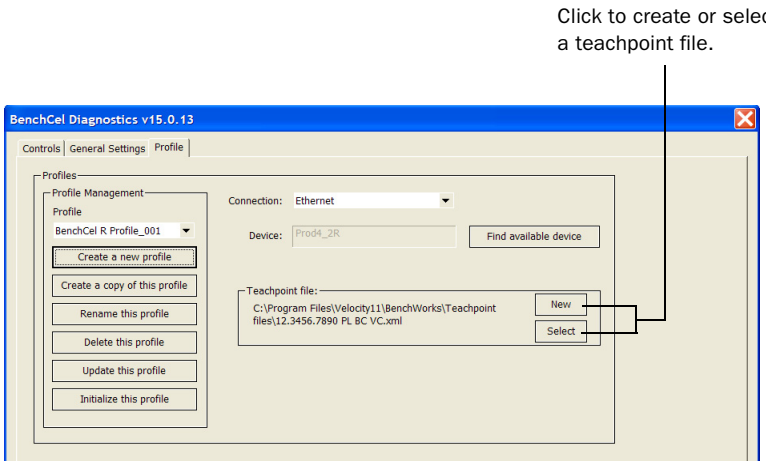
9. In the BenchCel Diagnostics dialog box, in the Teachpoint file area, click one of the following:

   a. **New.** Allows you to create a new teachpoint file. If you are setting up the BenchCel Workstation for the first time, you need to create a new teachpoint file. You will later add teachpoints to this file.

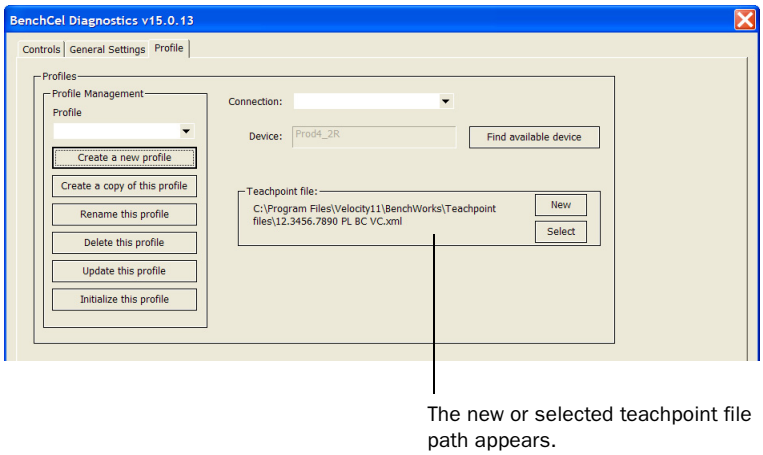
      When you click **New,** the Save As dialog box opens. Type a name for the teachpoint file, and then click **Save.** By default, the teachpoint file name is Teachpoints_<profilename>.xml, where <profilename> is the name of the profile, and the file will be saved in the following folder: C:\Program Files\Velocity11\Settings.

   b. **Select.** Allows you to select an existing teachpoint file. You load a teachpoint file if you want to use an existing teachpoint file, or if you want an existing profile to reference a different teachpoint file.

      When you click **Select,** the Select a Teachpoint File dialog box opens. Locate and select the teachpoint file, and then click **Open.**



When you are finished, the teachpoint file path appears in the Teachpoint File area.



10. Click **Update this profile** to save the changes.
11. Click **Initialize this profile** to establish communication with the BenchCel Workstation.
12. Click **OK** to return to the BenchWorks window.

If you are setting up the BenchCel Workstation for the first time, return to “Adding a BenchCel device” on page 56 and continue from step 5.

Related topics

For information about	See...
Adding a device in BenchWorks	“Creating and deleting a BenchCel device in BenchWorks” on page 54
Setting teachpoints	“Setting and managing teachpoints” on page 66

Setting and managing teachpoints

About this topic

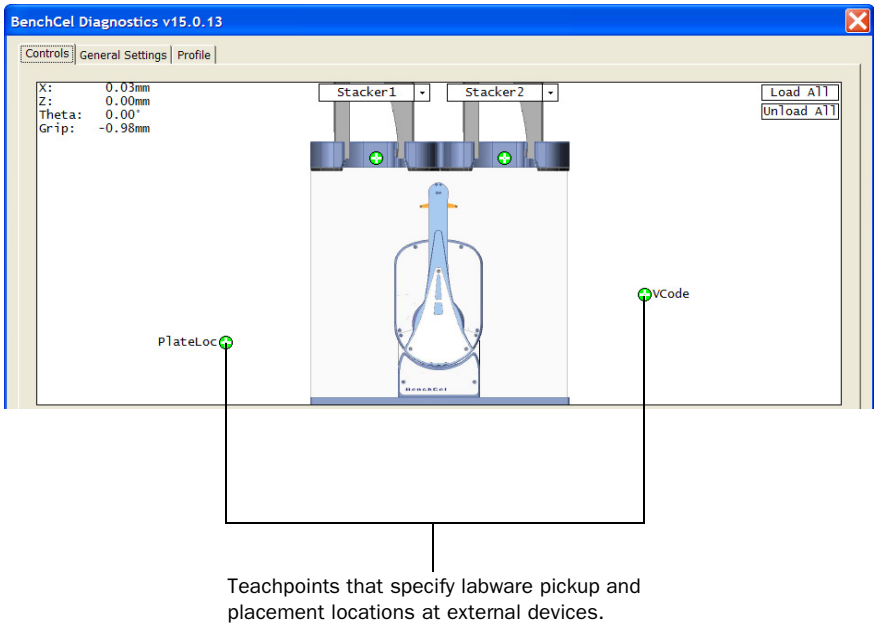
This topic explains how to set teachpoints.

Teachpoints

A teachpoint is a set of coordinates that define where the robot can pick up or place labware. The location can be on an external device or a platepad.

You set, edit, and save teachpoints in BenchCel Diagnostics. The teachpoints are displayed as plus signs (⊕) in the graphical display area in the BenchCel Diagnostics dialog box.

Note: The graphical display area also shows teachpoints (⊕) at the stacks. These teachpoints are preset at the factory and cannot be changed.



Teachpoint files

The teachpoints you set are saved in the XML format in a teachpoint file. The default teachpoint file is created by Velocity11 and the name contains the device serial number followed by your company name. By default, the file is stored in C:\Program Files\Velocity11\Setup. However, you can select another location when saving the file.

You must use one teachpoint file for each BenchCel device. If you integrate a new device in the BenchCel Workstation, you can add the new teachpoints to the existing file. If you have multiple BenchCel devices in a BenchCel Workstation, you must create a teachpoint file for each BenchCel device in the workstation.

!! DAMAGE HAZARD !! Before you begin changing teachpoints, make a backup copy of the teachpoint file. If the original teachpoint file becomes lost or damaged, you can use the backup copy instead of resetting all the teachpoints and creating a new file.

The teachpoint file is referenced by a profile. For information about profiles, see “Creating and managing profiles” on page 60.

Before you start

Make sure:

- ❑ The correct profile is initialized (“Creating and managing profiles” on page 60).
- ❑ The labware you want to use is defined (*BenchWorks Automation Control User Guide*).

Setting new teachpoints

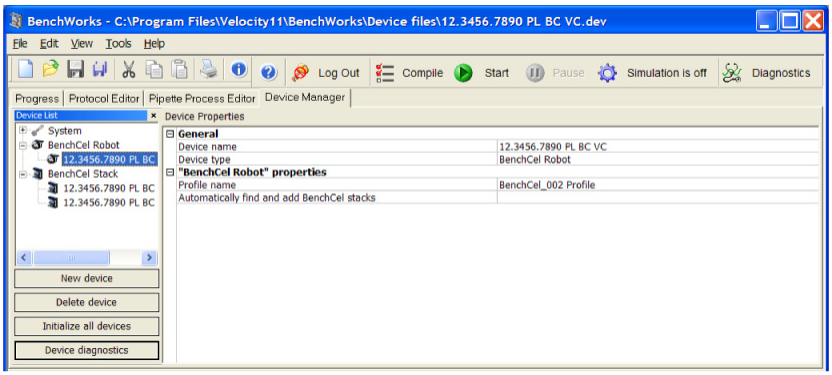
!! INJURY HAZARD !! During this procedure, make sure no one else can issue commands at the controlling computer while you are manually determining the teachpoint coordinates.

When you set a teachpoint, you need to:

1. Determine the coordinates of the pickup and placement location.
2. Record the coordinates in the teachpoint file and verify the teachpoint file selection in the device file.

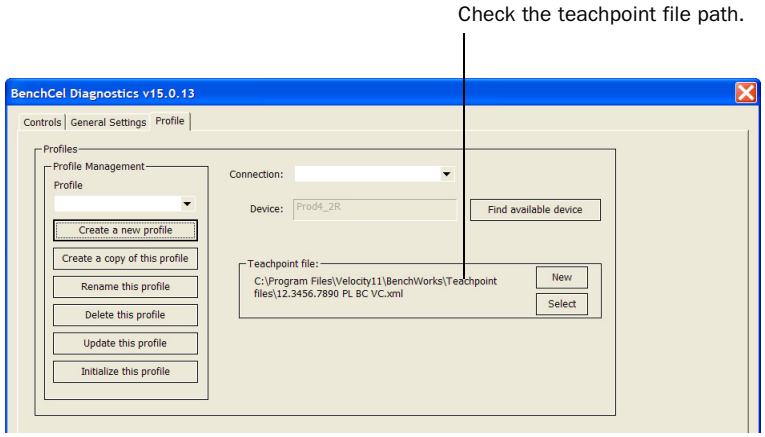
To determine the coordinates of the location:

1. Load two to three spare microplates in a stacker rack, and then install the rack on BenchCel Workstation. For instructions, see “Loading and unloading labware” on page 84 and “Installing and removing stacker racks” on page 85.
2. In the BenchWorks window, click the **Device Manager** tab.

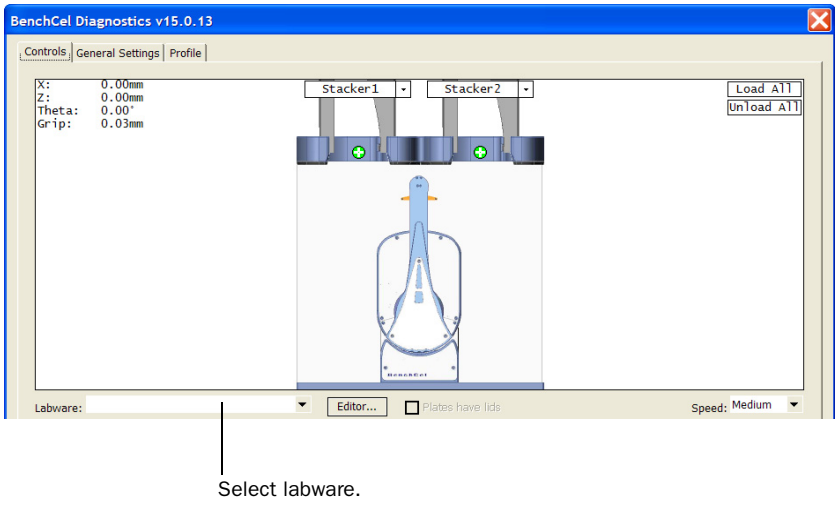


3. In the **Device List** area, select a BenchCel device and click **Device diagnostics.** The BenchCel Diagnostics dialog box opens.
4. In the **Profile** tab, check the **Teachpoint File** area to make sure the correct teachpoint file is loaded. You will be adding new teachpoints to this file.

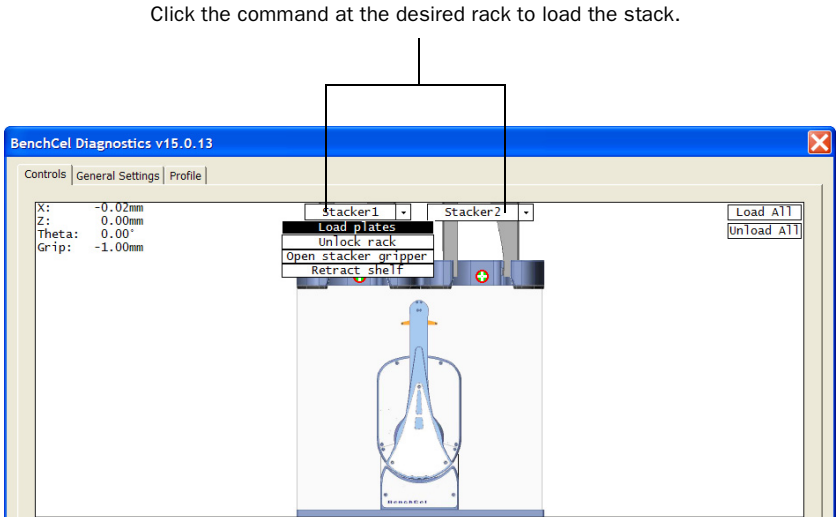
   !! IMPORTANT !! If you have not already done so, make a backup copy of this file.



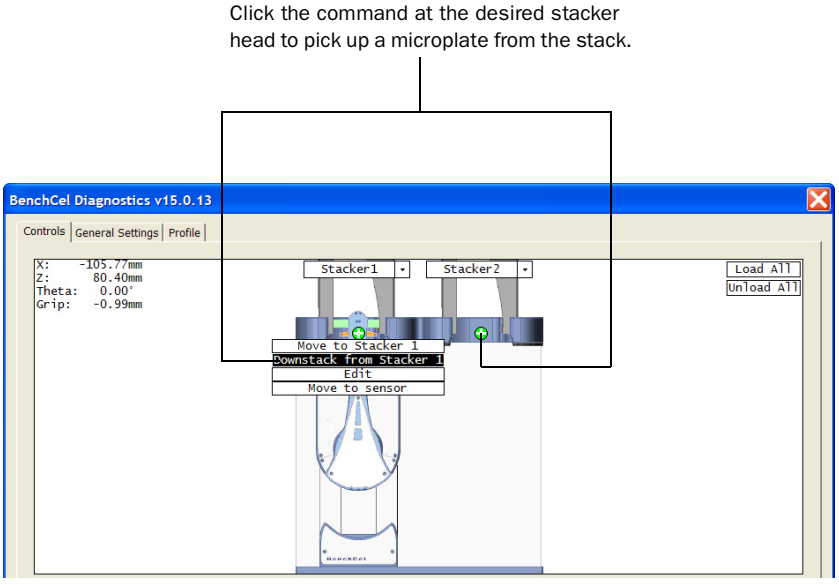
5. In the **Controls** tab, select the desired labware definition from the **Labware** list that is below the graphical display area.



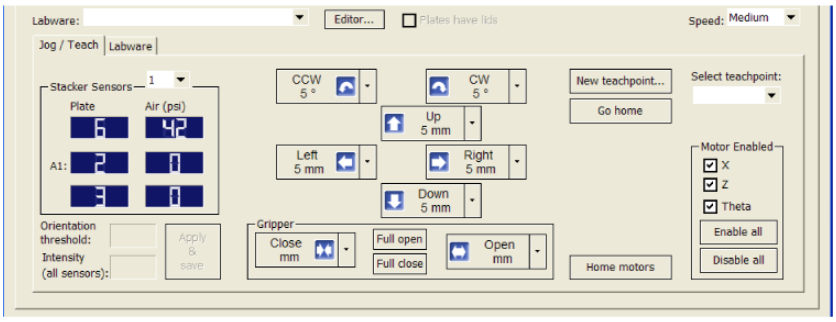
6. In the graphical display area, click **Stacker n** at the top of the rack that contains the spare microplates. In the command menu that appears, click **Load Stack.** The BenchCel device moves the stack down and holds it in the stacker grippers.



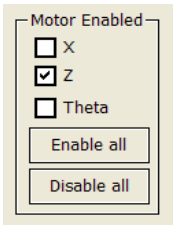
7. In the graphical display area, click the plus sign ( ) at the stacker head that contains the spare microplates. In the command menu that appears, click **Downstack from Stacker n,** where n is the stack that contains the spare microplates. The robot head moves under Stacker n and holds the first spare microplate in its grippers.



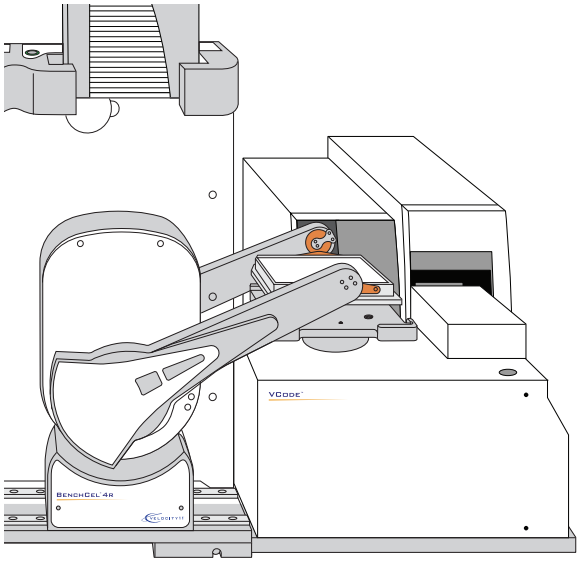
8. In the **BenchCel Diagnostics Controls** tab, click the **Jog/Teach** tab.



9. Click **Go Home.** The robot head moves to its home position at the center of the BenchCel Workstation.
10. In the **Motor Enabled** area, clear the check boxes for **X** and **Theta** to disable the X and Theta motors. The Z motor is still enabled (the Z box is selected).



11. With the robot grippers holding the spare microplate, gently push or pull the robot head and arms close to the teachpoint location. Position the robot head and arms so that the microplate rests in the target microplate location.



12. To fine-tune the teachpoint until you are able to place the microplate in the target location, use the following methods:
    - Visually inspect the position of the microplate relative to the plate stage. If the robot is not aligned with the plate stage along the *y*-axis (front-to-back direction), move the robot into the safe zone, physically slide the external device and its integration plate along the *y*-axis, move the robot back and see if the robot arms are aligned with the plate stage. You might have to loosen the clamp screw to slide the device (see "Integrating the devices" on page 35).
    - To move the robot head up or down in small, precise increments, in the BenchCel Diagnostics dialog box, click **Jog Up** () or **Jog Down** (). To change the jog increment, click the down arrow, and then select the desired increment.

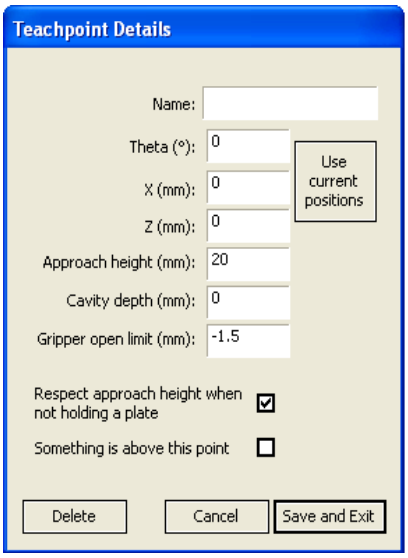
      

    - With the *x*-axis and *theta*-axis motors turned off, gently push or pull the robot and its arms so that the microplate is able to sit in the plate stage.

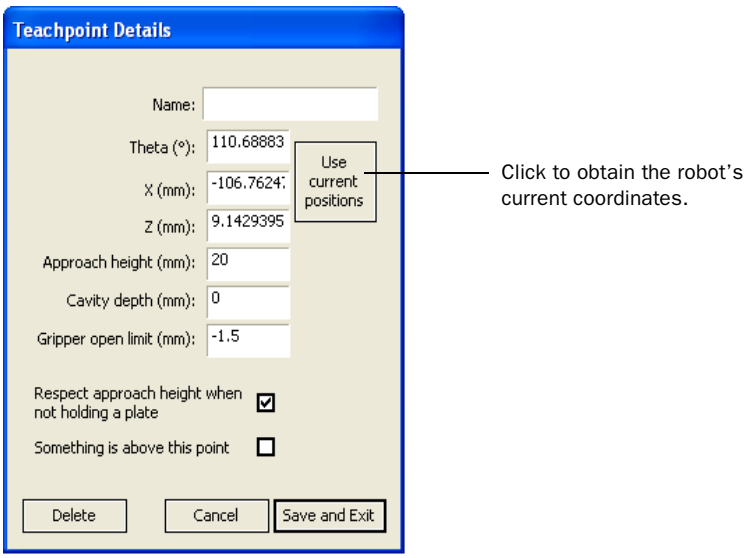
    When you are finished, the microplate should sit level on the target location. In addition, the robot arms do not come in contact with any part of the target platepad, plate stage, or other surfaces.
13. Visually inspect the position of the microplate on the target location. It should be centered on the location. If it is not, in the BenchCel Diagnostics window, disable the X and Theta motors, and then manually move the robot head to center the plate stage.

To record the coordinates in BenchCel Workstation Diagnostics:

1. In the **BenchCel Diagnostics Controls Jog/Teach** tab, click **New Teachpoint.** The Teachpoint Details dialog box opens.

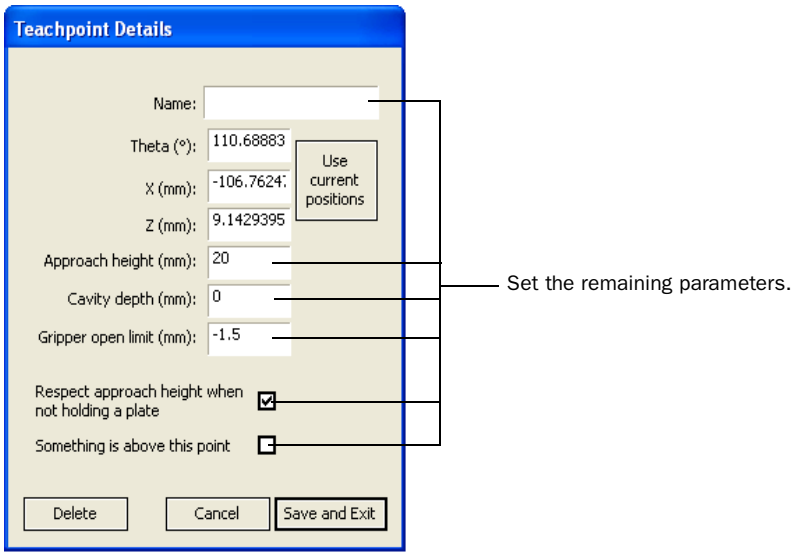


2. Click **Use current positions.** The robot's current coordinates fills the Theta, X, and Z boxes.

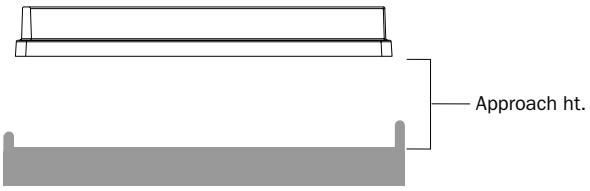
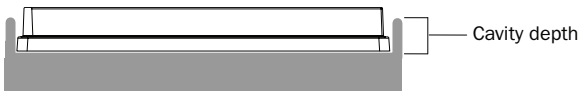


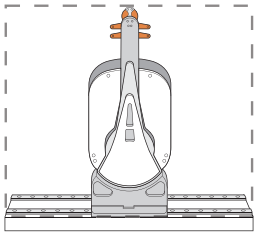
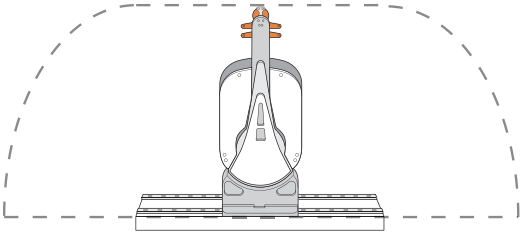
Setting	Comment
Theta	The angle that the robot arms are from their home position, in degrees. A positive value moves the arms counterclockwise from the home position. A negative value moves the arms are clockwise from the home position. The range of movement is from -115° to 115°.
X	The horizontal distance from the home position, in millimeters. A positive value moves the robot head to the right of the home position. A negative value moves the robot head to the left of the home position. The range of movement depends on the number of stacker heads. For two stacker heads, the range is from -145 mm to 145 mm.
Z	The vertical distance from the home or lowest *z*-axis position. A positive value moves the robot head up from the home position. A negative value moves the head down from the home position. The range of movement is from -1.5 mm to 104 mm.

3. Set the remaining teachpoint parameters and options in the Teachpoint Details dialog box:



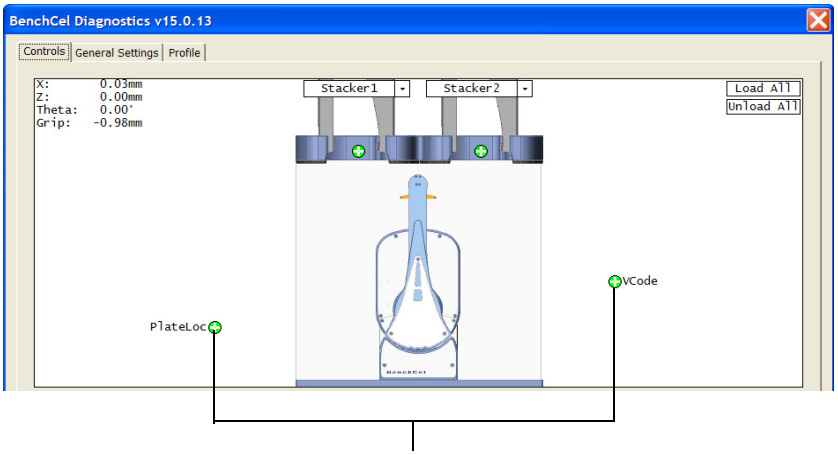
Setting	Comment
Name	Type a name for the teachpoint. For example, if the teachpoint is on an integrated VCode, you might want to name the teachpoint VCode. This name appears in the graphical display area in the BenchCel Diagnostics dialog box.

Setting	Comment
Approach height	Type the height clearance (in millimeters) the robot must maintain above the teachpoint as it moves towards or away from the teachpoint location. The valid range is from 0 mm to 40 mm.  Use this setting to prevent the robot from colliding with raised tabs or walls at the teachpoint location. Velocity11 recommends that you set the approach height at 20 mm (the default value). However, if there is an obstruction above the teachpoint, you might need to use a smaller approach height to prevent collision. *Note:* This value applies when the robot is holding a microplate. When it is not holding a microplate, the robot will approach the teachpoint at the height of the teachpoint, unless you select the Respect clearance both ways option.
Cavity depth	*Note:* This setting is not commonly used and should be set at 0 mm for most applications. Type the depth (in millimeters) below the Z teachpoint coordinate. The valid range is –35 mm to 0 mm. Use this setting to account for teachpoints that have a depth (or negative height). For example, suppose the Robot Gripper Offset is 5 mm and the platepad you want to use has depth of 9 mm. When the microplate sits in the platepad, the robot grippers cannot reach the offset height, as the following diagram shows. To account for this depth, you can set the Cavity depth at –9 mm. The robot grippers will grip the microplate 9 mm above the 5 mm offset (at 14 mm). 

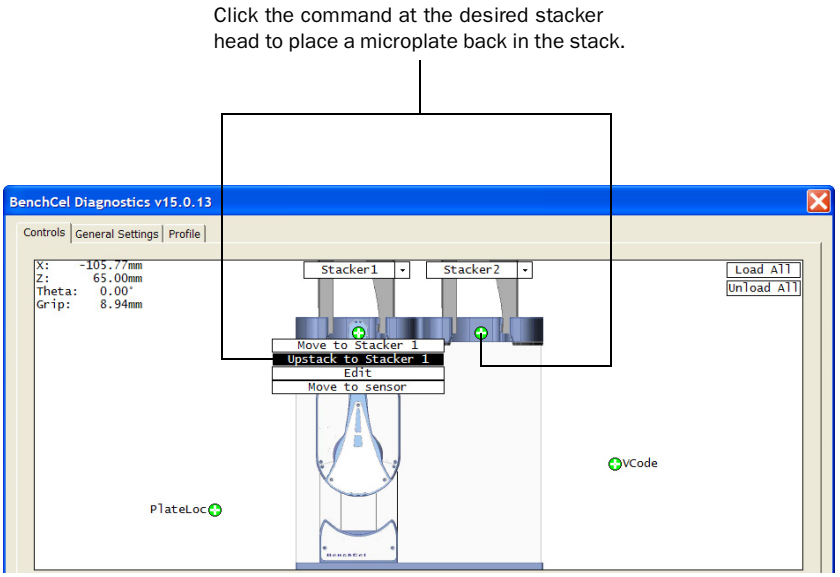
Setting	Comment
Open gripper limit	Type the maximum distance (in millimeters) the robot grippers are allowed to open as they prepare to grip the microplate at the teachpoint. The maximum value you set is less than or equal to the Robot Gripper Open Position value set in the BenchCel Diagnostics Controls Labware tab. Use this setting if the teachpoint area is narrower than the robot grippers open position. (To see this value, click **Save and exit,** and then click the Labware tab in the BenchCel Diagnostics Control tab.) *Note*: This value is used only at the teachpoint and not during other operations.
Respect approach height when not holding a plate	Select this option to use the approach height even when the robot is not holding a microplate. Clear the check box to have the robot approach or move away from the teachpoint at the height of the teachpoint when not holding a microplate.
Something is above this point	Select the option to limit the robot's movements within the robot safe zone. With this selection, the robot will only move along the *theta*-axis as long as all of its parts (head, arms, grippers, and labware) are within the safe zone when approaching or moving away from the teachpoint.  Clear the check box to allow the robot to use the full workspace. The robot's *theta*-axis movements are not limited when approaching and moving away from the teachpoint.  Use this option to limit the robot's movements to prevent collision when approaching a teachpoint. For example, when moving labware to and from a multi-shelf device such as the VPrep Pipettor, this option prevents the robot from colliding with the shelf above the target teachpoint.

4. Click **Save and exit** to save the teachpoint in the teachpoint file and close the Teachpoint Details dialog box.

   In the BenchCel Diagnostics dialog box, the new teachpoint appears in the graphical display area as a plus sign ( ).



5. Gently push or pull the robot into the safe zone.
6. Click **Go Home.** The software prompts you to enable all the motors. After the motors are enabled, the robot head moves to the center of the BenchCel device, and the robot arms are perpendicular to the *x*-axis. The robot grippers are still holding the spare microplate you used to set the teachpoint.
7. In the graphical display area, click the plus sign ( ) at the stacker head that is holding the spare microplates. In the command menu that appears, click **Upstack.** The robot moves the microplate back into the stack.



8. Save the device file.

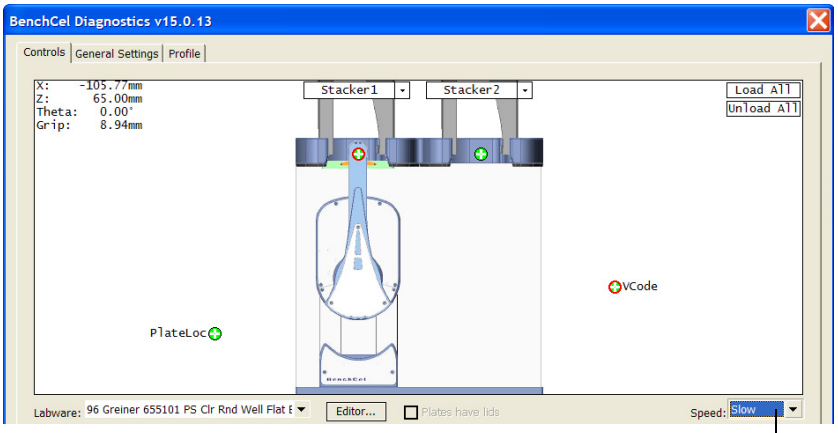
Verifying the teachpoints

To verify a teachpoint:

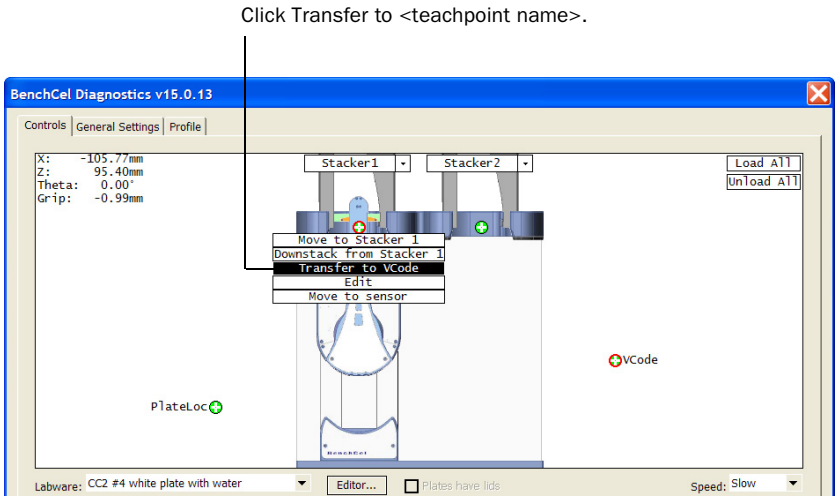
1. Load two to three spare microplates in the stacker rack and load the rack on the BenchCel device. For instructions, see “Loading and unloading labware” on page 84 and “Installing and removing stacker racks” on page 85.
2. In the **BenchCel Diagnostics Controls** tab, select the desired labware definition from the **Labware** list.
3. In the graphical display area of the BenchCel Diagnostics dialog box, click the plus sign ( ) at both of the following locations:
   - The stack that contains the spare microplates
   - The teachpoint you want to verify

   The selected teachpoints should be highlighted in red circles ( ).
4. In the **BenchCel Diagnostics Controls** tab, select the **Slow** speed.

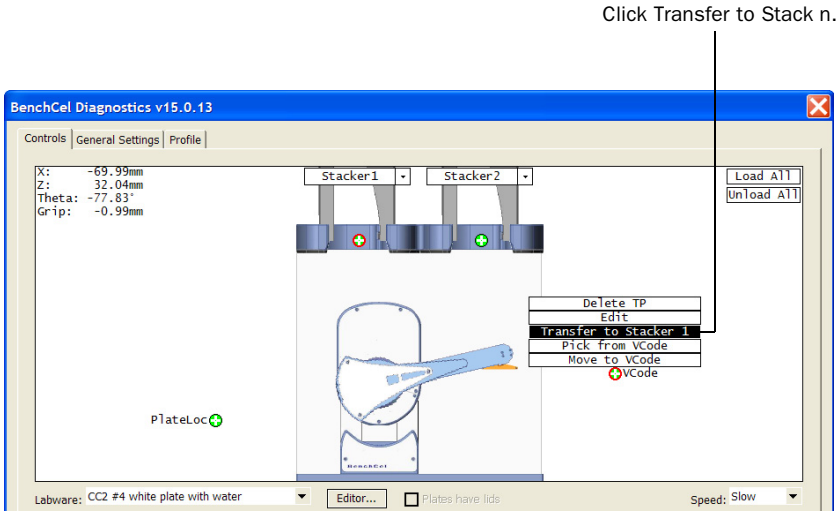
   Note: You can set the Slow speed as a percentage of the factory-set maximum speed. To do this, see “Changing the robot speed” on page 108.



5. In the graphical display area of the BenchCel Diagnostics dialog box, click the stack that contains the spare microplates. In the command menu that appears, click **Transfer to <teachpoint name>,** where <teachpoint name> is the name of the teachpoint you are verifying. The robot picks up the first microplate in the stack and moves it to the selected teachpoint.



6. If the robot did not move the microplate to the correct location, proceed to “Editing existing teachpoints” on page 79 to refine the teachpoint.
7. If the robot correctly placed the microplate at the teachpoint, move the microplate back to the stack. To do this, in the graphical display area of the BenchCel Diagnostics dialog box, click **Transfer to Stack n** at the teachpoint. The robot moves the microplate from the teachpoint back to the stack.



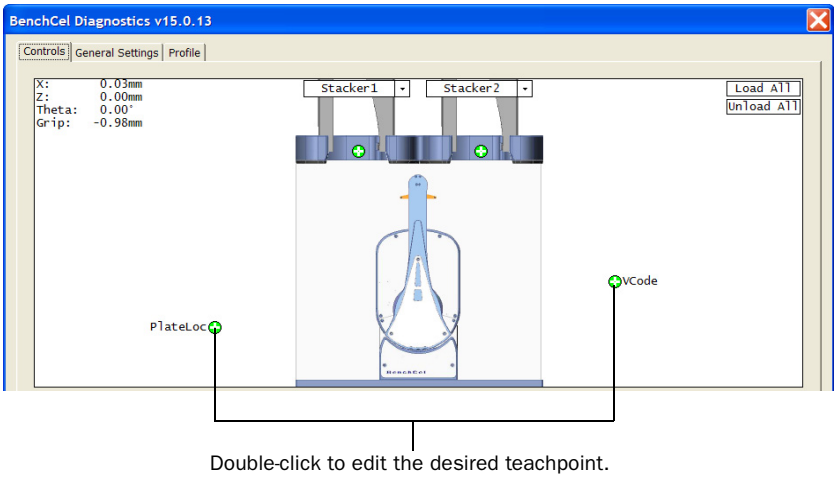
Editing existing teachpoints

When you set a teachpoint for the first time, you will likely set, verify, and edit the teachpoint a number of times to make sure the teachpoint is correct. After the teachpoint is set up correctly, you will not need to adjust or redefine it unless you do the following:

- ❑ Move the BenchCel Workstation
- ❑ Move or replace one of the devices in the workstation
- ❑ Adjust settings on the devices

To edit an existing teachpoint:

1. In the **BenchCel Diagnostics Profile** tab, verify that the correct teachpoint file is loaded.
2. In the graphical display area, double-click the teachpoint you want to edit. The Teachpoint Details dialog box opens and displays the current coordinates and settings for the selected teachpoint.



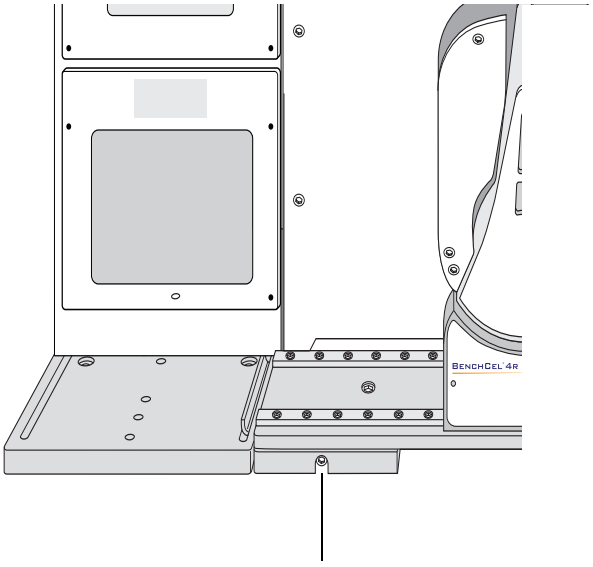
3. Do one of the following:
   - ◆ Follow the instructions in “Setting new teachpoints” on page 67 to manually move the robot head to a new teachpoint position and set the teachpoint.
   - ◆ Type new coordinate values or change any of the existing settings.
4. Click **Save and exit** to save the revised teachpoint in the teachpoint file and close the **Teachpoint Details** dialog box.

Locking the device positions

After you finish setting the teachpoint and verified that it is accurate, you can lock all the devices in their positions.

To lock the devices in their positions:

1. Tighten the BenchCel integration plate clamp screw using the 3-mm hex wrench.



2. Check the teachpoints again.

Deleting teachpoints

To delete a teachpoint:

1. In **BenchCel Diagnostics Profile** tab, verify that the correct teachpoint file is loaded.
2. In the graphical display area, double-click the teachpoint marker that represents the teachpoint you want to delete. The **Teachpoint Details** dialog box opens.
3. Click **Delete.** The current teachpoint file will automatically be updated when you delete a teachpoint.
4. Save the device file.

Related topics

For information about	See...
Setup procedure	“Setup Workflow” on page 50
Integrating external devices	“Integrating the devices” on page 35
Moving between teachpoints	“Diagnostic tools” on page 105

Performing a run

4

This chapter describes how to run an existing protocol on the BenchCel Workstation. All of the procedures in this chapter can be performed by someone with operator privileges.

This chapter contains the following topics:

Workflow for performing a run

About this topic

This topic presents the workflow for operating the BenchCel Workstation.

Workflow

The following table lists the steps for operating the BenchCel Workstation.

Step	For this task...	See...
1	Perform pre-run checks.	"Performing pre-run checks" on page 83
2	Open a protocol in the BenchWorks software.	*BenchWorks Automation Control User Guide*
3	Prepare devices and accessories.	Device user documentation
4	Load labware into a stacker rack.	"Loading and unloading labware" on page 84
5	Install a stacker rack.	"Installing and removing stacker racks" on page 85
6	Start a protocol run.	*BenchWorks Automation Control User Guide*
7	Monitor the run.	*BenchWorks Automation Control User Guide*
8	Pause the run.	*BenchWorks Automation Control User Guide*
9	Clean up after the run.	"Cleaning up after a protocol run" on page 89

Related topics

For information about...	See...
Creating protocols	*BenchWorks Automation Control User Guide*
Starting, pausing, monitoring, and stopping protocol runs	*BenchWorks Automation Control User Guide*

Performing pre-run checks

About this topic

Before you start a protocol run, you should check the BenchCel Workstation to ensure optimum operation. This topic provides the list you should check before each protocol run.

Procedure

To check that the BenchCel Workstation is ready for a run:

1. Make sure there are no stray microplates in robot-accessible locations, including:
   - Platepads
   - External device plate stages
   - Third-party device areas that will accept labware from the BenchCel Workstation
2. Remove any obstacle in the robot's pathways. Consider the path of the robot head and arms.
3. For the devices that require compressed air, make sure the air pressures meet the operating requirements. For the BenchCel Workstation air supply requirements, see "Verifying laboratory requirements" on page 29. For other Velocity11 devices, check the user documentation for the device. For third-party devices, check the product's user documentation.

   To check the BenchCel Workstation internal air pressure, see "Adjusting the stacker gripper pressure" on page 131.
4. Make sure all devices and accessories are set up correctly and prepared for the run. For instructions, see the user documentation for the device or accessory.

Related topics

For information about...	See...
BenchCel device air source requirements	"Verifying laboratory requirements" on page 29
External device air source requirements	External device user documentation
Diagnosing air pressure problems	"Maintenance and troubleshooting" on page 91

Loading and unloading labware

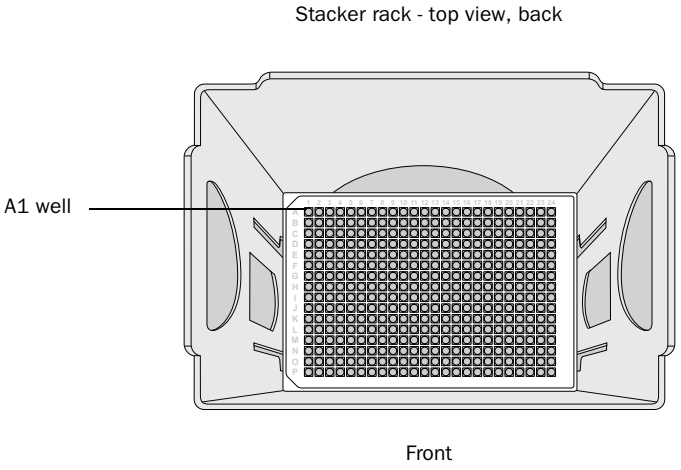
About this topic

This topic explains how to load labware into and unload labware from the BenchCel Workstation stacker racks.

Loading microplates into a stacker rack

To load microplates into a stacker rack:

While standing at the front of the stacker rack, place microplates in the stacker rack so that the A1 well is in the upper left corner. The following diagram shows the top view of the stacker rack that has a microplate loaded.



Note: For compatibility with other devices, you can load the microplates such that the A1 well is in the lower right corner. For example, if the VPrep Pipettor is installed to the left of the BenchCel Workstation, the A1 well should be in the lower right corner.

The first or bottom-most microplate in the stack will be process first. The last or top-most microplate in the stack will be processed last.

Unloading microplates from a stacker rack

To unload microplates from a stacker rack:

Carefully lift the microplates out of the rack.

Related topics

For information about...	See...
Automation-ready labware	“Labware considerations” on page 16
Installing the stacker rack on the BenchCel device	“Installing and removing stacker racks” on page 85

Installing and removing stacker racks

About this topic

This topic explains how to install and remove stacker racks.

Installing racks

!! IMPORTANT !! Make sure the power and compressed air are turned on before you install a stacker rack.

To install a rack:

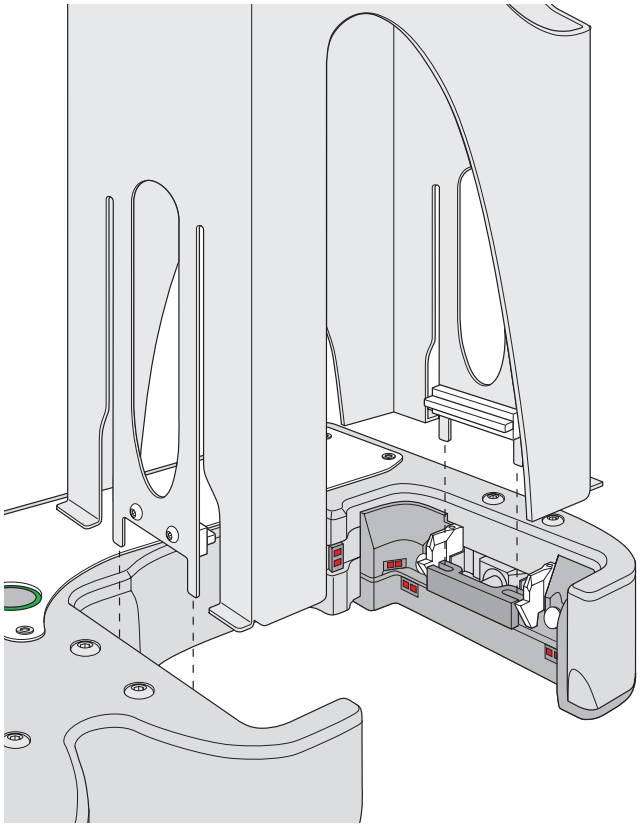
1. At the BenchCel device, verify that the clamps are closed (or extended) in the stacker head.

   When you load the rack, the prongs in the stacker rack tabs will be inserted into the slots in the clamps. If the clamps are open, the slots will be hidden, and you will not be able to load the rack.

2. To close the clamps, in the BenchCel Diagnostics graphical display area, click the desired rack. In the command menu that appears, click **Close Stacker Grippers.** You should hear a click sound as the clamps close.

3. With the rack's open side facing the front, lower the rack onto the stacker head. Make sure the prongs at the bottom of the rack insert into the slots in the extended clamps.

   The following diagram shows how to load the rack on the stacker head. Microplates are removed to show the prongs at the bottom of the rack.

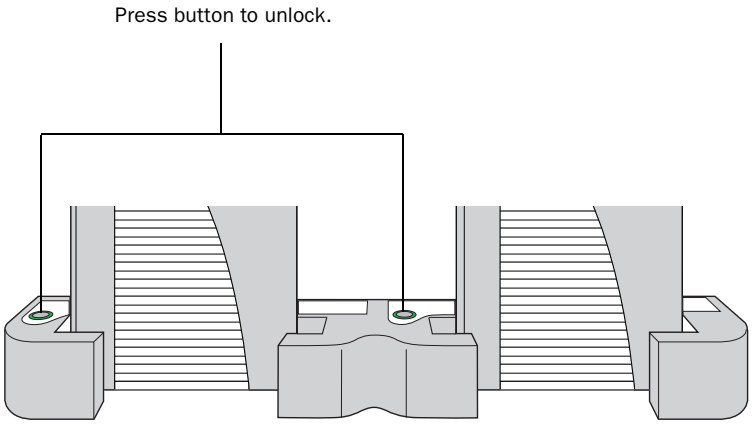


Removing racks

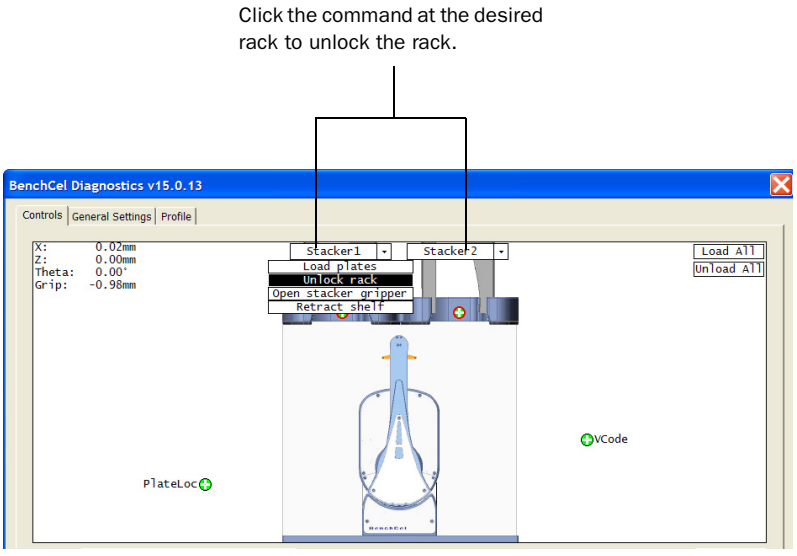
!! IMPORTANT !! Make sure the power and compressed air are turned on when unloading a stacker rack.

To remove a stacker rack from the BenchCel device:

1. Unlock the rack. Use one of following ways:
   - Press the green rack-release button at the top of the stacker head. The green status light flashes for 5 seconds to indicate that the rack is ready for unloading. You should hear a click sound as the locks retract. If the green light stops flashing, press the button again.



   - In the **BenchCel Diagnostics Controls** tab, click **Stacker n** at the top of the rack that you want to unload. In the command menu that appears, click **Unlock rack.** You should hear a click sound as the locks retract.



2. Carefully lift the stacker rack from the stacker head.

Related topics

For information about...	See...
Turning on the power and air	“Starting up and shutting down the BenchCel Workstation” on page 52
Automation-ready labware	“Labware considerations” on page 16
Loading labware into the stacker racks	“Loading and unloading labware” on page 84

Stopping the BenchCel device in an emergency

About this topic

This topic explains how to stop the BenchCel device in an emergency situation.

To pause and continue a run, use the Pause command in the BenchWorks software. For instructions, see the *BenchWorks Automation Control User Guide*.

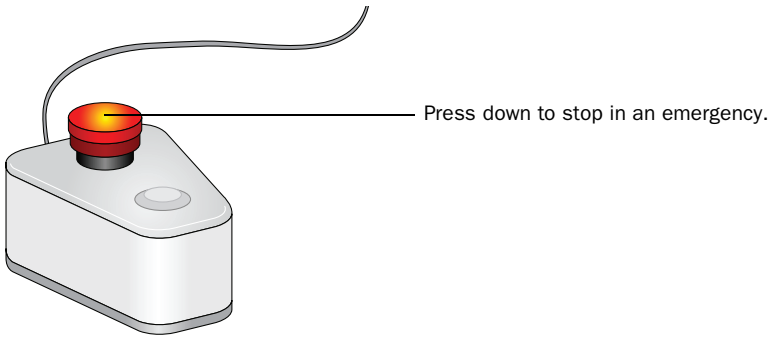
Stopping a run

!! INJURY HAZARD !! Pressing the robot disable button turns off power to the robot motors only. Power is still on in the rest of the workstation.

To stop a protocol run in an emergency:

Press the large robot disable button on the pendant. The safety interlock circuit is interrupted, disabling the robot motors. The BenchCel Workstation operation stops.

!! IMPORTANT !! After the motors are disabled, the robot head and arms might have momentum and continue to move until they come to the end of the *x*-, *z*-, or *theta*-axes, or until they bump into an obstacle.



To recover from the emergency stop, see “Recovering from an emergency stop” on page 103.

Related topics

For information about...	See...
Pausing and resuming protocol runs	*BenchWorks Automation Control User Guide*
The pendant and its use	“Hardware overview” on page 4
Restoring the workstation after an emergency stop	“Recovering from an emergency stop” on page 103

Cleaning up after a protocol run

About this topic

This topic describes the tasks you should perform when you have finished a protocol run.

Procedure

To clean up after a run:

1. Follow the BenchWorks software prompts for post-run software procedures, such as unloading the microplates. See the *BenchWorks Automation Control User Guide* for detailed instructions.
2. Unload used sample microplates from the stacker racks. See “Loading and unloading labware” on page 84.
3. Remove stacker racks from the BenchCel device. See “Installing and removing stacker racks” on page 85.

   !! IMPORTANT !! Make sure the power and compressed air are on when removing the racks.
4. Remove manually placed microplates from platepads and external devices.
5. See the device user documentation for cleanup instructions.
6. Check run logs for errors.
7. If you have administrator or technician privileges and you have modified the protocol, including selected options, you can save the protocol.
8. Log out of the operating software. See the *BenchWorks Automation Control User Guide* for instructions.

Related topics

For information about...	See...
Run logs	*BenchWorks Automation Control User Guide*
Protocols	*BenchWorks Automation Control User Guide*
Logging out	*BenchWorks Automation Control User Guide*
Shutting down the BenchCel Workstation	“Shutting down the BenchCel Workstation” on page 53

Maintenance and troubleshooting

5

This chapter tells you how to maintain your BenchCel device and provides troubleshooting information.

This chapter contains the following topics:

Routine maintenance

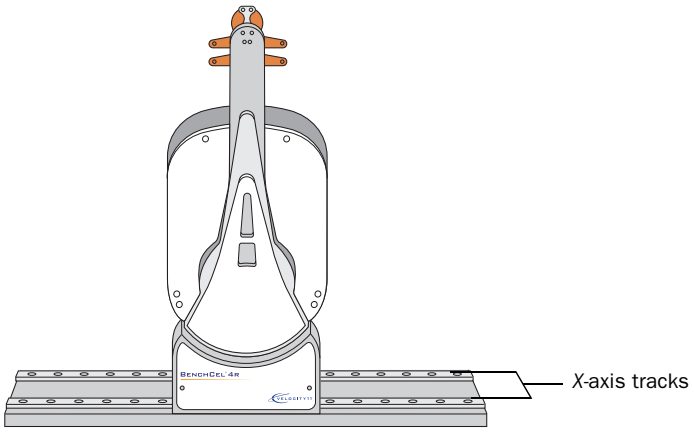
About this topic

This topic provides recommendations for maintaining the BenchCel device.

After every run

Make sure you:

- ❑ Immediately clean up spilled liquids.
- ❑ Check the *x*-axis tracks to make sure it is free of debris.

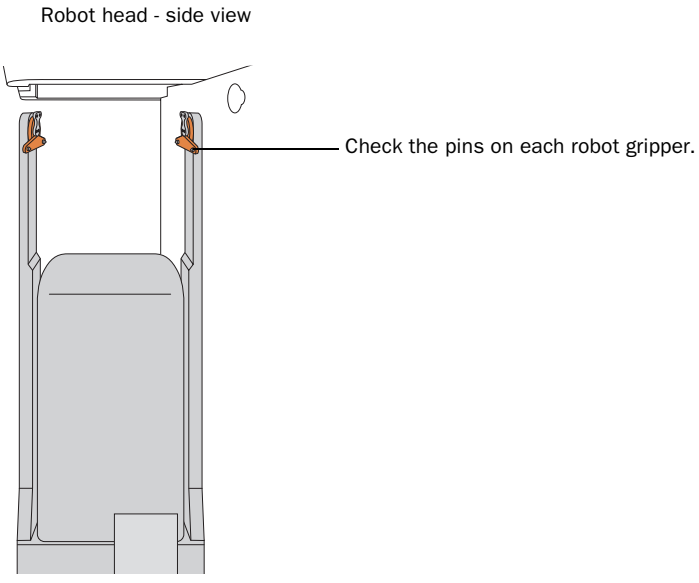


Monthly inspection and maintenance

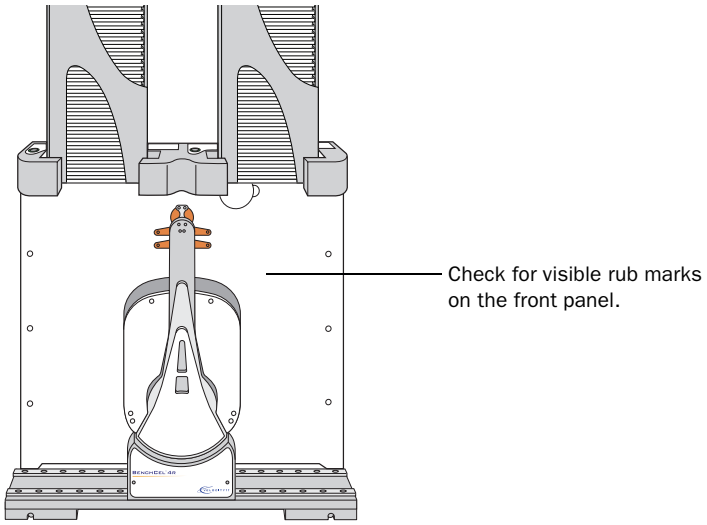
In general, practice good housekeeping by cleaning up spills and routinely cleaning after using the BenchCel Workstation.

Every month, check the following:

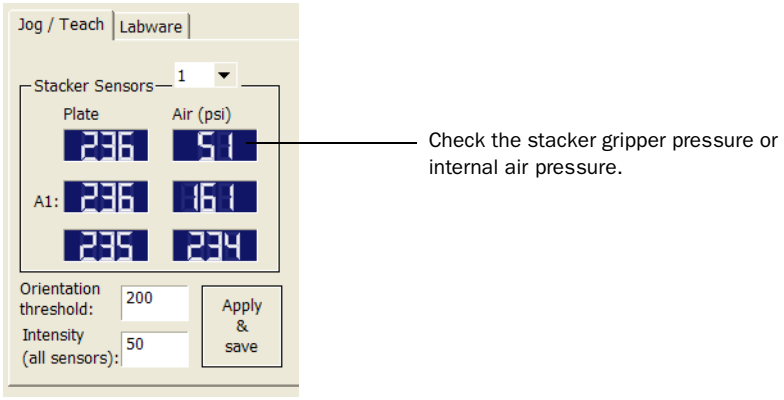
- ❑ Robot gripper pins to make sure they are not too dull to grip the microplates. If the pins have become dull, contact Velocity11 Technical Support to replace them.



- ❑ Moving parts to make sure they are not rubbing against each other. Look for rub marks or noises that might indicate rubbing. If you see rub marks, contact Velocity11 Technical Support.



- ❑ Air-supply tubing to make sure the tubing is in good shape and there are no leaks. Replace the broken tubing if necessary.
- ❑ Stacker gripper pressure is set correctly. The pressure is displayed in the BenchCel Diagnostics Controls tab.



Integrated device

For routine maintenance of the external devices, see the external device user documentation.

Related topics

For information about...	See...
Cleanup procedure after every protocol run	“Cleaning up after a protocol run” on page 89
Air source requirements	“Compressed air” on page 30
Checking and adjusting the stacker gripper pressure (internal air pressure)	“Adjusting the stacker gripper pressure” on page 131

Hardware problems

About this topic

This topic lists possible hardware problems, the causes of the problems, and ways to resolve the problems. If you are still experiencing problems with the BenchCel Workstation after trying the solutions, contact Velocity11 Technical Support.

Hardware problems

Problem	Cause	Solution
The BenchCel device does not turn on.	Your lab does not meet the electrical requirements.	Make sure your lab meets the electrical requirements. See “Verifying laboratory requirements” on page 29.
	The BenchCel device is not connected to the power source.	Connect the BenchCel device to the power source. See “Connecting the power source” on page 39.
	The fuse is blown.	Contact Velocity11 Technical Support.
A hissing sound can be heard.	A leak is present in the air connection or inside the device.	Check the air connections at the back of the device and at the source (house, cylinder, or pump). If the connections look fine, the leak is might be inside the device. Contact Velocity11 Technical Support.
Oil is present in the stacker head.	The compressed air is not from an oil-free compressor and oil has leaked into the BenchCel device.	Contact Velocity11 Technical Support.
The microplate drops from the robot grippers.	The labware definition for the microplate type might contain incorrect information.	Check the following in the labware definition: stacker gripper offset, robot gripper offset, stacking thickness, plate thickness, sensor intensity, and the plate-presence threshold. To check or correct these values, open BenchCel Diagnostics and click the Labware tab. *Note:* In the Plate offsets (mm) area, type 8 in the Robot gripper offset and the Stacker gripper offset boxes. 8 mm is the recommended offset for most labware. If the problem persists, contact Velocity11 Technical Support.
The microplate drops or is held loosely by the stacker grippers.	The stacker gripper pressure is too low so that the grippers are holding the microplate too loosely.	Increase the stacker gripper pressure. See “Adjusting the stacker gripper pressure” on page 131.

Problem	Cause	Solution
The microplate bends when held by the stacker grippers.	The stacker gripper pressure is too high so that the grippers are holding the microplate too tightly.	Decrease the stacker gripper pressure. See "Adjusting the stacker gripper pressure" on page 131.
The BenchCel device is unable to place a microplate on the target location correctly.	❑ The teachpoint is incorrect. ❑ The robot and the platepad are not aligned along the Y-axis (front-to-back direction), see "Integrating external devices" on page 38 to adjust the device positions. ❑ The robot grippers and the robot arms are not properly aligned. ❑ The robot homing offsets require adjustment.	Verify and edit the teachpoint. See Verifying the teachpoints and "Editing existing teachpoints" on page 79. If you suspect that one of the other factors is responsible for improper microplate placement, contact Velocity11 Technical Support.
A high-pitched sound can be heard when the robot moves up or down.	The Z-axis lacks lubrication.	Contact Velocity11 Technical Support.
The rack-release button does not turn green and the stacker rack cannot be removed.	The stack of microplates are still loaded.	Start BenchCel Diagnostics. Click the Controls tab. In the graphical display area, click the Unload plates command.

Related topics

For information about...	See...
BenchCel device component names	"Safety information" on page 22
Software error messages	"Software error messages" on page 97
Diagnosing problems	"Diagnostic tools" on page 105
Adjusting the plate-orientation sensors	"Adjusting the plate-orientation sensors" on page 124
Checking and adjusting the stacker gripper pressure (internal air pressure)	"Adjusting the stacker gripper pressure" on page 131
Reporting problems to Velocity11	"Reporting problems" on page 135

Software error messages

About this topic

This topic lists possible software error messages, the causes of the errors, and ways to resolve the errors. If you are still experiencing problems with the BenchCel Workstation after trying the solutions, contact Velocity11 Technical Support.

Software error messages

The following software error messages might appear during a protocol run or when you are in BenchCel Diagnostics. The messages are listed alphabetically.

Error message	Cause	Solution
Communication timed out	Communication between the controlling computer and the BenchCel device or external device failed.	Try the following: ❑ Restart the BenchWorks software. ❑ Restart the BenchCel Workstation. ❑ Check the Ethernet and serial cables. ❑ Verify that the Ethernet switch has power. If the problem continues, contact Velocity11 Technical Support.
Deadlock detected	The protocol run is unable to continue. Some or all of the target locations are unavailable, so the microplates cannot be moved to those locations.	Review the protocol and the run log. Run the simulator to determine the reason for the deadlock. In addition, check that the number of simultaneous microplates is not too high.
The device was not found	The BenchCel device is not connected to the controlling computer, or the incorrect profile is used.	To connect the device: a. Turn off the BenchCel device and exit the BenchWorks software. b. Connect the BenchCel device to the controlling computer. See “Connecting the computer” on page 44. c. Wait 10 seconds, and then turn on the BenchCel device. d. Wait for the BenchCel device to finish its homing routine, and then start the BenchWorks software. To check the profile: a. Start BenchCel Diagnostics. b. Click the Profile tab. c. Check or select the correct profile.

Error message	Cause	Solution
Flash operation not successful	The robot could not write to its flash memory.	In the error message dialog box, click Retry. If clicking Retry does not resolve the problem, restart the BenchCel device. If the problem persists, contact Velocity11 Technical Support.
The gripper positions are too close	The Gripper open position parameter value is less than the Gripper holding plate position parameter value.	In the labware definition, make sure the Gripper open position value is 3 mm or greater than the Gripper holding plate position value. You can change the two parameters in the Labware Editor or in BenchCel Diagnostics.
No plate in grippers	The Robot gripper offset parameter value is incorrect.	Correct the Robot gripper offset value in the Labware Editor or in BenchCel Diagnostics. Velocity11 recommends an 8 mm offset for most labware.
	No microplate is available at the pickup location.	Make sure you load or place labware at the target location.
No plate in stack	The plate-presence sensor does not detect a microplate in the stack because of one or more of the following: ❑ No microplate is in the stack. ❑ The plate-presence sensor is not working properly.	Verify microplates are loaded in the correct stack. If the problem persists, contact Velocity11 Technical Support.
Operation timed out	The robot was unable to execute a command.	In the error message dialog box, click Retry. If clicking Retry does not resolve the problem, restart the BenchCel device. If the problem persists, contact Velocity11 Technical Support.
Plate in grippers	The robot senses a microplate in its grippers, but it does not expect to have the microplate for the specified command or action.	In BenchCel Diagnostics, use commands to move and place the microplate at an available teachpoint. Retry the intended command.

Error message	Cause	Solution
Plate is rotated	The microplate is loaded in the wrong orientation.	Check the microplate orientation (notch selections) in the Labware Editor or in BenchCel Diagnostics. Make sure you load the microplates in the rack accordingly.
	Notch selection is incorrect in the labware definition.	Verify the notch selection in the Labware Editor or in BenchCel Diagnostics.
	The Orientation sensor offset parameter value is incorrect.	Adjust the Orientation sensor offset value in BenchCel Diagnostics. See “Adjusting the plate-orientation sensors” on page 124 for detailed instructions.
	The sensor intensity and threshold need adjusting.	See “Adjusting the plate-orientation sensors” on page 124 for detailed instructions.
Position error on grippers	The robot grippers failed to move to the commanded position. For example, something is blocking the robot grippers.	In the error message dialog box, click Retry. If clicking Retry does not resolve the problem, home the robot and retry the intended command. If the problem persists, contact Velocity11 Technical Support.
Position error on the Theta axis	The robot failed to move to the commanded position. For example, something is blocking the robot.	In the error message dialog box, click Retry. If clicking Retry does not resolve the problem, home the robot and retry the intended command. If the problem persists, contact Velocity11 Technical Support.
Position error on x axis	The robot failed to move to the commanded position. For example, something is blocking the robot.	In the error message dialog box, click Retry. If clicking Retry does not resolve the problem, home the robot and retry the intended command. If the problem persists, contact Velocity11 Technical Support.
Position error on z axis	The robot failed to move to the commanded position. For example, something is blocking the robot.	In the error message dialog box, click Retry. If clicking Retry does not resolve the problem, home the robot and retry the intended command. If the problem persists, contact Velocity11 Technical Support.

Error message	Cause	Solution
Rack not present	The stacker rack is not installed on the BenchCel device.	Install the stacker rack. See “Installing and removing stacker racks” on page 85 for the procedure.
	The rack-presence sensor is not able to detect the rack because one of the following: ❑ The rack sensor threshold is too low. ❑ The rack-presence sensor is not working.	In the BenchCel Diagnostics General Settings tab, adjust the value in the Rack sensor threshold box. If the problem persists, contact Velocity11 Technical Support.
Stack not loaded	The stack does not contain microplates. The BenchCel device is expecting to receive microplates in the stack. However, the stacker grippers are open or the shelves are extended when they should not be.	In BenchCel Diagnostics, use commands to close the stacker grippers or retract the shelves. Retry the intended commands.
	The stack contains microplates. The BenchCel device is expecting to deliver microplates from or receive microplates in the stack. However, the microplates are sitting on the shelves or are held by the stacker grippers when they should not be.	Unload the microplates from the stack. If a microplate is held by the stacker grippers, in BenchCel Diagnostics, use commands to open the stacker grippers to release the microplate. In BenchCel Diagnostics, use commands to retract the shelves or open the stacker grippers. Reload the microplates and retry the intended commands.
Stacker shelf not extended	The BenchCel device expected the shelves to be already extended but they are not.	In BenchCel Diagnostics Controls tab, click the Extend Shelf command at the desired stack.
Stacker shelf not retracted	The BenchCel device expected the shelves to be already retracted but they are not.	In BenchCel Diagnostics Controls tab, click the Retract Shelf command at the desired stack.
Stacker shelf position error	The BenchCel device is trying to extend or retract the shelves but was unable to do so.	Check for obstacles in the stacker head that might be blocking the shelves. In BenchCel Diagnostics Controls tab, click the Extend Shelf or Retract Shelf command at the desired stack.
Thermal cutoff active for theta-axis	The theta motor is overheated. **!! INJURY HAZARD !! Do not touch the robot head because it might be too hot.**	Shut down the BenchCel device and wait for the robot head to cool down before retrying the intended protocol run or commands.

Error message	Cause	Solution
Theta position out of bounds	The robot is commanded to move out of its range on the *theta*-axis.	Check the teachpoint *theta*-axis value to make sure it is not beyond the factory-set limits. If the problem persists, contact Velocity11 Technical Support.
Timeoout on grippers	The motor's controller did not respond as expected.	Home the robot, and then move the robot in the same axis. If the robot moves, continue on. If the robot does not move, quit the operating software and restart the BenchCel device. If the problem persists, contact Velocity11 Technical Support.
Timeout on theta-axis	The motor's controller did not respond as expected.	Home the robot, and then move the robot in the same axis. If the robot moves, continue on. If the robot does not move, quit the operating software and restart the BenchCel device. If the problem persists, contact Velocity11 Technical Support.
Timeout on x-axis	The motor's controller did not respond as expected.	Home the robot, and then move the robot in the same axis. If the robot moves, continue on. If the robot does not move, quit the operating software and restart the BenchCel device. If the problem persists, contact Velocity11 Technical Support.
Timeout on z-axis	The motor's controller did not respond as expected.	Home the robot, and then move the robot in the same axis. If the robot moves, continue on. If the robot does not move, quit the operating software and restart the BenchCel device. If the problem persists, contact Velocity11 Technical Support.

Error message	Cause	Solution
Wrong plate type	The microplate in the stack is different from the labware selected in the software.	Check the labware selected in the Labware Editor or in the BenchCel Diagnostics Controls tab.
	The microplate is loaded in the wrong orientation.	Check the microplate orientation (notch selections) in the labware definition and make sure you load the microplates in the rack accordingly.
	The plate-orientation sensors are not able to detect the microplate notches correctly because of one of the following: ❑ The microplate is not in the correct position to be detected by the sensors. ❑ The sensor intensity and threshold settings need adjustments.	See "Adjusting the plate-orientation sensors" on page 124.
X position out of bounds	The robot is commanded to move out of its range in the *x*-axis.	Check the teachpoint *x*-axis value to make sure it is not beyond the factory-set limits. If the problem persists, contact Velocity11 Technical Support.
Z position out of bounds	The robot is commanded to move out of its range in the *y*-axis.	Check the teachpoint *z*-axis value to make sure it is not beyond the factory-set limits. If the problem persists, contact Velocity11 Technical Support.

Related topics

For information about...	See...
BenchCel device component names	"Hardware overview" on page 4
Hardware problems	"Hardware problems" on page 95
Checking and adjusting the stacker gripper pressure (internal air pressure)	"Adjusting the stacker gripper pressure" on page 131
Reporting problems to Velocity11	"Reporting problems" on page 135

Recovering from an emergency stop

About this topic

After you press the robot disable button on the pendant, the robot stops. One of the following occurs:

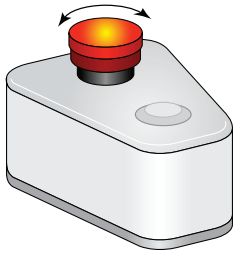
- ❑ If you stopped a protocol run, a prompt dialog box opens in the BenchWorks software.
- ❑ If you stopped the robot while diagnosing problems in BenchCel Diagnostics, a motor-disable message appears on the screen.

This topic explains how to recover the BenchCel device in both cases.

Procedure

To recover the BenchCel device after an emergency stop:

1. If the robot dropped labware before or during the emergency stop, remove labware that was dropped. Also remove labware at teachpoints or other locations.
2. If the robot ran into an obstacle, check the robot gripper alignment:
   a. Move the robot arms so that they are perpendicular to the *x*-axis.
   b. Make sure the bottom of the robot grippers are perpendicular to the robot arms. If they are not, contact Velocity11 Technical Support.
3. At the pendant, turn the robot disable button clockwise to restore power to the motors.



4. If you stopped a protocol run in an emergency, in the BenchWorks software, select one of the following in the prompt dialog box:

Selection	Description
Diagnostics	Opens the BenchCel Diagnostics dialog box. See step 5. *Note:* This selection is available only when you are in the middle of a protocol run and not while you are in BenchCel Diagnostics.
Retry	Attempts to restart the current command or task in the run.
Ignore and continue	Ignores the current command or task and continues to the next command or task in the protocol sequence.
Abort	Aborts the current command or task in the run. Select Abort if you have determined that the protocol run is not recoverable.

For a full description of the selections, see the *BenchWorks Automation Control User Guide*.

5. *Optional.* In BenchCel Diagnostics, use the available commands to manually move the robot or other components, including:
   - Release the microplate that the robot is currently holding.
   - Upstack the microplate that the robot is currently holding.
   - Replace the lid on the microplate.
   - Home the robot.
   - Verify teachpoints.

   Always start BenchCel Diagnostics if a physical crash occurred. You will need to home the robot and verify teachpoints.

   See “Diagnostic tools” on page 105 for instructions, or see “Quick reference” on page 153 for the complete list of available commands you can use.

Related topics

For information about...	See...
Pausing and resuming protocol runs	*BenchWorks Automation Control User Guide*
The pendant and its use	“Hardware overview” on page 4
Using commands in BenchCel Diagnostics	“Diagnostic tools” on page 105

Diagnostic tools

About this topic

The BenchCel Diagnostics software has three tabs: Controls, General Settings, Profile. You use the command and parameters available in the Controls and General Settings tabs when troubleshooting problems.

This topic explains how to use the commands and parameters in the Controls and General Settings tabs to do the following:

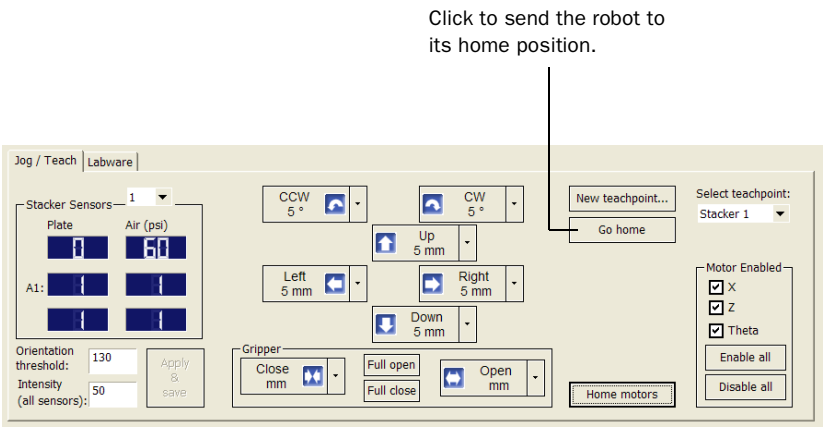
See "Quick reference" on page 155 for the complete list of available commands you can use.

Sending the robot to the home position

The home position is where the robot head is at the center of the BenchCel device and the robot arms are perpendicular to the x-axis. You send the robot to the home position if you want the robot out of the way in a safe position.

To send the robot to the home position:

1. In the **Controls** tab, click **Jog/Teach.**
2. Click **Go Home.**

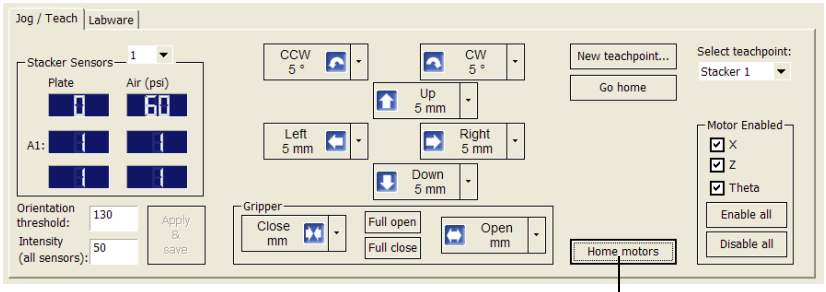


Homing the robot

Homing the robot sends the robot to the factory-defined home position for each axis of motion. The homing process recalibrates the robot position along each axis. Home the robot if you notice that the robot is not accurately picking up or placing plates. You might also want to home the robot after recovering from an emergency stop.

To home the robot:

1. In the **Controls** tab, click **Jog/Teach.**
2. Click **Home Motors.**



Click to home the robot.

Disabling and enabling the robot motors

Disabling the robot motors allows you to move the device by hand, making it easier to set and edit teachpoints.

To disable the robot motors:

1. In the **Controls** tab, click **Jog/Teach.**
2. In the **Motor Enabled** area, select or click the following:

Option or command	Description
X	Select the option to enable the x-axis motor. Clear the check box to disable the x-axis motor.
Z	Select the option to enable the x-axis motor. Clear the check box to disable the x-axis motor.
Theta	Select the option to enable the x-axis motor. Clear the check box to disable the x-axis motor.
Enable All	Click to turn on all the motors.
Disable All	Click to turn off all the motors.

To enable the robot motors:

In the **Motor Enabled** area:

- ❑ Select the motor you want to enable: **X, Z,** or **Theta.**
- ❑ Click **Enable all.**

Jogging the robot

Jogging the robot moves the robot and robot grippers in small, precise increments along one of the axes. You can jog the robot to fine-tune its position when creating and editing teachpoints.

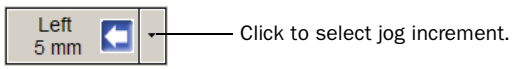
To jog the robot:

1. In the **Controls** tab, click **Jog/Teach.**
2. Enable the robot motors. See "Disabling and enabling the robot motors" on page 106.
3. In the robot movement area, click one of the following:

Command	Description
	Jogs the robot arm counterclockwise from the current position by the specified *theta*-axis increment.
	Jogs the robot arm clockwise from the current position by the specified *theta*-axis increment.
	Jogs the robot head left from the current position by the specified *x*-axis increment.
	Jogs the robot head up from the current position by the specified *z*-axis increment.
	Jogs the robot head right from the current position by the specified *x*-axis increment.
	Jogs the robot head down from the current position by the specified *z*-axis increment.
	Opens the robot grippers by the specified grip increment.
	Closes the robot grippers by the specified grip increment.
Full Open	Opens the robot grippers to the Robot Gripper Open Position value set in the Labware tab.
Full Close	Closes the robot grippers to the Robot Gripper Holding Stack value set in the Labware tab.

To change the jog increment, click the down arrow, and then select the desired increment.

!! DAMAGE HAZARD !! Always select smaller jog increments so that the robot does not bump into obstacles in its path (such as the stacker heads and plate stages).



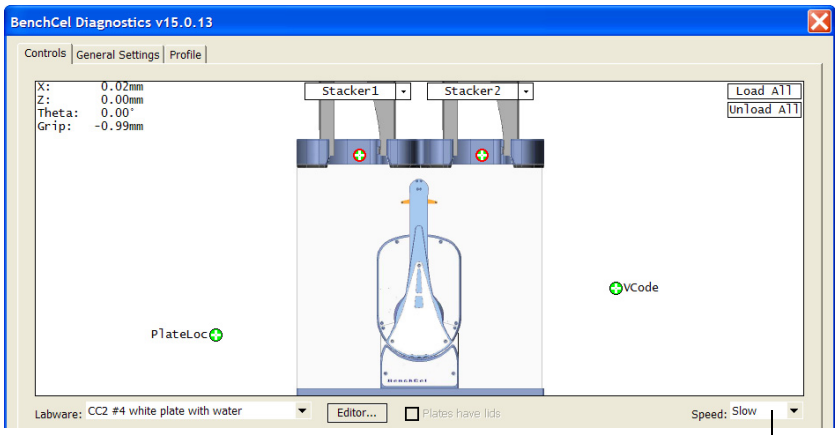
Changing the robot speed

You can select the robot speed to accommodate the task you are performing. For example, you can select the Slow speed when you are creating new teachpoints, creating and testing protocols, or diagnosing problems with the system. When you are ready to run a protocol that you have tested, you can select the High speed.

You can also set the each speed (High, Medium, or Slow) as a percentage of the factory-set maximum speed. You can set the speed for each of the robot axes.

To select the robot speed:

In the **Controls** tab, select the Speed: **Fast, Medium,** or **Slow.**

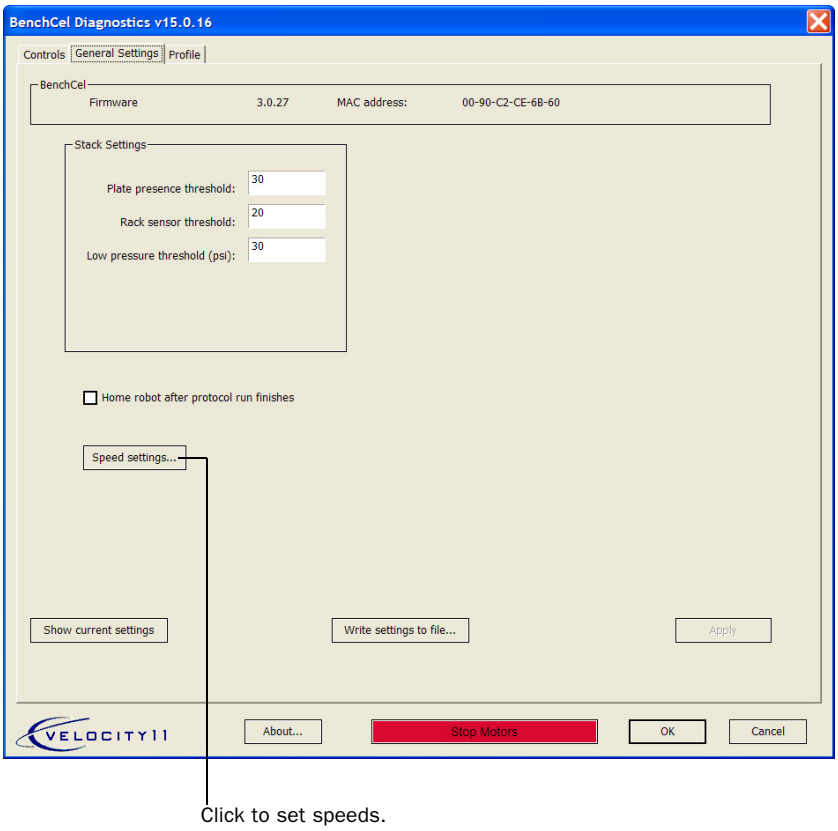


The speed you select in BenchCel Diagnostics applies only to the robot commands in BenchCel Diagnostics (Jog, Move, Transfer, and so on). If the robot is holding a microplate, the slower of the following will be applied: the speed you selected in the Labware Editor or the speed you selected in BenchCel Diagnostics.

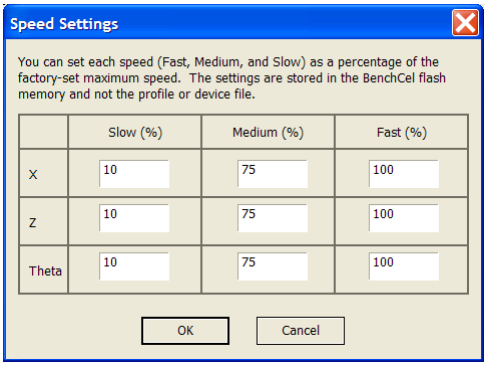
Note: During a protocol run, the robot will use the speed selection in the BenchWorks Tools > Options dialog box. If the robot is holding a microplate, the slower of the following will be applied: the speed in the Labware Editor or the speed in the Tools > Options dialog box. For more information, see the *BenchWorks Automation Control User Guide*.

To set the Slow, Medium, and Fast speeds as a percentage of the factory-set maximum speed:

1. In the General Settings tab, click **Speed Settings.**



The Speed Settings dialog box opens.



2. In the desired box, type the percentage of the factory-set maximum speed.

   Note: The speed settings apply to the speeds you select in BenchCel Diagnostics, Labware Editor, and the BenchWorks Options dialog box.

3. When you are finished, click **OK** to save the changes.

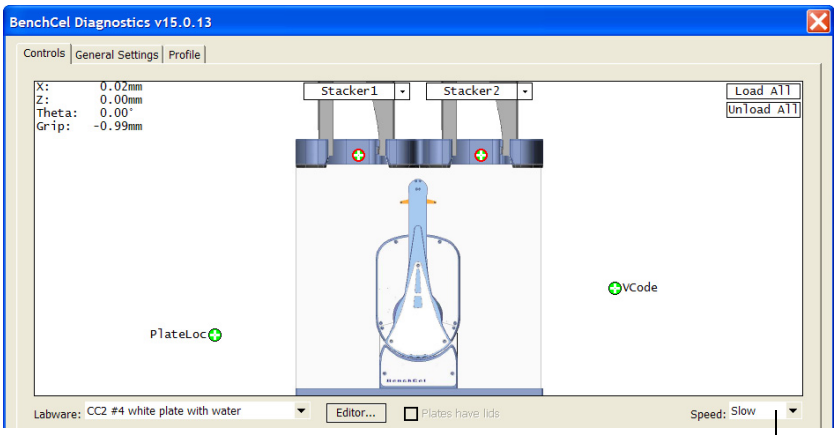
Moving plates between teachpoints

You can move a microplate between teachpoints when you are verifying a teachpoint or to check if you need to home the motors.

!! DAMAGE HAZARD !! To prevent collision, remove obstacles in the path of the robot.

To move plates between teachpoints:

1. Manually place a microplate at the two teachpoints.
2. In the **BenchCel Diagnostics Controls** tab, select the **Slow** speed.



3. In the graphical display area of the BenchCel Diagnostics dialog box, click the plus sign ( ) at either of the following:
   - The teachpoint you want to move to
   - Two teachpoints between which you want to move a plate

   The selected teachpoints should be highlighted in red circles ( ).
4. Rest the pointer on a selected teachpoint. In the command menu that appears, select one of the following:

Command	Description
Move to <teachpoint>	Moves the robot from its current position to the selected teachpoint. The robot places the microplate on the teachpoint and stays at the teachpoint.
Pick from <teachpoint>	Picks up the microplate from the selected teachpoint and moves the plate to the ready-for-upstack position under the stacker head.
Place at <teachpoint>	Moves the robot from its current position and places the microplate at the selected teachpoint. After placing the microplate, the robot backs away from the teachpoint into the safe zone.

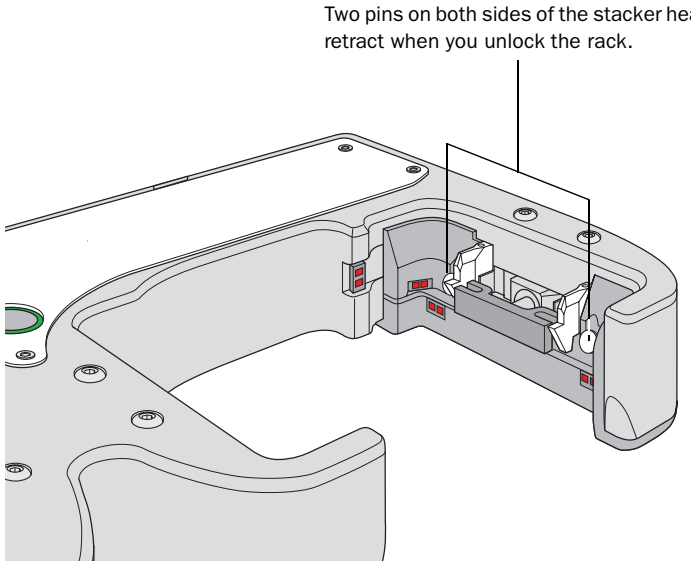
Command	Description
Transfer to <teachpoint>	Moves a microplate from the currently selected teachpoint to the other selected teachpoint. To transfer a microplate from a stack, you must first click Load Stacker n. During the transfer, the robot downloads the plate, places it at the other selected teachpoint, and then backs into the safe zone. If the robot is transferring a plate from one teachpoint to another, the robot picks up the microplate from the currently selected teachpoint, places the microplate at the other selected teachpoint, and then backs into the safe zone.
Delid from <teachpoint>	*Lidded labware only.* Removes the lid from the labware that is at the selected teachpoint.

Locking and unlocking stacks

When you install a rack, the rack is automatically locked into position. You do not have to manually lock the rack.

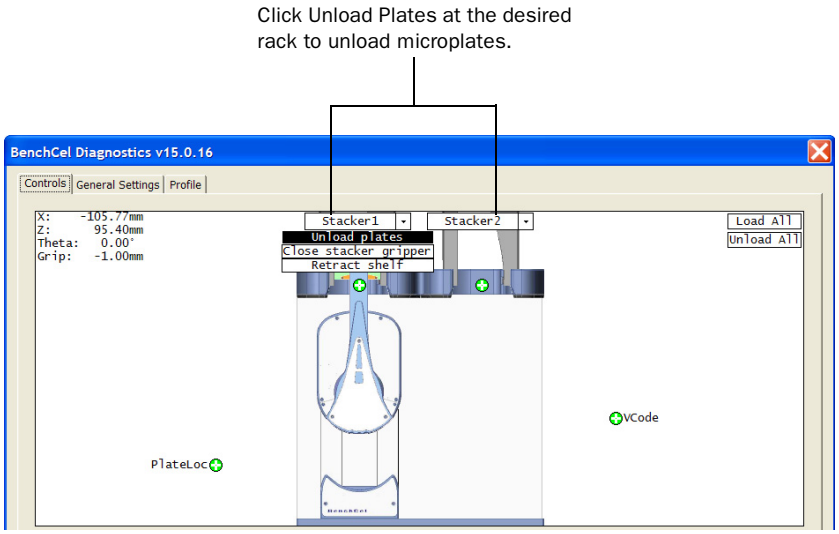
To remove a rack, you must first use the Unload Plates command in BenchCel Diagnostics, and then you can use one of two methods to unlock the rack:

- ❑ Press the green rack-release button at the top of the stacker head to unlock the rack. See “Installing and removing stacker racks” on page 85.
- ❑ Use the Unlock command in BenchCel Diagnostics if it is more convenient.

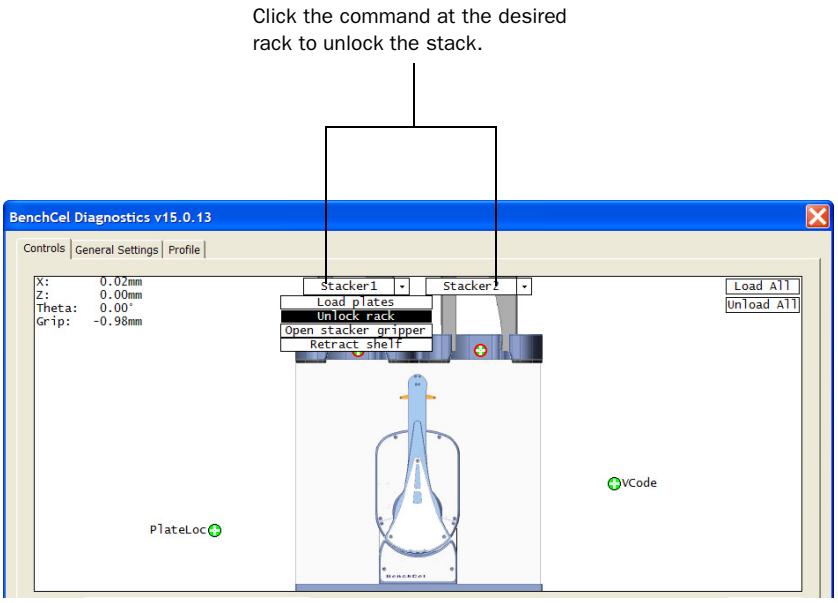


To use the Unlock command in BenchCel Diagnostics:

1. In the **BenchCel Diagnostics Controls** tab, click **Stacker n** at the top of the rack that you want to unload. The command menu appears.
2. If you have not already done so, click **Unload Plates.**



3. Click **Unlock.** You should hear a click sound as the locks retract.

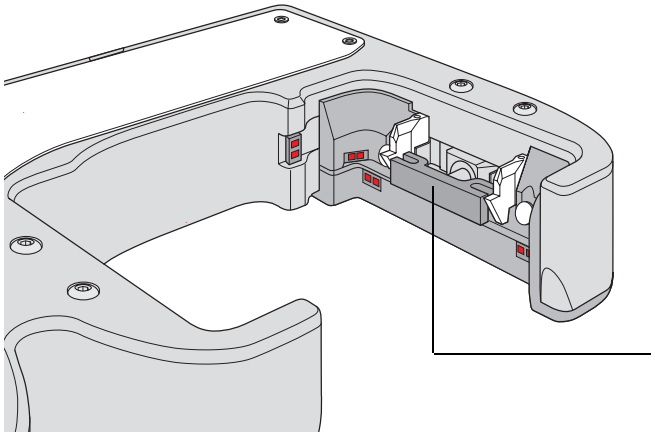


Opening and closing clamps

The clamps in the stacker head close and open the grippers at the bottom of the stacker rack to hold and release the first plate in position for the robot grippers. Compressed air is used to move the clamps.

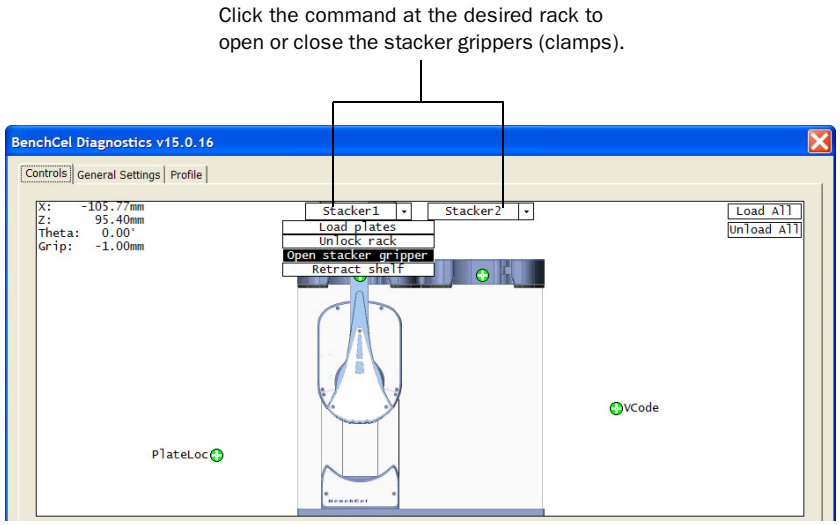
The clamps close and open the stacker grippers automatically during the loading, unloading, downstacking, and stacking procedures. When diagnosing problems or after an aborted run, you can use the commands in BenchCel Diagnostics to open or close the clamps (stacker grippers). For example, you might want to open the clamps (stacker grippers) to remove a microplate.

!! DAMAGE HAZARD !! Opening the clamps (stacker grippers) might cause the microplate or stack of microplates to drop.



To open or close the clamps (stacker grippers):

In the **BenchCel Diagnostics Controls** tab, click **Stacker n** at the top of the rack that you want to load or unload. In the command menu that appears, click **Open Stacker Grippers** or **Close Stacker Grippers.** You should hear a click sound as the clamps (stacker grippers) open or close.

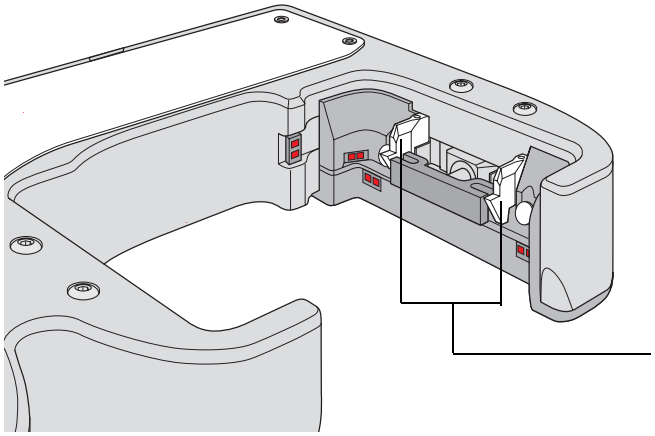


Extending and retracting shelves

The shelves in the stacker head are used to hold the stack of labware temporarily during the downstacking and upstacking processes. Resting the microplates on the shelves levels the microplates, allowing the robot grippers to accurately hold the microplate at the specified offset position. Compressed air is used to move the shelves.

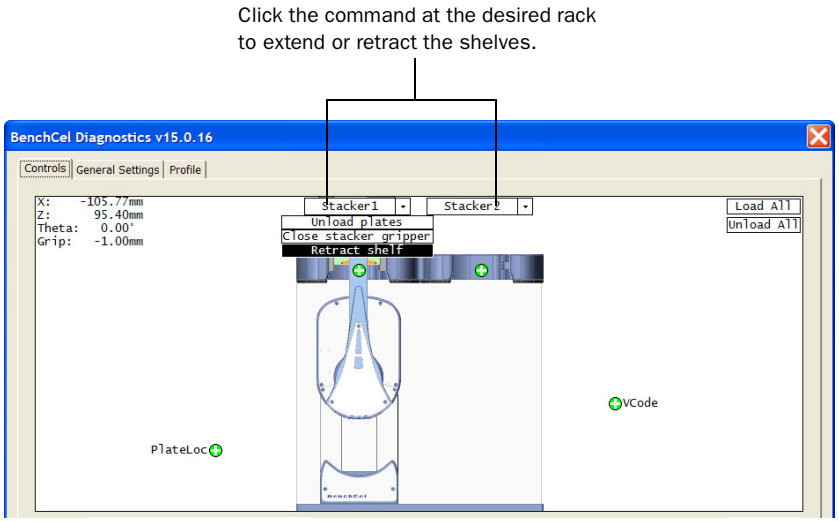
The shelves extend and retract automatically during the downstacking and upstacking processes. When diagnosing problems or after an aborted run, you can use the commands in BenchCel Diagnostics to extend or retract the shelves.

!! DAMAGE HAZARD !! Retracting the shelves might cause the microplate or stack of microplates to drop.



To extend or retract the shelves:

In the **BenchCel Diagnostics Controls** tab, click **Stacker n** at the top of the desired rack. In the command menu that appears, click **Extend Shelves** or **Retract Shelves.** You should hear a click sound as the shelves extend or retract.



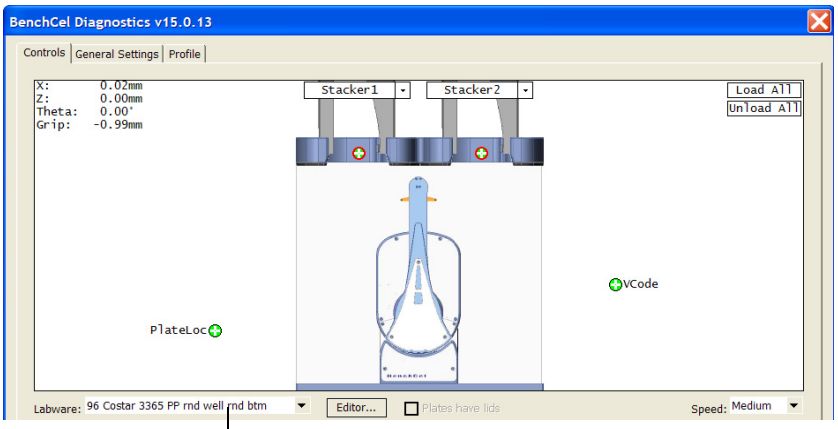
Changing labware parameters

When testing new or troubleshooting existing labware definitions, you can use BenchCel Diagnostics to make changes to some of the labware parameters without opening Labware Editor. For example, you can change the stacking thickness, gripper offsets, notch specification, and lid specifications.

Note: Changes you make to the labware parameters in BenchCel Diagnostics are also updated in the Labware Editor.

To make quick changes to labware parameters:

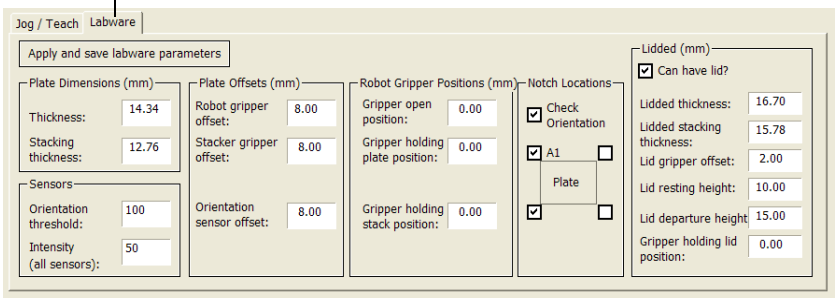
1. In the **BenchCel Diagnostics Controls** tab, select the labware definition you want to test or troubleshoot from the **Labware** list.



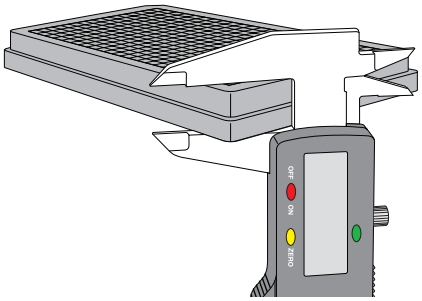
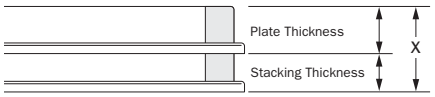
Select labware.

2. Click the **Labware** tab.

Click to display the Labware tab.



3. In the **Plate Dimensions (mm)** area, type a new value for the following:

Parameter	Description
Thickness	The distance, in millimeters, from the bottom surface of the microplate to the top surface of the microplate. For a tip box, this is the distance from the bottom surface of the box to the top of the tips. To increase the number of contact points, measure the distance at the corner of the microplate or tip box (using calipers). This method is especially useful if the microplate has a lip at the top and the caliper can angle inward, producing inaccurate measurements. 
Stacking thickness	The thickness, in millimeters, of two stacked plates minus the thickness of one plate. For example: Thickness of two stacked plates (x) = 23.14 mm Thickness of one plate = 14.14 mm Stacking thickness: 23.14 mm - 14.14 mm = 9.00 mm 

4. In the **Sensors** area, type a new value for the following:

Parameter	Description
Orientation threshold	The value that determines the presence of a microplate notch. If the sensor value is below this threshold, the device reports a notch in the corner corresponding to the orientation sensor. If the sensor value is above this threshold, no notch is reported. The default value is 100. To check the sensors and for adjustment guidelines, see "Adjusting the plate-orientation sensors" on page 124.
Intensity (all sensors)	The value that sets the intensity of the emitting sensor light. The value is a percent of the maximum intensity. The default value is 50%. *Note:* This setting applies to the plate-presence sensor, orientation sensor, and the rack-presence sensor. Some microplates are more reflective than others. Increase the intensity if microplate sensor readings are too low (not significantly higher than the corresponding threshold value) when either a microplate is present, or a notch is absent. Changing this setting affects the sensor readings of the four orientation sensors. Always adjust the intensity and threshold values together. To check the sensors and for adjustment guidelines, see "Adjusting the plate-orientation sensors" on page 124.

5. In the **Plate offsets (mm)** area, type a new value for the following:

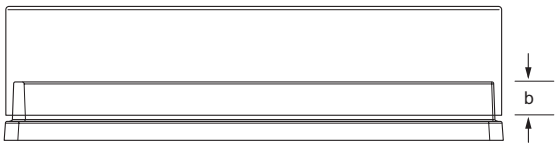
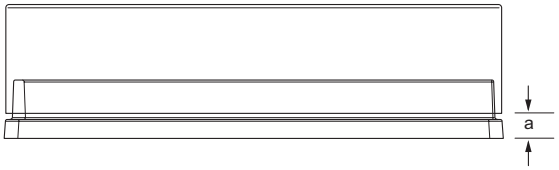
Parameter	Description
Robot gripper offset	The distance, in millimeters, from the bottom of a microplate to where the robot grippers will hold the microplate. Velocity11 recommends that you use an offset of 8 mm.
Stacker gripper offset	The distance, in millimeters, from the bottom of a microplate to where the stacker grippers will hold the microplate. Velocity11 recommends that you use an offset of 8 mm.
Orientation sensor offset	The distance, in millimeters, from the bottom of a microplate to where the orientation sensors will check for notches. Velocity11 recommends that you calculate the offset as follows: Determine the halfway distance between the top of the microplate and the top of the microplate skirt, and then add the height of the skirt.

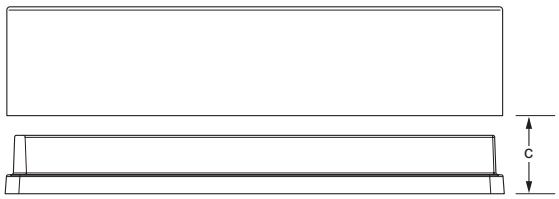
6. In the **Robot Gripper Positions (mm)** area, type a new value for the following:

Parameter	Description
Gripper open position	The distance, in millimeters, that each gripper moves from its home position as the robot releases a microplate. A larger value moves the grippers closer together. A smaller value opens the grippers wider. The parameter value is applied to both robot grippers. For example, a value of -1.00 mm opens each robot gripper -0.50 mm from its home position.
Gripper holding plate position	The distance, in millimeters, that the grippers move from their home position when holding a microplate that is not in a stack. A larger value moves the grippers closer together and holds the microplate tighter. A smaller value opens the grippers wider. The parameter value is applied to both robot grippers. For example, a value of 5.25 mm moves each robot gripper 2.625 mm toward each other from its home position. *Note:* How tightly the robot grippers should hold a microplate depends on the microplate material and design. You might want to run some tests to optimize the parameter.

Parameter	Description
Gripper holding stack position	The distance, in millimeters, that each gripper moves from its home position when holding a microplate that is in a stack. A larger value moves the grippers closer together and holds the microplate tighter. A smaller value opens the grippers wider. The parameter value is applied to both robot grippers. For example, a value of 5.25 mm moves each robot gripper 2.625 mm toward each other from its home position. *Note:* Because the weight of the entire stack will be on the robot grippers, you should use a value greater than the Gripper holding plate parameter.

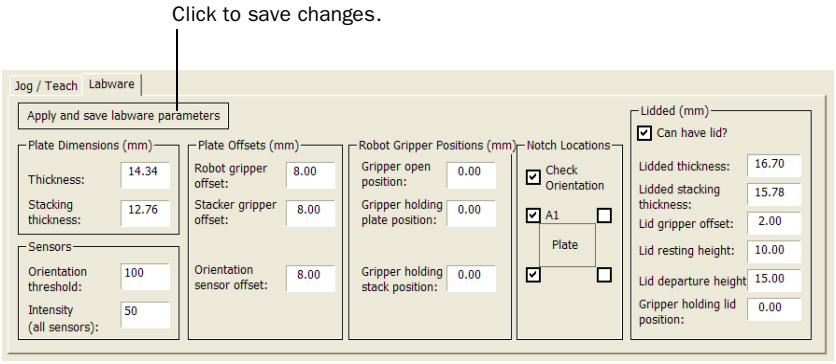
7. In the **Notch Locations** area, select Verify Notches if you want to check for notches, and then select one or more of the microplate corners to indicate the notch location.
8. In the **Lidded (mm)** area, select the following options or type a new value for the following:

Parameter	Description
Can have lid?	The option to include a microplate lid. If you select this option and plan to process lidded microplates, make sure you select the Plates have lids check box under the graphical display area.
Lidded thickness	The thickness, in millimeters, of the plate with a lid in place. Available only if **Can have lid?** is selected.
Lidded stacking thickness	The stacking thickness, in millimeters, of the plate with the lid in place. Available only if **Can have lid?** is selected.
Lid gripper offset	The height, in millimeters, above the lid resting height at which to grip the lid. (Shown as *b* below.) 
Lid resting height	The height, in millimeters, above the bottom of the plate at which the bottom of a plate lid rests. (Shown as *a* below.) 

Parameter	Description
Lid departure height	The height, in millimeters, above the bottom of the plate to which the lid is lifted. 
Gripper holding lid position	The distance, in millimeters, that each gripper moves inward from its home position when holding a microplate lid. An increasing value moves the grippers closer together and holds the microplate tighter. A decreasing value opens the grippers wider. The parameter value is applied to each robot gripper. For example, a value of 5.25 mm moves each robot gripper 2.625 mm toward each other from its home position. In general, type a value that is less than Gripper holding plate position to open the grippers slightly. Holding the lid too tightly might cause the microplate to be lifted with the lid.

9. To make changes to other labware parameters, click **Editor.** You can make changes in the Labware Editor dialog box. See the *BenchWorks Automation Control User Guide* for instructions on using the Labware Editor.

10. When are you finished making the changes, click **Apply and save labware parameters.**



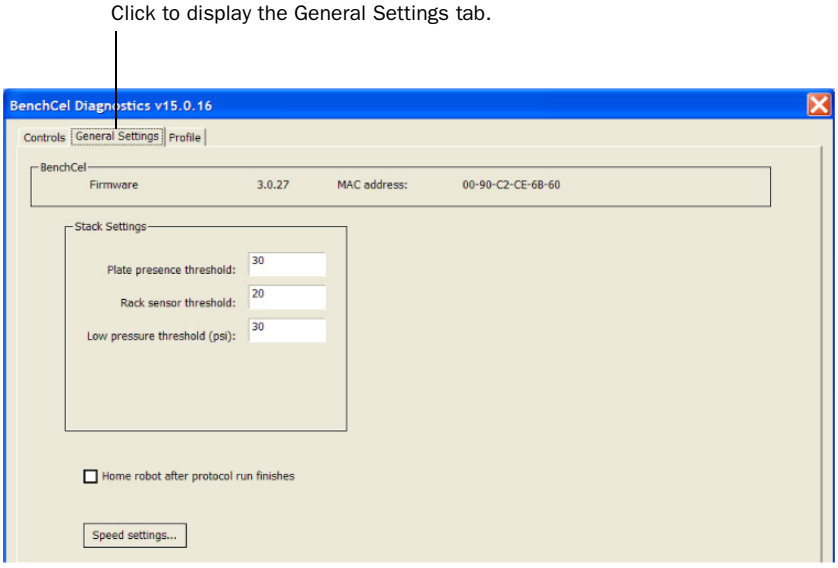
Changing the general settings

!! DAMAGE HAZARD !! Be careful when changing the general settings. Changes in this tab will affect existing protocols.

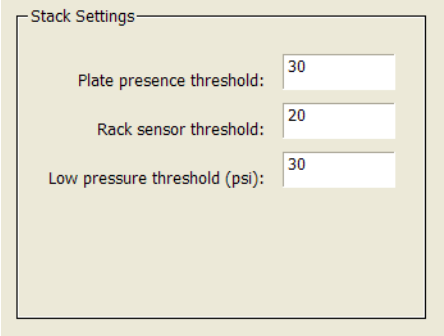
!! DAMAGE HAZARD !! The changes are stored in the BenchCel flash memory. The changes you make to the general settings will take affect any time you are using this BenchCel device regardless of profile, protocol file, or device file.

To change general settings:

1. In BenchCel Diagnostics, click the **General Settings** tab.

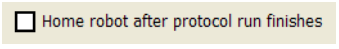


2. In the **Stack Settings** area, type a new value for the parameter you want to change.



Setting	Comment
Plate presence threshold	The value above which a plate is considered present at the plate-presence sensor. This value is applied to all the sensors in all the stacks.
Rack sensor threshold	The value above which a rack is considered present at the rack-presence sensor.
Low pressure threshold (psi)	The value at or below which the system will display a low-pressure warning. Note: If you set this value too low, the device could drop microplates without generating a low air-pressure warning. Velocity11 recommends that you set the threshold at 20 psi.

3. Select **Home robot after protocol run finishes** if you want the robot to return to its home position after the protocol run is finished.



4. *Optional.* To change the speed, click **Speed Settings.** See “Changing the robot speed” on page 108 for instructions.
5. When you are finished making the changes, click **OK** to apply and save the new setting values.

Related topics

For more information about...	See...
Hardware problems	“Hardware problems” on page 95
Software error messages	“Software error messages” on page 97
Defining labware in BenchWorks	*BenchWorks Automation Control User Guide*
Teachpoints	“Setting and managing teachpoints” on page 66
Installing and removing stacker racks	“Installing and removing stacker racks” on page 85

Adjusting the plate-orientation sensors

About this topic

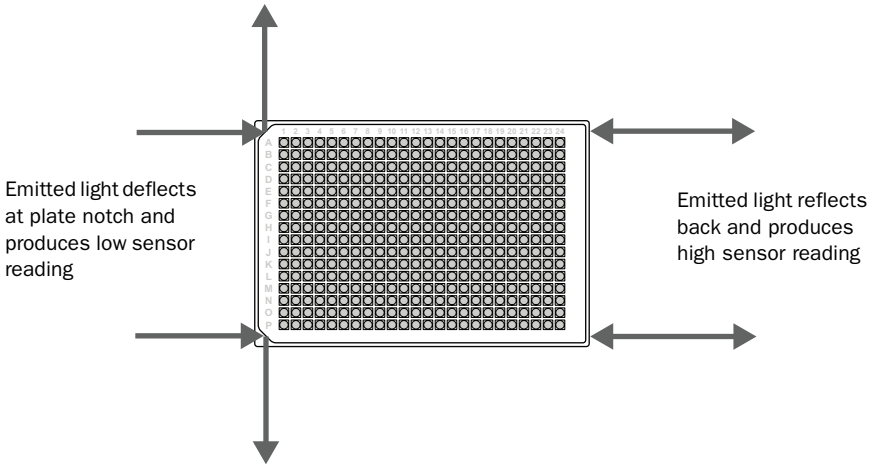
One of the causes of the “Wrong plate type” error message is the plate-orientation sensors are not able to detect the microplate notches correctly. To resolve this problem, make sure the microplate is in the correct position to be detected by the sensor. In addition, you might have to adjust the plate-orientation sensor intensity and threshold.

This topic explains how to align the microplate with the plate-orientation sensors and adjust the notch sensor intensity and threshold.

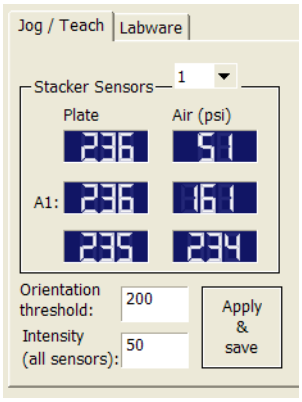
How the plate-orientation sensors work

Four plate-orientation sensors on the inside wall of the stacker head detect the presence of microplate notches when the microplate is downstacked. Each sensor contains a light emitter that transmits light and a receiver that reads the amount of light reflected by the surface of the microplate.

If the light beam bounces off of a wall that is perpendicular to its path, most of the light will reflect back. The resulting reading is relatively high. If the light beam bounces off of a wall that is not perpendicular to the light path, the light will be deflected. The resulting reading is significantly lower.



The amount of light that the sensor receives is displayed in the BenchCel Diagnostics Controls tab. The microplate corners that have notches should have much lower readings than the corners that do not have notches. In the following example, the sensors detect a notch in the upper right corner of the microplate.



The following factors can affect the reading of the notch sensor and might require that you adjust the sensor light intensity:

- ❑ *Microplate position*. For optimum results, the sensor light should bounce off of the plate at halfway between the top of the plate and the top of the plate skirt.
- ❑ *Microplate color*. Darker plate color might require higher light intensity.
- ❑ *Microplate material*. Shiny or reflective plates might require lower light intensity.
- ❑ *Microplate condition*. Cracks, chips, scratches, or defects in the area where the sensor light contacts the plate can affect sensor reading.
- ❑ *Ambient light*. Brighter rooms might require lower light intensity.

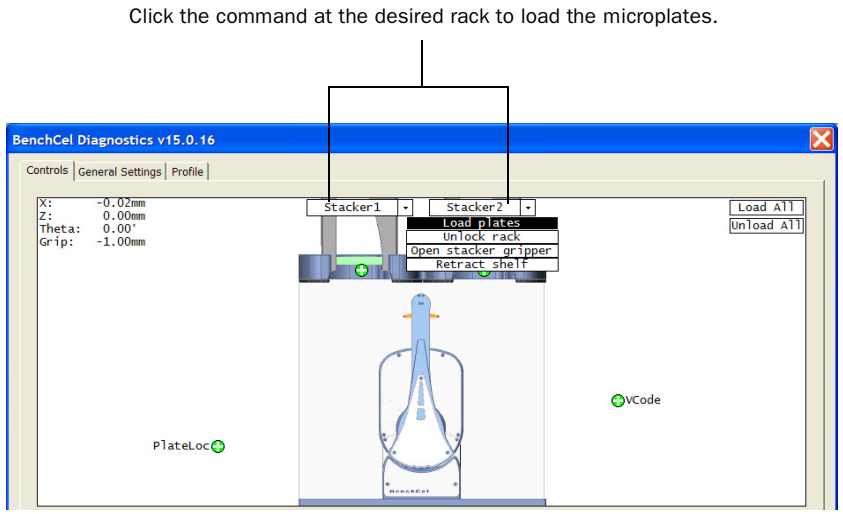
Aligning the plate with the sensors

Make sure the microplate is aligned with the plate-orientation sensors and that the sensor light hits the plate halfway between the top of the microplate and the top of the microplate skirt.

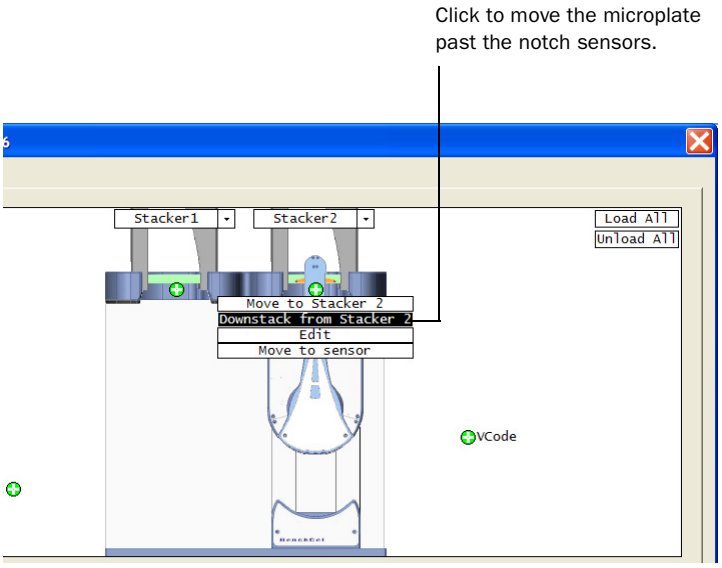
To align the plate with the notch sensors:

1. Load two to three spare microplates in a stacker rack, and then load the rack on the BenchCel device. For loading instructions, see “Loading and unloading labware” on page 84 and “Installing and removing stacker racks” on page 85.
2. In BenchCel Diagnostics, click the **Controls** tab.
3. Select the desired labware in the **Labware** list.

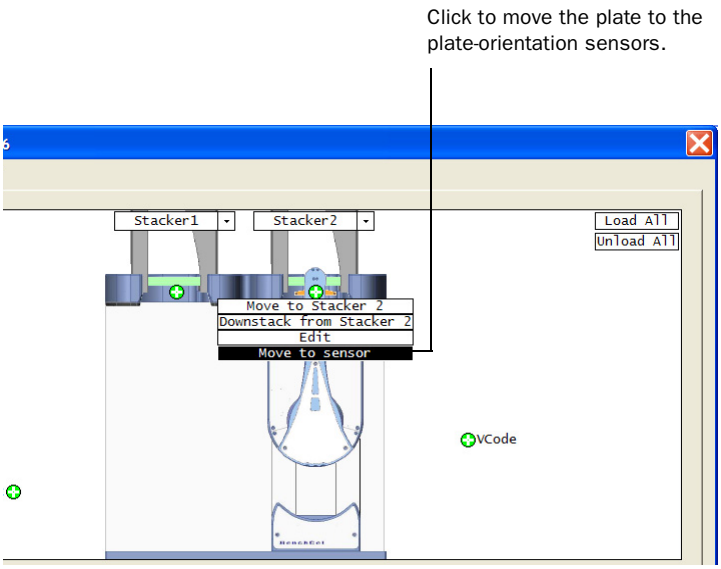
4. In the graphical display area, click **Stacker n** at the top of the rack that contains the spare microplates. In the command menu that appears, click **Load Plates.** The BenchCel device moves the first microplate from the top of the stacker grippers and places it on the shelves.



5. In the graphical display area, at the stack where you have loaded the microplates, click **Downstack.** The robot grippers hold the first microplate and moves it down past the sensors.

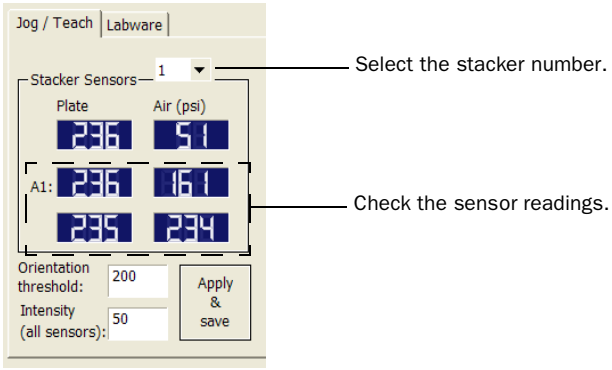


6. In the graphical display area, at the stack where you have downstacked the first microplate, click **Move to Sensor.** The robot moves the microplate into the line of sight of the plate-orientation sensors.



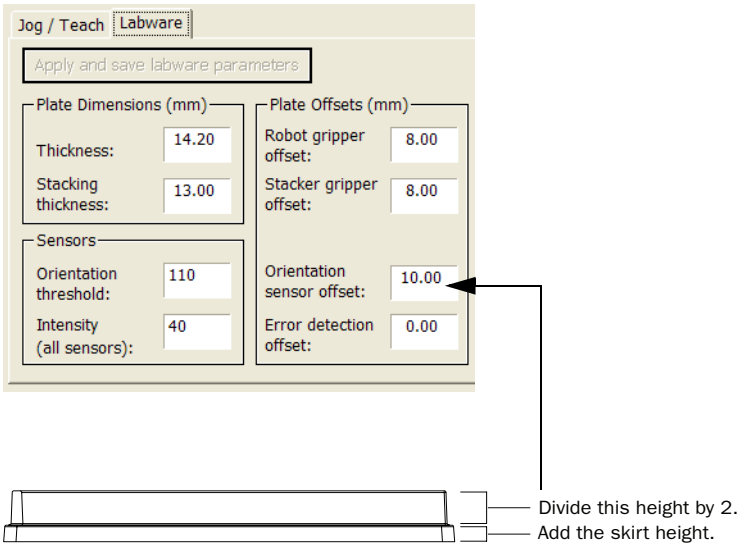
7. In the **Jog/Teach** tab, in the **Stacker Sensors** area, select the stacker number, and then check the notch sensor readings. The corners with the notches should have much lower readings than the other corners.

   In the following example, the plate notch is in the upper right corner, so the reading at that corner is significantly lower than the other corners.



8. If the corners with notches do not have lower readings than the other corners, in the **BenchCel Diagnostics Controls** tab, click the **Labware** tab.

9. In the **Plate Offsets (mm)** area, in the **Orientation Sensor Offset** box, type the sum of the following:
   - The distance (in millimeters) that is halfway between the top of the microplate and the top of the skirt.
   - The height of the microplate skirt (in millimeters).



10. Click **Save and Apply Labware Parameters.**
11. In the graphical display area, at the stack where you have loaded the plates, click **Move to Sensor.** The robot moves the first plate into the line of sight of the notch sensors.
12. Click the **Jog/Teach** tab and check the notch sensor readings. The corners with the notches should have much lower readings than the other corners.

    If the notch sensor readings are still not correct, proceed to adjust the sensor intensity and threshold.

Adjusting the sensor light intensity

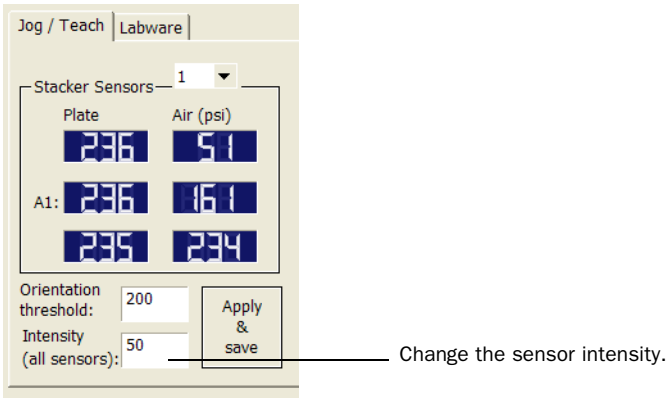
Ideally, the sensor intensity should be set such that the orientation sensor reading is at the maximum (near 255) when no notch is present. However, different plate color, plate material, and ambient light might require that you adjust the intensity to create the maximum possible difference between the highest and lowest sensor readings.

!! IMPORTANT !! Perform this procedure after you have aligned the plate with the plate-orientation sensors. See "Aligning the plate with the sensors" on page 125.

To adjust the plate-orientation sensor light intensity:

1. Follow the instructions in "Aligning the plate with the sensors" on page 125 to make sure that the plate is correctly aligned with the plate-orientation sensors.
2. In BenchCel Diagnostics, click the **Controls** tab, and then click the **Jog/Teach** tab.

3. In the **Stacker Sensors** area, type a new value in the **Intensity (all sensors)** box.



   - Increase the intensity if the sensor values are too low (for example, lower than 10).
   - Decrease the intensity if the values are too high (for example, 245), or if the difference between the notch and non-notch readings are too small (for example, the difference is 5).
   - Increase the intensity if the plate color is darker, if the plate material has a matte finish, or if the ambient light is darker.
   - Decrease the intensity if the plate color is lighter, if the plate material is shiny, or if the ambient light is brighter.

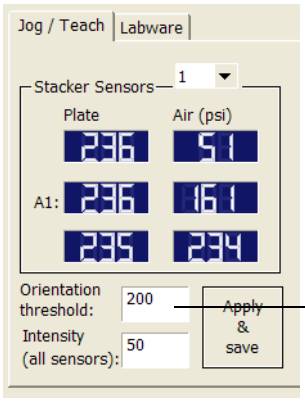
4. Check the orientation sensor readings. The corners with the notches should have much lower readings than the other corners. The maximum value is 255.
5. If the readings appear to be correct, click **Apply and save** to save the settings.

Adjusting the orientation sensor threshold

To adjust the orientation sensor threshold:

1. In BenchCel Diagnostics, click the **Controls** tab, and then click the **Jog/Teach** tab.
2. In the **Orientation threshold** box, type the threshold value you want to use. The threshold value should be the midpoint between the notch corner reading (lowest value) and the regular corner reading (highest value).

For example, if the notch signal is 161 and the regular corner signal is 236, you can set the threshold at 200.



Related topics

For more information about...	See...
Hardware problems	“Hardware problems” on page 95
Software error messages	“Software error messages” on page 97
Defining labware in BenchWorks	*BenchWorks Automation Control User Guide*
Using commands in BenchCel Diagnostics	“Diagnostic tools” on page 105

Adjusting the stacker gripper pressure

About this topic

This topic explains how to check the stacker gripper pressure (internal air pressure) and how to adjust it.

Stacker gripper pressure

Compressed air is used to move the clamps that open and close the stacker rack grippers and the shelves that level the microplates. See “Hardware overview” on page 4 for the location of these components.

Although the required air pressure from your lab is 0.65–0.69 MPa (95–100 psi), the BenchCel device down-regulates the pressure inside the device.

You typically do not need to adjust the internal air pressure. You might want to adjust the pressure when troubleshooting Load Plate problems or when you want to load different labware on the same BenchCel Workstation.

In general, you can set the internal air pressure within the range of 30–50 psi. For plates that are flexible and tend to bend, you should decrease the air pressure. For less flexible plates, you can increase the air pressure.

For each plate type or application, you should run optimization tests to determine the best internal pressure setting.

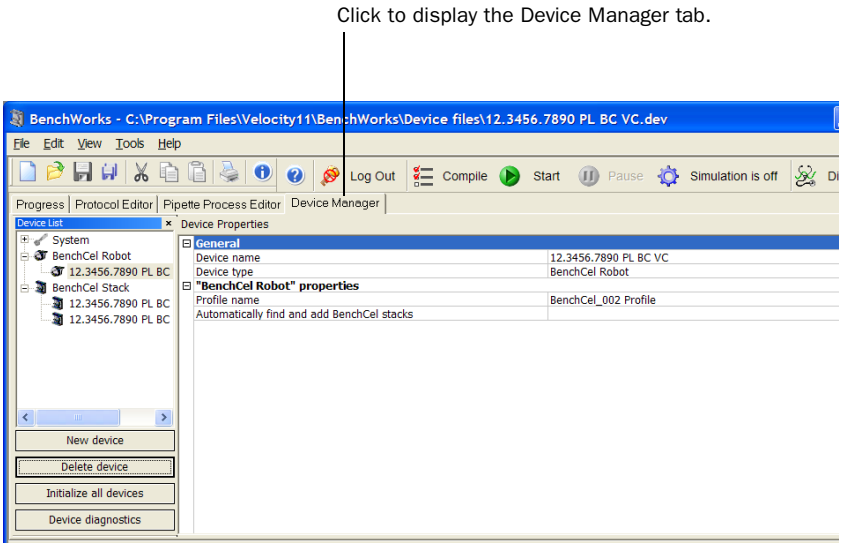
Before you start

Make sure you turned on the air supply at the source (house, cylinder, or pump).

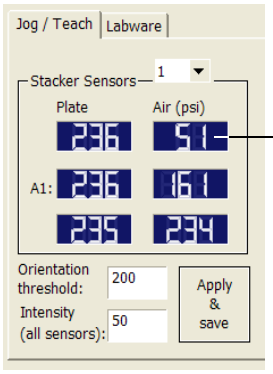
Checking the internal air pressure

To check the internal air pressure:

1. Start the BenchWorks software and click the **Device Manager** tab.



2. In the **Device List** area, select a BenchCel device and click **Device diagnostics.** The BenchCel Diagnostics dialog box opens.
3. Click the **Controls** tab, and then click the **Jog/Teach** tab.
4. In the **Stacker Sensors** area, check the air pressure value.

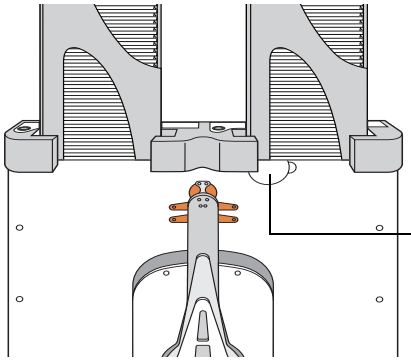


Check the stacker gripper pressure (internal air pressure).

Adjusting the internal air pressure

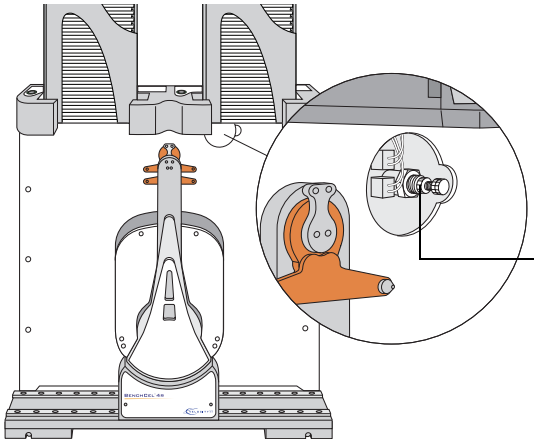
To adjust the internal air pressure:

1. At the front of the BenchCel device, lift the circular cover.



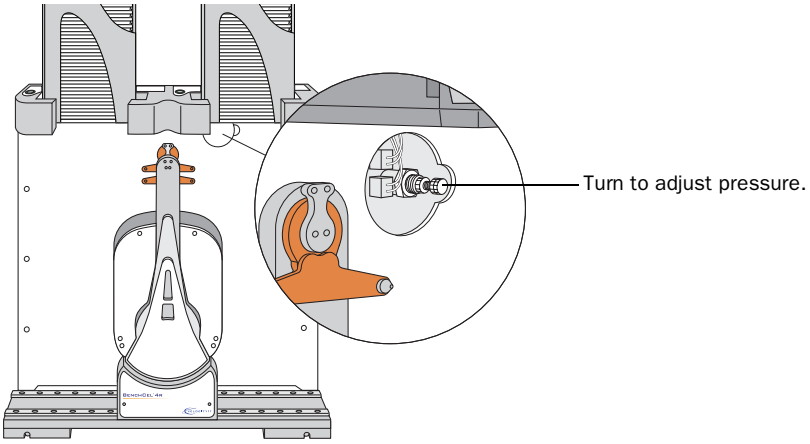
Lift cover to access the air pressure regulator.

2. Turn the lock screw counterclockwise to unlock the air pressure regulator knob.

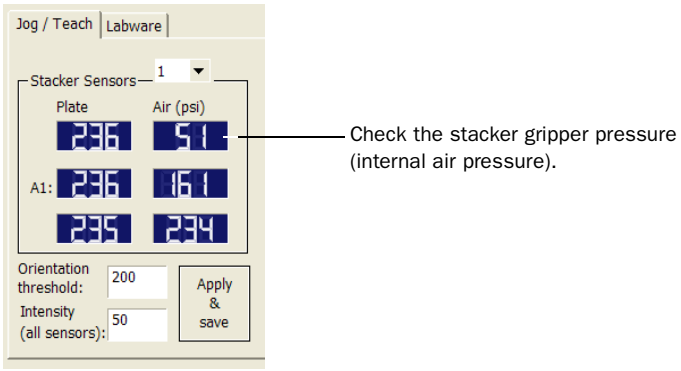


Turn counterclockwise to unlock.

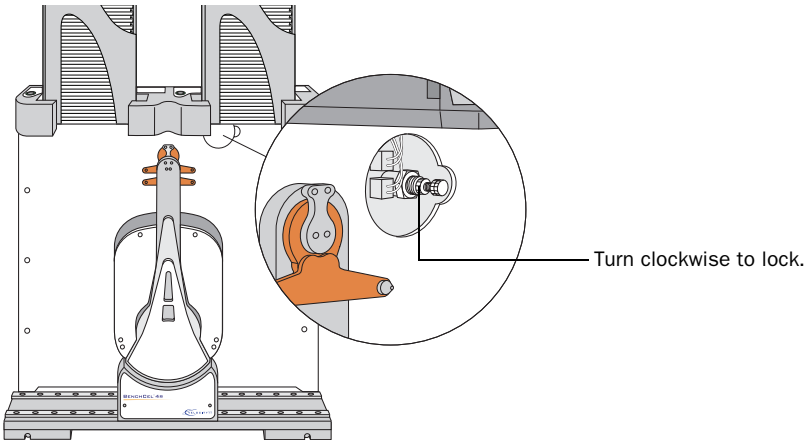
3. Turn the air pressure regulator knob. Turning the knob clockwise increases the internal air pressure. Turning the knob counterclockwise decreases the internal air pressure.



4. Check the air pressure value in the BenchCel Diagnostics window. A valid air pressure value displays only when the stacker grippers are closed.



5. Turn the lock screw clockwise to lock the air pressure regulator knob. This prevents accidental adjustments.



6. When you are finished, place the cover on the front of the BenchCel device.

Related topics

For information about...	See...
Air pressure requirements	“Compressed air” on page 30
Hardware problems	“Hardware problems” on page 95
Software error messages	“Software error messages” on page 97

Reporting problems

About this topic

If you have a technical problem that you cannot resolve after reading the maintenance and troubleshooting instructions, read the information in this topic for how to report hardware, software, and user guide problems.

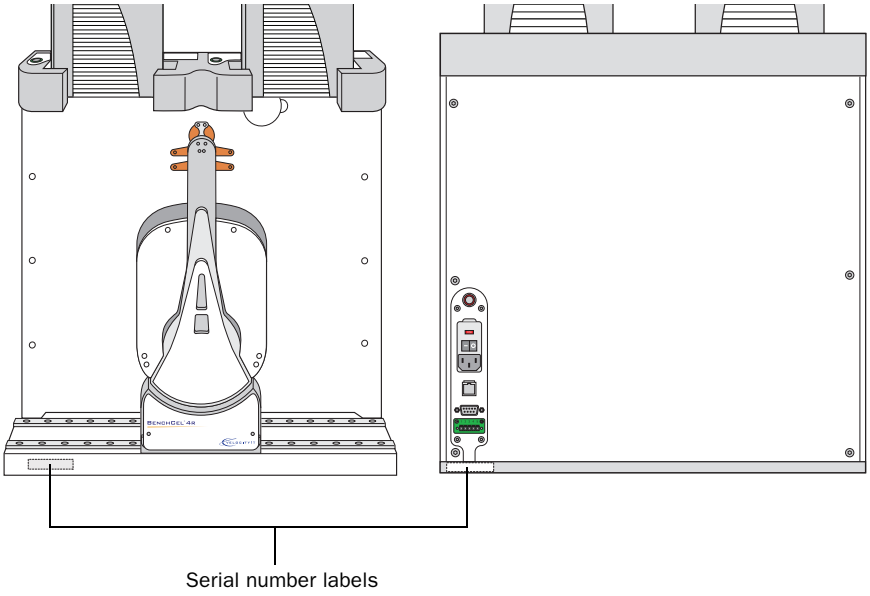
Contacting Velocity11

If you find a problem with the BenchCel Workstation, contact Velocity11 Technical Support using one of the following methods:

- ❑ Sending an email to service@velocity11.com or euroservice@velocity11.com
- ❑ Calling Velocity11 Technical Support at 1.800.979.4811 or +1.650.846.6611 outside the US
- ❑ Sending a bug report from within BenchWorks software

Reporting hardware problems

When contacting Velocity11, make sure you have the serial number of the device ready. You can locate the serial number on the front and the back of the BenchCel device.



Reporting software problems

When reporting software problems, make sure you provide the following:

- ❑ Software version number
- ❑ Relevant software files

Finding the software version number

When you contact Velocity11 Technical Support, make sure you have the software version number ready. To find the BenchWorks software version number, see the *BenchWorks Automation Control User Guide*.

You can find the BenchCel Diagnostics software version number in the software. To do this:

1. Open **BenchCel Diagnostics.**
2. Read the version number on the title bar.

Sending files

When resolving software bugs or other problems, send the following files:

- ❑ Detailed, precise description of the problem you are experiencing
- ❑ Device files (if the issue occurs when a device file is open)
- ❑ Protocol files (if the issue occurs during a protocol run or simulation)
- ❑ Protocol log file (if the issue occurs during a protocol run or simulation)
- ❑ Velocity11 registry files from the Windows registry
- ❑ Error message text (or screen capture of the error message window)
- ❑ Screen capture of the About window

For instructions on how to locate the device, protocol, protocol log, and registry files, see the *BenchWorks Automation Control User Guide*.

Reporting user guide problems

If you find a problem with this user guide or have suggestions for improvement, please send your comments using the feedback button in the online help. Your comments will be reviewed promptly and used to write the next version of the guide.

You can also send an email directly to documentation@velocity11.com.

Related topics

For more information about...	See...
Resolving hardware problems	“Hardware problems” on page 95
Resolving software errors	“Software error messages” on page 97
Safety information	“Safety information” on page 22
Hardware description	“Hardware overview” on page 4

BenchCel ActiveX control

A

This chapter gives integrators the ActiveX control information they need to integrate another company's lab automation device into the BenchCel Workstation.

The ActiveX has been verified to work with both Visual Studio 6 and Visual Studio .NET (v 7.1).

This chapter contains the following topics:

About ActiveX controls

What is the BenchCel ActiveX control

The BenchCel ActiveX control is the software component that allows the BenchCel device to interact with any Velocity11 or a third-party lab automation system.

How the BenchCel ActiveX control is used

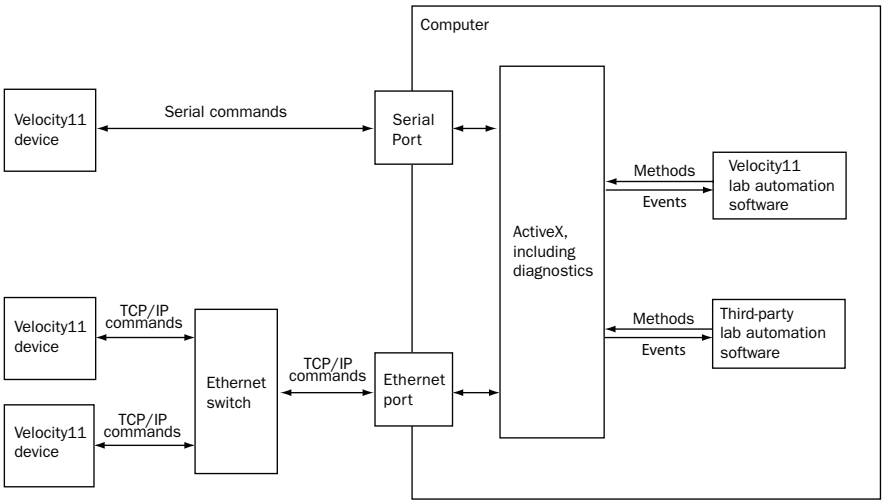
In a Velocity11 lab automation system, lab automation system software such as VWorks or BenchWorks is already configured to interface with the BenchCel device. The operator can control the device using the software.

In a third-party lab automation system, you need to use ActiveX to enable the third-party software to interface with the BenchCel device. Each ActiveX control consists of a collection of the following:

- *Methods*. Functions that can be called to invoke individual operations
- *Properties*. Variables that are used in methods (for example, speed = fast)
- *Events*. Notifications that methods have completed or resulted in errors

When integrating the BenchCel device in a lab automation system, you need to know the available methods and properties for the ActiveX control.

The following diagram illustrates the use of the BenchCel ActiveX control in a lab automation system environment. Actions you perform are conducted through ActiveX methods. System responses are relayed back through ActiveX events.



Properties

IPictureDisp* ControlPicture

Description

Read-only property that the client can use to get an icon to represent the ActiveX control.

This example paints a BenchCel bitmap over a button.

Visual C++ example

/*The CPicture class is imported into your project when the ActiveX is installed*/

```
CButton button;
```

//Create a button

```
CPicture BenchCelPic;
```

```
BenchCelPic = m_BenchCel.GetControlPicture();
```

//Retrieve the picture

```
button.SetBitmap((HBITMAP)BenchCelPic.GetHandle());
```

/*Paint the bitmap onto the button*/

Visual Basic example

'Assume that there is a button

'named Command1 on the

'current form. You must set

'the style property of

'Command1 to Graphical

```
Command1.Picture = BenchCel.ControlPicture
```

SHORT Speed

Description

Property to specify how fast the BenchCel should move. 0 = slow, 1 = medium, 2 = fast. This property should not be changed during an operation. Setting this property to an invalid value will have no effect (call will be ignored).

Visual C++ example

//Set the speed to fast

```
m_BenchCel.speed = 2;
```

Visual Basic example

'Set the speed to fast

```
BenchCel.Speed = 2
```

BOOL Blocking

Description

Specifies whether the ActiveX should block during an execution of a command. If true, commands, such as PickAndPlace, will not return until the action completes or an error occurs. If false, the command will return immediately without waiting for the action to complete and invoke an event to indicate successful completion of the command.

Errors will be indicated through one of two means; 1) the return value might not be S_OK (0), in this case, no event will be fired; 2) an error event is fired. When an error occurs, the ActiveX expects a call to Abort, Retry or Ignore. ShowDiagsDialog can be called to allow the user to exercise specific diagnostic/corrective functions, but when the main execution resumes, a call to Abort, Retry or Ignore is necessary to continue the operation.

Visual C++ example

//Set the BenchCel to block until the command completes

```
m_BenchCel.Blocking =1;
```

Visual Basic example

Set the BenchCel to block until the command completes

```
m_BenchCel.Blocking = TRUE
```

Methods

void AboutBox()

Description

Shows a small window that indicates some version information.

Parameters

None

Returns

None

Visual C++ example

```
BenchCel.AboutBox()
```

Visual Basic example

```
m_BenchCel.AboutBox();
```

BSTR GetVersion ()

Description

Method to programmatically retrieve the version of the ActiveX.

Parameters

None

Returns

Version string

Visual C++ example

```
CString strVersion =

m_BenchCel.GetVersion();
```

Visual Basic example

```
Version = BenchCel.GetVersion()
```

LONG Initialize(BSTR Profile)

Description

Method to connect to the BenchCel device. A BenchCel profile specifies how to connect to the device (serial or Ethernet; if Ethernet, which device on the network and if serial, which port to use) and which teachpoint file to use. If this is called in non-blocking mode, the client application should wait for InitializeComplete before calling other methods. This method should be called before most other methods.

Parameters

Argument Type	Argument Name	Range	Description
BSTR	Profile	Valid profile name	The name of the profile to be used for initialization

Returns

S_OK (0) on success; other value otherwise.

Visual C++ example

```
LONG1Result =

m_BenchCel.Initialize("ethernet");
```

Visual Basic example

```
LONG1Result =

BenchCel.Initialize("ethernet")
```

LONG ShowDiagsDialog(BOOL bModal, SHORT iSecurityLevel)

Description

Method to show the graphical diagnostics menu that allows the user to troubleshoot and correct problems. This method can be called before Initialize to create a profile.

Parameters

Argument Type	Argument Name	Range	Description
BOOL	bModal	TRUE,FALSE	Whether the diagnostics should be shown modally
SHORT	iSecurityLevel	0-3	The security level that the user has to operate the diagnostics 0 = Administrator 1 = Technician 2 = Operator 3 = Guest –1 - No access

Returns

LONG —no meaning.

Visual C++ example

```
m_BenchCel.ShowDiagsDialog(TRUE,0);
```

Visual Basic example

```
BenchCel.ShowDiagsDialog 1, 0
```

void Close()

Description

Method to disconnect from the BenchCel device.

Parameters

None

Returns

None

Visual C++ example

```
m_BenchCel.Close();
```

Visual Basic example

```
BenchCel.Close
```

BSTR GetLastError()

Description

Method to retrieve a text message explaining the last error. This method can be called in blocking mode, after a command returns with a failure code, or in non-blocking mode, after the Error event has been fired.

Parameters

None

Returns

Error string

Visual C++ example

```
strError = m_BenchCel.GetLastError();
```

Visual Basic example

```
strError = BenchCel.GetLastError()
```

LONG Retry()

Description

Method to retry an action after an error occurred. For example, if there is insufficient air pressure during a LoadStack operation, the application can call Retry after the air pressure has been increased.

Parameters

None

Returns

S_OK if success; other value otherwise

Visual C++ example

```
m_BenchCel.Retry();
```

Visual Basic example

```
BenchCel.Retry
```

LONG Abort()

Description

Method to clear an error and state information.

Parameters

None

Returns

S_OK if success; other value otherwise

Visual C++ example

```
m_BenchCel.Abort();
```

Visual Basic example

```
BenchCel.Abort
```

LONG Ignore()

Description

Method to ignore the previously issued error. This is not a recommended course of action, as the errors are issued for a reason. However, ignoring some errors, such as “Plate is rotated”, can be appropriate if the operator understands the implications.

Parameters

None

Returns

S_OK if success; other value otherwise

Visual C++ example

```
m_BenchCel.Ignore();
```

Visual Basic example

```
BenchCel.Ignore
```

LONG PickAndPlace(BSTR PickFrom, BSTR Place To, VARIANT_BOOL bLidded, LONG nRetractionCode)

Description

Method to transfer a microplate. Stacker locations are called “Stacker 1”, “Stacker 2”, etc. Downstacking can be specified by using a stacker location for PickFrom and upstacking can be specified by using a stacker location for PlaceTo. bLidded indicates whether the robot should treat the microplate as if it has a lid. nRetractionCode should be 3 (reserved for future options).

Parameters

Argument Type	Argument Name	Range	Description
BSTR	PickFrom	Valid teachpoint name	Destination to pick from
BSTR	PlaceTo	Valid teachpoint name	Destination to place to
VARIANT_BOOL	bLidded	VARIANT_TRUE, VARIANT_FALSE	Whether the microplate is lidded
LONG	nRetractioCode	0–2	0 = Do nothing 1 = Retract arms normally 2 = Retract arms only in Z + 0 clearance that is specified in teachpoint detail 3 = Retract arms so they are vertical

Returns

S_OK if success; other value otherwise

Visual C++ example

```
1Result = m_BenchCel.PickAndPlace("Stacker 1", "PlateLoc",
FALSE, 2)
```

Visual Basic example

```
1Result = BenchCel.PickAndPlace("Stacker 1", "PlateLoc",
FALSE, 2)
```

VARIANT GetTeachpointNames()

Description

Method to retrieve the teachpoints known to the device. This method must be called after initialization is complete and it returns an array of available teachpoints, including the stackers.

Parameters

None

Returns

A safe array of teachpoint names

Visual C++ example

```
VARIANT vTeachpoints = m_BenchCel.GetTeachpointNames();

SAFEARRAY *psa = vTeachpoints.parray;

BSTR* bstrArray;
if
(FAILED(SafeArrayAccessData(psa,reinterpret_cast<void**>(
&bstrArray))))
{
VariantClear(&vTeachpoints);
return;
}

for (ULONG i = 0; i < psa->rgsabound[0].cElements; i++)
{
MessageBox(CString(bstrAdday[i])));
}
SafeArrayUnaccessData(psa);VariantClear(&vTeachpoints);
```

Visual Basic example

```
TeachpointNames = BenchCel.GetTeachpointNames

For i= LBound(teachpointNames) To UBound(teachpointNames)

MsgBox teachpointNames(i)

Next
```

LONG ProtocolStart()

Description

Method to be called at the beginning of a run. The device is not expected to move.

Parameters

None

Returns

S_OK on success; other value on failure.

Visual C++ example

```
1Result = m_BenchCel.ProtocolStart();
```

Visual Basic example

```
1Result = BenchCel.ProtocolStart()
```

LONG ProtocolFinish()

Description

Method to be called at the end of a run. The device might home during this call.

Parameters

None

Returns

S_OK if success; other value otherwise

Visual C++ example

```
1Result = m_BenchCel.ProtocolFinish();
```

Visual Basic example

```
1Result = BenchCel.ProtocolFinish()
```

LONG SetLabware(BSTR bstrLabware)

Description

Method to set the labware to use. The selection will be in effect for all operations until a different labware is set. If diagnostics are shown and the user selects a different labware, the original labware will be restored when the diagnostics window is closed. This method should not be called when any movement is in progress.

Parameters

Argument Type	Argument Name	Range	Description
BSTR	bstrLabware	Valid labware name	Labware to be used for subsequent operations

Returns

S_OK if successful; other value if there was an error.

Visual C++ example

```
1Result = m_BenchCel.SetLabware("MyPlateType");
```

Visual Basic example

```
1Result = BenchCel.SetLabware("MyPlateType")
```

LONG GetStackCount(LONG *pCount)

Description

Method to retrieve the number of stacks on the BenchCel device. This method must be called after a successful connection in order for it to indicate the current number.

Parameters

Argument Type	Argument Name	Range	Description
LONG*	pCount	Valid pointer to receive the stack count	If successful, the value pointed to by pCount should indicate the number of stacks the device has

Returns

S_OK if successful; other value otherwise.

Visual C++ example

```
1Result = m_BenchCel.GetStackCount(&numStacks);
```

Visual Basic example

```
1Result = BenchCel.GetStackCount(numStacks)
```

LONG IsStackLoaded(SHORT sStack, [in, out] VARIANT_BOOL* pLoaded

Description

Method to test whether a stack has been loaded. The stack number is 0-based. This method should be called after a successful connection.

Parameters

Argument Type	Argument Name	Range	Description
SHORT	sStack	0 to n-1, where n is the number of stacks	Which stack to check
VARIANT_BOOL*	pLoaded	Valid pointer to receive whether or not the stack is loaded	On a successful call, the value pointed to by pLoaded should indicate whether the stack is loaded or not

Returns

S_OK if successful; other value otherwise.

Visual C++ example

```
1Result = m_Benchcel.IsStackLoaded(1,&bStackLoaded);
```

Visual Basic example

```
1Result = BenchCel.IsStackLoaded(1,bStackLoaded)
```

LONG IsPlatePresent(SHORT sStack, [in, out] VARIANT_BOOL* pPresent

Description

Method to test whether a stack has a microplate and is loaded. If the stack is not loaded, the result returned through pPresent will not be meaningful. The stack number is 0-based. This method should be called after a successful connection.

Parameters

Argument Type	Argument Name	Range	Description
SHORT	sStack	0 to n-1, where n is the number of stacks	Which stack to check
VARIANT_BOOL*	pLoaded	Valid pointer to receive whether a microplate is present	On a successful call, the value pointed to by pPresent should indicate whether the stack is loaded and has a microplate available for downstacking

Returns

S_OK if successful, other value otherwise.

Visual C++ example

```
1Result = m_Benchcel.IsPlatePresent(1,&bPlatePresent);
```

Visual Basic example

```
1Result = BenchCel.IsPlatePresent(1,bPlatePresent)
```

LONG ReleaseStack(SHORT sStack)

Description

Method to release a stack. A released stack can be freely taken from the device for the loading or unloading of microplates. However, the BenchCel cannot downstack from or upstack to a released stack. The stack number is 0-based.

Note: This method can also be used to perform the close clamp function.

Parameters

Argument Type	Argument Name	Range	Description
SHORT	sStack	0 to n-1, where n is the number of stacks	The stack to be released

Returns

S_OK if successful, other value otherwise.

Visual C++ example

```
1Result = m_BenchCel.ReleaseStack(0);
```

Visual Basic example

```
1Result = BenchCel.ReleaseStack(0)
```

LONG LoadStack(SHORT sStack)

Description

Method to release a stack. To downstack from or upstack to a stack, the stack must be loaded. A loaded stack is locked into the stacker head and cannot be freely taken from the device. The stack number is 0-based.

Parameters

Argument Type	Argument Name	Range	Description
SHORT	sStack	0 to n-1, where n is the number of stacks	The stack to be loaded

Returns

S_OK if successful; other value otherwise.

Visual C++ example

```
1Result = m_BenchCel.LoadStack(0);
```

Visual Basic example

```
1Result = BenchCel.LoadStack(0)
```

LONG MoveToHomePosition()

Description

Method to move the device to the origin. This method is not commonly used.

Parameters

None

Returns

S_OK if successful; other value otherwise.

Visual C++ example

```
1Result = BenchCel.MoveToHomePosition();
```

Visual Basic example

```
1Result = BenchCel.MoveToHomePosition()
```

LONG ShowLabwareEditor(BOOL bModal, BSTR bstrLabware)

Description

Method to display the labware editor graphical user interface. Through this interface dialog, the user can specify labware parameters that will be used by the device to handle the microplates. Parameters such as microplate height and notch information will be associated with a labware name, which can be used by SetLabware to indicate to the device how to handle the next microplate.

Parameters

Argument Type	Argument Name	Range	Description
BOOL	bModal	TRUE, FALSE	Whether to show the editor modally or not
BSTR	bstrLabware	Valid labware name	The labware to be selected when the editor is displayed

Returns

S_OK if successful; other value otherwise.

Visual C++ example

```
m_BenchCel.ShowLabwareEditor(1,"MyPlateType");
```

Visual Basic example

```
BenchCel.ShowLabwareEditor 1,"MyPlateType"
```

LONG Pause()

Description

Method used to pause the BenchCel movement.

Parameters

None

Returns

S_OK if successful; other value if there was an error.

LONG Unpause()

Description

Method used to unpause the BenchCel movement. The BenchCel will continue any remaining movements before the call to pause the device.

Parameters

None

Return

S_OK if successful; other value if there was an error.

LONG OpenClamp()

Description

Method used to open the stacker grippers of a given stack.

Parameters

Argument Type	Argument Name	Range	Description
SHORT	Stack	0 – (number of Stacks – 1)	Specify which stack's gripper to open

Returns

S_OK if successful; other value if there was an error.

LONG IsConnected()

Description

Method used to check whether a connection to the BenchCel is established. The BenchCel is ready to process commands from the BenchCel Active X driver when a connection has been established (using the Initialize() method).

Parameters

None

Returns

1 if there is a connection and 0 if disconnected.

LONG Delid()

Description

Method used to remove a lid from a microplate. You will need to specify where the microplate is located and where to place the lid once it is removed from the microplate. The DelidTo parameter is optional. The BenchCel robot will hold onto the lid if the DelidTo parameter is empty. The third argument, RetractionCode, specifies how to position the arms after delidding the microplate:

1– retract normally

2– retract only in Z to clearance that is specified in the teachpoint details

3– retract so that arms are vertical

Parameters

Argument Type	Argument Name	Range	Description
BSTR	DelidFrom	Available teachpoints	Name of teachpoint where the microplate with the lid is located

Returns

S_OK if successful; other value if there was an error.

LONG Relid()

Description

Method used to put a lid on a microplate. You will need to specify where the lid is located and where the microplate is located. If the first RelidFrom argument is blank, then it is expected that the robot is holding the lid. The third argument, RetractionCode, specifies how to position the arms after relidding the microplate:

1– retract normally

2– retract only in Z to clearance that is specified in the teachpoint details

3– retract so that arms are vertical

Parameters

Argument Type	Argument Name	Range	Description
BSTR	DelidFrom	Available teachpoints or blank string	Name of teachpoint where the microplate with the lid is located
BSTR	DelidTo	Available teachpoints	Name of teachpoint to place the lid after it has been removed from the microplate
Int	nRetraction Code	1–3	Specify the retraction position of the BenchCel robot arms

Returns

S_OK if successful; other value if there was an error.

VARIANT GetLabwareNames()

Description

Method to retrieve a list of defined labware. The strings in this array are the options that should be used for SetLabware.

Parameters

None

Returns

An array of labware names

Visual C++ example

```
VARIANT vLabware = m_BenchCel.GetLabwareNames();

SAFEARRAY *psa = vLabware.parray;
if
(FAILED(SafeArrayAccessData(psa, reinterpret_cast<void**>(
&bstrArray))))
{
VariantClear(&vLabware);
return;
}
for (ULONG i = 0; i < psa->rgsabound[0].cElements; i++)
{
MessageBox(CString(bstrArray[i])));
}
SafeArrayUnaccessData(psa); VariantCLear(&vLabware);
```

Visual Basic example

```
LabwareNames = BenchCel.GetLabwareNames

For i = LBound(labwareNames) To UBound(labwareNames)

MsgBox labwareNames(i)

Next
```

VARIANT EnumerateProfiles()

Description

Method to retrieve a list of defined profiles. The strings in this array are the options that should be used for Initialize.

Parameters

None

Returns

An array of profile names.

Visual C++ example

```
VARIANT vPRofiles = m_BenchCel.EnumerateProfiles();

SAFEARRAY *psa = vProfiles.parray;

BSTR* bstrArray;
if
(FAILED(SafeArrayAccessData(psa,reinterpret_cast<void**>(
&bstrArray))))
{
VariantClear(&vProfiles);
return;
}
for (ULONG i = 0; i < psa->rgsabound[0].cElements; i++)
{
MessageBox(CString(bstrArray[i])));
}
SafeArrayUnaccessData(psa); VaraintClear(&vProfiles);
```

Visual Basic example

```
profileNames = BenchCel.EnumerateProfiles()

For i = LBound(profileNames) To UBound(profileNames)

MsgBox profileNames(i)

Next
```

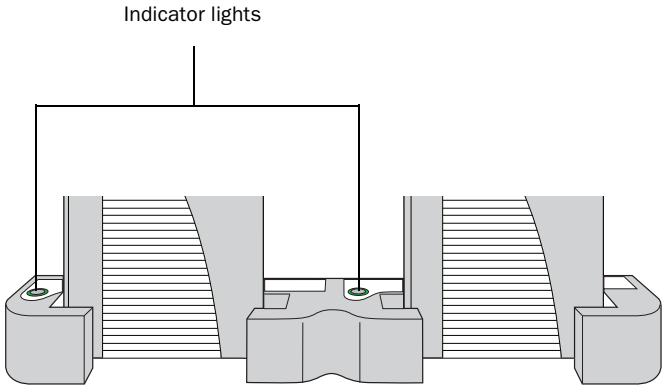
Quick reference

B

This appendix provides a quick reference of the following:

Rack-release button indicator light

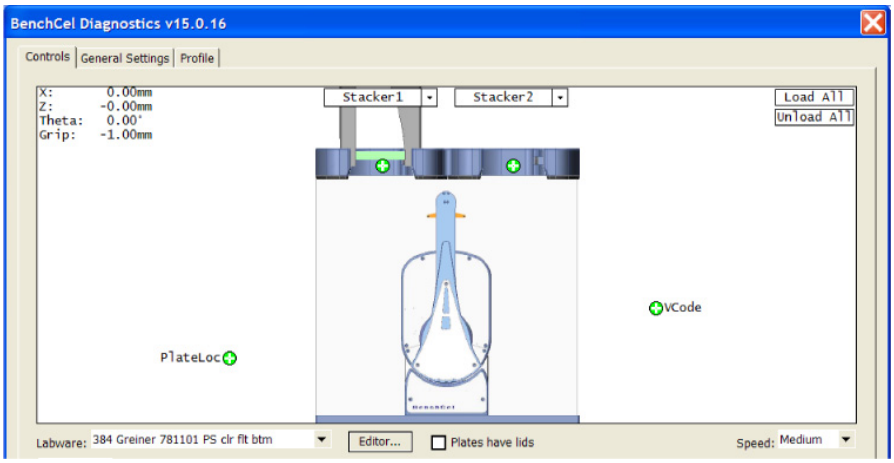
The rack-release button at the top of each stacker head displays different colors to indicate the status of the adjacent stacker rack. The following table lists the possible colors and the corresponding status description.



Light color	Meaning
Green (solid)	The stacker rack is installed correctly on the BenchCel device and the stack of microplates are unloaded. ❑ The stack of microplates are ready for processing. ❑ You can unlock and remove the stacker rack.
Green (flashing)	The stacker rack is unlocked and can be removed.
Blue (solid)	A microplate is loaded and the stacker rack cannot be removed.

BenchCel Diagnostics - Controls tab

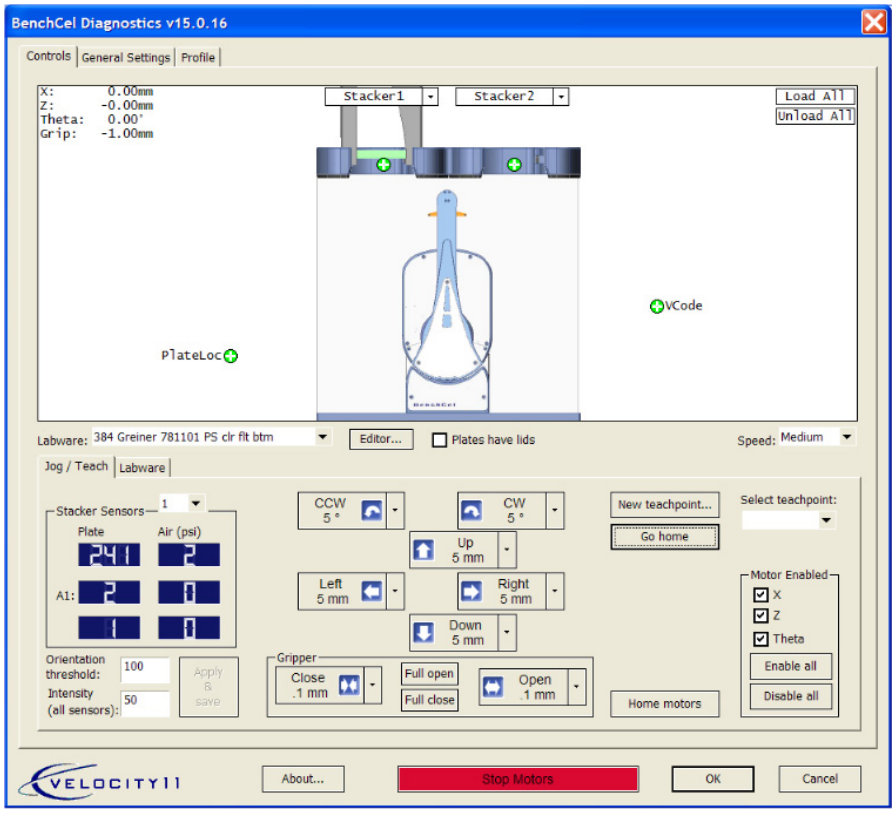
Graphical display area



Selection or command	Description
Labware	The list of defined labware.
Editor	The command that opens the Labware Editor dialog box.
Plates have lids	The selection that indicates the labware you selected for processing have lids.
Speed	The relative speed at which the robot head and arms moves: Fast, Medium, and Slow.
Load All	The command that places all the stacks of labware on the shelves in preparation for a protocol run. After a stack of labware is loaded, you cannot remove the stacker rack.
Unload All	The command that places all the stacks of labware on the stacker grippers so that you can remove the stacker rack.
Stacker n - Load plates	Loads a microplate at the specified stacker rack in preparation for a downstack process or protocol run.
Stacker n - Unload plats	Moves a microplate back in the specified stacker rack.
Stacker n - Unlock rack	Retracts the locking pin to allow you to remove the stacker rack.
Stacker n - Open stacker gripper	Opens the clamps that open the stacker grippers in the stacker rack.

Selection or command	Description
Stacker n - Close stacker gripper	Closes the clamps that close the stacker grippers in the stacker rack.
Stacker n - Extend shelf	Extends the shelf at the specified stack.
Stacker n - Retract shelf	Retracts the shelf at the specified stack.
Move to Stacker n	Moves the microplate into the stacker rack.
Downstack from Stacker n	Moves the first microplate from the specified stacker rack in preparation for a protocol run.
Upstack to Stacker n	Moves the microplate into the specified stacker rack.
Edit	Opens the Teachpoint Details dialog box. See “Teachpoint Details dialog box” on page 172.
Move to sensor	Moves the microplate to the sensor offset position.
Move to <teachpoint>	Moves the robot from its current position to the selected teachpoint. The robot places the plate on the teachpoint and stays at the teachpoint.
Pick from <teachpoint>	Picks up the plate from the selected teachpoint and moves the plate to the ready-for-upstack position under the stacker head.
Place at <teachpoint>	Moves the robot from its current position and places the plate at the selected teachpoint. After placing the plate, the robot backs away from the teachpoint into the safe zone.
Transfer to <teachpoint>	Moves a plate from the currently selected teachpoint to the other selected teachpoint. To transfer a plate from a stack, you must first click Load Stacker n. During the transfer, the robot downloads the plate, places it at the other selected teachpoint, and then backs into the safe zone. If the robot is transferring a plate from one teachpoint to another, the robot picks up the plate from the currently selected teachpoint, places the plate at the other selected teachpoint, and then backs into the safe zone.
Delid from <teachpoint>	*Lidded labware only.* Removes the lid from the labware that is at the selected teachpoint.

Jog/Teach tab



Stacker Sensors area

Setting, status, or command	Description
Stacker list	The stacker identifier, numbered from left to right. For example, to select the left-most stacker, select 1.
Plate	The plate-presence sensor reading.
Air (psi)	The internal air pressure measurement, in psi.
A1	The plate-orientation sensor reading for the A1 corner of the microplate.
Top-right	The plate-orientation sensor reading for the top-right corner of the microplate.
Bottom-left	The plate-orientation sensor reading for the bottom-left corner of the microplate.
Bottom-right	The plate-orientation sensor reading for the bottom-right corner of the microplate.

Setting, status, or command	Description
Orientation threshold	The value that determines the presence of a microplate notch. A notch is present if the value is below this value. If the sensor value is above this threshold, no notch is reported. The default value is 100. *Note:* The setting is also available in the Labware tab.
Intensity (all sensors)	The intensity of the emitting sensor lights. The value is a percent of the maximum intensity. The default value is 50%. You adjust the intensity in conjunction with the Orientation threshold to better detect microplate notch locations. The adjustments you make depend on the microplate color, material, ambient light, and other factors. For example, darker microplates might require higher intensity. Brighter rooms might require that you reduce the intensity. This setting applies to the plate-presence sensor, orientation sensor, and the rack-presence sensor. *Note:* The setting is also available in the Labware tab.
Apply and Save	The command that saves the updated settings in the tab.

Robot movement area

Command	Description
	Jogs the robot arm counterclockwise from the current position by the specified *theta*-axis increment.
	Jogs the robot arm clockwise from the current position by the specified *theta*-axis increment.
	Jogs the robot head left from the current position by the specified *x*-axis increment.
	Jogs the robot head up from the current position by the specified *z*-axis increment.
	Jogs the robot head right from the current position by the specified *x*-axis increment.
	Jogs the robot head down from the current position by the specified *z*-axis increment.

Command	Description
	Opens the robot grippers by the specified grip increment.
	Closes the robot grippers by the specified grip increment.
Full Open	Opens the robot grippers to the Robot Gripper Open Position value set in the Labware tab.
Full Close	Closes the robot grippers to the Robot Gripper Holding Stack Position value set in the Labware tab.

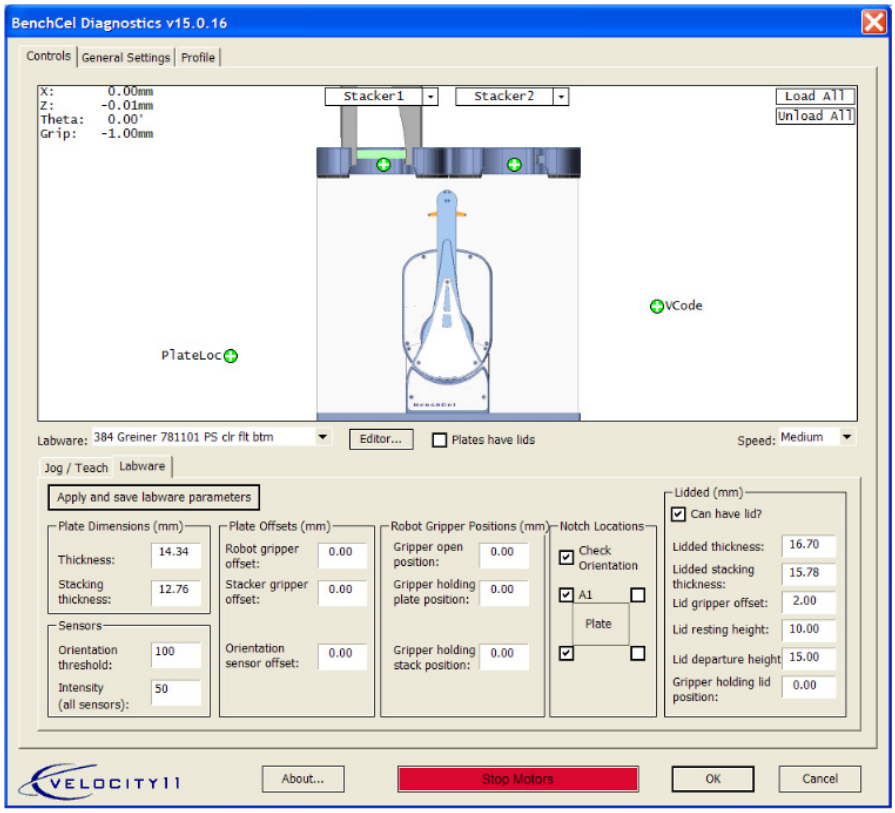
Teachpoint area

Selection or command	Description
New Teachpoint	The command that opens the Teachpoint Details dialog box. See “Teachpoint Details dialog box” on page 172.
Go Home	The command that moves the robot head to the center of the BenchCel Workstation device and the robot arms are perpendicular to the *x*-axis.
Select	The list of available teachpoint files.

Motor Enabled area

Command	Description
Home Motors	Sends the robot to the factory-defined home position for each axis of motion.
X	Enables or disables the x-axis motor. Select the check box to enable the motor. Clear the check box to disable the motor.
Z	Enables or disables the y-axis motor. Select the check box to enable the motor. Clear the check box to disable the motor.
Theta	Enables or disables the z-axis motor. Select the check box to enable the motor. Clear the check box to disable the motor.
Enable All	Enables all of the robot motors simultaneously.
Disable All	Disables all of the robot motors simultaneously.

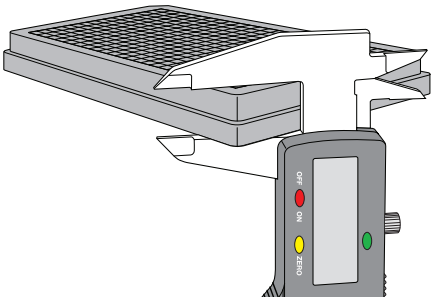
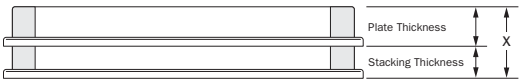
Labware tab



Commands

Command	Description
Save and Apply Labware Parameters	Saves the updated settings in the tab.

Plate Dimensions area

Parameters	Description
Thickness	The distance, in millimeters, from the bottom surface of the plate to the top surface of the plate. For a tip box, this is the distance from the bottom surface of the box to the top of the tips. To increase the number of contact points, measure the distance at the corner of the plate or tip box (using calipers). This method is especially useful if the plate has a lip at the top and the caliper can angle inward, producing inaccurate measurements. 
Stacking thickness	The thickness, in millimeters, of two stacked plates minus the thickness of one plate. For example: Thickness of two stacked plates (x) = 23.14 mm Thickness of one plate = 14.14 mm Stacking thickness: 23.14 mm - 14.14 mm = 9.00 mm 

Sensors area

Parameters	Description
Orientation threshold	The value that determines the presence of a microplate notch. A notch is present if the value is below this value. If the sensor value is above this threshold, no notch is reported. The default value is 100. *Note:* The setting is also available in the Jog/ Teach tab.
Intensity (all sensors)	The intensity of the emitting sensor lights. The value is a percent of the maximum intensity. The default value is 50%. You adjust the intensity in conjunction with the Orientation threshold to better detect microplate notch locations. The adjustments you make depend on the microplate color, material, ambient light, and other factors. For example, darker microplates might require higher intensity. Brighter rooms might require that you reduce the intensity. This setting applies to the plate-presence sensor, orientation sensor, and the rack-presence sensor. *Note:* The setting is also available in the Jog/ Teach tab.

Plate Offsets (mm) area

Parameters	Description
Robot gripper offset	The distance, in millimeters, from the bottom of a microplate to where the robot grippers will hold the microplate.
Stacker gripper offset	The distance, in millimeters, from the bottom of a microplate to where the stacker grippers will hold the microplate.
Orientation sensor offset	The distance, in millimeters, from the bottom of a microplate to where the orientation sensors will check for notches.

Robot Gripper Positions (mm) area

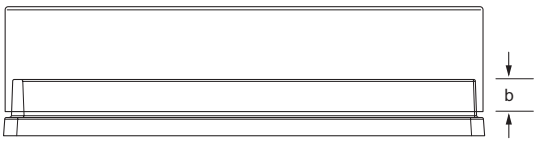
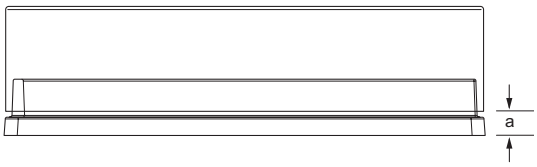
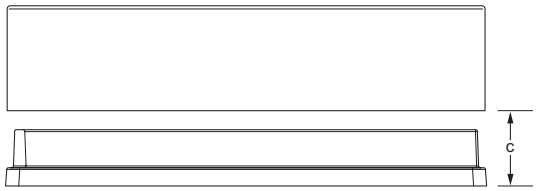
Parameters	Description
Gripper open position	The distance, in millimeters, that each gripper moves from its home position as the robot releases a microplate. A larger value moves the grippers closer together. A smaller value opens the grippers wider. The parameter value is applied to each robot gripper. For example, a value of -1.00 mm opens each robot gripper -0.50 mm from its home position.
Gripper holding plate position	The distance, in millimeters, that the grippers move inward from their home position when holding a microplate that is not in a stack. A larger value moves the grippers closer together and holds the microplate tighter. A smaller value opens the grippers wider. The parameter value is applied to both robot gripper. For example, a value of 5.25 mm moves each robot gripper 2.625 mm toward each other from its home position. *Note:* How tightly the robot grippers should hold a microplate depends on the microplate material and design. You might want to run some tests to optimize the parameter.
Gripper holding stack position	The distance, in millimeters, that each gripper moves inward from its home position when holding a microplate that is in a stack. A larger value moves the grippers closer together and holds the microplate tighter. A smaller value opens the grippers wider. The parameter value is applied to each robot gripper. For example, a value of 5.25 mm moves each robot gripper 2.625 mm toward each other from its home position. *Note:* Because the weight of the entire stack will be on the robot grippers, you should use a value greater than the Gripper holding plate parameter.

Notch Locations (mm) area

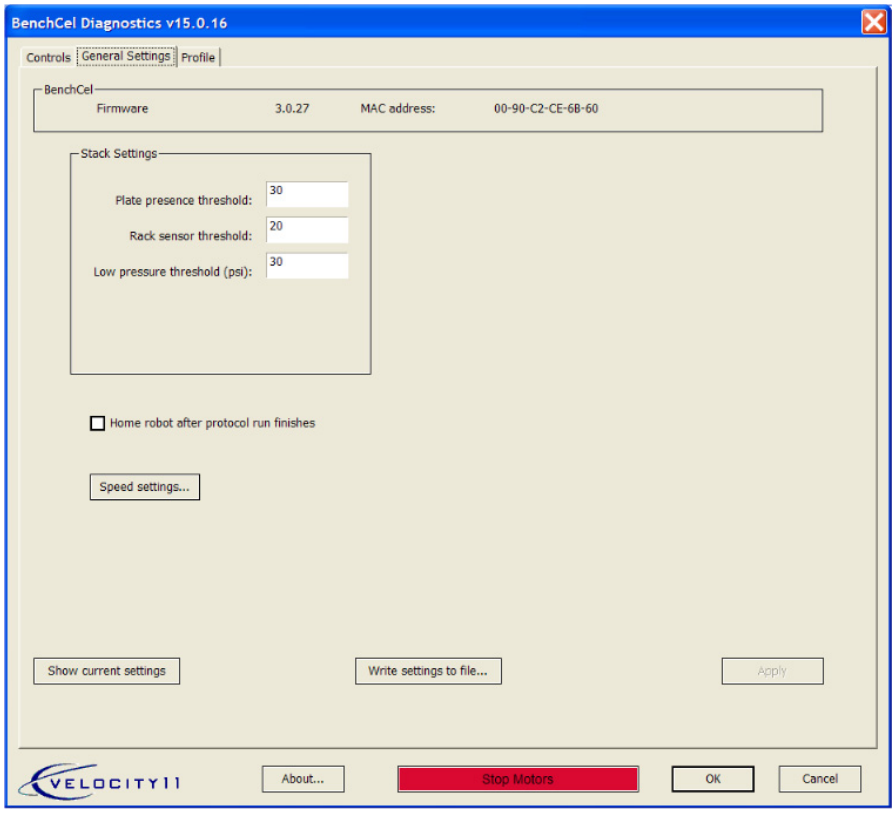
Options	Description
Verify Notches	The switch that turns on or turns off the plate-orientation sensors. Select the option to turn on the sensors. Clear the check box to turn off the sensors.
A1	The A1-notch indicator. Select the option to indicate that the A1 corner has a notch. Clear the check box to indicate that the A1 corner does not have a notch.
Upper right corner	The upper right-corner notch indicator. Select the option to indicate that the upper right corner has a notch. Clear the check box to indicate that the upper right corner does not have a notch.
Lower left corner	The lower left-corner notch indicator. Select the option to indicate that the lower left corner has a notch. Clear the check box to indicate that the lower left corner does not have a notch.
Lower right corner	The lower right-corner notch indicator. Select the option to indicate that the lower right corner has a notch. Clear the check box to indicate that the lower right corner does not have a notch.

Lidded (mm) area

Parameters	Description
Can have lid?	The option to include a microplate lid. If you select this option and plan to process lidded microplates, make sure you select the Plates have lids check box under the graphical display area.
Lidded thickness	The thickness, in millimeters, of the plate with a lid in place. Available only if **Can have lid?** is selected.
Lidded stacking thickness	The stacking thickness, in millimeters, of the plate with the lid in place. Available only if **Can have lid?** is selected.

Parameters	Description
Lid gripper offset	The height, in millimeters, above the lid resting height at which to grip the lid. (Shown as *b* below.) 
Lid resting height	The height, in millimeters, above the bottom of the plate at which the bottom of a plate lid rests. (Shown as *a* below.) 
Lid departure height	The height, in millimeters, above the bottom of the plate to which the lid is lifted. 
Gripper holding lid position	The distance, in millimeters, that each gripper moves inward from its home position when holding a microplate lid. An increasing value moves the grippers closer together and holds the microplate tighter. A decreasing value opens the grippers wider. The parameter value is applied to each robot gripper. For example, a value of 5.25 mm moves each robot gripper 2.625 mm toward each other from its home position. In general, type a value that is less than Gripper holding plate position to open the grippers slightly. Holding the lid too tightly might cause the microplate to be lifted with the lid.

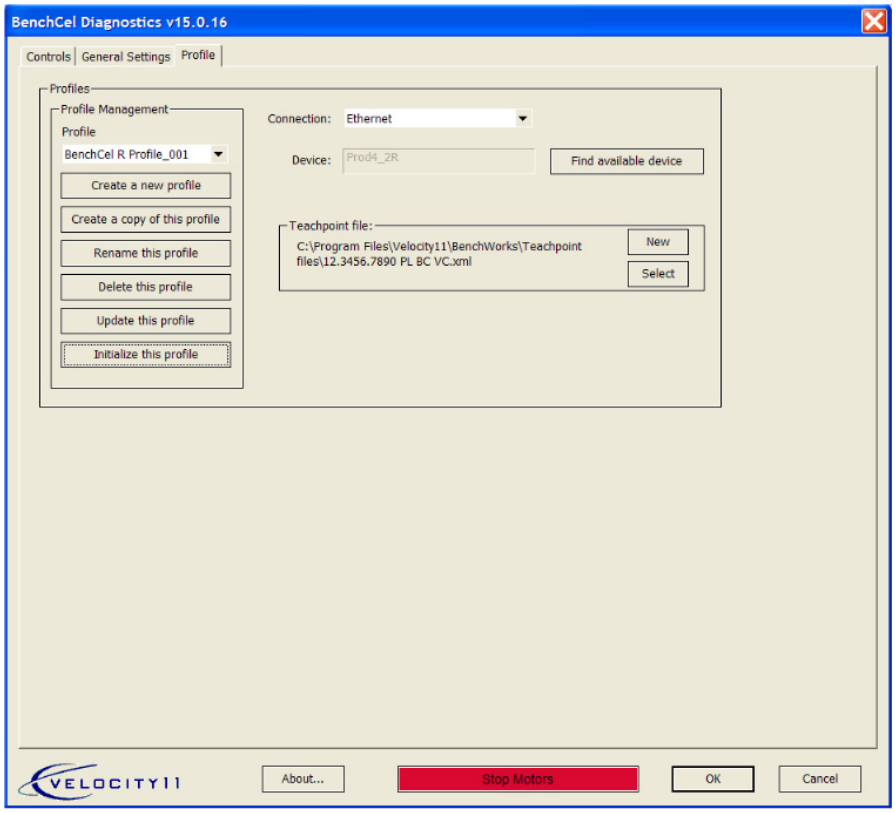
BenchCel Diagnostics - General Settings tab



Parameters	Description
Plate presence threshold	Any value at or higher than this means a microplate is present. Below this value means there is no microplate.
Rack sensor threshold	Any value at or higher than this means a rack is present. Below this value means there is no rack.
Low pressure threshold (psi)	The value at or below which the system will display a low-pressure warning. Note: If you set this value too low, the device could drop microplates without generating a low air-pressure warning. Velocity11 recommends that you set the threshold at 20 psi.
Home robot after protocol run finishes	The option to return the robot to its home position after the protocol run is finished.
Speed settings	Opens the Speed Settings dialog box and allows you to set each speed (Slow, Medium, and Fast) as a percentage of the factory-set maximum speed.

Parameters	Description
Show current settings	Displays the parameter values that were last saved.
Write settings to file	Allows you to save the Advanced Settings information to a file.
Apply	Applies the changes so that the new values are used.

BenchCel Diagnostics - Profiles tab



Profile Management area

Selections and commands	Description
Profile list	The list of profiles.
Create a new profile	Creates a new profile.
Create a copy of this profile	Creates a duplicate copy of the selected profile.
Rename this profile	Renames the selected profile.
Delete this profile	Deletes the selected profile.
Update this profile	Saves changes to the selected profile.
Initialize this profile	Initiates communication with the BenchCel device using the selected profile.

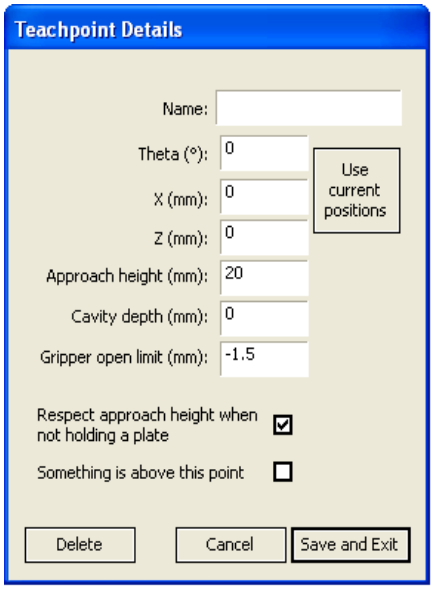
Connection area

Selections and commands	Description
Connection list	The list of connection types: Ethernet or Serial (COM) port.
Find available device	*Ethernet connection only.* The command that opens the Discovered BioNet Devices dialog box. You select the BenchCel device in the dialog box to establish communication between the controlling computer and the device. This command is only available if you select the Ethernet connection.
Use flow control	*Serial connection only.* Allows the BenchCel device to stop the flow of data from the computer before it overruns the device communication buffer. Velocity11 recommends that you select this option to optimize communication over the serial connection.

Teachpoint file area

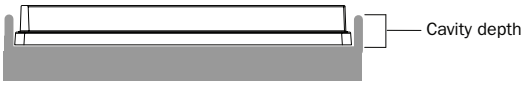
Commands	Description
New	Allows you to create a new teachpoint file.
Select	Allows you to select an existing teachpoint file.

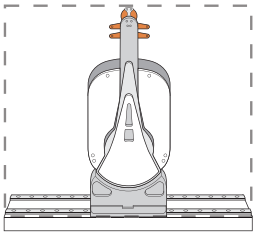
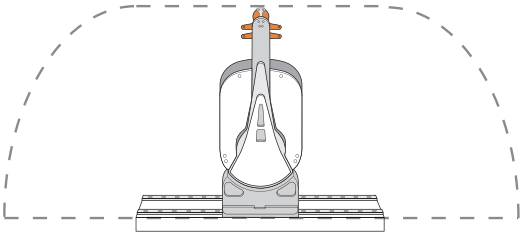
Teachpoint Details dialog box



Parameter or command	Description
Name	A name for the teachpoint. For example, if the teachpoint is on an integrated VCode, you might want to name the teachpoint VCode. This name appears in the graphical display area in the BenchCel Diagnostics dialog box.
Theta	The angle that the robot arms are from their home position, in degrees. A positive value moves the arms counterclockwise from the home position. A negative value moves the arms are clockwise from the home position. The range of movement is from -115° to 115°.
X	The horizontal distance from the home position, in millimeters. A positive value moves the robot head to the right of the home position. A negative value moves the robot head to the left of the home position. The range of movement depends on the number of stacker heads. For two stacker heads, the range is from -145 mm to 145 mm.
Z	The vertical distance from the home or lowest z-axis position. A positive value moves the robot head up from the home position. A negative value moves the head down from the home position. The range of movement is from -1.5 mm to 104 mm.

Parameter or command	Description
Use current positions	The command that reads the robot's current coordinates and writes them in the Theta, X, and Z boxes.
Approach height	The height clearance (in millimeters) the robot maintains above the teachpoint as it moves towards or away from the teachpoint location. The valid range is from 0 mm to 40 mm.  Use this setting to prevent the robot from colliding with raised tabs or walls at the teachpoint location. Velocity11 recommends that you set the approach height at 20 mm (the default value). However, if there is an obstruction above the teachpoint, you might need to use a smaller approach height to prevent collision. *Note:* This value applies when the robot is holding a microplate. When it is not holding a microplate, the robot will approach the teachpoint at the height of the teachpoint, unless you select the Respect clearance both ways option.

Parameter or command	Description
Cavity depth	*Note:* This setting is not commonly used and should be set at 0 mm for most applications. The depth (in millimeters) below the Z teachpoint coordinate. The valid range is –35 mm to 0 mm. Use this setting to account for teachpoints that have a depth (or negative height). For example, suppose the Robot Gripper Offset is 5 mm and the platepad you want to use has depth of 9 mm. When the microplate sits in the platepad, the robot grippers cannot reach the offset height, as the following diagram shows. To account for this depth, you can set the Cavity depth at –9 mm. The robot grippers will grip the microplate 9 mm above the 5 mm offset (at 14 mm). 
Open gripper limit	Type the maximum distance (in millimeters) the robot grippers are allowed to open as they prepare to grip the microplate at the teachpoint. The maximum value you set is less than or equal to the Robot Gripper Open Position value set in the BenchCel Diagnostics Controls Labware tab. Use this setting if the teachpoint area is narrower than the robot grippers open position. (To see this value, click **Save and exit,** and then click the Labware tab in the BenchCel Diagnostics Control tab.) *Note*: This value is used only at the teachpoint and not during other operations.
Respect approach height when not holding plate	The option to use the approach height even when the robot is not holding a microplate. Select this option to use the approach height. Clear the check box to have the robot approach or move away from the teachpoint at the height of the teachpoint when not holding a microplate.

Parameter or command	Description
Something is above this point	The option to limit the robot's movements within the robot safe zone. With this selection, the robot will only move along the θ-axis as long as all of its parts (head, arms, and grippers) are within the safe zone when approaching or moving away from the teachpoint.  Clear the check box to allow the robot to use the workspace. The robot's θ-axis movements are not limited when approaching and moving away from the teachpoint.  Use this option to limit the robot's movements to prevent collision when approaching a teachpoint. For example, when moving labware to and from a multi-shelf device such as the VPrep System, this option prevents the robot from colliding with the shelf above the target teachpoint.

Glossary

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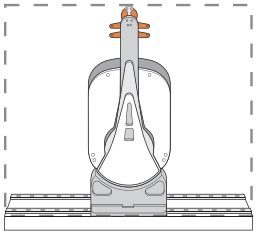
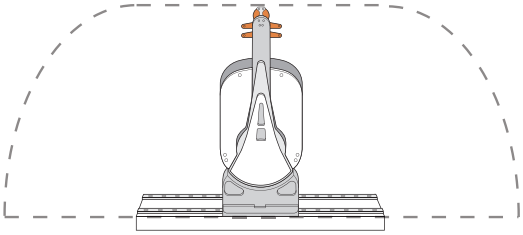
Term	Definition
clamps	The components inside of the stacker head that close and open the stacker grippers during the loading, unloading, downstacking, and upstacking processes.
controlling computer	The lab automation system computer that controls the devices in the system.
device	An item on your lab automation system that has an entry in the device manager. A device can be a robot, an instrument, or a location on the lab automation system that can hold a piece of labware.
device file	A file that contains the configuration information for a device. The device file has the .dev file name extension and is stored in the folder that you specify when saving the file.
downstack	The process in which the first microplate in the stack is moved past the orientation sensors and to the ready position.
home position	The position where all robot axes are at the 0 position (the robot head is approximately at the center of the *x*-axis and at 0 of the *z*-axis, and the robot arms are perpendicular to the x-axis).
homing	The process in which the robot is sent to the factory-defined home position for each axis of motion.
plate stage	The platform on which the robot can place a microplate.
profile	The Windows registry entry that contains the communication settings needed for communication between a device and the Velocity11 lab automation software.
protocol	A sequence of tasks to be performed by the lab automation system.
robot grippers	The two orange metallic components that are perpendicular to the robot arms. The orange components have pins that the robot uses to hold labware.
run	A process in which one or more microplates are processed. In a standalone device, the run consists of one cycle. In a lab automation system, a run can consist of multiple cycles that are automated.

Term	Definition
safe zone	The boundary within which the robot (head, arms, and grippers) is allowed to move without colliding with external devices. 
shelves	The components inside of the stacker head that provide leveling surfaces for the microplates, thus ensuring accurate robot gripping, during the downstacking process.
stacker grippers	The padding at the bottom of the stacker racks that hold microplates when a microplate is loaded, downstacked, or upstacked.
task parameters	The parameters associated with each task in a protocol. For example, in a labeling task, the parameters include the label value.
teachpoint	A teachpoint is a set of coordinates that define where the robot can pick up or place labware and the location of a known object.
teachpoint file	The XML file that contains the settings for one or more external device teachpoints.
upstack	The process in which a microplate is moved back into the stack.
workspace	The boundary within which the robot (head, arms, and grippers) can move without limitations. 

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Note: You can also search our technical documentation on our website at www.velocity11.com.

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