

Instructions For Use

Echo 525 Liquid Handler



CE

001-11665-Revision 06
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Beckman Coulter, Inc.
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Brea, CA 92821 U.S.A.



Echo 525 Liquid Handler

Instructions For Use

PN 001-11665 Revision 06 (July 2023)

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Contact Us

If you have any questions, contact our Customer Support Center.

- Worldwide, find us via our website at www.beckman.com/support/technical
- In the USA and Canada, call us at 1-800-369-0333.
- In Austria, call us at 0810 300484
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- In Ireland, call us at +353 (01) 4073082
- In Italy, call us at +39 0295392 456
- In other locales, contact your local Beckman Coulter Representative.

Glossary of Symbols is available at beckman.com/techdocs (PN C24689).



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*May be covered by one or more pat. - see
www.beckman.com/patents*

Original Instructions

Revision Status

Version 3, August 2021

Version 05, July 2022

Changes were made to the Electrical Safety Warnings, Symbols Glossary, Laser Labels, Client PC specifications, Site Requirements, Components Included with the Echo Liquid Handler Step 5, Remove the fuse from the holder and replace it with the same type and rating as the old fuse. and Electrical.

Version 06, July 2023

Changes were made to [CHAPTER 4, Scheduled Maintenance](#); Removed Six Month Preventative Maintenance, Added [One Year Preventative Maintenance](#).

This document applies to the latest software and higher versions. When a subsequent software version affects the information in this document, a new issue will be released to the Beckman Coulter Web site. For labeling updates, go to www.beckman.com/techdocs and download the latest version of the manual for your instrument.

Safety Notice

Read all product manuals and consult with Beckman Coulter-trained personnel before attempting to operate instrument. Do not attempt to perform any procedure before carefully reading all instructions. Always follow product labeling and manufacturer's recommendations. If in doubt as to how to proceed in any situation, [contact us](#).

Beckman Coulter, Inc. urges its customers and employees to comply with all national health and safety standards such as the use of barrier protection. This may include, but is not limited to, protective eyewear, gloves, and suitable laboratory attire when operating or maintaining this or any other automated laboratory analyzer.

Alerts for Warning and Caution

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. May be used to indicate the possibility of erroneous data that could result in an incorrect diagnosis.

CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. May be used to indicate the possibility of erroneous data that could result in an incorrect diagnosis.

Safety Precautions

WARNING

Risk of operator injury if:

- All doors, covers, and panels are not closed and secured in place prior to and during instrument operation.
- The integrity of interlocks and sensors is compromised.
- Instrument alarms and error messages are not acknowledged and acted upon.
- You contact moving parts.
- You mishandle broken parts.
- Doors, covers, and panels are not opened, closed, removed, and/or replaced with care.
- Improper tools are used for troubleshooting.

To avoid injury:

- Keep doors, covers, and panels closed and secured in place while the instrument is in use.
- Take full advantage of the safety features of the instrument. Do not defeat interlocks and sensors.
- Acknowledge and act upon instrument alarms and error messages.
- Keep away from moving parts.
- Report any broken parts to your Beckman Coulter Representative.
- Open/remove and close/replace doors, covers, and panels with care.
- Use the proper tools when troubleshooting.

CAUTION

System integrity could be compromised and operational failures could occur if:

- This equipment is used in a manner other than specified. Operate the instrument as instructed in the Product Manuals.
- You introduce software that is not authorized by Beckman Coulter into your computer. Only operate your system's computer with software authorized by Beckman Coulter.
- You install software that is not an original copyrighted version. Only use software that is an original copyrighted version to prevent virus contamination.
- You connect external devices such as thumb drives, external hard drives, and CD/DVDs. Ensure that all external devices are free from viruses before connecting.

 CAUTION

If you purchased this product from anyone other than Beckman Coulter or an authorized Beckman Coulter distributor, and, it is not presently under a Beckman Coulter service maintenance agreement, Beckman Coulter cannot guarantee that the product is fitted with the most current mandatory engineering revisions or that you will receive the most current information bulletins concerning the product. If you purchased this product from a third party and would like further information concerning this topic, [contact us](#).

 CAUTION

Risk of inaccurate time and date stamp on results if you enable daylight savings time. Daylight savings time has been disabled to ensure that time changes do not affect the time and date stamp of results. It is recommended that you keep daylight savings time disabled.

 CAUTION

The instrument Workstation is vulnerable to malware, viruses, data corruption, and unauthorized instrument setting changes, or privacy breaches if unauthorized access is gained by malicious personnel. To reduce the risk of such events, only allow authorized laboratory personnel access to the instrument Workstation. Contact your institutional security department for assistance.

 CAUTION

The instrument Workstation is vulnerable to malware and viruses from physical media such as CDs, DVDs, or USB drives. To reduce the risk of data corruption or unauthorized setting changes, only use physical media such as CDs, DVDs, or USB drives that are known to be free from viruses or malware. Contact your IT professional for assistance.

 CAUTION

Risk of instrument damage. This device is intended for indoor use only. To avoid device damage, do not install the instrument outdoors.

 WARNING

Risk of personal injury. Safety protection can be impaired if used in a manner not specified by the manufacturer. To avoid personal injury, use the instrument according to the manufacturer's instructions only.

About This Guide

The Echo 525 Liquid Handler User Guide contains important information regarding the safe use of an Echo Liquid Handler. Read and understand the safety information thoroughly before you begin operating the Echo Liquid Handler.

The Echo 525 Liquid Handler is referred to as the Echo Liquid Handler throughout this guide. For other Echo Liquid Handler models, please refer to the appropriate guide.

Intended Audience

The intended audience for this guide is laboratory personnel. Researchers can use the Echo Liquid Handler to transfer samples and reagents to conduct a wide range of laboratory experiments or assays.

Safety Warnings and Precautions

The Echo Liquid Handler has been designed for safe operation.

The safety warnings and precautions in this section and throughout the guide must be observed during maintenance, repair, and normal operation of an Echo Liquid Handler.

Failure to comply with these warnings and precautions, or with specific cautions and warnings found elsewhere in this guide, violates the safety standards of design, manufacture, and intended use of an Echo Liquid Handler. This can result in hazardous exposure to laser light, high voltage, or moving parts. Exposure to these hazards can cause severe injury.

Safety Notation Marks

This manual uses the following symbols in the left margin to draw your attention to the specified type of information.

Symbol	
 WARNING	Warning- Warnings alert all users to the following: • Potentially hazardous conditions • Actions that may result in personal injury or death
 CAUTION	Caution - Cautions alert the user to actions that may result in the following: • Damage to the equipment • Lost or corrupted data • Unrecoverable interruption of the operation being performed
NOTE	Note - Notes emphasize or expand upon the surrounding information.

Electrical Safety Warnings

Always observe the following electrical safety warnings:



WARNING

Plug the Echo Liquid Handler into a grounded circuit (Class 1). The minimum circuit requirement is:

- 10 A for AC 100-120V, 50/60 Hz power source
- 5 A for AC 200-230V, 50/60 Hz power source

If you are unable to insert an AC plug into your AC receptacle, contact an electrician to correct the situation.



WARNING

The Echo Liquid Handler operates with voltages and currents that can be lethal. Pushing objects of any kind into the Echo Liquid Handler, through slots or holes in its covers, may cause serious electrical shock or may short out electrical circuits or parts. Do not spill any liquid inside or on the Echo Liquid Handler.



WARNING

The Echo Liquid Handler contains AC power fuses. If a fuse requires replacement, see [CHAPTER 4, Replacing the Fuse](#).



WARNING

Do not use AC power cords if the following conditions exist:

- The power cords are frayed or damaged.
- Other attached cords, cables, or receptacles are frayed or damaged.

Use of damaged power cords can cause an electrical shock hazard and result in severe injury.

 WARNING

Do not operate and disconnect (unplug) AC power cords if the following conditions exist:

- **The Echo Liquid Handler, or attached equipment, has been exposed to excessive moisture, or to liquids that have been spilled on it.**
- **The Echo Liquid Handler, or any of its subassemblies or components, has been dropped or damaged.**
- **You suspect service or repair is required.**
- **The Echo Liquid Handler is being cleaned, handled during a maintenance procedure, or repaired—except as directed in the applicable written procedure.**

These conditions can cause an electrical shock hazard and result in severe injury.

The power cord set attaching to the instrument appliance coupler is considered the mains disconnect device. Ensure this is accessible after installation.

Electromagnetic Compatibility

This device complies with the emissions and immunity requirements as specified in the EN/IEC 61326 series of Product Family Standards for a "basic electromagnetic environment." Such equipment is supplied directly at low voltage from public mains network. This equipment is not intended for residential use.

This device generates, uses, and can radiate unintentional radio-frequency (RF) energy. If this device is not installed and operated correctly, this RF energy can cause interference with other equipment. It is the responsibility of the end user to be sure that a compatible electromagnetic environment for the device can be maintained so that the device operates as intended.

In addition, other equipment can radiate RF energy to which this device is sensitive. If one suspects interference between this device and other equipment, Beckman Coulter recommends the following actions to correct the interference:

- Evaluate the electromagnetic environment before installation and operation of this device.
- Do not operate this device close to sources of strong electromagnetic radiation (for example: unshielded intentional RF sources), as these can interfere with proper operation. Examples of unshielded intentional radiators are handheld radio transmitters, cordless phones, and cellular phones.
- Do not place this device near medical electrical equipment that can be susceptible to malfunctions caused by close-proximity to electromagnetic fields.
- This device has been designed and tested to CISPR 11, Class A emission limits. In a domestic environment, this device can cause radio interference, in which case, you need to take measures to mitigate the interference.

Additional Safety Warnings

WARNING

The Echo Liquid Handler has not been certified for use with flammable liquids. Do not load plates containing flammable liquids into the Echo Liquid Handler or otherwise operate the instrument with flammable liquids in the interior.

WARNING

Do not try to gain access to the interior of the Echo Liquid Handler. Do not remove the Echo Liquid Handler exterior covers. Exposure to laser light, high voltage, or moving parts inside the Echo Liquid Handler can cause severe injury.

WARNING

Keep your hands, fingers, and clothing clear of the door and microplate assemblies, except when loading or unloading a plate. Be aware of the possibility that either the source or the destination plate gripper stages may move.

WARNING

Use good laboratory practices and follow the manufacturer's precautions when working with chemicals. Beckman Coulter is not responsible or liable for any damages as a result of, or as a consequence of, the use of hazardous chemicals.

WARNING

The Echo Liquid Handler weighs approximately 142 kg (313 lbs). Moving or lifting the Echo Liquid Handler incorrectly can cause severe injury. Never attempt to move or lift the Echo Liquid Handler without using proper equipment and proper safety techniques. Contact the safety coordinator at your company for information.

Safety Cautions

To protect the Echo Liquid Handler from damage, follow these precautions:

 CAUTION

Use Ultrapure* Water. Use of improper fluids may contaminate fluidics, adversely impact performance and invalidate warranty.

 CAUTION

Always use the normal shutoff routine or the Stop button to turn off the Echo Liquid Handler. Turning off the instrument by other methods (for example, unplugging the power cord), can potentially result in damage to the electronics or corrupt the software.

 CAUTION

Do not attempt to service or repair the internal Echo Liquid Handler mechanisms yourself. The electrical, laser, and mechanical systems must be maintained by Beckman Coulter field engineers. If you have any questions regarding what may be serviced by an Echo Liquid Handler user, please [contact us](#).

 CAUTION

Do not make modifications to the Echo Liquid Handler.

 CAUTION

Use labware that is ANSI/SLAS-compliant† or approved by Beckman Coulter.

 CAUTION

Do not obstruct the air vents. Keep all air vents free of dirt or dust. For information on the recommended Echo Liquid Handler working envelope specifications, see [CHAPTER 5, Physical](#).

 CAUTION

Handle the Echo Liquid Handler coupling fluid and waste water carefully. Avoid all spills. Immediately wipe spills to avoid corrosion on the instrument.

* Type 1 Ultrapure water must meet the specifications of ASTM standard D-1193. Most commercial laboratory water purification systems such as Millipore Milli-Q, ElgaPURELY and others conform to this. Before using water from such a source, confirm that it is rated to produce Type 1 Ultrapure Water and properly maintained according to manufacturer's recommendations.

† Society for Laboratory Automation Systems. See Labware.

 CAUTION

Keep corrosive agents, or otherwise damaging material, away from the Echo Liquid Handler and its attached devices.

 CAUTION

Do not expose the Echo Liquid Handler to excessive moisture (>80% relative humidity). Moisture, or condensation, can damage electrical components.

 CAUTION

Do not expose the Echo Liquid Handler to temperatures outside of the storage range: 5°C – 45°C (41°F–113°F). Temperatures outside of this range can damage the instrument.

 CAUTION

Do not run the Echo Liquid Handler without the chiller. Ensure that the chiller is correctly connected to the Echo instrument and is running at the recommended temperature. Incorrect coupling fluid temperature can reduce the precision and accuracy of the fluid that is transferred. Extreme fluid temperatures can potentially damage the acoustic transducer.

 CAUTION

Do not allow the acoustic transducer to dry out. The Echo Liquid Handler is designed to run continuously to keep the acoustic transducer wet. Allowing the transducer to dry out may result in instrument damage and may invalidate instrument warranty. If there is a need to power down the Echo Liquid Handler for more than four days, see [CHAPTER 4, Extended Non-Use and Storage](#).

 CAUTION

Do not run the pump if the chiller tubing is not connected. Running the pump without the chiller tubing may damage other system components.

Laser Safety Warnings

The Echo Liquid Handler is a Class I laser instrument that can house up to three laser-based barcode scanners.

When operated as specified in this User Guide, the Echo Liquid Handler does not expose the operator to laser light. Nevertheless, during a barcode scan, the Class II diode lasers (with maximum power up to 1.5 mW at either 650nm or 660 nm) can be visible from the interior of the unit. The barcode scanners are not interlocked; therefore, if the Echo Liquid Handler is operated with the

covers off, the operator may be exposed to a Class II laser light hazard. Do not operate the Echo Liquid Handler if its covers have been removed.

Toxic Fumes

If the user is working with volatile solvents or toxic substances, an efficient laboratory ventilation system is required to remove any vapors that may be produced.

Flammable Fluids

The Echo systems have not been evaluated for use with flammable liquids, and should not be used with flammable liquids.

Intellectual Property Label

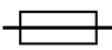
The intellectual property label cites United States patents and other applicable legal protection. This information is found on the Product Label.

Symbols Glossary

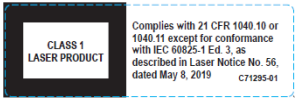
Glossary Symbols Table

Symbol/ Regulatory Mark	Meaning of Symbol from Standard
	CE Markings A "CE" mark indicates that a product has been assessed before being placed on the market, and has been found to meet European Union safety, health, and/or environmental protection requirements.
	Country of Origin Symbol This symbol indicates the country in which the product was manufactured.
	UKCA Mark A "UKCA" mark indicates that a product has been assessed before being placed in the UK market, and has been found to meet UK safety, health, and/or environmental protection requirements.
	Warning; Crushing of hands This symbol indicates a warning of closing motion of mechanical parts of equipment. ISO 7010. Graphical Symbols-Safety colors and safety signs. #W024. Supplemental Product-Specific Manufacturer Information. Use caution to avoid injury to hands when close to equipment with moving mechanical parts.

Glossary Symbols Table (Continued)

Symbol/ Regulatory Mark	Meaning of Symbol from Standard
	Recycling Symbol The symbol of a crossed-out wheeled bin on the product is required in accordance with the Waste Electrical and Electronic Equipment (WEEE) Directive of the European Union. The presence of this marking on the product indicates: 1. that the device was put on the European Market after August 13, 2005 and 2. that the device is not to be disposed via the municipal waste collection system of any member state of the European Union. For products under the requirement of WEEE directive, please contact your dealer or local Beckman Coulter office for the proper decontamination information and take-back program which will facilitate the proper collection, treatment, recovery, recycling, and safe disposal of device. For the Japan market: This system is considered an industrial waste, subject to special controls for infectious waste. Before disposal of the system, refer to the Waste Disposal and Public Cleaning Law for compliance procedures.
	“ON” (power) This symbol indicates connection to the mains, at least for mains switches or their positions, and all those cases where safety is involved.
	Stop This symbol identifies the control or the indicator to stop the active function. IEC 60417: Graphical Symbols for use on equipment-Overview and application, #5110 Supplemental Product-Specific Manufacturer Information This symbol indicates a stop button.
	“OFF” (power) This symbol indicates disconnection from the mains, at least for mains switches or their positions, and all those cases where safety is involved. IEC 60417: Graphical Symbols for use on equipment-Overview and application, #5008 Supplemental Product-Specific Manufacturer Information This symbol indicates the off position.
	Fuse This symbol indicates fuse boxes or their location. IEC 60417: Graphical Symbols for use on equipment-Overview and application, #5016 Supplemental Product-Specific Manufacturer Information This symbol can also indicate a fuse location and rating.

Glossary Symbols Table (Continued)

Symbol/ Regulatory Mark	Meaning of Symbol from Standard
	Dangerous voltage This symbol indicates hazards arising from dangerous voltages. IEC 60417: Graphical Symbols for use on equipment-Overview and application, #5036 Supplemental Product-Specific Manufacturer Information This symbol can also indicate an area of the system to not access under any circumstances, due to possibility of high voltages and the risk of electrical shock.
	Protective earth; protective ground This symbol indicates a terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode. IEC 60417: Graphical Symbols for use on equipment-Overview and application, #5019
	Laser Compliance This symbol indicates that the product is a Class 1 Laser Product and is in compliance with international standards and US requirements. 21 CFR 1040
	Laser Class 2 Panel Label This symbol on a panel indicates that there is Class 2 laser light radiation beyond the panel it is placed on. Use caution and do not stare into the beam when laser light is on the area. IEC 60825: Safety of laser products - Part 1: Equipment classification and requirements, clause 7.4.
	Warning; Laser Beam This symbol indicates a warning of a laser beam. ISO 7010. Graphical Symbols-Safety colors and safety signs. #W004 Supplemental Product-Specific Manufacturer Information This symbol indicates that there can be laser light radiation in the area. Take precautions to prevent exposure.
	Warning; Hot Surface This symbol indicates a warning of a hot surface. ISO 7010. Graphical Symbols-Safety colors and safety signs. #W017
	Water System Maintenance The water system maintenance label is provided by Beckman Coulter to remind the user to follow recommended maintenance procedures. It emphasizes the use of Type 1 Ultrapure water.
	Safety Certification The cNRTLus label indicates a certification from a safety agency to the conformity to the safety standards for the United States and Canada (UL/CSA 61010 series). The adjacent symbols are representations of these certification marks.

Glossary Symbols Table (Continued)

Symbol/ Regulatory Mark	Meaning of Symbol from Standard
	RCM Symbol
	RoHS Caution Symbol
	Manufacturer This symbol indicates the medical device manufacturer. <i>ISO 15223-1 Medical Devices – Symbols to be used with medical device labels, labeling, and information to be supplied-Part 1: General Requirements. #5.1.1</i> Supplemental Product-Specific Manufacturer Information This symbol indicates who the legal manufacturer of the product is.
	Authorized representative in the European Community This symbol indicates the Authorized representative in the European Community. <i>ISO 15223-1 Medical Devices – Symbols to be used with medical device labels, labeling, and information to be supplied-Part 1: General Requirements. #5.1.2</i>
	Catalog Number Indicates the manufacturer's catalog number so that the medical device can be identified. <i>ISO 15223-1 Medical Devices – Symbols to be used with medical device labels, labeling, and information to be supplied-Part 1: General Requirements. #5.1.6</i>
	Caution This symbol indicates the need for the user to consult the instructions for use for important cautionary information such as warnings and precautions that cannot, for a variety of reasons, be presented on the medical device itself. <i>ISO 15223-1 Medical Devices – Symbols to be used with medical device labels, labeling, and information to be supplied-Part 1: General Requirements. #5.4.4</i>
	Consult instructions for use This symbol indicates the need for the user to consult the instructions for use. <i>ISO 15223-1 Medical Devices – Symbols to be used with medical device labels, labeling, and information to be supplied-Part 1: General Requirements. #5.4.3</i>
	Date of Manufacture This symbol indicates the date when the medical device was manufactured. <i>ISO 15223-1 Medical Devices – Symbols to be used with medical device labels, labeling, and information to be supplied-Part 1: General Requirements. #5.1.3</i>

Glossary Symbols Table (Continued)

Symbol/ Regulatory Mark	Meaning of Symbol from Standard
	California Proposition 65 This product can expose you to chemicals known to the State of California to cause Cancer and Reproductive Harm. For more information go to https://www.P65Warnings.ca.gov .
	Serial number This symbol indicates the manufacturer's serial number so that specific medical device can be identified. <i>ISO 15223-1 Medical Devices – Symbols to be used with medical device labels, labeling, and information to be supplied-Part 1: General Requirements. #5.1.7</i>

Stop Switch

The Stop label identifies the Stop switch, which is used in an emergency to shut down all mechanical activity in the Echo Liquid Handler.

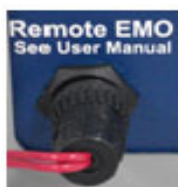
There are two Stop switches and one remote input for a satellite Stop switch:

- One Stop switch on the front panel of the Echo Liquid Handler
- One Stop switch on the rear panel of the Echo Liquid Handler
- One remote input for a satellite Stop switch

NOTE Beckman Coulter Access Workstations or Systems include a cable and connector that can be used to connect the remote input for a satellite Stop switch. In cases where an Echo is not integrated on an Access, ensure the remote input connector is in place, otherwise the remote input behaves as if it has been pressed.



EMO switch

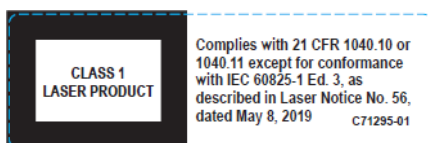


**Remote EMO
connector**

Laser Labels

Below are the laser labels on the instrument.

Class 1/CDRH Label on Rear Panel



Class 2 Label on the Front Below the Door



Related Documentation

Echo documentation consists of the following publications:

- *Echo Dose-Response User Guide*
- *Echo Plate Reformat User Guide*
- *Echo Cherry Pick User Guide*
- *Echo Plate Audit User Guide*
- *Echo Array Maker User Guide*
- *Echo Combination Screen User Guide*
- *Echo 21CFR11 Compliance Manager User Guide*
- *Echo 21CFR11 Compliance Manager Admin User Guide*
- *Echo Software Applications Integration Guide*
- *Echo Liquid Handler Software Integration Guide*
- *Tempo Automation Control Software User Guide*
- *Access Dual Robot System User Guide*

Documentation Conventions

Some of the text in this manual uses special formatting to help indicate emphasis or keystrokes. The text conventions are as follows:

Style	Purpose
<i>blue italicized text</i> (PDF, Web only)	Cross references, link, Web addresses
courier std	Commands, filenames, directories, paths, user input
bold text	Interactive interface objects, keys, buttons
<i>italicized text</i>	Book titles, glossary terms

Safety Notice

Safety Warnings and Precautions

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Introduction

About This Guide

The Echo 525 Liquid Handler User Guide contains important information regarding the safe use of an Echo Liquid Handler. Although many features are shared across this platform of products, this guide only addresses the characteristics of the Echo 525 Liquid Handler. Read and understand the safety information thoroughly before you begin operating the Echo Liquid Handler.

The Echo 525 Liquid Handler is referred to as the Echo Liquid Handler throughout this manual. For other Echo Liquid Handler models, please refer to the appropriate guide.

Intended Audience

The intended audience for this guide is laboratory personnel. Researchers can use the Echo Liquid Handler to transfer samples and reagents to conduct a wide range of laboratory experiments or assays.

Related Documentation

Echo documentation consists of the following publications:

- *Echo Dose-Response User Guide*
- *Echo Plate Reformat User Guide*
- *Echo Cherry Pick User Guide*
- *Echo Plate Audit User Guide*
- *Echo Array Maker User Guide*
- *Echo Combination Screen User Guide*
- *Echo 55X Liquid Handler User Guide*
- *Tempo Automation Control Software User Guide*
- *Echo Software Application Integration User Manual*
- *Echo Liquid Handler Integration Manual*
- *Access Laboratory Workstation Hardware User Guide*
- *POD Automation Platform Hardware User Manual*

Documentation Conventions

Some of the text in this manual uses special formatting to help indicate emphasis or keystrokes. The text conventions are as follows:

Table 1 Documentation Conventions

Style	Purpose
<i>blue italicized text</i> (PDF, Web only)	Cross references, link, Web addresses
UniMono bold italic	Commands, filenames, directories, paths, user input
bold text	Interactive interface objects, keys, buttons
<i>italicized text</i>	Book titles, glossary terms

NOTE NOTE is used to call attention to notable information that should be followed during use or maintenance of this equipment.

Introduction

This guide addresses the characteristics of the Echo 525 Liquid Handler.

Figure 1 Echo 525 Liquid Handler



All models utilize ADE (acoustic droplet ejection) technology patented by Labcyte Inc. Ultrasound-based ADE precisely transfers nanoliter volumes of liquid buffers with or without proteins or

nucleic acids, surfactants, cell culture media and serum between microplates. Specifically, the Echo 525 Liquid Handler can be used for aqueous transfer only.

Excellent accuracy and precision in nanoliter volumes allow for direct transfer of reagent fluids, which reduces the need for intermediate plates and multiple dilutions, and produces more accurate results in less time. The Echo 525 Liquid Handler dispenses as little as 25 nL without using pins, tips, or washing.

Echo qualified source plates are specifically designed for the Echo Liquid Handler to take advantage of acoustic transfer technology and improve liquid transfer performance.

Nanoliter dispensing also makes an Echo Liquid Handler an excellent fit for many challenging life science applications in drug discovery, genomics, and proteomics. The Echo 525 Liquid Handler can be used for genomics and proteomics.

What are the Echo Liquid Handler features?

Echo Liquid Handlers are well suited to transferring nanoliter or low microliter volumes of aqueous solutions for a wide variety of applications.

Echo Liquid Handler features that will be important to any organization include:

Touchless Fluid Transfers

Echo technology uses *touchless* fluid transfer. Nothing physically touches the fluid in the wells or the interior walls of the microplate. Droplets are ejected using an ultrasound wave transmitted from below the source microplate. The ejected droplet is directly transferred upward from the supply plate to the receiver.

Touchless fluid transfer provides the following benefits:

- No physical contact eliminates potential for tip-based or pin-based cross-contamination
- Improved reliability
- Lower maintenance requirements
- Lower transfer costs
- Reduced waste

Reliability

The Echo Liquid Handler has been designed for heavy duty-cycles and reliable operation. Compared to operating and maintaining other liquid handling equipment, Echo technology offers the customer a simpler, trouble-free device.

Proactive control and monitoring of the systems reduce lost operational time or material if an error occurs:

- Multiple sensors monitor the coupling fluid system.

- Compressed air and vacuum systems are monitored for correct supply and operation.
- Each of the moving mechanisms includes multiple sensors that define home positions and absolute limits, reducing the possibility of mechanical interference or misalignment.

When a problem is detected, any or all of the following actions may occur:

- The coupling fluid pump immediately turns off (depending on the problem).
- Front and rear panel fault lamps and LCD messages notify the operator that a problem has occurred.
- ActiveX events notify remote systems that are connected to the Echo Liquid Handler.

Ease of Use

An Echo Liquid Handler is quickly ready for use.

- Minimal operator training is required.
- User calibration or recalibration are not required.
- Preparation for liquid transfers requires little more than defining a transfer protocol and selecting the source and destination plates being used. Protocols or destination plates can be quickly defined by the operator.
- Liquid transfer requires only a few clicks by the operator, using the Echo Liquid Handler software, which is included with each instrument.
- The Echo Liquid Handler can be operated manually by a researcher or as part of a fully automated lab.

The simple, two-step process includes creating a protocol and then running the fluid transfer protocol using the Echo Liquid Handler software program. For more information, see [Create a Liquid Transfer Protocol](#).

System Integration Friendly

The Echo Liquid Handler excels in its ease of integration into automated systems.

- The main body of the Echo Liquid Handler has a very small footprint: 53.9 cm wide and 68.3 cm deep (21.2 in x 26.9 in).
- Facilities requirements (power, temperature, ventilation, compressed air, vacuum, communications) are simple and straight forward.
- Source and destination microplates are loaded onto stages presented outside the instrument and placed in a fixed location for easy access by a robotic arm (see the following figure).
- Most barcode standards are supported. Barcodes can be located on the short or long side of a microplate.
- The control software supports the following manual operations “out of the box”.
 - device control
 - system monitoring
 - creation of destination plates and protocol definitions

- protocol execution
-
-
- Customers choosing to develop their own Echo software applications are supported by an ActiveX control library.

Figure 2 Access Workstation Loading a Source Microplate



For more information, see [What system configurations are supported?](#)

Low Maintenance Requirements

Echo instrument up-time is high, not only because it is reliable, but also because very little maintenance is required.

- Routine operator maintenance takes only minutes each week — for coupling fluid maintenance.
- Field service maintenance is scheduled once per year for customers with service contracts.
- Echo technology means that there are no tips, no pins, and no washing.
- The acoustic transducer itself has no moving parts to wear out. It simply converts RF (radio frequency) energy to ultrasound energy. The mechanisms that move it into position are designed for a long and serviceable life.

Cost Savings

The Echo Liquid Handler reduces operating costs by:

- Enabling the routine use of higher density, lower volume assays. Moving to smaller assay volumes reduces the costs of reagents and solvents.
- The use of higher density microplates dramatically increases the number of assays that can be performed with a limited amount of test reagent used.

- Minimizing the use of expendable supplies (for example, intermediate microplates, tips, pins, and wash solutions).
- Eliminating washing stations and their complex procedures and fluids.
- Eliminating the requirement to calibrate reduces upkeep time or delays in adopting new liquid handling procedures.

High Accuracy, Precision and Speed

High throughput capabilities are maintained without degrading fluid transfer accuracy and precision.

Droplet-to-droplet volumetric precision exhibits a low CV (coefficient of variation) for all fluid types tested to date. This is attributed to the elimination of sample contact with the ejection mechanism. The use of a single transfer mechanism within the Echo Liquid Handler reduces the chance of imprecise transfer due to intraplate sample variability, as compared to tip-based and other instruments that transfer samples in parallel.

Value-added Quality Control

In addition to precise and accurate transfer of fluids, the Echo Liquid Handler has an auditing function that can provide quality control of fluid samples. The Echo Liquid Handler applies a low-energy sound pulse to the fluid sample in each well and the reflected signal is used to calculate the following:

- **Aqueous solutions:** approximate fluid volume in the well based on the measured fluid height.
- **Glycerol-based solutions:** fill height and percentage of glycerol concentration (up to 50%).
- **Glycerol and salt-based solutions:** fill height and impedance measurement in megaRayls (unit of acoustic impedance) up to 2.23 MRayl.

The data can then be uploaded to a LIMS (Laboratory Information Management System) for post transfer processing and analysis.

For example, the following figure shows part of the plate survey of samples in the buffer. The plate survey was saved to CSV (comma separated values) file format and opened in Microsoft Excel.

Figure 3 Example of Aqueous Fluid Thickness Data Imported Into a Spreadsheet for Analysis

	A	B	C	D	E	F	G	H	I	J	K	L
1	Date	5/10/2016										
2	Time	13:39:58										
3												
4												
5		1	2	3	4	5	6	7	8	9	10	11
6	A	2.353	2.353	2.334	2.347	2.322	2.334	2.334	2.362	2.361	2.359	2.386
7	B	2.325	2.33	2.333	2.344	2.337	2.352	2.318	2.337	2.359	2.37	2.385
8	C	2.331	2.352	2.349	2.361	2.328	2.344	2.347	2.37	2.377	2.374	2.371
9	D	2.333	2.306	2.328	2.328	2.31	2.336	2.327	2.365	2.377	2.352	2.377
10	E	2.298	2.322	2.304	2.272	2.282	2.273	2.309	2.365	2.393	2.376	2.386
11	F	2.364	2.333	2.295	2.303	2.273	2.298	2.321	2.338	2.338	2.359	2.359
12	G	2.371	2.364	2.327	2.346	2.313	2.353	2.336	2.292	2.371	2.373	2.364
13	H	2.35	2.387	2.337	2.31	2.324	2.341	2.324	2.337	2.341	2.365	2.374
14	I	2.387	2.407	2.393	2.382	2.353	2.355	2.377	2.392	2.356	2.337	2.383
15	J	2.385	2.367	2.356	2.402	2.367	2.374	2.39	2.365	2.362	2.365	2.395
16	K	2.371	2.379	2.334	2.41	2.355	2.362	2.401	2.456	2.423	2.398	2.385
17	L	2.383	2.382	2.356	2.401	2.341	2.37	2.385	2.386	2.399	2.374	2.35
18	M	2.338	2.387	2.377	2.347	2.355	2.346	2.334	2.356	2.359	2.429	2.398
19	N	2.322	2.328	2.35	2.301	2.331	2.307	2.35	2.39	2.298	2.368	2.367
20	O	2.309	2.325	2.309	2.318	2.319	2.304	2.312	2.313	2.289	2.33	2.327
21	P	2.313	2.33	2.322	2.371	2.298	2.322	2.336	2.319	2.303	2.309	2.337

What system configurations are supported?

The Echo Liquid Handler can be used in a manual configuration or in several levels of automated, system integrated configurations. This section explores the following operating modes:

- Manual mode using the Liquid Handler software
- Manual mode using the Echo application software
- Modular workstation mode
- Small cell mode
- Multi-cell mode

The client/server architecture allows multiple client computers/programs to connect to an Echo Liquid Handler at the same time. Read [Multi-Client Considerations](#) for a discussion of the advantages and disadvantages of multiple-client operation.

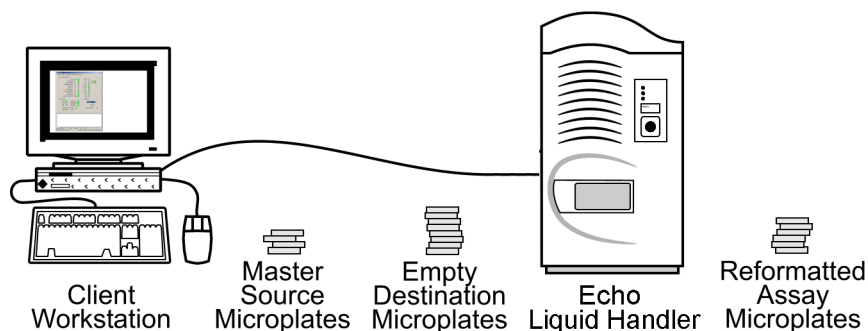
NOTE The software comes with a static IP address (192.168.1.1 or 192.168.0.25). If both of these IP addresses are not available, or if you are installing more than one Echo Liquid Handler on a network, use the Echo Admin Client (on the Echo Server 2.6 disk) to change the IP address.

Manual mode using the Liquid Handler software

Manual mode using the Liquid Handler software leaves control of every step to the operator:

- Defining new fluid transfer protocols or new destination microplates
- Executing a fluid transfer protocol
- Loading and unloading both source and destination microplates
- Monitoring status
- Performing periodic maintenance and focus calibration

Figure 4 Manual mode using the Liquid Handler software



Manual mode using the Echo application software

Beckman Coulter provides the following Echo Applications that extend the Echo Liquid Handler software to enable the operator to easily create a variety of more complex destination plates. Beckman Coulter currently provides the following software applications:

- **Echo Dose-Response:** Prepares IC_{50} , EC_{50} or any type of dose-response curves using the unique ability of the Echo Liquid Handler to perform direct dilution. The intuitive graphical user interface allows the sample distribution, back-filling and control transfer required for each curve to be incorporated into a single protocol.
- **Echo Cherry Pick:** Guides file-driven transfers of samples from any source well to any destination well. Echo Cherry Pick software supports pick lists and produces output files in nearly any CSV file format-typically required by LIMS or other workflow management software.
- **Echo Plate Reformat:** Enables a broad range of plate transfer functions from plate replication to library compression/reformatting and custom mapping. A drag-and-drop interface, combined

with color-coded plate previews, simplifies setting up even the most complex cross-pooling protocols.

- **Echo Plate Audit:** Analyzes and compares sample composition and volume. Echo Plate Audit utilizes the ability of the Echo Liquid Handler to acoustically analyze sample properties for pre-run validation and tracking.
- **Echo Combination Screen:** Provides a variety of plate transfer functions to the Echo Liquid Handler and works with all Echo Liquid Handlers. When creating a new transfer protocol in Echo Combination Screen application, you will create the dilution curves and destination plate layout first. You must also define the source wells in a user-generated pick list based on a template that matches the protocol you are creating.
- **Echo Array Maker:** Provides a variety of plate transfer functions using an interactive graphical editor that allows researchers to design custom spotting patterns to build custom arrays. Researchers can create and edit protocols that map the transfer of fluids from microplates to the custom arrays using the Echo Liquid Handler. A variety of spotting patterns can be created for microarrays, MALDI-chips, and more.

For customers requiring additional customization, Beckman Coulter also provides Echo application programming interfaces and code examples via the Echo SDK (software development kit) to integrate the Echo system into their own laboratory automation system. The *Echo Application Integration Manual* describes the Echo programming interfaces that are designed to be used by administrators, software programmers, system integrators, or any person who will be involved in custom programming for Echo applications.

[Contact us](#) for information on the Echo applications listed above or on the Echo SDK.

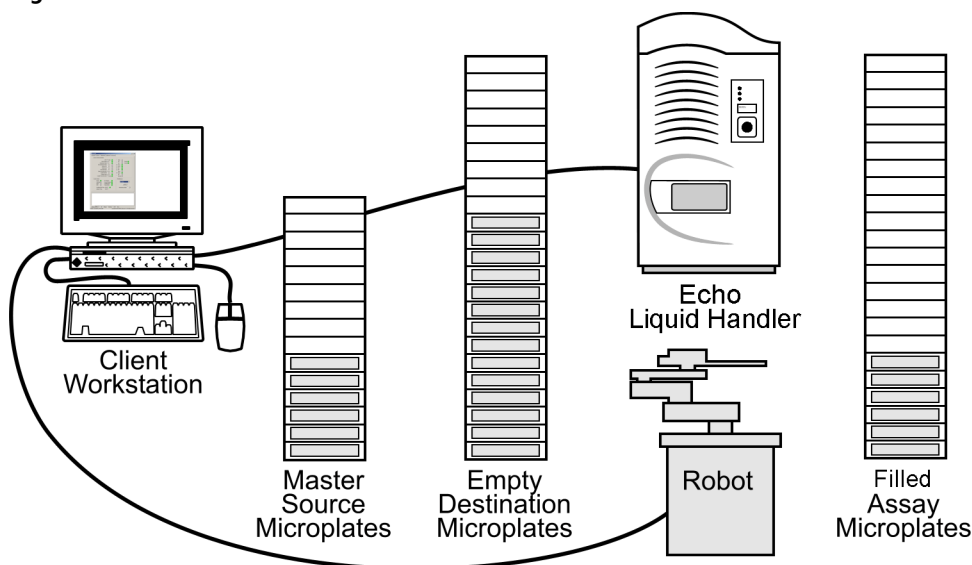
Modular Workstation Mode

Modular workstation mode differs from manual mode using the Liquid Handler software with the addition of a robot to automate the loading and unloading of source and destination plates. Typically, a custom program is written that controls and synchronizes the Echo Liquid Handler and robot interactions.

An operator is still involved and performs the following functions:

- Deliver master source microplates from the reagent library.
- Maintain a supply of empty destination microplates.
- Select and execute the fluid transfer protocol.
- Deliver the filled assay microplates to the next step in the process.
- Monitor the status of the Echo Liquid Handler and the robot, possibly with the assistance of a custom software program.

Figure 5 Modular Workstation Mode

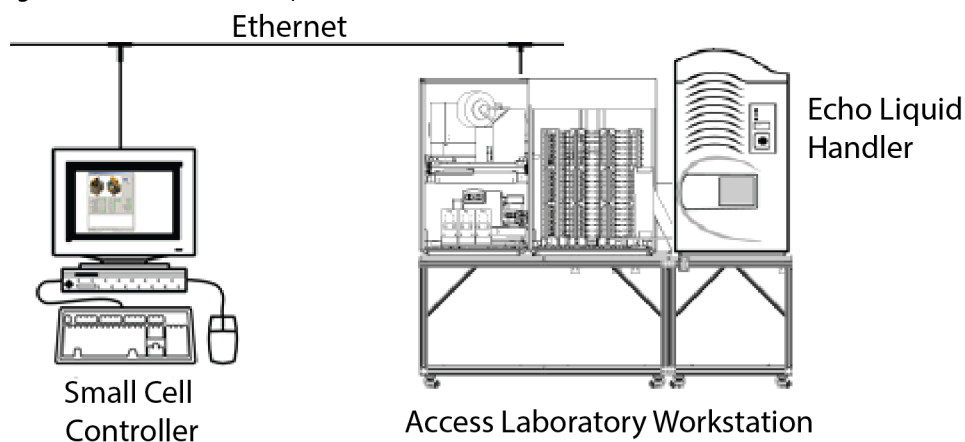


Small Cell Operation

Small cell operation includes the automation of High Throughput Screening (HTS) processes other than liquid transfer. Those processes might include several of the following:

- Lidding and delidding
- Microplate labeling
- Microplate sealing
- Incubation
- Reaction detection
- Temperature or humidity control
- Reagent addition
- Wash station (used with other instruments)

Figure 6 Small Cell Mode Operation



Multi-cell Mode

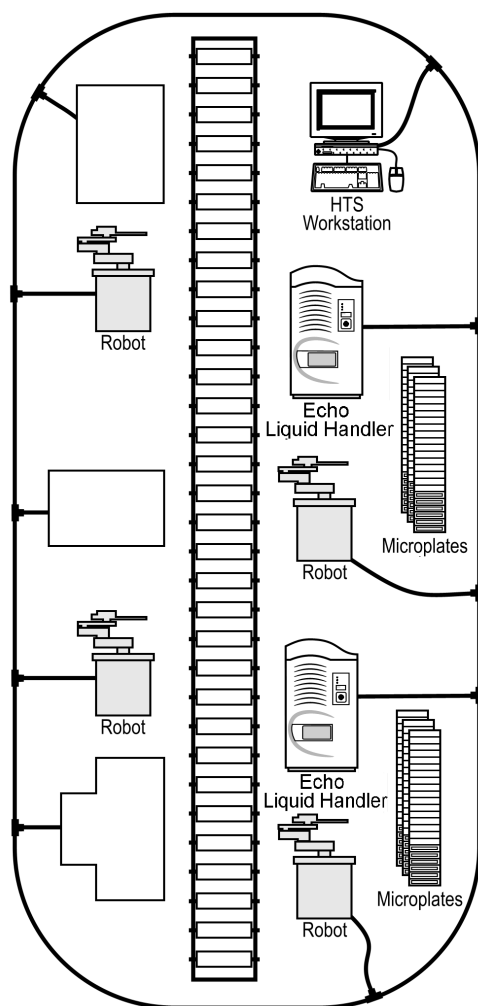
The multi-cell mode expands on the small cell concept and may incorporate a larger range of processes and operations.

Larger, fully automated labs might include the following:

- A larger combination of the processes and stations listed in the discussion of a small cell mode operation. For more information, see [Small Cell Operation](#).
- One or more supervisory workstations.
- A conveyor system to move microplates and other material not only between stations, but into and out of the lab.
- Multiple robots, individually chosen and programmed to support a specific function or machine.
- Multiple Echo Liquid Handlers.

NOTE Echo Admin Client allows the operator to change the IP address on the Echo instrument to match the integrator's IP address. This is included with the Echo Server 2.6 disk.

Figure 7 Multi-cell Mode

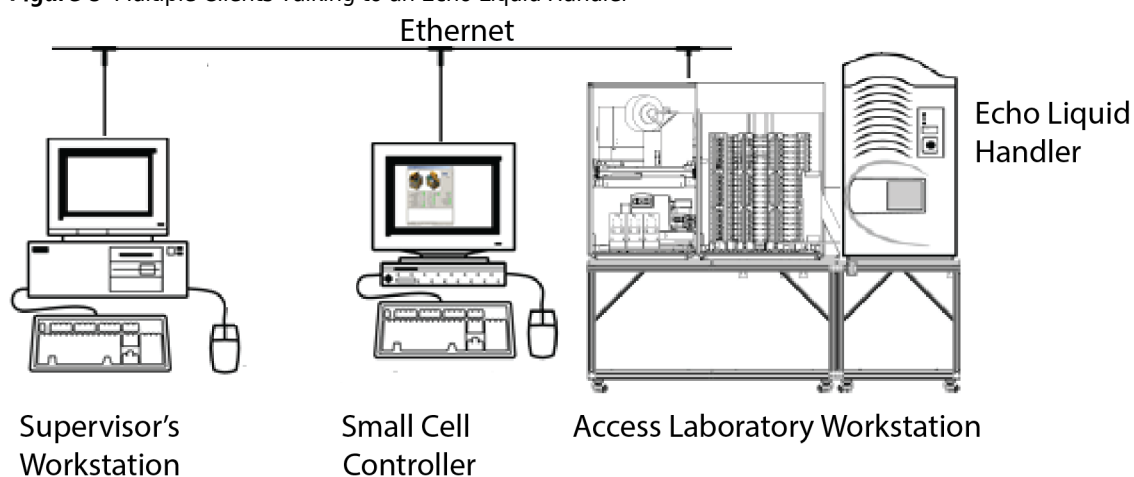


Multi-Client Considerations

Larger research labs may have many computers, instruments, controllers, and other devices interconnected on an Ethernet LAN (local area network). Please review the following information and take appropriate measures to avoid conflicts caused by multiple workstations controlling an Echo Liquid Handler inappropriately.

The Echo Liquid Handler can be connected to a network or to more than one workstation. This configuration allows one or more users to control the Echo remotely, to download liquid transfer information directly to the network, or to connect more than one Echo Liquid Handler to an automated filling operation.

Figure 8 Multiple Clients Talking to an Echo Liquid Handler



For example, a local workstation might be used to do the following:

- Monitor instrument status.
- Perform user maintenance.
- Execute troubleshooting procedures.

At the same time, a central system may be used to control all of the day-to-day work flow involving the instruments in the lab. In relation to an Echo Liquid Handler, it might be involved in the following:

- Define fluid transfer protocols.
- Define destination microplates.
- Deliver source and destination microplates to the Echo Liquid Handler via conveyor belt and robot.
- Remove source and destination microplates.
- Execute fluid transfer protocols.
- Handle all of the data.

The Echo Liquid Handler is a client/server system. The *client* is the external workstation that contains the user interface software to define plate and protocol information. The server is the controller that runs the instrument motors and sensors. Each subsystem is independent, with its own system checks. This architecture allows the Echo Liquid Handler to be commanded by multiple

clients to run concurrent operations, yet ensure that each operation is safe with respect to each other.

For example, one user might command the Echo Liquid Handler to do a microplate survey, then a liquid transfer protocol. During the source microplate survey, another user might command the Echo Liquid Handler to extend the source plate. The microplate survey that is in progress will continue to completion, then extend the source microplate. Thus, while the Echo Liquid Handler guarantees safe operation, it cannot prevent the commands of one user interfering with those of a second user. Therefore, it is the responsibility of the users to coordinate their actions to ensure the proper fulfillment of a transfer protocol.

Also, if more than one user creates, edits, or deletes fluid transfer protocol definitions or destination microplate definitions, then there must be communication between users to ensure that the definitions are consistent with the protocols.

Users should be aware of the following considerations with the client/server architecture:

- An Echo Liquid Handler is not limited to a single client. One or more clients can either monitor its status or command it to execute its functions.
- Uncoordinated clients can cause out-of-order execution that interferes with other users' protocols. For example, client A can delete or edit a protocol or destination microplate definition created by client B. An edited protocol definition can only be detected if the original definition is stored on client B and compared to the definition in the database.

Introduction

What system configurations are supported?

CHAPTER 1

General Description

The topics below describe the Echo Liquid Handler features and components:

- System Overview
 - Front Panel
 - Back Panel
- Component Description
 - Door
 - Source Plate Gripper Stage
 - Source Plate Insert
 - Destination Plate Gripper Stage
 - Status Indicator Lights
 - LCD Screen
 - Stop Switch
 - Anti-Static Bars
 - Barcode Scanner
 - AC Power and Fuse Compartment
 - Ethernet Connection
 - Coupling Fluid Bottle
 - Air Compressor
 - Vacuum Pump
 - Fluid Chiller
 - Surge Tank
 - Fluidics Panel
 - Barcodes
 - Consumables
 - Critical Micelle Concentrations
 - Client PC (Sold separately by Beckman Coulter)

System Overview

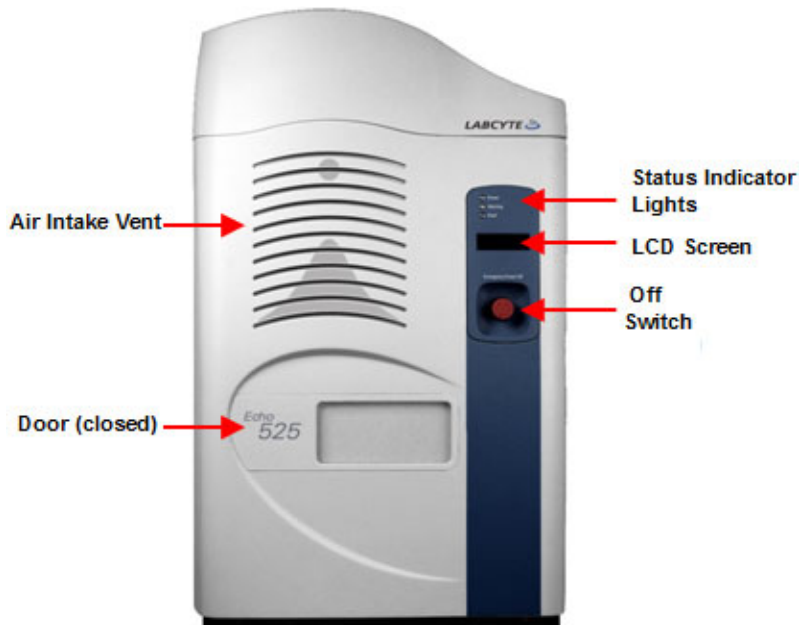
The topics below describe the front and back panel of the Echo 525 Liquid Handler.

- [Front Panel](#)
- [Back Panel](#)

Front Panel

This topic provides a brief description of the components located on the front panel of the Echo 525 Liquid Handler.

Figure 1.1 Echo 525 Liquid Handler front panel



- **Door:** The door protects the operator from the moving mechanisms and blocks stray light emitted by the barcode scanner lasers. For more information, see the [Door](#) topic.
- **Air Intake Vent:** The Echo uses fans to cool its internal components, therefore the air intake vent should be unobstructed.
- **Status indicator lights:** There are three status indicator lights on the front of the Echo Liquid Handler:
 - **Power** (green): The Echo Liquid Handler is on and ready.
 - **Warning** (yellow): A component is out of position or a parameter is out of range and may require attention.
 - **Fault** (red): A problem has occurred that stops the current task and requires immediate attention.

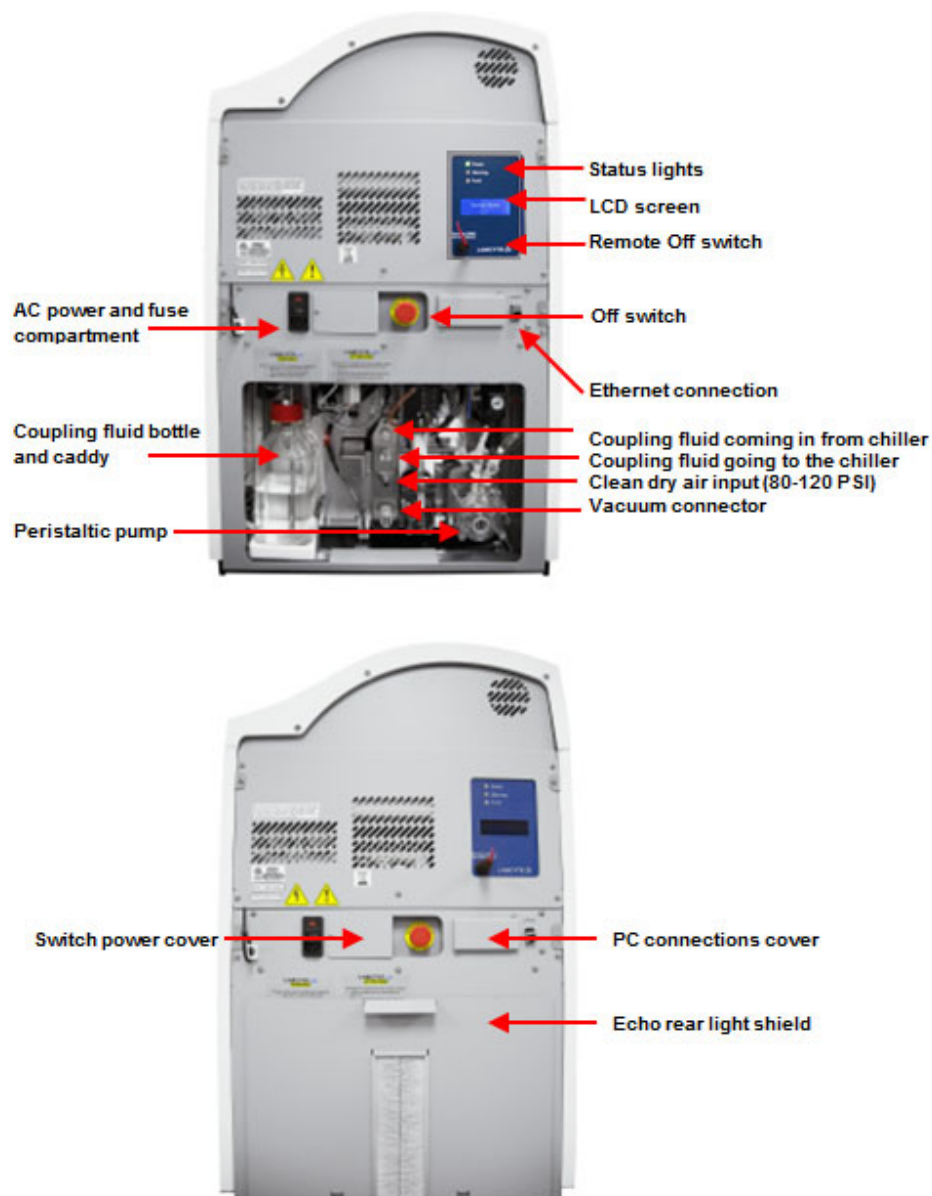
These status indicator lights are also provided on the back panel. For more information, see the [Status Indicator Lights](#) topic.

- **LCD screen:** The LCD screen on the front of the Echo Liquid Handler reports what the Echo Liquid Handler is doing or what operator action is required. This display is also provided on the back panel. For more information, see the [LCD Screen](#) topic.
- **Stop:** The Stop switch shuts down all mechanical Echo Liquid Handler activity. This switch is also available on the rear panel. For more information, see [Stop Switch](#).

Back Panel

This topic provides a brief description of the components located on the back panel of the Echo 525 Liquid Handler.

Figure 1.2 Echo 525 Liquid Handler back panel



- **AC power and fuse compartment:** The AC power and fuse compartment (also called the power input module) contains the main Echo Liquid Handler power on/off switch, AC power inlet, and fuse compartment. For more information, see [AC Power and Fuse Compartment](#).
- **Coupling fluid bottle and caddy:** The 1000 mL coupling fluid bottle provides the coupling fluid (Type 1 Ultrapure Water) that is pumped through the acoustic transducer to maintain constant temperature and transfer acoustic energy to the well. The coupling fluid bottle caddy contains a sensor that monitors the fluid level and issues a warning when the fluid level is less than 250 mL. For more information, see [Coupling Fluid Bottle](#).
- **Status light indicators, LCD screen, and Stop switch:** Same as the components on the front panel. Remote Stop cable enables the customer to set up a remote Stop button more accessible to the operator.
- **Ethernet connection:** RJ-45 Ethernet network port connects the Echo Liquid Handler to a PC or to a network. For more information, see [Data Connection](#).
- **Tubing and hose connections:** The Echo Liquid Handler has connections for two chiller lines (supply and return), pressurized clean dry air (CDA) and a vacuum.
- **Standalone vacuum with surge tank (10 L):** 100 Torr (133 mbar, 26 inches Hg Vac), minimum pumping speed 2.0 m³/hr.
- **Chiller lines:** There are two chiller lines; only one chiller line includes an inline filter.
- **Echo rear light shield:** Used to minimize algae growth.
- **Peristaltic pump:** Sets the coupling fluid flow rate.

Component Description

Each of the components that the user may interact with are described in detail in the topics below.

Door

The door is normally closed to protect the operator from moving mechanisms in the Echo Liquid Handler and from any stray light emitted by the barcode scanner lasers. When a fluid transfer protocol is executed, the door will be opened automatically, allowing easy human or robotic loading or unloading of microplates. For a complete picture of the door in the front panel, see the [Front Panel](#) topic.

Figure 1.3 Door (closed)



WARNING

Any time the door is open, whether or not one of the microplate assemblies has been extended outside of the Echo Liquid Handler, there is a pinch hazard. The pinch point label shown here is visible on the front of the unit and both microplate assemblies and reminds you to keep your hands and fingers clear of the mechanisms.

Figure 1.4 Pinch Point Warning label

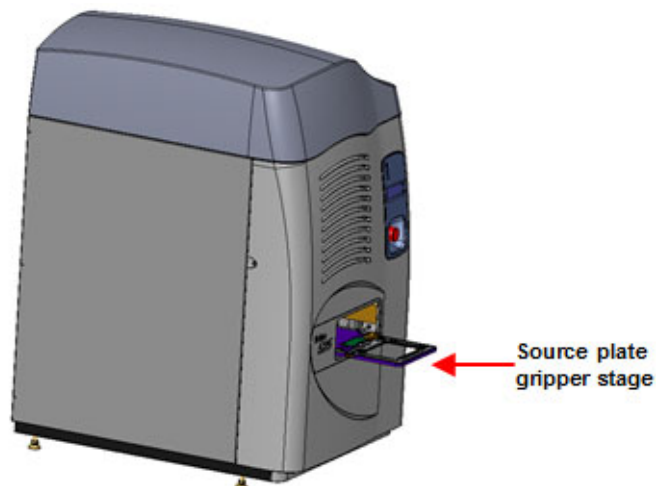


Source Plate Gripper Stage

The source plate gripper stage is the lower plate stage that extends from the Echo Liquid Handler. The plate gripper holds the microplate containing the liquid that will be transferred.

NOTE In the figure below, the source plate gripper stage extends out of the bottom of the door.

Figure 1.5 Extended source plate gripper stage



Source Plate Insert

To keep the source plate secure, the plate gripper includes a plate insert designed for specific plate types. See the following table of plate inserts.

Table 1.1 Plate Inserts for Echo 525 Liquid Handler

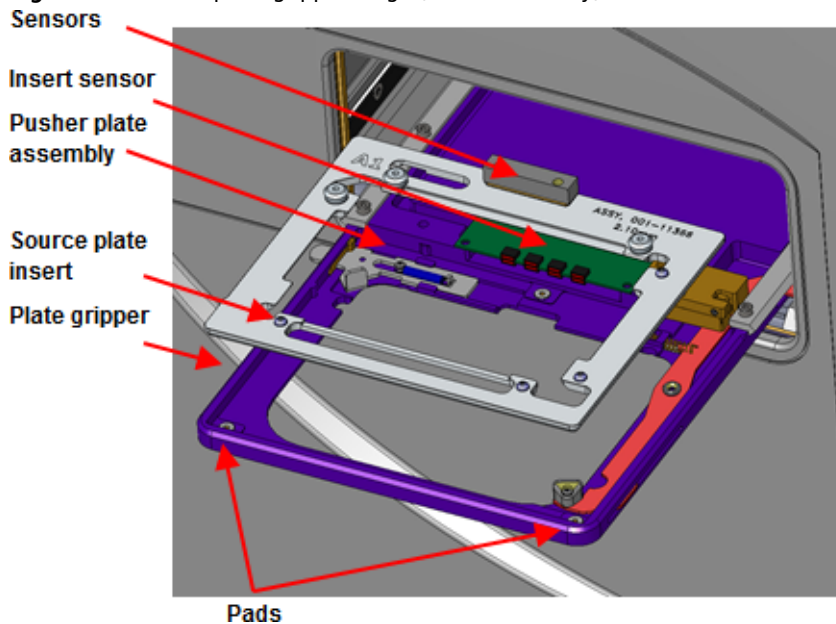
Plate Insert Part#	Insert Size	Compatible Plates (Catalog #)
001-11366 Assy, Insert, 384PP/Reservoir	2.10 mm	Echo Qualified 384-Well Polypropylene Microplate
		• 384PP (001-14555) • 384PP Plus (001-14622)
		Echo Qualified Reservoir 6RES (001-11101)
001-6291 Assy, Insert, LDV/HB/ER	4.50 mm	Echo Qualified 384-Well Low Dead Volume Microplate 384LDV Plus (001-13070)

Insert size refers to the difference in height between plate well bottom and the bottom of the microwell plate skirt.

NOTE Handle the plate inserts carefully. They can be damaged from dropping or rough handling, which can affect instrument performance.

When you place the microplate insert onto the plate gripper, the sensors will be flush against the insert sensor. The plate insert will rest on top of three pads and should move easily from side to side.

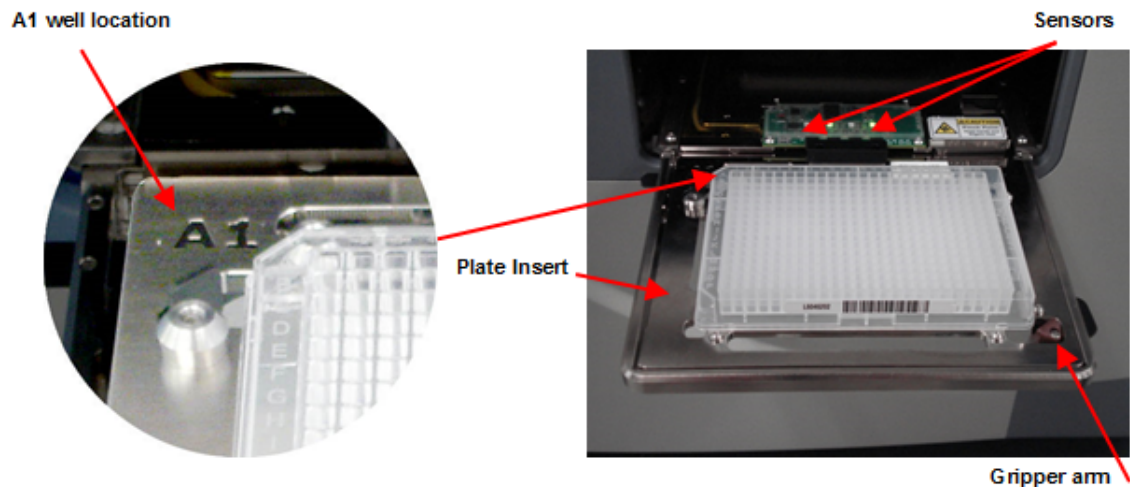
Figure 1.6 Source plate gripper stage (entire assembly)



The plate insert will be moved into the correct position by the gripper arm when the source plate gripper stage moves through the door.

When you load a source microplate onto the plate insert, well A1 is located in the upper left corner (see figure below). As a reminder, the upper left corner of the plate insert is labeled A1. The insert contains sensors that inform the Echo Liquid Handler which plate is being used.

Figure 1.7 Plate insert and gripper arm securely hold the source microplate



Destination Plate Gripper Stage

The destination plate gripper stage is the upper plate stage that extends from the Echo Liquid Handler. The plate gripper holds the microplate that will receive the liquid being transferred.

When you load the plate onto the plate gripper, well A1 goes into the upper left corner (nearest the Echo model number).

Figure 1.8 Extended destination plate gripper stage



When the destination plate gripper stage is commanded to retract into the Echo Liquid Handler, the microplate is gripped and simultaneously rotated down. It is in this inverted position that the microplate will be able to receive the fluid droplets ejected upwards from the source plate wells.

Figure 1.9 Inverting the destination plate



As the destination plate gripper stage retracts into the Echo Liquid Handler, a sensor detects whether a plate is or is not present. Normally, a transfer will not be executed if a destination plate is not detected. The human operator, or a controlling program, can override the plate presence check, if necessary.

When the destination plate gripper stage extends out of the Echo Liquid Handler, the plate is rotated back to its upright position.

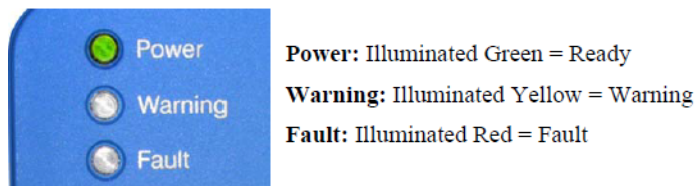
Status Indicator Lights

There are three status indicator lights on the front of the Echo Liquid Handler and a duplicate set on the rear panel.

A quick glance can confirm whether the Echo Liquid Handler is operating normally or that it needs operator attention.

- The **Power** light (green) is on when the instrument on and initialized.
- The **Warning** light (yellow) turns on when a condition is outside of normal limits, but the instrument can continue to operate.
- The **Fault** light (red) turns on when a condition exceeds warning conditions and the instrument can no longer operate.

Figure 1.10 Echo Liquid Handler front panel



Power Light

The states for the power light are listed below:

- **Green:** Normally the Power/Ready light is illuminated, indicating that the Echo Liquid Handler is both turned on and that its internal controller has completed its initialization and is ready.
- **Off:** When the Power/Ready light is turned off, either the Echo Liquid Handler has not been turned on or its internal controller has not completed initialization.

Warning Light

The states for the warning light are listed below:

- **Off:** Normally the Warning light is turned off, indicating that the Echo Liquid Handler is functioning correctly.
- **Yellow:** The Warning light is illuminated when any of the following conditions are true:
 - The Echo Liquid Handler stages are not homed or are in the process of being homed. For more information, see [Home Calibration](#).
 - The coupling fluid bottle level is low. For more information, see [Coupling Fluid Indicator](#).

NOTE When the coupling fluid falls below its recommended minimum level, air bubbles may be introduced into the coupling fluid, which reduces the accuracy or precision of source plate surveys and fluid transfers. Beckman Coulter recommends that you refill the coupling fluid bottle as soon as possible after the Warning light has been turned on. For more information, see [Echo Coupling Fluid Maintenance](#).

- The coupling fluid temperature is outside of the normal range and within the warning range. The normal range is $22.1^{\circ}\text{C} \pm 0.9^{\circ}\text{C}$. The warning range is $20.2^{\circ}\text{C} - 21.2^{\circ}\text{C}$ or $23.0^{\circ}\text{C} - 24.0^{\circ}\text{C}$.
- The focus calibration check should be performed. For more information, see [Focus Calibration Check](#).
- The door is neither fully open nor fully closed.
- The upper anti-static bar is neither fully up nor fully down.
- The source plate dryer nozzle is neither fully up nor fully down.

Fault Light

The states for the fault light are listed below:

- **Off:** Normally the Fault light is turned off, indicating that the Echo Liquid Handler is functioning correctly.
- **Red:** The Fault light is turned on when any of the following conditions are true:
 - The user-supplied compressed air supply is low (< 80 PSI) or nonexistent. For more information, see [Compressed Air Pressure Indicator](#).
 - The user-supplied vacuum pressure is low (< 23 in Hg Vac) or nonexistent. For more information, see [Vacuum Supply Pressure Indicator](#).
 - The coupling fluid temperature is outside of the warning range: $22.1^{\circ}\text{C} \pm 1.9^{\circ}\text{C}$. If the temperature is less than 20.2°C or greater than 24.0°C , a fault is generated.
 - A coupling fluid leak has been detected. For more information, see [Fluid Leak Indicator](#).
 - The Stop switch has been activated. For more information, see [Stop Indicator](#).

LCD Screen

There is a four-row LCD screen on the front of the Echo Liquid Handler and a duplicate on the rear panel. They display messages that report what the Echo Liquid Handler is doing or what operator action is required. Types of messages displayed include the following:

- Operating states
- Procedure progress
- Status
- Requests for operator assistance

Stop Switch

The Stop switch can be used in an emergency to shut down all mechanical activity in the Echo Liquid Handler. There are two Stop switches, one on the front panel and one on the rear panel of the Echo Liquid Handler.

Figure 1.11 Location of Stop switch



- To use the Stop switch in an emergency, push it in.
- To reset the Stop switch, turn the knob clockwise until it pops out (see arrows etched in the knob).

NOTE If the Stop switch is used, if you have a protocol running, it may be interrupted and may need to be restarted.

When to use the Stop switch:

- Any time the safety of the operator is in question.
- Any time strange, loud, or potentially damaging noises are coming out of the Echo Liquid Handler.
- When the instrument door will not open, and the source or destination plate gripper stages collide with the door.
- If water is leaking from the Echo Liquid Handler.
- In any other situation that suggests immediate shutdown of the Echo Liquid Handler is appropriate.

When the Stop switch is used, the following actions are performed:

- All motors are disabled.
- The coupling fluid pump is turned off.
- All pneumatic actuators are sent to their default positions.
- The anti-static bars are turned off.
- All RF devices (RF power supply, RF amplifier, RF switch, and so on) are turned off.
- The HV grid is turned off.
- The internal controller aborts all processes in progress, returns an error to the system invoking the aborted process, designates the three stages as not calibrated, and goes into a halted state.

Activating the Stop switch does not turn off the following:

- Internal Echo Liquid Handler controller.
- AC power inside the Echo Liquid Handler power distribution panel.
- Internal 24 VDC power supply (power output, however, is interrupted).
- External communications (Ethernet, USB).
- Coupling fluid chiller.

Recovering from a Stop shutdown

If the Stop switch has been used to shutdown the Echo Liquid Handler, use the following procedure to start up again:

1. Determine and resolve the original problem.
2. Turn the Echo Liquid Handler back on by twisting the Stop switch clockwise. It will pop out to its normal operating position.

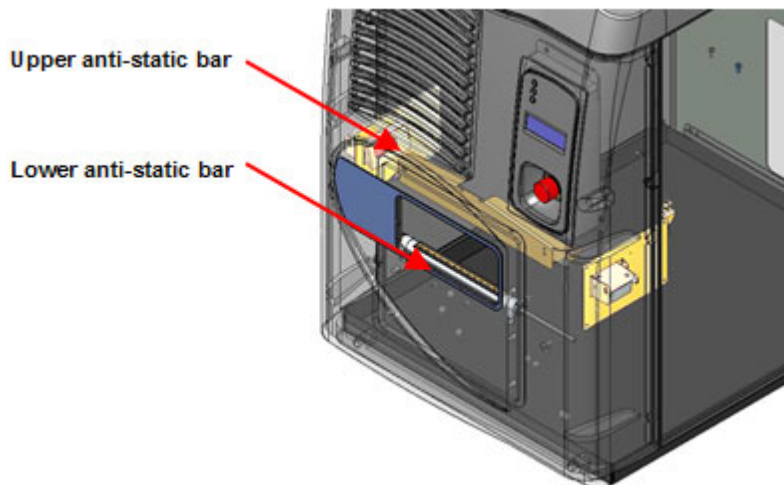
When the Stop switch is returned to its normal position, power is then supplied to most internal systems and most internal mechanisms are enabled. The Echo Liquid Handler stage motors are not automatically enabled. The operator must explicitly command a stage homing procedure. For more information, see [Motion Calibration](#).

NOTE If you cannot determine the original problem, or you cannot correct the problem, you must arrange for a Beckman Coulter field engineer to restore your Echo Liquid Handler to normal use. Make sure to protect the transducer from dehydrating during the shutdown period to prevent damage to the transducer. See [CHAPTER 3, Turn Off Echo Power](#).

Anti-Static Bars

The upper and lower anti-static bars (also called ionizer bars) remove any electrostatic charge from the source and destination microplates. Electrostatic charge can affect the placement of the transferred drop during liquid transfer.

Figure 1.12 Anti-static bars

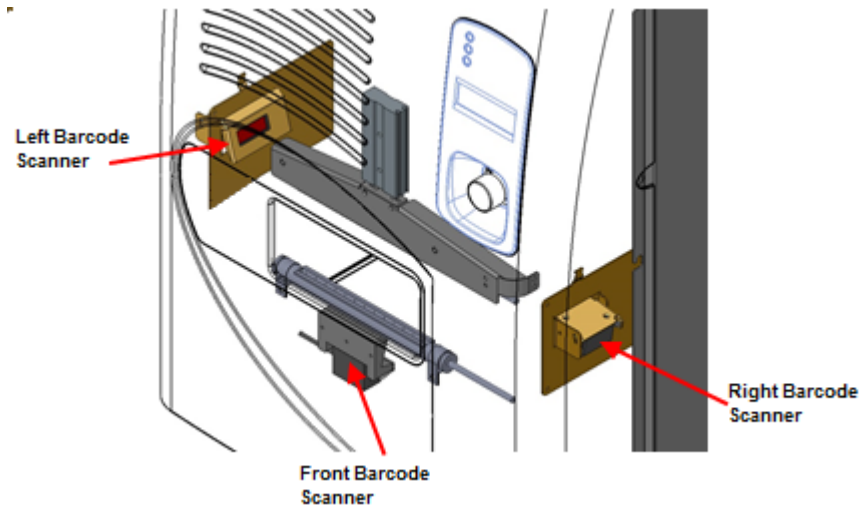


Barcode Scanner

The Echo Liquid Handler optionally includes one or more barcode scanners. The location of each scanner depends on the location of your barcode labels on the microplates.

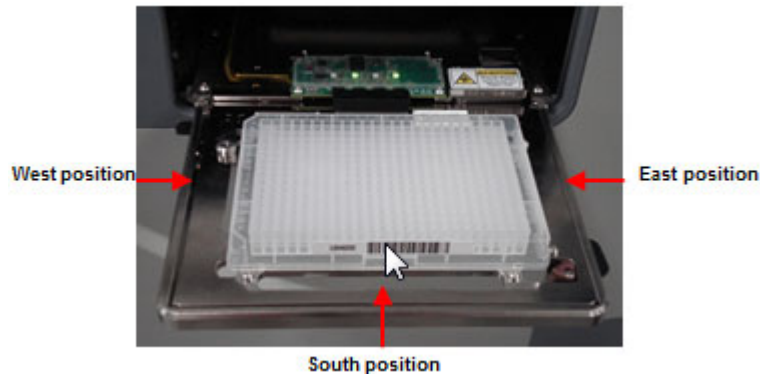
You can purchase one or more barcode scanners to add to your Echo Liquid Handler that will read and report barcoded microplates.

You can only specify one location at-a-time for a plate. That is, you can specify that a barcode is on the West, South, or East side. If the Echo has been configured for West-side reads, then both source and destination plates must have West-side barcodes. If the Echo has been configured to East-side reads, then both source and destination plates must have East-side barcodes. If a Southside reader is present, you can mix and match plates with South-side barcodes and either West or East side reads.

Figure 1.13 Barcode scanner locations

The location of each scanner depends on the location of your barcode labels on the microplates. You can use either the front scanner or the side scanner, but not both at the same time.

NOTE Several terms are used to specify barcode locations on a microplate. Standing in front of an Echo Liquid Handler, the two readable barcode locations are identified as follows:

Figure 1.14 Barcode label locations

NOTE The default configuration is to place side barcode labels on the left side of both source and destination microplates. The Echo Liquid Handler uses the barcode scanner on the left side to read the barcode on the source plate, but uses the barcode scanner on the right side to read the barcode on the destination plate-after it is inverted. A third barcode scanner can be added in the front to support reads on both source and destination plates. However, this is typically not used.

Beckman Coulter supports the following barcode scanner codes:

Table 1.2 Barcode Reader(s)

Compatible barcode reader formats	Readable bar width (mm)
CODE 39	0.19–1.0
ITF	0.19–1.0
INTERLEAVED 2 of 5	0.19–1.0
CODABAR	0.19–1.0
UPC/EAN	0.19–1.0
CODE 128	0.25–1.0
COOP 2 of 5	0.19–1.0
CODE 93	0.25–1.0

NOTE The readable bar width expresses the range in which the width of thin barcode bars (narrow bar width) is readable.

The Echo Liquid Handler can be configured to read eight different barcode formats. By default, Beckman Coulter installs the barcode formats in bold listed above.

[Contact us](#) to install or move the barcode scanners.

AC Power and Fuse Compartment

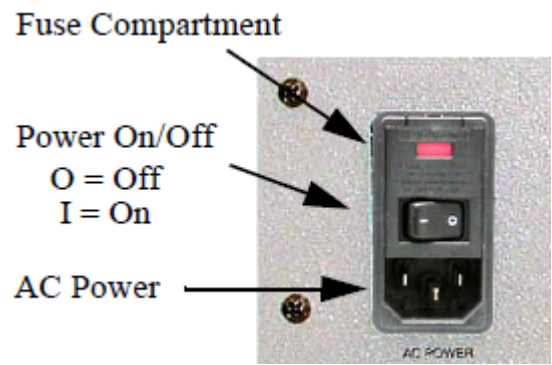
The AC power and fuse compartment (also called the Power Entry Module) is located on the rear panel, to the left of the Stop button. It contains the main Echo Liquid Handler power on/off switch, AC power inlet, and fuse compartment.

Refer to [Table 5.2, Electrical Configurations for the Echo Liquid Handler](#) that describes the AC Power and Fuse requirements for the Echo Liquid Handler.

NOTE The power cord may need to be replaced with one conforming to local AC power receptacles. To determine which AC power configuration you have, see the Power and Fuse Rating Label on the back panel of the Echo Liquid Handler.

The fuse compartment for the Echo Liquid Handler contains two AC power fuses. If a fuse requires replacement, refer to [CHAPTER 4, Replacing the Fuse](#).

Figure 1.15 AC power and fuse compartment

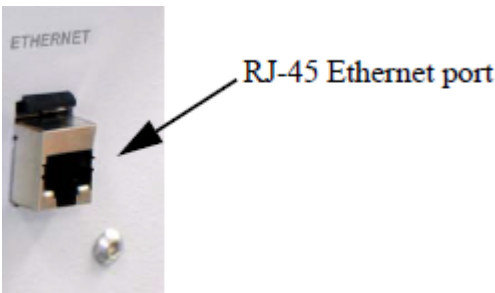


Ethernet Connection

The Echo Liquid Handler includes several communication connections to the right of the Stop button. The RJ-45 Ethernet port is the only data connection required for normal Echo Liquid Handler operation. The Ethernet cable connects the Echo Liquid Handler directly to the client PC or to a network. This connection allows you to monitor and control the Echo Liquid Handler. If the Echo Liquid Handler is connected directly to a client PC, the Ethernet cable must be a “cross-over” cable.

Other data connection ports are used by Beckman Coulter authorized personnel.

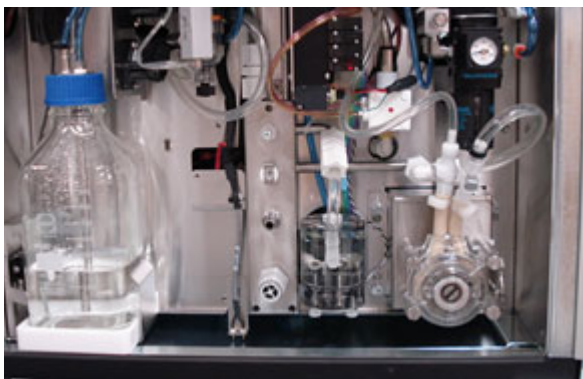
Figure 1.16 External connections: power and data



Coupling Fluid Bottle

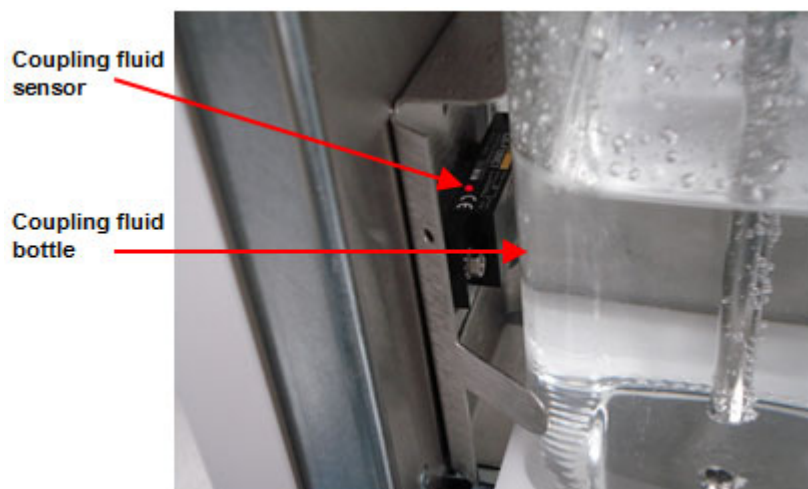
The Echo system comes with a 1000 mL coupling fluid bottle.

Figure 1.17 Coupling fluid bottle



The Echo Liquid Handler detects if the coupling fluid bottle falls below a specific level. If the sensor indicates that the fluid has fallen below the minimum level, a low fluid volume alert warning is sent to the Echo server. For information on how to refill coupling fluid, see [Echo Coupling Fluid Maintenance](#).

Figure 1.18 Coupling fluid bottle and sensor connections



Air Compressor

The Echo Liquid Handler requires a compressed air source that provides clean, filtered, oil-free, dry air at 552 kPa (80 PSI) minimum and 1034 kPa (150 PSI) maximum.

The user must also provide a fitting between the compressed air supply and the Echo Liquid Handler. Beckman Coulter provides the compressed air line and fitting with the Echo Liquid Handler, but the customer must provide a source compatible with 170 in ID/.250 in OD tubing.

NOTE Maximum consumption by Echo Liquid Handler does not exceed 1 cfm at 150 PSI.

Vacuum Pump

The Echo Liquid Handler requires a vacuum source. This requirement can be met through a house vacuum or a vacuum pump.

The vacuum source should have the following specifications:

- House supply: Minimum 200 Torr (266 mbar, 22 in Hg Vac) minimum pumping speed 8.0 m³/hr
- Standalone vacuum with surge tank (10 L): 100 Torr (133 mbar, 26 in Hg Vac), minimum pumping speed 2.0 m³/hr

The vacuum returns the coupling fluid to the supply bottle and dries source plates before they are unloaded. Customers must provide a fitting that connects the vacuum source and the Echo Liquid Handler vacuum line. The supplied vacuum line is HercoBraid, 9.5 mm (3/8 in) ID, 9.5 mm (5/8 in) OD (RyanHerco P/N 0512-072).

A standalone vacuum system can be purchased from Beckman Coulter. This vacuum is a dual voltage/cycle compatible system.

When vacuum demand is at its highest, a 10 L surge tank (provided with the Echo Liquid Handler) ensures a continuous source of vacuum. It prevents system errors resulting from low vacuum in laboratories where house vacuum barely meets the minimum vacuum requirement or is inconsistent due to other laboratory demands.

For information on monitoring the vacuum supply pressure, see the [Vacuum Supply Pressure Indicator](#) topic.

Fluid Chiller

The Echo's Liquid Handler's peristaltic pump pushes the coupling fluid through the chiller to maintain the coupling fluid temperature.

Coupling fluid temperature control

The recommended Echo Liquid Handler coupling fluid temperature operating window is 22.1°C ± 0.9°C. This temperature can be viewed on the **Diagnostics** tab of the Echo Liquid Handler software. For more information, see [Coupling Fluid Temperature and Indicator](#).

The nominal fluid chiller set point is 22.0°C. The chiller set point should be chosen so that the coupling fluid temperature is kept within the required operating window. Warmer or colder environmental conditions may require adjustment of this set point.

CAUTION

Incorrect fluid temperature can reduce the precision and accuracy of the fluid that is transferred, and potentially damage the acoustic transducer. Ensure that the chiller is correctly connected to the Echo instrument and is running at recommended temperature.

Surge Tank

A 10 L surge tank is standard with the Echo Liquid Handler system. When vacuum demand is at its highest, the surge tank ensures a continuous source of vacuum. It prevents system errors resulting from low vacuum in laboratories where house vacuum barely meets the minimum vacuum requirement or is inconsistent due to other laboratory demands. Surge tanks are available for purchase for older Echo units. For more information, [contact us](#).

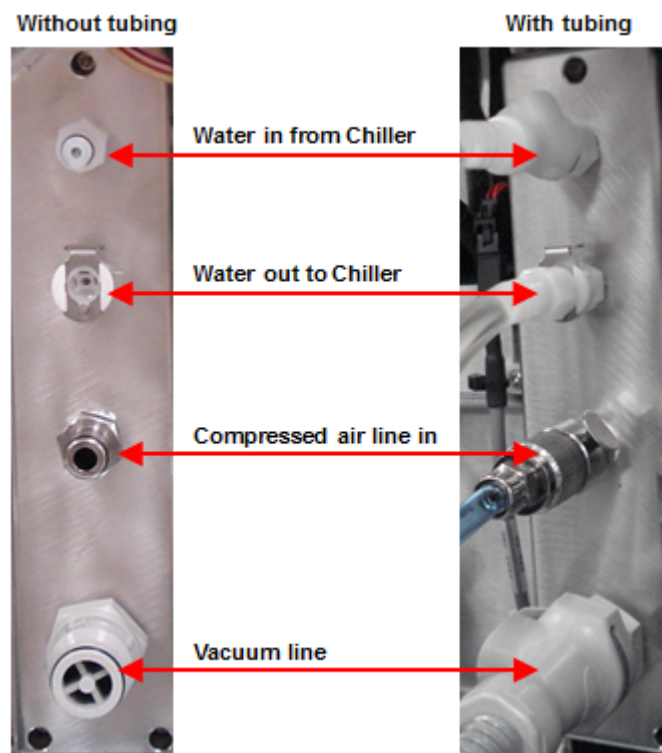
Figure 1.19 Surge Tank



Fluidics Panel

The fluidics panel contains tubing and hose connections to the following components:

Figure 1.20 Fluidics panel



NOTE Beckman Coulter provides the 001-12466 accessory kit with all the necessary connectors and tubing.

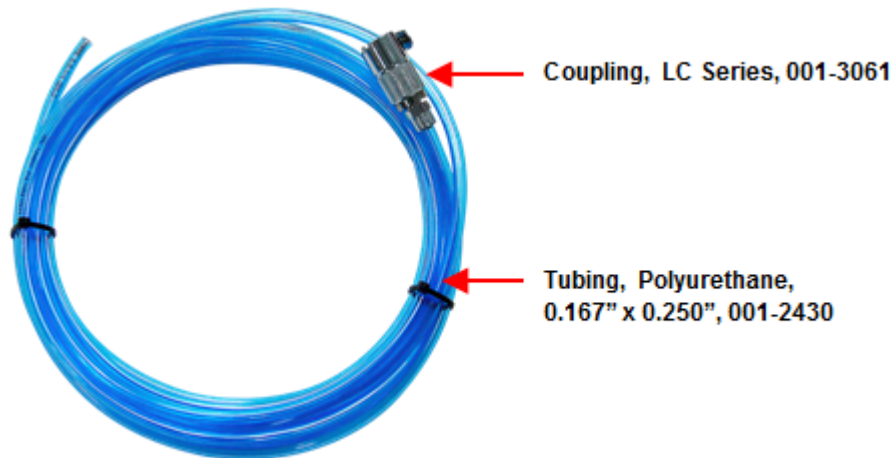
- **Chiller tubing:** The chiller tubing provides the coupling fluid circulation path between the Echo Liquid Handler and the chiller. The chiller maintains the fluid temperature at 22°C.

The tubing is sufficiently long to allow the chiller to be placed on the floor below the Echo Liquid Handler (for reduced vibration and good ventilation).

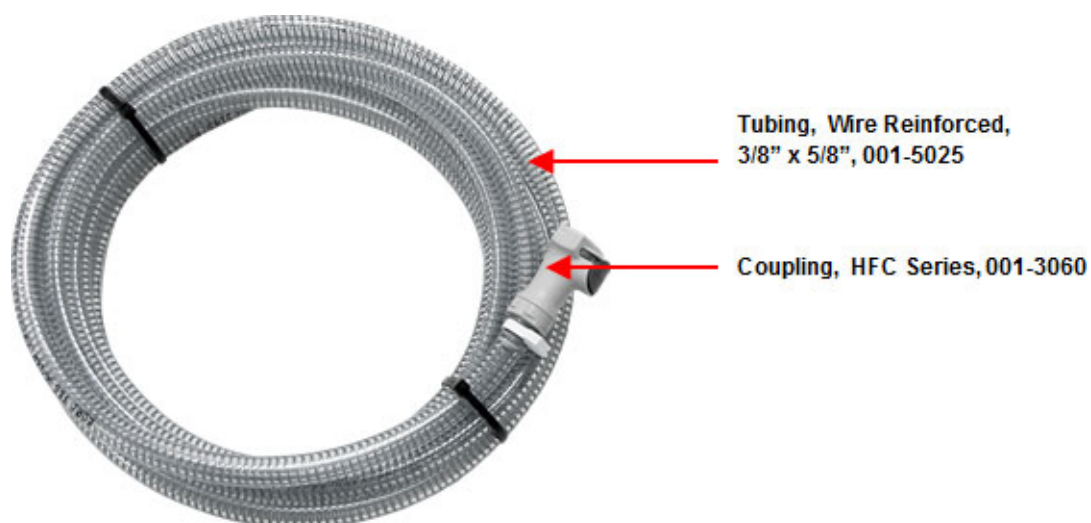


- **Compressed air connector:** The compressed air connector connects an external air supply to the Echo Liquid Handler and the dryer.

NOTE Use clean, dry air. Air pressure must be between 80 to 150 psi.



- **Vacuum connector:** The vacuum connector shown below connects the Echo Liquid Handler to a user supplied vacuum source. If the vacuum falls below minimum recommended levels, an error message is sent to the Echo Liquid Handler and the coupling fluid pump will shut down.



- **Surge tank connector:** The surge tank connector shown below is used to connect to a 10 L surge tank which comes standard with the Echo Liquid Handler system. One end may be removed and connected directly to the house vacuum connector if required. When vacuum demand is at its highest, the surge tank ensures a continuous source of vacuum. It prevents system errors resulting from low vacuum in laboratories where house vacuum barely meets the minimum vacuum requirement or is inconsistent due to other laboratory demands.



Barcodes

The Echo Liquid Handler optionally includes one or more barcode scanners. The location of each scanner depends on the location of your barcode labels on the microplates.

You can only specify one location at-a-time for a plate. That is, you can specify that a barcode is on the West, South, or East side. If the Echo has been configured for West-side reads, then both source and destination plates must have West-side barcodes. If the Echo has been configured to East-side

reads, then both source and destination plates must have East-side barcodes. If a Southside reader is present, you can mix and match plates with South-side barcodes and either West or East side reads.

Chiller

The SMC chiller (001-11149) is included with your Echo system. The SMC chiller utilizes a stainless steel thermoelectric (Peltier) heat exchanger that regulates fluid temperature.

- The SMC chiller ships preconfigured for operation with Echo Liquid Handlers
- Weight: 14 kg (31 lbs)
- Dimensions:
 - Width: 30 cm (11.8 in) plus fittings
 - Depth: 34 cm (13.4 in)
 - Height: 18 cm (36.4 in)
- The SMC chiller uses an autoswitching power supply capable of running any single phase AC voltage in the range 100–240V, 50–60 Hz
 - A power cord suitable for the install location is provided
 - Maximum power is 500W
- The SMC chiller controls the temperature to ± 0.02 °C by cooling and heating as appropriate
- The SMC chiller is air cooled
- Ambient Operating Conditions
 - Temperature: 10-35 °C
 - Relative Humidity: 35-80%

NOTE The SMC chiller is not connected to the Echo Stop circuit. If the Stop is activated, the SMC chiller needs to be turned off separately.

NOTE It is recommended that the coupling fluid chiller be placed within 121.9 cm (48 in) of the Echo Liquid Handler.

Table 1.3 SMC Configurations Supported

Chiller Configuration	Part Number
SMC Chiller	001-11149 SMC Chiller, 100-240V, 50-60Hz 001-11168 SMC Chiller Upgrade Kit (Must be purchased separately)

A Beckman Coulter service representative will set up the chiller with the Echo system. Refer to the following sections for safety information, equipment setup (if the Echo system is relocated), operation, and troubleshooting.

Figure 1.21 SMC chiller



Safety Warnings and Precautions

The SMC chiller has been designed for safe operation. Observe all safety warnings and precautions in this section during installation, relocation, maintenance, and normal operation of a chiller.

WARNING

Do not use the chiller if the power cord is frayed. This condition can cause a shock hazard.

WARNING

Do not disassemble the chiller:

- Access to internal components can cause a shock hazard.
- Improper servicing can damage the chiller unit and void the warranty.

WARNING

Avoid strikes to the housing, vibrations, damage to the control panel, and contamination.

WARNING

Make sure that the mains power supply has low impedance to avoid any negative effects on instruments being operated on the same mains.

 WARNING

Protect the unit from contamination.

 WARNING

This unit is designed for operation in a controlled electromagnetic environment. Therefore, transmitting devices (such as mobile phones) should not be used in the immediate vicinity. Magnetic radiation may affect other devices with components sensitive to magnetic fields.

 WARNING

Do not expose the unit to sunlight.

 CAUTION

Do not operate the chiller above 35°C.

 CAUTION

Do not store the chiller above 70°C.

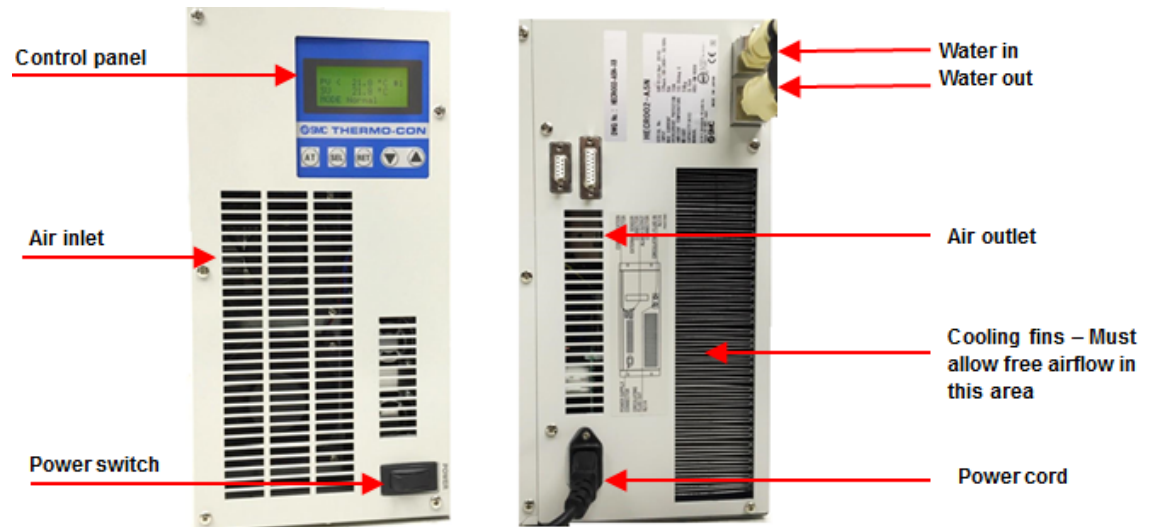
 CAUTION

Do not obstruct the rear air outlet and cooling fans; restriction of air flow will impair performance. Maintain a minimum of 3-inch clearance around the rear air outlet and cooling fans.

Chiller Setup

A Beckman Coulter service representative will set up the chiller during Echo Liquid Handler installation. If you need to set up the chiller again (for example, after relocation of the Echo Liquid Handler), use the procedure below. The references in parenthesis throughout the steps refer to the callouts in the chiller image below.

Figure 1.22 Front and rear view for SMC chiller



- 1 Place the chiller on a stable base under the Echo Liquid Handler or on a stable base beside the Echo Liquid Handler. Avoid exposure to strong vibrations and shock.

NOTE It is assumed that the chiller is being set up in a typical laboratory environment. Avoid direct exposure to water/steam, oil, chemicals, or prolonged sunlight.



- 2 Ensure the chiller is setup so that there is free airflow around the air inlets at the front of the chiller and at the air outlet and cooling fins at the back of the chiller.

NOTE Do not place the chiller in a sealed enclosure.

- 3 Connect the chiller tubing to the **Echo (Water in) > Chiller (Water out)** and **Echo (Water out) > Chiller (Water in)** as shown above.

NOTE The connectors are keyed so they can only be installed in the correct configuration. Do not modify the connectors.

- 4 The connectors are keyed so they can only be installed in the correct configuration. Do not modify the connectors.

-
- 5 Connect chiller power cable to a correctly grounded power outlet in your facility using the provided cable.
-



- 6 Toggle the power switch to the | or on position .
- The chiller control panel lights up and displays the firmware version for about a second.
 - It displays the normal operation screen.
 - The chiller starts controlling temperature immediately.

NOTE The parameters in the control panel are explained below:

PV – Current or Present Value for temperature.

SV – Target or Setpoint Value for temperature.

If an alarm arises, the error code is indicated in the top line.

Mode - Indicates operation mode.



-
- 7 If necessary, press **SEL** button to change the setpoint value.
- a. The **MODE** parameter on the control panel will change from **Normal** to **blank**.

- b. The “ < ” indicator on the control panel switches from **PV** to **SV**.



- c. Press the **Up Arrow** or **Down Arrow** buttons to change the temperature setpoint value (SV) to the desired number.
- d. Press the **RET** button to confirm the change.

NOTE If the **RET** button is not pressed within 1 minute from the last button press, the unit will revert to the initial settings.

NOTE Settings are permanent even if the chiller is powered down.

Powering Down the Chiller

To power down the chiller, toggle the power switch to the **O** position. Wait a minimum of 3 seconds before turning the power back on.

NOTE If the chiller will remain powered down for an extended period of time, drain the fluid from the interior. Store the chiller with the power cord and fluid lines disconnected.

Chiller Maintenance

It is recommended to inspect the chiller periodically to ensure there are no leaks.

It is also recommended to periodically inspect the air inlet/outlet and cooling fins to make sure they are not obstructed by dust. Remove any accumulated dust using a vacuum cleaner.

NOTE Do not use liquid cleaners in these areas.

Chiller Troubleshooting

The SMC chiller utilizes a stainless steel thermoelectric (Peltier) heat exchanger to regulate coupling fluid temperature. If the coupling fluid temperature at the Echo Liquid Handler is poorly controlled, and there are no errors at the chiller, check for any flow obstructions, such as a kink in the tubing or a blocked filter.

In case a power cord replacement is required, order the correct Echo Liquid Handler power cord for your region since the chiller power cord is the same as the Echo Liquid Handler power cord.

In cases where a chiller error occurs, the chiller control panel displays an error code. See the table below for details on error codes, descriptions, and corresponding user actions.

Error Code	Description	User Action
WRN	Temperature Limit Warning	Check that the heat load from the Echo Liquid Handler is normal and ambient temperatures are in specified range.
ERR01	System Error	Toggle the chiller power using the switch on the front panel. If the unit does not recover, contact us .
ERR02	System Error	Toggle the chiller power using the switch on the front panel. If the unit does not recover, contact us .
ERR03	System Error	Toggle the chiller power using the switch on the front panel. If the unit does not recover, contact us .
ERR11	DC Power Supply Failure	Check the input voltage to the chiller. Check for obstruction of the cooling fan (visible through the air inlet).
ERR12	Internal overheat temperature sensor has tripped	Check that the ambient conditions are in range and there is good airflow around the chiller.
ERR13	Internal low temperature sensor has tripped	Check that the ambient conditions are in range and there is good airflow around the chiller.
ERR14	Thermostat Alarm	Contact us .
ERR15	Thermal Overload	This can occur even if the warning limits are not reached when the chiller cannot change the temperature to the setpoint at 100% heating/cooling output. Check that the heat load from the Echo Liquid Handler is normal and ambient temperatures are in specified range.

For additional information on the SMC chiller maintenance procedures, refer to the SMC chiller manual.

Consumables

The consumables and corresponding specifications recommended to be used with the Echo Liquid Handler are listed below:

Table 1.4 Compatible Source Plates for Echo 525 Liquid Handler

	384PP Plate		384PP Plus Plate		384LDV Plus Plate		Echo Qualified Reservoir	
Number of Wells	384		384		384		6	
Surface Treated	No		Yes		Yes		Yes	
Volume Range (μL)	20–65		20–65		4.5–14		250–2,800	
Working Volume (μL)	45		45		9.5		2,550	
	Calibration	Example Fluids	Calibration	Example Fluids	Calibration	Example Fluids	Calibration	Example Fluids
Calibration and Example Fluids	384PP_AQ_BP	buffer with protein	384PP_Plus_AQ_BP	buffer with protein	384LDV_AQ_GP	buffer with glycerol, protein	6RES_AQ_BP2	buffer 0–30% V/V glycerol and 0–2.5% CMC surfactant
	384PP_AQ_SP	buffer with surfactant and protein	384PP_Plus_AQ_SP	buffer with surfactant and protein			6RES_AQ_GPSA2	buffer 0–30% V/V glycerol and 2.5–30% CMC surfactant
	384PP_AQ_SPHigh	buffer with surfactant and protein, surfactant >= 50% CMC (Critical Micelle Concentration	384PP_Plus_AQ_GP	buffer with glycerol and protein			6RES_AQ_GPSB2	buffer with 0–30% V/V glycerol and 30–50% CMC surfactant
			384PP_Plus_AQ_GPSA	buffer with glycerol, protein, and surfactant; surfactant 5–14% CMC				
			384PP_Plus_AQ_GPSB	buffer with glycerol, protein, and surfactant; surfactant 14–50% CMC				

Table 1.5 Source Microplate Specifications for Echo 525 Liquid Handler

	384PP Plate	384PP Plus Plate	384LDV Plus Plate	Echo Qualified Reservoir
Dead Volume (μL) ^a	20 μL	20 μL	4.5 μL	250 μL
Max Fill Volume (μL) ^a	65 μL	65 μL ^b	14 μL	2800 μL
Wicking	No limitation	Max fill of 40 μL for 50–200% Critical Micelle Concentration (CMC) ^c	Max fill of 8 μL for 2 hours for 50% Critical Micelle Concentration (CMC) ^c	No limitation
Centrifugation Recommendation ^d	1500 g's for 5 min	1500 g's for 5 min	1500 g's for 5 min	1500 g's for 5 min
Echo Insert Type	2.1 mm	2.1 mm	4.5 mm	2.1 mm
BP	0–2% CMC	0–5% CMC	N/A	N/A
SP	5–50% CMC	2.5–50% CMC	N/A	N/A
SPHigh	200% CMC	N/A	N/A	N/A
GP	N/A	0–50% Glycerol and 0–5% CMC	0–50% Glycerol	N/A
GPSA	N/A	0–50% Glycerol and 5–14% CMC	N/A	N/A
GPSB	N/A	0–50% Glycerol and 14–50% CMC	N/A	N/A
BP2	N/A	N/A	N/A	0–30% Glycerol and 0–2% CMC
GPSA2	N/A	N/A	N/A	0–30% Glycerol and 2–30% CMC
GPSB2	N/A	N/A	N/A	0–30% Glycerol and 30–50% CMC GP

a. Varies with fluid properties. May be lower.

b. Max of 40 μL for fluid with >50% Critical Micelle Concentration (CMC) for long term storage, due to wicking.

c. Not recommended for long term storage of fluids containing surfactants, at levels > 50% Critical Micelle Concentration (CMC).

d. Recommended to remove bubbles caused by the filling process or reagent outgassing.

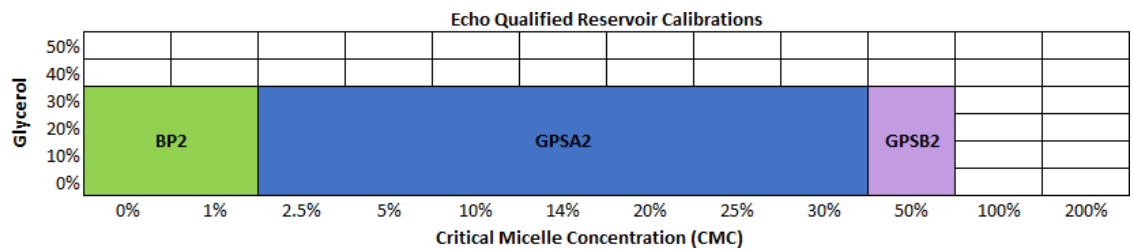
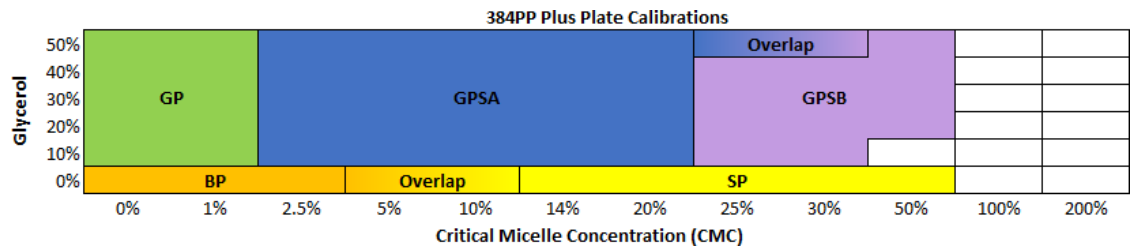
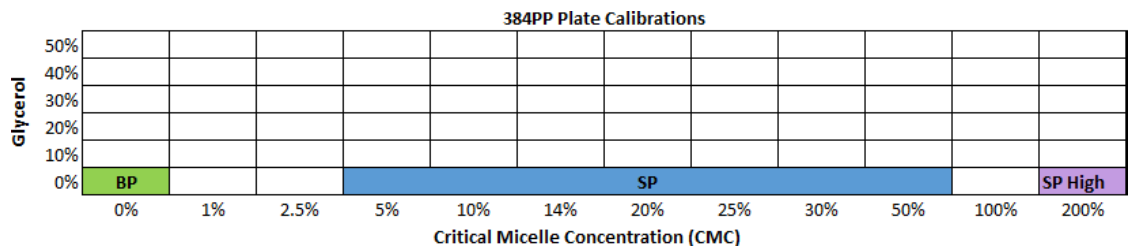
For more details on CMC conversions, see the [Critical Micelle Concentrations](#) topic.

NOTE The 384PP Plus plate is the optimal source plate for the Echo 525 Liquid Handler. The 384PP plate may be used, but accuracy and precision may be compromised for certain fluid types and destination plates. The 384PP Plus plate and the Echo Qualified Reservoir are only designed for use with the Echo 525 Liquid Handler and are not compatible with any other models of Echo Liquid Handlers.

Please [contact us](#), if you have any questions in determining what source plate options best fit your needs.

NOTE By design, the 384PP Plus plate has improved drop placement. Therefore, Beckman Coulter recommends using 384PP Plus plates rather than 384PP plates when transferring to 1536 targets. Use of 1536 well plates as destination plates is application dependent.

The tables below illustrate the glycerol and CMC percentage ranges for each plate calibration.



Critical Micelle Concentrations

The following tables provide critical micelle concentration conversion values.

Critical Micelle Concentration: Percent Weight to Volume Conversions Table

Concentration (% Weight/Volume)			% Critical Micelle Concentration (CMC)							
Detergent	Type	MW ¹	0	2.5	5	10	14	50	100	200
Triton X-100 ³	Non-Ionic	628.00	0	3.88E-04	7.75E-04	1.55E-03	2.17E-03	7.75E-03	1.55E-02	3.10E-02
Tween 20 ³	Non-Ionic	1228.00	0	1.85E-04	3.70E-04	7.40E-04	1.04E-03	3.70E-03	7.40E-03	1.48E-02
SDS ^{3,6}	Anionic	288.38	0	5.00E-03	1.00E-02	2.00E-02	2.80E-02	1.00E-01	2.00E-01	4.00E-01
Brij 35 ³	Non-Ionic	1200.00	0	2.75E-03	5.50E-03	1.10E-02	1.54E-02	5.50E-02	1.10E-01	2.20E-01
NP-40 ³	Non-Ionic	680.00	0	4.48E-04	8.95E-04	1.79E-03	2.51E-03	8.95E-03	1.79E-02	3.58E-02
Chaps ^{3,7,10,11}	Zwitterionic	614.88	0	1.38E-03	2.75E-02	5.50E-02	7.70E-02	2.75E-01	5.50E-01	1.10E+00
CTAB ^{8,9,12}	Cationic	364.45	0	9.11E-03	1.82E-02	3.65E-02	5.10E-02	1.82E-01	3.65E-01	7.29E-01
Pluronic F-68 ³	Non-Ionic	8350.00	0	8.25E-04	1.65E-03	3.30E-03	4.62E-03	1.65E-02	3.30E-02	6.60E-02

Critical Micelle Concentration: Concentration in mM Conversions Table

Concentration (mM)			% Critical Micelle Concentration (CMC)							
Detergent	Type	MV	0	2.5	5	10	14	50	100	200
Triton X-100 ³	Non-Ionic	628.00	0	6.00E-03	1.20E-02	2.40E-02	3.36E-02	1.20E-01	2.40E-01	4.80E-01
Tween 20 ¹	Non-Ionic	1228.00	0	1.50E-03	3.00E-03	6.00E-03	8.40E-03	3.00E-02	6.00E-02	1.20E-01
SDS ^{3,6}	Anionic	288.38	0	1.75E-01	3.50E-01	7.00E-01	9.80E-01	3.50E+00	7.00E+00	1.40E+01
Brij 35 ¹	Non-Ionic	1200.00	0	2.25E-03	4.50E-03	9.00E-03	1.26E-02	4.50E-02	9.00E-02	1.80E-01
NP-40 ³	Non-Ionic	680.00	0	7.25E-03	1.45E-02	2.90E-02	4.06E-02	1.45E-01	2.90E-01	5.80E-01
Chaps ^{1,3,7,10,11}	Zwitterionic	614.88	0	2.25E-01	4.50E-01	9.00E-01	1.26E+00	4.50E+00	9.00E+00	1.80E+01
CTAB ^{3,8,12}	Cationic	364.45	0	2.50E-02	5.00E-02	1.00E-01	1.40E-01	5.00E-01	1.00E+00	2.00E+00
Pluronic F-68 ¹	Non-Ionic	8350.00	0	1.00E-04	2.00E-03	4.00E-03	5.60E-03	2.00E-02	4.00E-02	8.00E-02

¹ Sigma Aldrich, Biological Detergents Poster.

² Calbiochem Guide to Detergents (booklets), 2001.

³ Pierce/Thermo Scientific website - Detergents for Cell Lysis and Protein Extraction
<http://www.piercenet.com/method/detergents-cell-lysis-protein-extraction#detergent-types>

⁴ Surfactants from Renewable Resources, M. Kjellin and I. Johansson, editors. Wiley. p. 245. 2010.

⁵ Sigma Aldrich Hexadecyltrimethylammonium bromide (H 6269) product information sheet.

⁶ The CMC for SDS has a range of 6-8 mM, depending on the temperature and salt concentration.

⁷ The CMC for Chaps has a range of 4.3-10 mM, depending on the temperature and salt concentration.

⁸ The CMC for CTAB has a range of 0.2-1.1 mM, depending on the temperature and salt concentration.

⁹ Calculated from CMC (mM) value.

¹⁰ Micellar properties of the zwitterionic bile derivative CHAPS. 1988. (Upper bound, pure water value, and pH & temperature insensitivity) <http://www.ncbi.nlm.nih.gov/pubmed/3365263>

¹¹ Membrane Protein Solubilization: Recent Advances and Challenges in Solubilization of Serotonin Receptors. 2005. (Lower bound)
<http://onlinelibrary.wiley.com/doi/10.1080/15216540500167237/pdf>

¹² Colloids and Surfaces A: Physicochem. Eng. Aspects 290 (2006) 206–212.

NOTE CMC is based on the surfactant in water at room temperature. Additives and changes in temperature will impact these values.

Client PC (Sold separately by Beckman Coulter)

Client PC specifications:

- Software license key from Beckman Coulter Inc.
- Computer system meeting the following requirements:
 - **Operating system:** Microsoft Windows 10 64-bit, (must be run in Windows 7 Compatibility Mode); Microsoft .Net Framework 4.6
 - **CPU:** Intel Core™ i5 or later
 - **Memory:** 4 GB or greater
 - **Network connection:** 2 x 10/100/1000 BaseT
 - **Network protocol:** TCP/IP
 - **Hard drive:** 4 GB Free Space Available
 - **Video:** Minimum 1600 x 1200 resolution

Included Accessories:

- Monitor, 22 in, DVI-D/DP/VGA/HDMI
- USB Keyboard, Black
- USB Optical Mouse
- Beckman Coulter Mousepad

Software specifications:

Optionally, the following Echo software applications are available for purchase:

- Echo Plate Reformat
- Echo Dose-Response
- Echo Cherry Pick
- Echo Array Maker
- Echo Plate Audit
- Echo Combination Screen
- Echo 21CFR11 Compliance Manager

- Echo 21CFR11 Compliance Manager Admin

Customer Responsibilities

The customer is responsible for installing, configuring, and securing the Windows 10 operating system on their computer, including the creation of any user accounts and password complexity rules that may apply, and the application of any software patches and security updates that are necessary to keep the system secure. The customer is also responsible for installing anti-virus and anti-malware software and keeping the virus definitions from the vendor up to date so as to keep the computer safe.

The Echo application software accepts certain inputs, such as Sample ID and Sample Name, which the user might populate with personally identifiable information. Furthermore, the Echo application software uses those inputs to generate reports that are stored unencrypted on the disk. Accordingly, it is the responsibility of the customer to ensure that the information provided to the Echo application, and subsequent reports that are stored on the disk, do not contain any personally identifiable information, or that the information is obfuscated or encrypted when stored on the disk to comply with any applicable regulations related to data privacy and security.

CHAPTER 2

Installation and Relocation

Beckman Coulter installs the Echo Liquid Handler and Echo Liquid Handler software for the customer. However, site preparation and additional software installation are the customer's responsibility.

This chapter covers pre-installation requirements, additional software installation, and instrument relocation.

It also provides a brief overview of the shipment contents and installation steps performed by Beckman Coulter field engineers.

- [Pre-Installation Requirements](#)
- [Installation Overview](#)
- [Echo Liquid Handler Software Installation](#)
- [Instrument Relocation](#)

Pre-Installation Requirements

The pre-installation requirements are described in the topics below:

- [Site Requirements](#)
- [Additional Components](#)

Site Requirements

The following site requirements must be met before the Echo Liquid Handler can be installed:

- **Operating environment:**
 - Temperature: $21^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($70^{\circ}\text{F} \pm 9^{\circ}\text{F}$)
 - Relative humidity: 10-80%, non-condensing
- **AC power (2 options):**
 - 100–120 V, 50/60 Hz, > 10A
 - 200–230 V, 50/60 Hz, > 5A
- **Compressed air source:**
 - Clean, filtered, oil-free, dry air at 552 kPa (80 PSI) minimum, 1034 kPa (150 PSI) maximum
 - Maximum consumption by Echo Liquid Handler does not exceed 1 cfm at 150 PSI

The user must also provide a fitting between the compressed air supply and the Echo Liquid Handler. Beckman Coulter provides the compressed air line and fitting with the Echo Liquid Handler, but the customer must provide a source compatible with 170 in ID/.250 in OD tubing.

NOTE The power configuration is factory set and cannot be changed onsite.

- **Vacuum source (2 options):**

Vacuum returns the coupling fluid to the supply bottle and dries source plates before they are unloaded. Customer must provide a fitting that connects 3/8 in ID, 5/8 in OD tubing to either house vacuum or vacuum pump. The supplied vacuum line is HercoBraid, 9.5 mm (3/8 in) ID, 9.5 mm (5/8 in) OD (RyanHerco P/N 0512-072).

Vacuum source should have the following specifications:

- House supply: Minimum 200 Torr (266 mbar, 22 in Hg Vac) minimum pumping speed 8.0 m³/hr
- Standalone vacuum with surge tank (10 L): 100 Torr (133 mbar, 26 in Hg Vac), minimum pumping speed 2.0 m³/hr

NOTE The 10 L surge tank comes standard with the Echo Liquid Handler to ensure consistent vacuum.

- **Electrical Sockets Required:**

- One mains outlet for Echo Liquid Handler
- One mains outlet for Chiller
- One mains outlet for Client PC
- One mains outlet for monitor
- One mains outlet for Vacuum pump (if not using house vacuum)
- One mains outlet for Compressor (if not using house air)

- **Operating space envelope (minimum):**

- Width: 61 cm (24 in) with bottle caddy in back
- Depth: 99 cm (39 in) including 30.5 cm (12 in) of exhaust space behind the instrument
- Height: 97 cm (38.2 in)

- **Clearance:**

- **Top:** It is recommended to have 25.4 cm (10 in) above the instrument to remove the top cover for servicing.

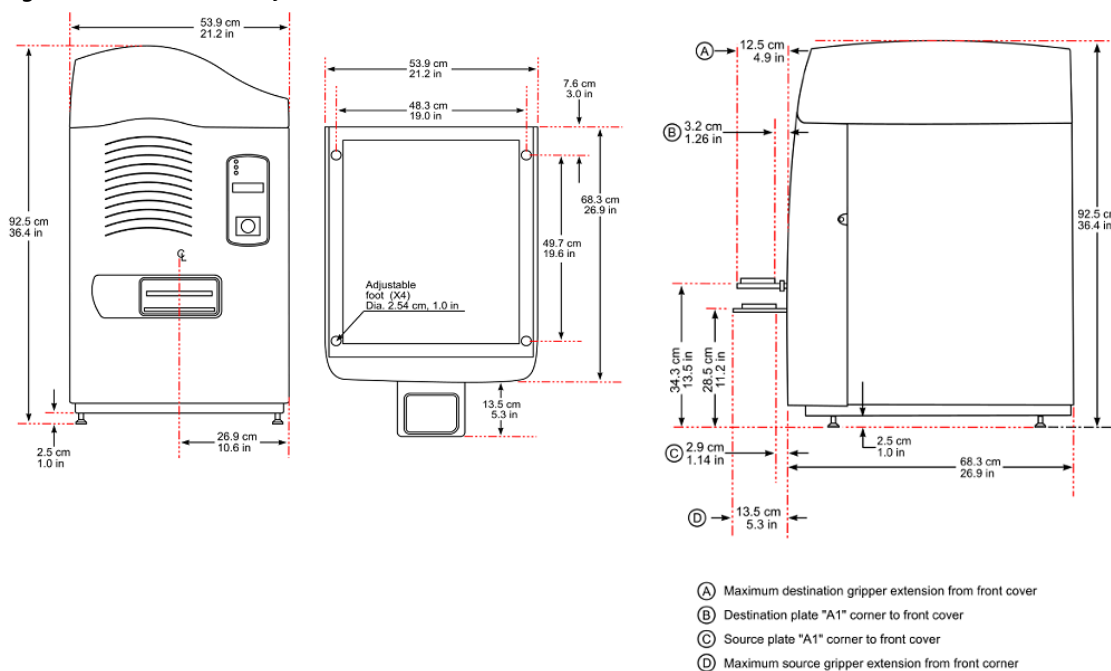
NOTE The instrument can be installed with a minimum of 2.5 cm (1 in) if there is sufficient space to lift the top and slide it all the way forward. [Contact us](#) for additional details.

- **Front:** It is recommended to have 40.6 cm (16 in) to allow sufficient clearance to load and unload microplates by hand or by robot.
- **Side:** It is recommended to have 121.9 cm (48 in) minimum on left and right sides to allow for serviceability. The Echo Liquid Handler should have sufficient space to be rotated, otherwise, it will need to be removable for service.

- **Rear:** It is recommended to have 30.5 cm (12 in) minimum behind the instrument to allow for cables, hoses, tubing, and maintenance access.

NOTE Additional space for the client PC, coupling fluid chiller (if it is on the work surface), any robotics in the system, and microplates must also be considered. The coupling fluid bottle and caddy fit within the rear clearance.

Figure 2.1 Instrument Layout (Front View, Side View, Bottom View)



Additional Components

The following components are needed to work with the Echo Liquid Handler:

- **Client PC** (customer's computer) running the Echo Liquid Handler software to monitor and control the Echo Liquid Handler. See [CHAPTER 1, Client PC specifications](#).

NOTE If you are integrating the Echo Liquid Handler into an automated HTS (High Throughput Screening) system and need to install the Client + Server software onto a workstation, it must contain an Intel Core i5 processor or better.

NOTE A Client PC can be purchased directly from Beckman Coulter (Part #ECHO-Client Computer). For information on the Client PC available from Beckman Coulter, see [CHAPTER 1, Client PC specifications](#).

NOTE To run Microsoft Windows 10 on the Client PC, see the [Echo Liquid Handler Software Installation Procedure for Microsoft Windows 10 64-bit OS](#) topic. The Microsoft Windows 10 option is **ONLY** available on standalone Echo Liquid Handlers and not on the Access Laboratory Workstation.

- **Network IP address:** A static IP address must be allocated for the Echo Liquid Handler. If you cannot use the pre-configured IP address (192.168.0.25) on your network, or if you are installing

more than one Echo Liquid Handler, use the Echo Admin Client (included on the Echo Server 2.6 disk) to change the IP address on the client PC.

- Standalone Echo Liquid Handler IP address: **192.168.0.25**
- Echo Liquid Handler connected to Access or POD IP address: **192.168.0.25**
- **Mounting surface (minimum):** The Echo Liquid Handler can emit vibration while in operation and is susceptible to vibration from other devices. For this reason, the Echo system should be placed on a sturdy surface that is isolated from surrounding equipment or designed to suppress the transmission of vibration from devices. The surface must be sturdy, level, and water-resistant with cross-bracing or welded joints. The surface must be capable of supporting a minimum of 128 kg (283 lbs) weight with sufficient surface area to accommodate the Echo Liquid Handler in the recommended operating envelope. If the mounting surface is a table top, the table legs should not rest on casters. If the table has casters, they should be locked.

Components Included with the Echo Liquid Handler

The following components are included with the Echo Liquid Handler:

- **Plate Inserts:**
 - 384-well LDV plate insert (001-6291), 4.5 mm insert size.
 - 384-well propylene plate and 6-well Echo Qualified Reservoir plate insert (001-11366), 2.1 mm insert size.
- **Vacuum line:** HercoBraid, 9.5 mm (3/8 in) ID, 9.5 mm (5/8 in) OD (RyanHerco P/N 0512-072). HFCD 17612 coupling body (Colder Products).
- **Vacuum Surge Tank Assembly:** Not required but included with the Echo (P/N 001-5150).
- **Compressed air line:** 15 feet of polyurethane tubing; 6.35 mm (0.25 in) OD, 4.24 mm (0.167 in) ID (SMC Pneumatics P/N TIUB07-BU). LCD 13004 coupling body (Colder Products).
- **Coupling fluid bottle:** 1 L (P/N 001-5438).
- **Accessory kit:** Includes tubing and power cord for connecting the chiller (P/N 001-12466).
- **SMC chiller:** P/N 001-11149.
- **Ethernet cable:** Crossover, 10 ft.
- **AC power and configuration and fuses:**

Table 2.1 Electrical Configurations for the Echo Liquid Handler

Voltage	Frequency	Power	Fuse
100–120 V	50 Hz	8 A	115 VAC, 10 A, FAST (P/N 001-3966)
100–120 V	60 Hz	8 A	115 VAC, 10 A, FAST (P/N 001-3966)
200–230 V	50 Hz	5 A	250 VAC, 5 A, FAST (P/N 001-3967)
200–230 V	60 Hz	5 A	250 VAC, 5 A, FAST (P/N 001-3967)

NOTE The power cord may need to be replaced with one conforming to local AC power receptacles. To determine which AC power configuration you have, see the Product Label on the back panel of the Echo Liquid Handler.

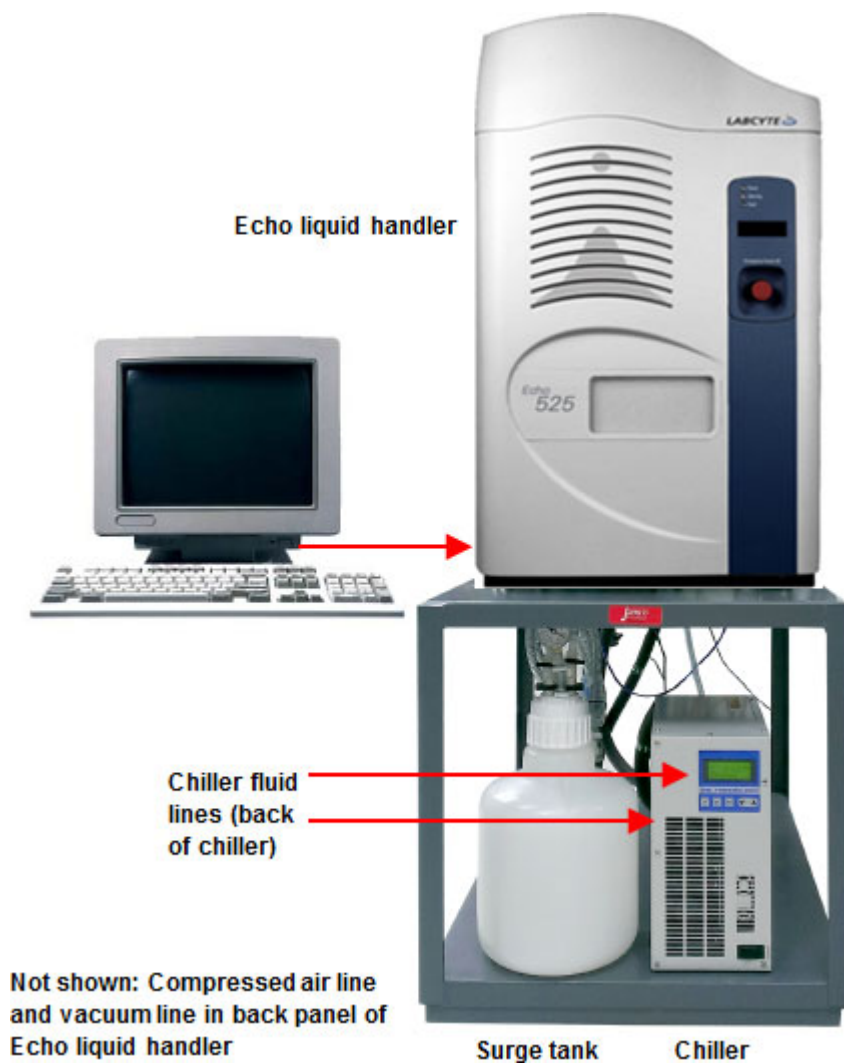
- Echo Liquid Handler software installation CD, including Echo Liquid Handler User Guide.

Installation Overview

The Echo Liquid Handler is installed by Beckman Coulter field engineers. The following is a brief overview of the hardware and software installation steps they perform:

1. Unpack the Echo Liquid Handler and place it in the area that meets the minimum operating space requirement.
2. Connect the Echo Liquid Handler to AC power, air pressure, vacuum pressure, surge tank, coupling fluid bottle, and the coupling fluid chiller.
3. Fill the coupling fluid bottle and prime the coupling fluid circuit.
4. Perform a basic functional check of the Echo Liquid Handler.
5. Perform the Site Acceptance Test (SAT) process (optional).
6. Change the Echo IP address, if a different IP address is required by your system administrator.
7. Install the Echo Liquid Handler software onto the customer-supplied PC (client workstation).
8. Connect the client PC to the Echo Liquid Handler and verify communications.

Figure 2.2 Installed system



NOTE The surge tank is included with the Echo but not required. The surge tank should be used when the house vacuum does not support the volumetric flow required by the Echo.

Echo Liquid Handler Software Installation

Beckman Coulter installs the Echo Liquid Handler software onto the client PC that is connected to the Echo Liquid Handler. If you need to install the software onto additional computers, such as network PCs, use the instructions provided in this section. See [Multi-Client Considerations](#) for advantages and disadvantages of connecting more than one workstation.

NOTE If you are connecting the Echo Liquid Handler to a LAN via a hub, switch, or router, use a standard ethernet cable. If you are connecting the Echo Liquid Handler directly to a workstation, use the included “cross-over” Ethernet cable.

During installation the Echo Liquid Handler software will provide the following installation types:

- **Client (Only):** Installs the Echo Liquid Handler software onto the client PC that is connected to the Echo Liquid Handler (normal mode). The software allows the operator to communicate with, control, and monitor an Echo Liquid Handler through easy-to-use software screens (Graphical User Interface). This option requires a host name or IP address of the Echo server.
- **Client and Server:**
 - **Normal Mode** installs the Echo client software onto the client PC and the Echo server software onto the Echo controller. This software is installed by Beckman Coulter field engineers.
 - **Stub Mode** creates a virtual Echo instrument onto the client PC that developers can use to develop and test custom software.

NOTE Use this installation type only if you are writing your own programs that will call the Echo ActiveX programming interface. [Contact us](#) if you have any questions regarding this installation type.

Install the Echo Liquid Handler Software

The following procedure describes installation of Client (Only) software. For information on installing Client + Server software, refer to the Echo Integration Guide.

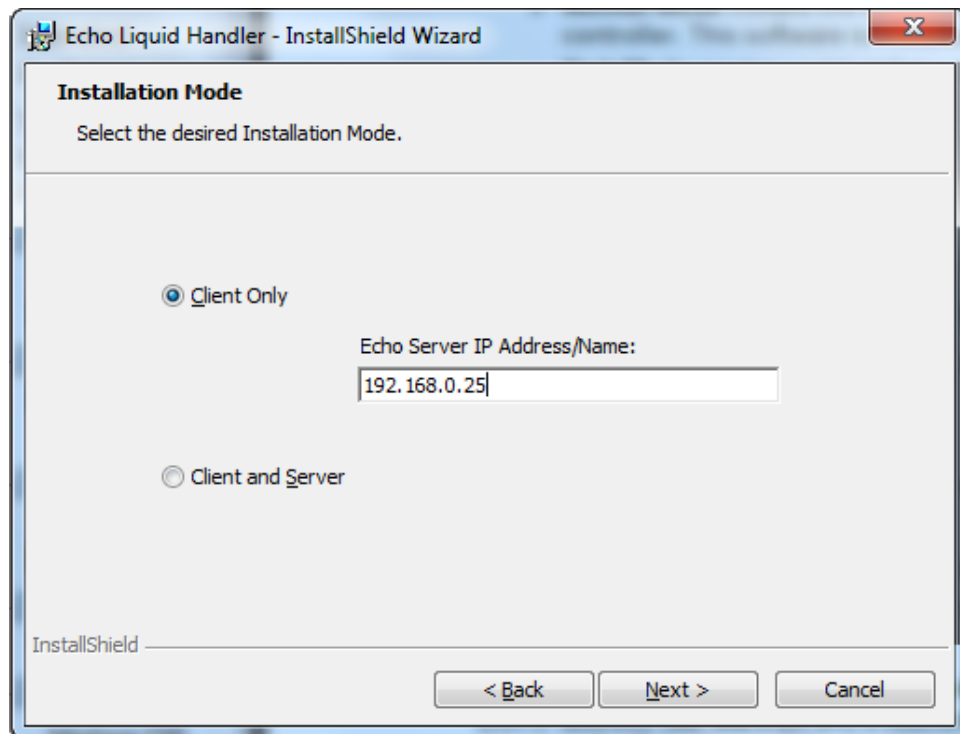
NOTE To run Microsoft Windows 10 on the Client PC, see the [Echo Liquid Handler Software Installation Procedure for Microsoft Windows 10 64-bit OS](#) topic. The Microsoft Windows 10 option is **ONLY** available on standalone Echo Liquid Handlers and not on the Access Laboratory Workstation.

To install Echo Liquid Handler software:

- 1 Insert the Echo Liquid Handler software installation CD into the CD drive. The installation should automatically start.
If the installation does not start:
 - a. Go to **My Computer** and double-click the drive icon for the CD drive.
 - b. Look for **setup.exe** in the directory on the CD and double-click the icon.
 - c. Select **Install Client (Only)**

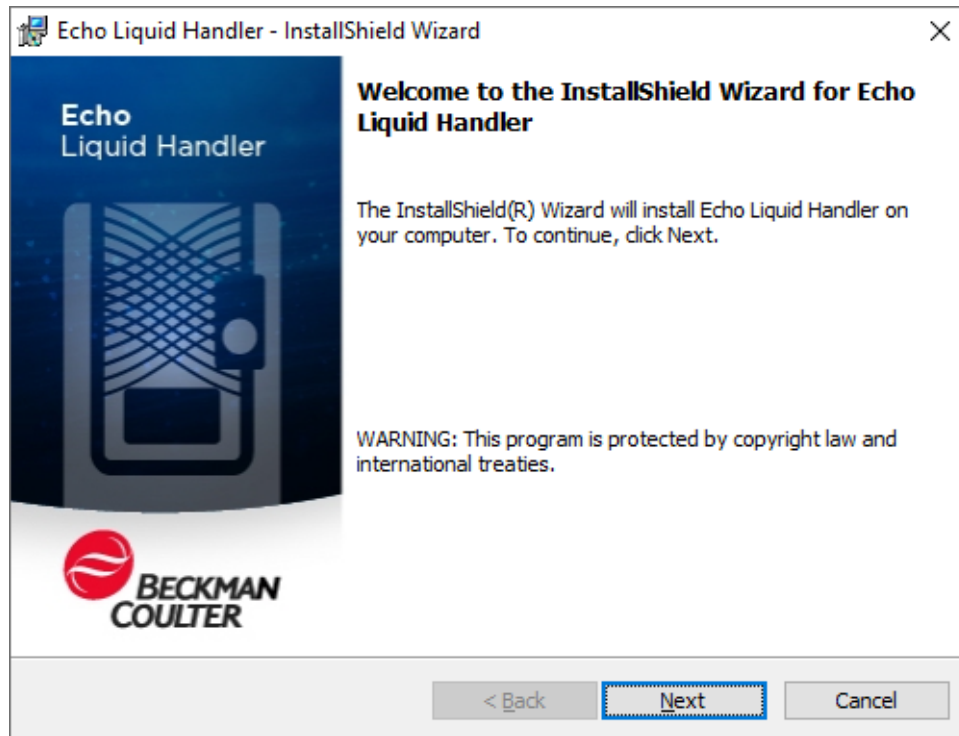
- 2 Enter the Host Name or IP address that will be used by the Echo server. The Echo Liquid Handler comes pre-configured with IP address **192.168.0.25** and a subnet mask of **255.255.0.0**. If you cannot use this IP address, run the Echo Admin Client on the Echo Server 2.6.x disk to enter a different IP address.

Figure 2.3 Entering host name



- 3 Click **Next** and then **Install** to start the installation. Edit or verify the previously entered information or selections by clicking the **Back** button.

Figure 2.4 Starting installation



A dialog window will report the installation's activity and progress.

- 4 Click the **Finish** button when the installation is done.

NOTE Read the release notes for information about the version of software being installed. The release notes are stored in the Echo Liquid Handler folder on your Windows Desktop for later viewing.

Echo Liquid Handler Software Installation Procedure for Microsoft Windows 10 64-bit OS

The minimum Client PC specifications for the Echo Liquid Handler software must be configured before installing Windows 10. For more information, see [Client PC \(minimum requirements\)](#).

To run an Echo Liquid Handler software on Microsoft Windows 10, the following guidelines must be adhered to:

- Microsoft Windows 10 installation should be done in Windows 7 Compatibility mode
- Applications should run in Windows 7 Compatibility mode

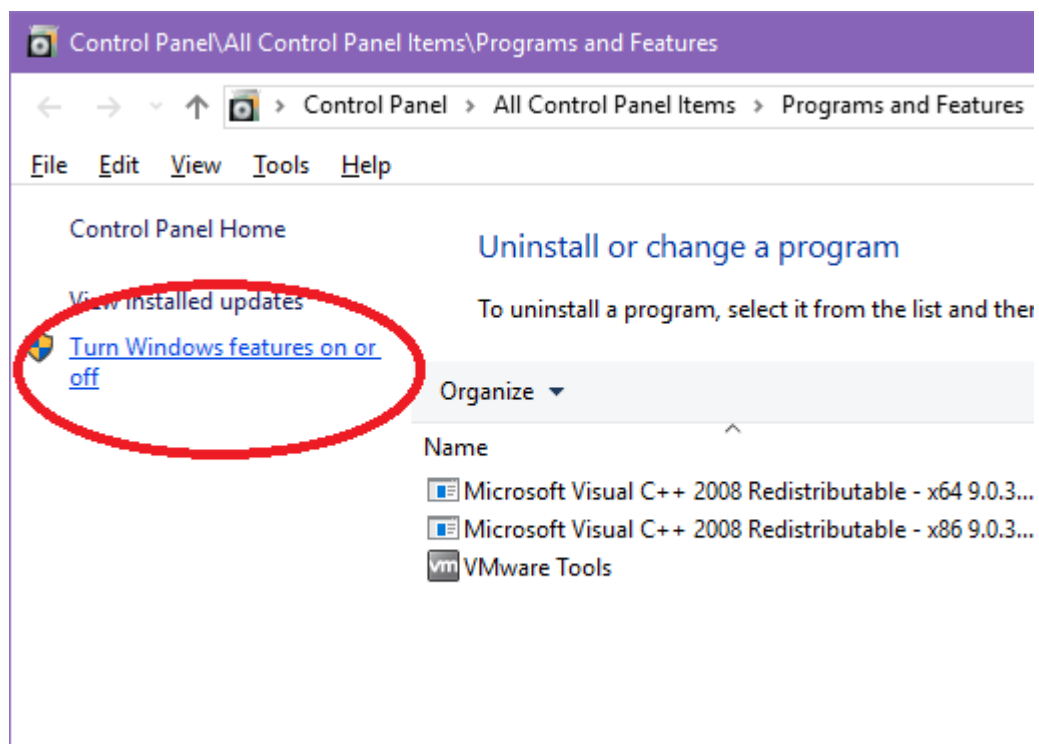
- Administrator access is not required
- Windows firewall adjustments are not required

The four areas that changes are required to run Echo Liquid Handler software on Windows 10 are listed below and described in detail in the sections following.

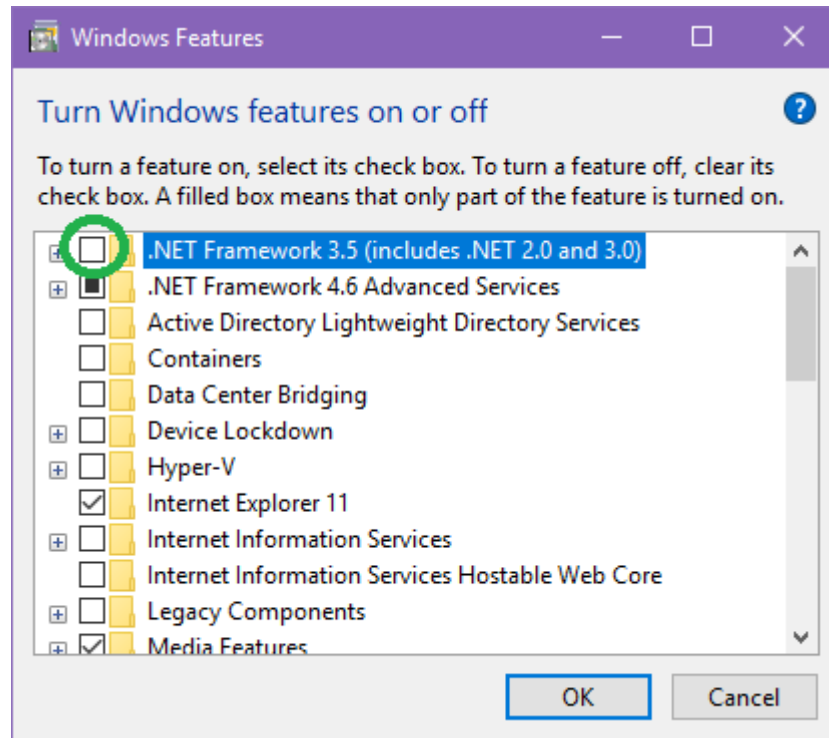
- OS support for Microsoft .NET versions 2.0 and 3.5 must be enabled
- Properties must be changed for the Echo GUI Client Installation
- Properties must be changed for Echo GUI compatibility
- Echo Apps installation procedure for Windows 10 64bit OS.

To enable OS support for Microsoft.NET (version 2.0 and 3.5):

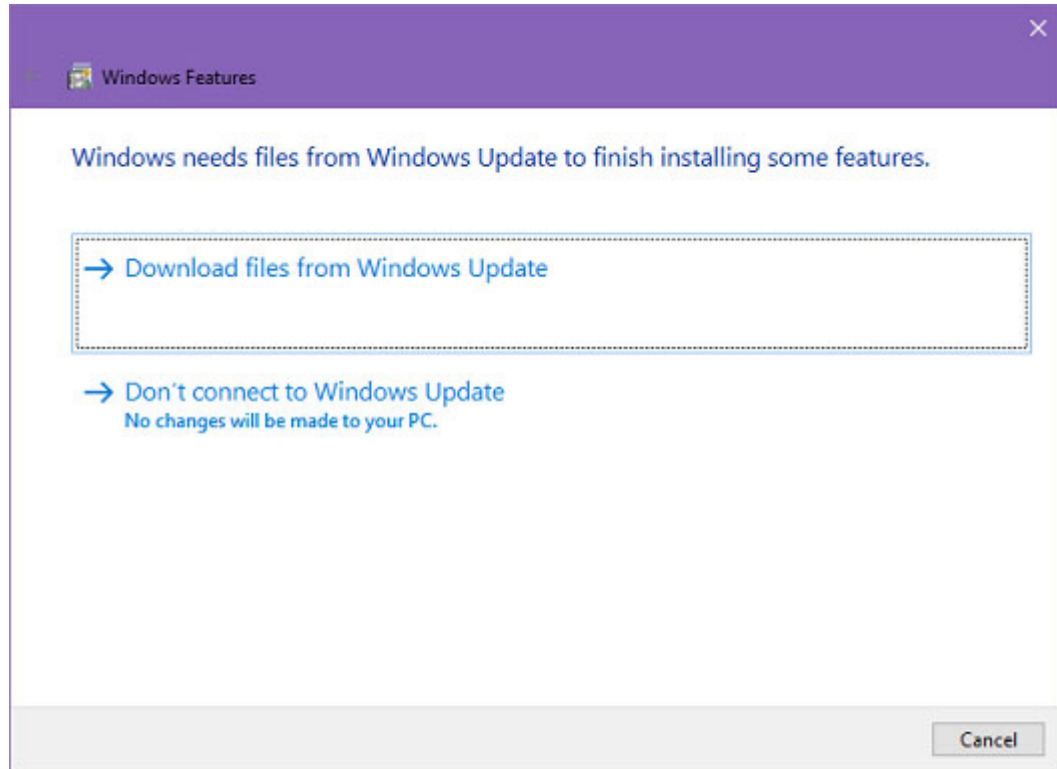
- 1 Open **Control Panel** and navigate to **Control Panel > All Control Panel Items > Programs and Features**.
- 2 Click the **Turn Windows features on or off** link.



- 3 Select the checkbox for the **.NET Framework 3.5 (Includes .NET 2.0 and 3.0)** feature in the **Windows Features** dialog box and click **OK**.



- 4 If a window appears with a request for the additional files, click **Download files from Windows Update**.



- 5 Wait for the installation to finish before moving on to the next steps.

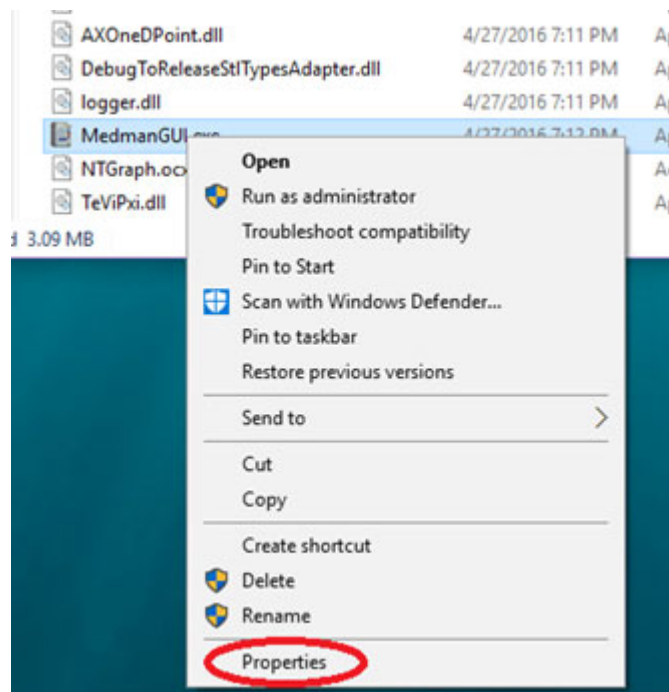
Change the following properties for the Echo Liquid Handler Software Installation:

- 1 Navigate to the Echo Liquid Handler software installation folder and locate **setup.exe**.
- 2 Right-click **setup.exe** and select **Properties**.
- 3 Navigate to the **Compatibility** tab.
- 4 Click **Change settings for all users**.
- 5 Select the **Run this program in compatibility mode for:** checkbox and select **Windows 7** from the drop-down listbox.

- 6 Click **Apply** and **OK** to apply the changes.
- 7 Click **OK** to close the **Properties** dialog box.
- 8 Execute **setup.exe** to complete the installation of the Echo Liquid Handler software in Windows 7 Compatibility mode.
- 9 Restart the PC to complete the installation.

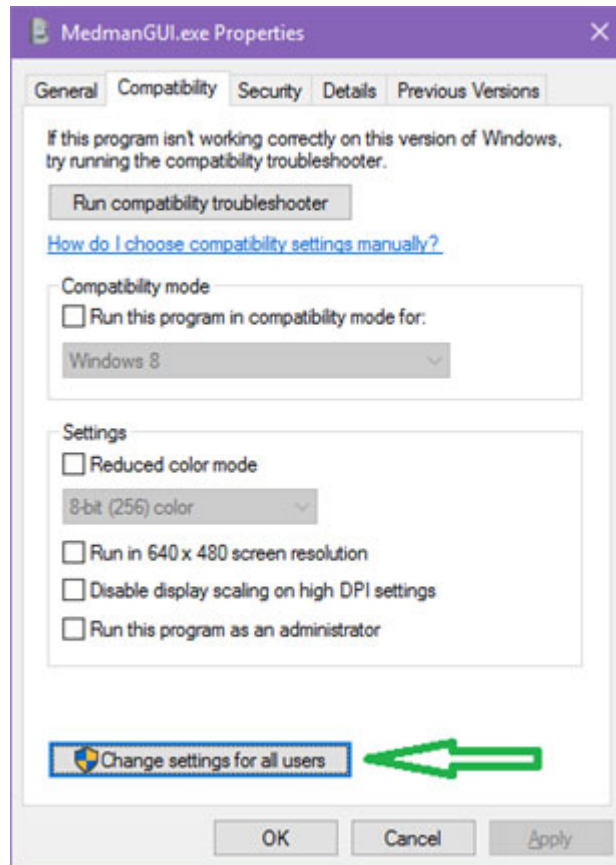
Change the following properties for Echo Liquid Handler Software compatibility:

- 1 Navigate to the Echo Liquid Handler software installation folder, **C:\Program Files (x86)\Beckman Coulter\Bin\Release folder**.
- 2 Right-click on the **MedmanGUI.exe** and select **Properties**.

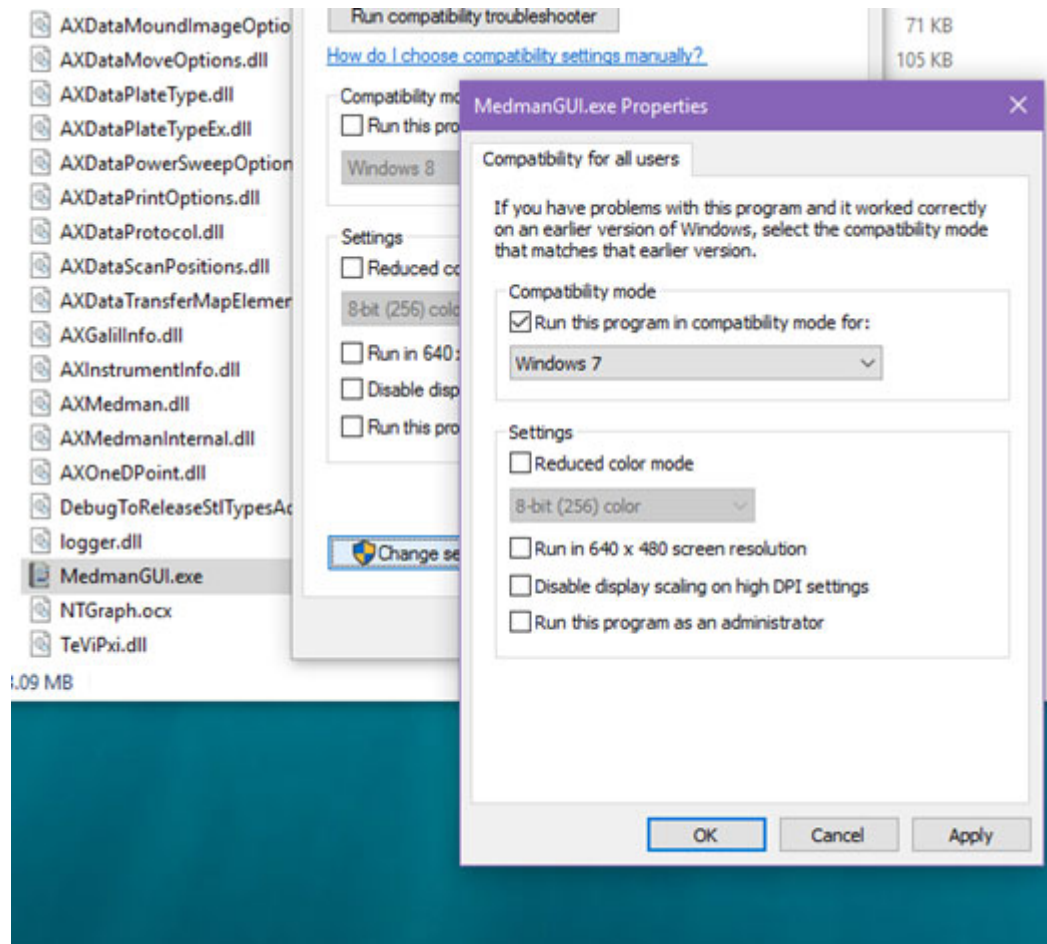


3 Navigate to the **Compatibility** tab.

4 Click **Change settings for all users**.



- 5 Select the **Run this program in compatibility mode for:** checkbox and select **Windows 7** from the drop-down listbox.



- 6 Click **Apply** and **OK** to apply the changes.
- 7 Click **OK** to close the Properties dialog box.

To install the Echo Software Applications for Windows 10 64-bit OS:

Echo Software Application Installation

- 1 For each Echo Software Application (Echo Plate Reformat, Echo Plate Audit, Echo Dose-Response, Echo Cherry Pick, Echo Array Maker, Echo Combination Screen), navigate to the installation folder and locate **setup.exe**.
- 2 Right-click **setup.exe** and select **Properties**.

- 3 Navigate to the **Compatibility** tab.
- 4 Click **Change settings for all users**.
- 5 Select the **Run this program in compatibility mode for:** checkbox and select **Windows 7** from the drop-down listbox.
- 6 Click **Apply** and **OK** to apply the changes.
- 7 Click **OK** to close the Properties dialog box.
- 8 Execute **setup.exe** to complete the installation of the Echo Software Application in **Windows 7** Compatibility mode.

Echo Software Application Compatibility Preparation

- 1 For each Echo Software Application, navigate to **C:\Program Files(x86)\Beckman Coulter*ApplicationName*** folder.
- 2 Right-click on ***ApplicationName.exe*** and select **Properties**.
- 3 Navigate to the **Compatibility** tab.
- 4 Click **Change settings for all users**.
- 5 Select the **Run this program in compatibility mode for:** checkbox and select Windows 7 from the drop-down listbox.
- 6 Click **Apply** and **OK** to apply the changes.
- 7 Click **OK** to close the **Properties** dialog box.

Uninstall the Echo Liquid Handler Software

If you need to uninstall the Echo Liquid Handler software, use the following procedure:

- 1 Click the **Start** button on the Windows Taskbar.
- 2 Point to **Settings** and select **Control Panel**.
- 3 Double-click **Add Or Remove Programs**.
- 4 Select Echo Liquid Handler and click **Remove**.

Upgrade the Echo Liquid Handler Software

Upgrading the software requires a new Echo Liquid Handler software CD. [Contact us](#) for the most current version.

Instrument Relocation

There are two ways to move the Echo Liquid Handler and they are explained in the topics below:

- [Prepare the Echo Liquid Handler for a move](#)
- [Reinstall the Echo Liquid Handler after a move](#)

NOTE If you do not plan to set up the Echo Liquid Handler within two weeks, refer to [Extended Non-Use and Storage](#).

Prepare the Echo Liquid Handler for a move

Use the following procedure if the Echo Liquid Handler must be moved:

- 1 Determine if the move must involve Beckman Coulter.
 - If the move requires transportation (truck, air, train) [contact us](#). Do not attempt to move the Echo Liquid Handler yourself.
 - If the move can be easily accomplished using a moving dolly or cart that can support a minimum of 128 kg (283 lbs) weight, the move can be performed without Beckman Coulter involvement. If you have any questions, [contact us](#).
- 2 Finish any operation in progress.

-
- 3 Remove microplates and microplate inserts from the Echo Liquid Handler.
 - 4 Turn off the Echo Liquid Handler and the fluid chiller. For more information, see [Turn Off Echo Power](#) and [Chiller Setup](#).
 - 5 After the Echo Liquid Handler has been powered down, disconnect the following lines from the back panel.
 - Chiller input and output tubing
 - Compressed air supply line
 - Vacuum supply line
 - Ethernet cable
 - AC power cable
 - Coupling fluid bottle, caddy, and cable
 - Remote Stop connector (if connected)
 - 6 Use proper safety procedures to lift the Echo Liquid Handler gently onto a moving dolly or cart of sufficient size and strength to support the unit.
-  **WARNING**
- The Echo Liquid Handler weighs approximately 128 kg (283 lbs.). Moving or lifting the Echo Liquid Handler incorrectly can cause severe injury. Never attempt to move or lift the Echo Liquid Handler without using proper equipment and trained personnel.**
-
- 7 Move the Echo Liquid Handler and ancillary equipment and material (bottles, tubing, microplates, source plate inserts, etc.) to the new location, which should already be prepared and comply with all pre-installation requirements. For more information, see [Pre-Installation Requirements](#).
-

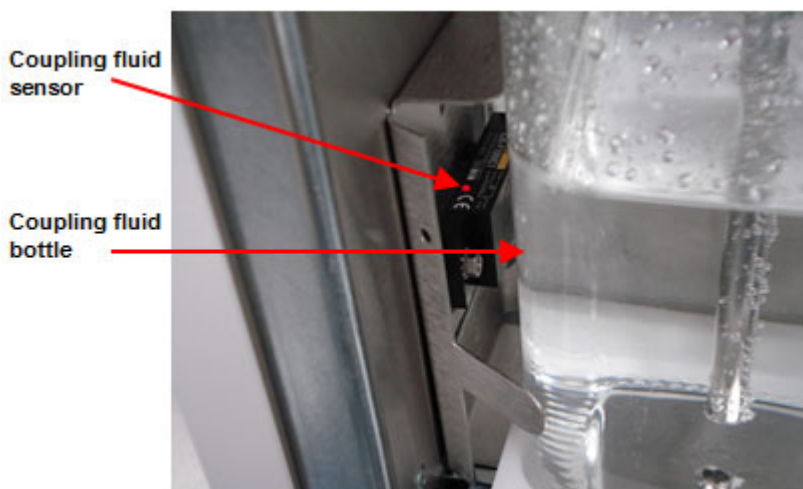
Reinstall the Echo Liquid Handler after a move

After the move, use the following procedure to restore an Echo Liquid Handler to normal operation.

NOTE The steps below apply to a standalone configuration of the Echo Liquid Handler. If the Echo Liquid Handler is integrated into an Access system, please [contact us](#).

- 1 Ensure that the new mounting surface is level.
- 2 Set up the Echo Liquid Handler, bottles, computer, and other ancillaries. Remember to allow for minimum operating space around the Echo Liquid Handler. For more information, see [Site Requirements](#).
- 3 Set up and start the chiller. For more information on Chiller setup, see [Chiller Setup](#).
- 4 Set up the coupling fluid bottle. Ensure that the bottle cap is firmly attached to ensure a tight vacuum seal. Place the filled coupling fluid bottle in the caddy. The fluid level sensor (red LED) should be visible on the side wall of the instrument to confirm that the bottle is positioned correctly and is filled.

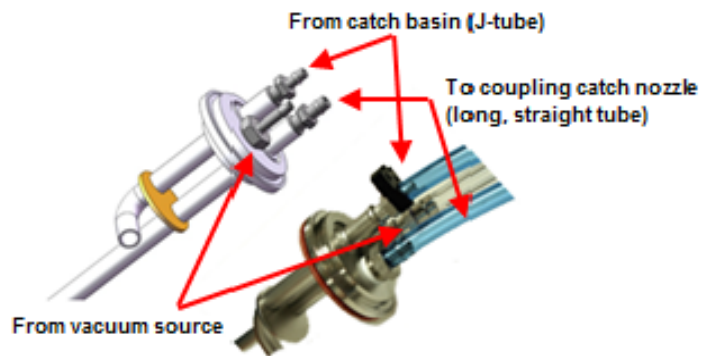
Figure 2.5 Coupling fluid level sensor in bottle caddy



NOTE Coupling fluid bottle should be pressed against the sensor located in the adjustable metal bracket to ensure that it works correctly.

- 5 Connect the air pressure and vacuum pressure supply lines to the fluidics panel.

Figure 2.6 Bottle connections



CAUTION

Do not run the pump until the vacuum source is connected and active. Running the pump without vacuum can lead to flooding the system or a system error.

- 6 Connect the chiller. Attach the plastic tubing between the chiller and the Echo Liquid Handler.

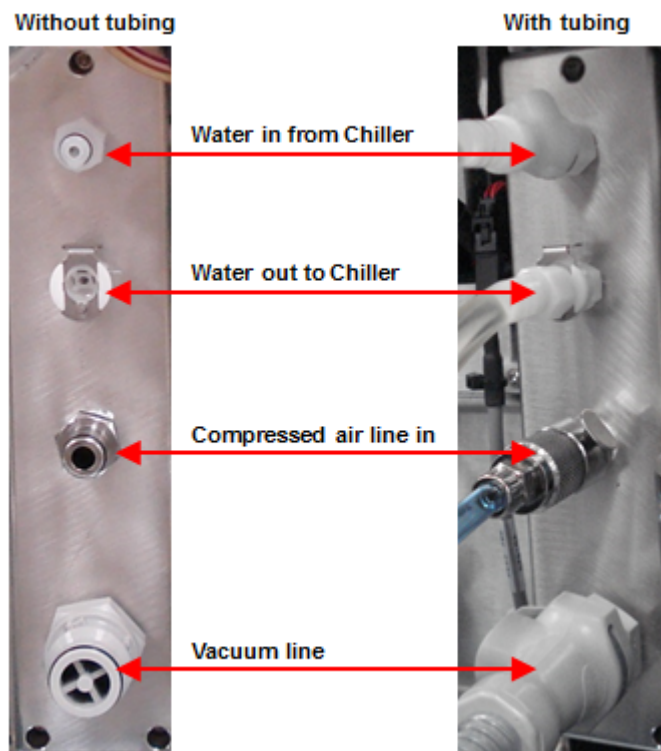
Figure 2.7 Tubing connections on the chiller



CAUTION

Do not run the pump until the chiller tubing is connected. Running the pump without the chiller tubing may damage other system components.

Figure 2.8 Tubing connections on the Echo system



- 7 Use the “cross-over” Ethernet cable to connect the Echo Liquid Handler to the client PC. The client PC should have the Echo Liquid Handler software already installed.
- 8 Fill the coupling fluid bottle and the fluidics circuit. For more information, see [Echo Coupling Fluid Maintenance](#) and [Cycle Fluid Through Echo System](#).

This chapter describes using the Echo Liquid Handler. The following procedures are described:

- [What types of liquid transfers are supported?](#)
- [Supported Labware](#)
- [Startup/Shutdown](#)
- [Echo Liquid Handler Software](#)

What types of liquid transfers are supported?

The Echo Liquid Handler supports a variety of simple to complex microplate liquid transfer protocols. The bundled Echo Liquid Handler software allows a user to set up the following types of protocol transfers:

Table 3.1 Liquid Transfer Types using the Standard Echo Liquid Handler Client Software

Source (Src) Microplate	Destination (Dest) Microplate	Transfer Map Type (Full)	Transfer Map Type (Partial)
384-well	96-well	destacking ^a quadrant (4 regions from 1 src plate to 4 dest plates)	destacking interleaved (2x2, or every other dest well)
384-well	384-well	standard (1 src plate to 1 dest plate)	standard (1 src plate to 1 dest plate)
384-well	1536-well	stacking ^b quadrant (4 src plates to 4 regions on 1 dest plate)	stacking interleaved (2x2, or every other dest well)

a. Destacking: transferring liquid from a single source (src) plate to several destination (dest) plates

b. Stacking: transferring liquid from several source plates to a single destination plate

NOTE The Echo 525 Liquid Handler client software that comes standard with the Echo instrument is designed for 384-well and 1536-well plate replication protocols. However, the Echo 525 Liquid Handler software does not currently support the 6-well Echo Qualified Reservoir plate. To use the 6-well Echo Qualified Reservoir plate that is configured on some Echo 525 Liquid Handlers, one of the following applications must be installed on the client: Echo Plate Reformat application, Echo Cherry Pick application, Echo Dose Response application. For more information, see the *Echo 525 Liquid Handler - Echo Qualified Reservoir Quick Start Guide*.

Liquid transfer can be tailored to the user's specific requirements. Variables that are user selectable or definable include the following:

- Source microplate type (from the list of qualified plates)
- User-definable destination microplate or surface
- Transfer type (for example, interleaved or quadrant 384-well to 96-well transfers)

- Transfer volume
- Number of copies (how many times the transfer protocol is executed)
- Transfer map specifying exactly which wells, or regions of wells, will be transferred

For information on these fluid transfer attributes and choices, see [Echo Liquid Handler Software](#).

Examples of these protocols are described later in this section. Additional and more complex fluid transfer protocols can be defined with the Echo Applications software packages (Echo Plate Reformat, Echo Cherry Pick, Echo Dose-Response, Echo Plate Audit, Echo Array Maker, and Echo Combination Screen), as well as with the extensive ActiveX control library defined in the Echo Software Development Kit (Echo SDK). These protocols can specify virtually any combination of transfers from source microplate wells to destination wells and slides. Refer to the Echo Application guides and the Echo Integration Guide for more information.

Supported Labware

The table below lists the Echo qualified source microplates that are available.

Table 3.2 Compatible Source Plates for Echo 525 Liquid Handler

	384PP Plate		384PP Plus Plate		384LDV Plus Plate		Echo Qualified Reservoir	
Number of Wells	384		384		384		6	
Surface Treated	No		Yes		Yes		Yes	
Volume Range (µL)	20–65		20–65		4.5–14		250–2,800	
Working Volume (µL)	45		45		9.5		2,550	
	Calibration	Example Fluids	Calibration	Example Fluids	Calibration	Example Fluids	Calibration	Example Fluids
Calibration and Example Fluids	384PP_AQ_BP	buffer with protein	384PP_Plus_AQ_BP	buffer with protein	384LDV_AQ_GP	buffer with glycerol, protein	6RES_AQ_BP2	buffer 0–30% V/V glycerol and 0–2.5% CMC surfactant
	384PP_AQ_SP	buffer with surfactant and protein	384PP_Plus_AQ_SP	buffer with surfactant and protein			6RES_AQ_GPSA2	buffer 0–30% V/V glycerol and 2.5–30% CMC surfactant
	384PP_AQ_SPHigh	buffer with surfactant and protein, surfactant $\geq$ 50% CMC (Critical Micelle Concentration)	384PP_Plus_AQ_GP	buffer with glycerol and protein			6RES_AQ_GPSB2	buffer with 0–30% V/V glycerol and 30–50% CMC surfactant
			384PP_Plus_AQ_GPSA	buffer with glycerol, protein, and surfactant; surfactant 5–14% CMC				
			384PP_Plus_AQ_GPSB	buffer with glycerol, protein, and surfactant; surfactant 14–50% CMC				

Destination microplates: All Echo qualified microplates and most ANSI-compliant/SBS-standard microplates in 96-well and 384-well format that are 8–16 mm in height are compatible. Use of 1536-well plates as destination plates is application dependent.

NOTE ANSI=American National Standards Institute; SBS=Society for Biomolecular Sciences. For information on plate standards, go to <http://www.slas.org/education/microplate.cfm>.

Short and medium flange height microplates (SBS-3, 4.1 and 4.2) are supported. Tall flange height microplates (SBS-3, 4.3) are not supported. Supported microplate height (SBS-2, 4.2.1.1) is 8.0–16 mm (0.31–0.63 in).

The table below lists the barcode reader formats that are supported by the Echo Liquid Handler.

Table 3.3 Barcode Reader(s)

Compatible barcode reader formats	Readable bar width (mm)
CODE 39	0.19–1.0
ITF	0.19–1.0
INTERLEAVED 2 of 5	0.19–1.0
CODABAR	0.19–1.0
UPC/EAN	0.19–1.0
CODE 128	0.25–1.0
COOP 2 of 5	0.19–1.0
CODE 93	0.25–1.0

NOTE The readable bar width expresses the range in which the width of thin barcode bars (narrow bar width) is readable.

Startup/Shutdown

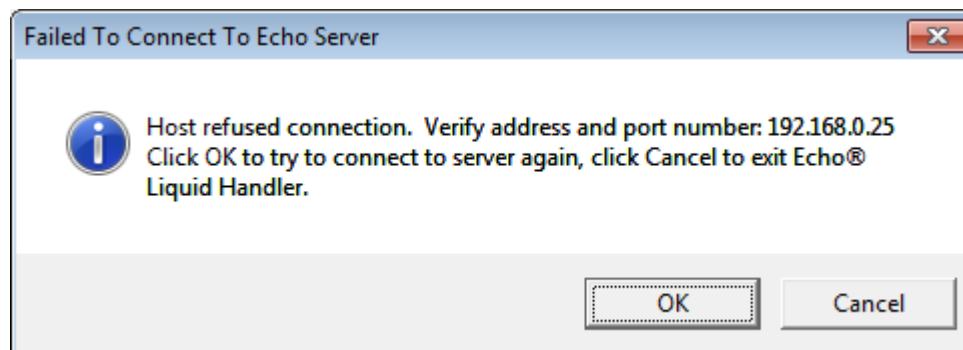
Before proceeding, ensure the hardware and client PC software installations are complete. All fluid, air, and electrical connections should be complete and functioning. Your Beckman Coulter field engineer performs a set of function tests to ensure that the system is operating correctly.

Turn on Echo Power

Turn on the Echo Liquid Handler by pressing the AC power switch located on the back panel.

The following message may appear while the Echo Liquid Handler initializes:

Figure 3.1 Connection failure message



NOTE It is recommended to wait 30 seconds for the Echo Server to boot before clicking OK. Or please wait 10 seconds after the system has initialized before trying to connect with the software.

Possible causes for connection failure include:

- The Echo Liquid Handler has not completed its initialization.
 - Check the gripper stage homing sequences, particularly the theta rotation of the destination gripper stage. For more information, see [Home Calibration](#).
 - Check the door opening sequence.
- The Ethernet cable is not connected between the client PC and the Echo Liquid Handler.
- The Echo Liquid Handler software is not configured to connect to the instrument (IP address or hostname is missing or incorrect).

Check for the cause, attempt to resolve the problem, and try to launch the software again. If the message persists, [contact us](#).

Echo Initialization

The Echo Liquid Handler performs a system initialization that includes the following actions:

- All three stages move to their home position:
 - Source stage moves front to rear on its Y axis.
 - Destination stage moves left to right on its X axis, front to rear on its Y axis, up and down on its Z axis, and partially rotates on its theta axis.
 - Acoustic transducer stage moves left to right on its X axis, front to rear on its Y axis, and up and down on its Z axis.

NOTE The LCD screen reports each step of the homing sequence as it occurs. Homing synchronizes the mechanical stages with the controlling software.

- Door opens.
- Destination stage extends, then retracts.
- Door closes.
- Upper anti-static bar moves to its uppermost position, then both anti-static bars turn off.

- Plate dryer nozzle moves to the down position.
- Coupling fluid nozzle moves to the down position.
- Power lamp turns on (green).
- Warning lamp turns off (yellow to clear).
- Fault lamp turns off (red to clear).
- Coupling fluid pump turns on.
- Power to the RF amplifier turns on.

Echo Liquid Handler Warm-Up

The Echo Liquid Handler requires a warm-up period after the power is turned on. The RF amplifier and the acoustic transducer must reach a stable operating temperature. If the instrument has been off for an extended period of time, a 60 minute warm-up period is recommended to allow all components to reach proper operating temperatures.

NOTE The suggested minimum warm-up time is 30 minutes.

Launch Echo Liquid Handler Software

The Echo Liquid Handler software can be launched by either of the following methods:

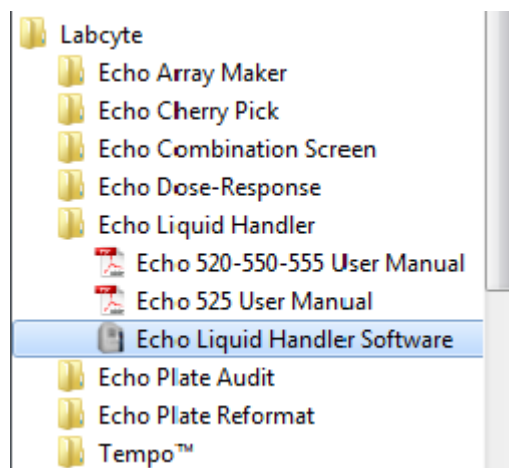
- Open the Echo folder on the desktop and double-click the icon for your Echo Liquid Handler.

Figure 3.2 Starting the Echo Liquid Handler Software from the Windows Desktop



- Go to **Start > Programs > Beckman Coulter > Echo Liquid Handler > Echo Liquid Handler Software**.

Figure 3.3 Starting the Echo Liquid Handler from the Start menu



The Echo Liquid Handler software connects to the Echo Liquid Handler and displays the following welcome screen.

Figure 3.4 Echo Liquid Handler welcome screen



Turn Off Echo Power

You may need to power off the Echo Liquid Handler for any of the following reasons:

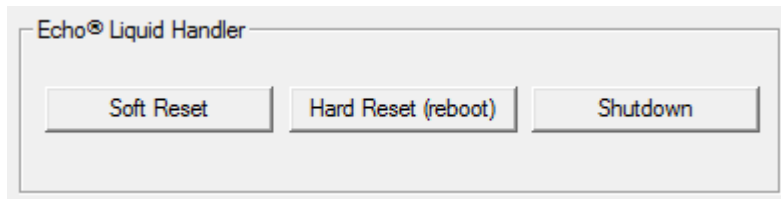
- Extended periods of non-use
- Preventive maintenance
- Service or repair

- Power interruptions, such as scheduled facility power interruptions
- Moving it to a new location

When you need to turn the power off, use the following procedure:

- 1 Shutdown the controller inside the Echo Liquid Handler. From the **Advanced** window, click the **Shutdown** button.

Figure 3.5 System reset and shutdown controls



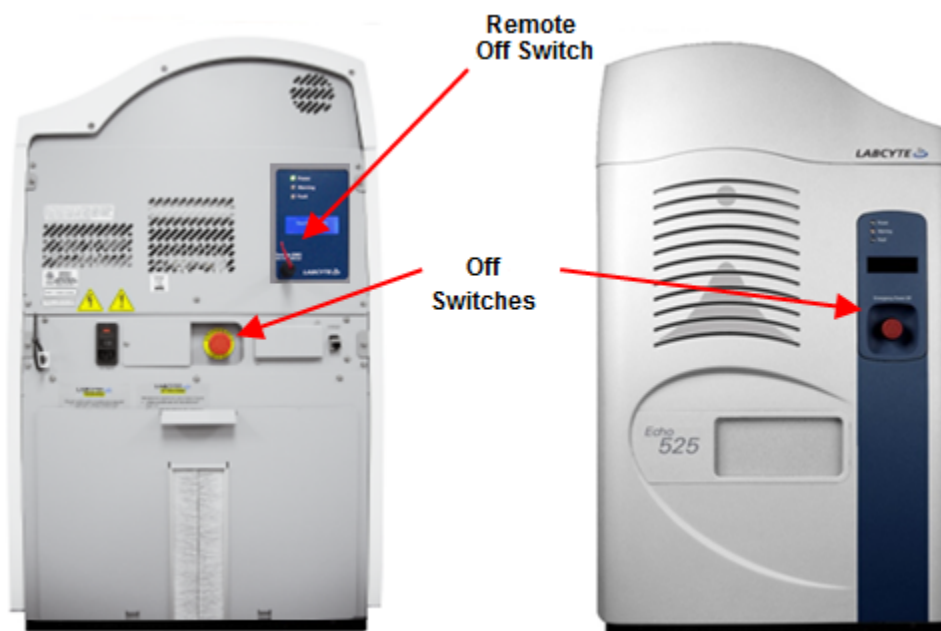
- 2 Leave the vacuum supply line connected and the vacuum source turned on.
- 3 Switch off the AC power switch on the Echo Liquid Handler.
- 4 Wait three minutes to allow the coupling fluid to completely drain out of the catch basin.
- 5 Leave the chiller on and the air pressure and vacuum lines connected.

NOTE If the Echo Liquid Handler is going to be shut down for longer than a week, start up and run the pump once a week to keep the acoustic transducer wet. For more information, see [Extended Non-Use and Storage](#).

Stop Switch

The Stop switch can be used in an emergency to shut down all mechanical activity in the Echo Liquid Handler. There are two Stop switches, one on the front panel and one on the rear panel of the Echo Liquid Handler.

Figure 3.6 Location of Stop switches



- To use the Stop switch in an emergency, push it in.
- To reset the Stop switch, turn the knob clockwise until it pops out (see arrows etched in the knob).

NOTE If the Stop switch is used, if you have a protocol running, it may be interrupted and may need to be restarted.

When to use the Stop switch:

- Any time the safety of the operator is in question.
- Any time strange, loud, or potentially damaging noises are coming out of the Echo Liquid Handler.
- When the instrument door will not open, and the source or destination plate gripper stages collide with the door.
- If water is leaking from the Echo Liquid Handler.
- In any other situation that suggests immediate shutdown of the Echo Liquid Handler is appropriate.

When the Stop switch is used, the following actions are performed:

- All motors are disabled.
- The coupling fluid pump is turned off.
- All pneumatic actuators are sent to their default positions.
- The anti-static bars are turned off.
- All RF devices (RF power supply, RF amplifier, RF switch, and so on) are turned off.

- The HV grid is turned off.
- The internal controller aborts all processes in progress, returns an error to the system invoking the aborted process, designates the three stages as not calibrated, and goes into a halted state.

Activating the Stop switch does not turn off the following:

- Internal Echo Liquid Handler controller
- AC power inside the Echo Liquid Handler power distribution panel
- Internal 24 VDC power supply (power output, however, is interrupted)
- External communications (ethernet, USB)
- Coupling fluid chiller

Recovering from a Stop shutdown

If the Stop switch has been used to shutdown the Echo Liquid Handler, use the following procedure to start up again:

- 1 Determine and resolve the original problem.
- 2 Turn the Echo Liquid Handler back on by twisting the Stop switch clockwise. It will pop out to its normal operating position.

When the Stop switch is returned to its normal position, power is then supplied to most internal systems and most internal mechanisms are enabled. The Echo Liquid Handler stage motors are not automatically enabled. The operator must explicitly command a stage homing procedure. For more information, see [Motion Calibration](#).

NOTE If you cannot determine the original problem, or you cannot correct the problem, you must arrange for a Beckman Coulter field engineer to restore your Echo Liquid Handler to normal use.

Echo Liquid Handler Software

The Echo Liquid Handler comes with user software. The Echo Liquid Handler software provides a Windows-based graphical user interface (GUI). The user can control the Echo Liquid Handler and execute most of its functions which are listed below:

- [Protocols Window](#): defines new liquid transfer protocols and edit or delete existing protocols; run the protocols.
- [Labware Window](#): defines new destination plates, and edit or delete existing destination plate definitions.
- [Diagnostics Window](#): monitors Echo Liquid Handler status; directly control most of the Echo Liquid Handler motor function and perform diagnostic procedures.
- [Calibration Window](#): performs calibration procedures.

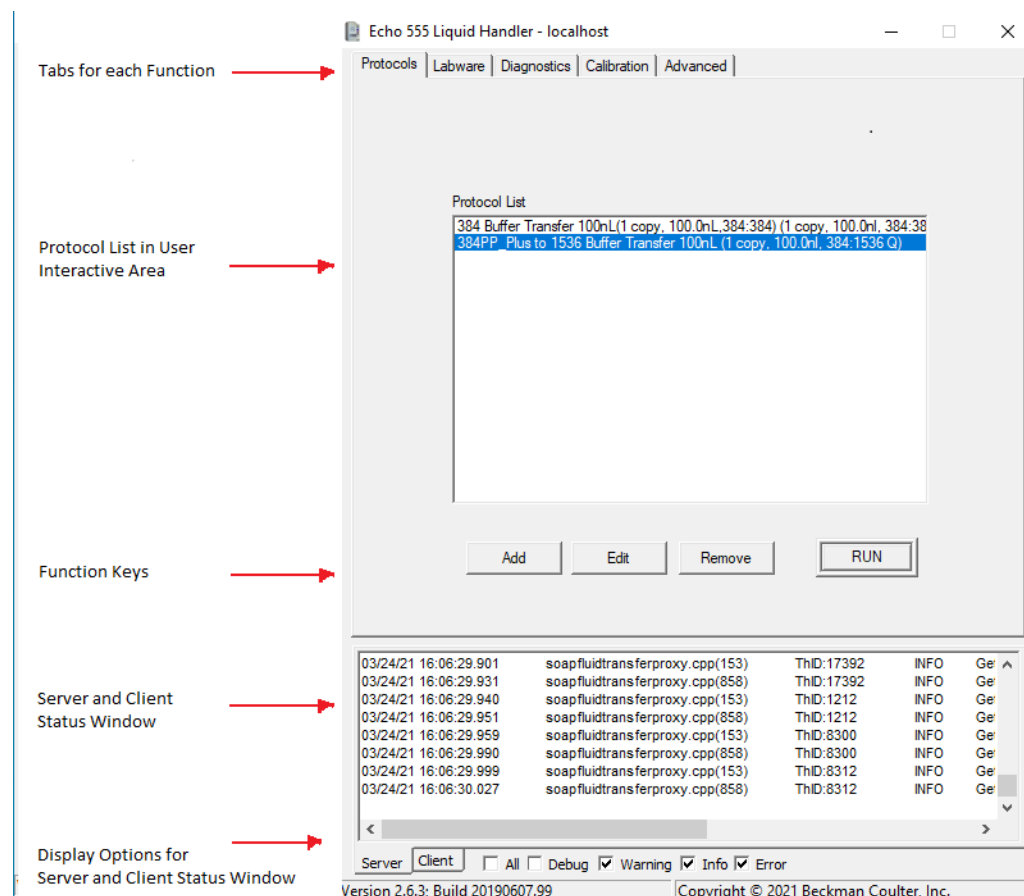
- [Advanced Window](#): changes transfer options; reset or shut down the Echo controller.
- [Status Window](#): monitors Echo Liquid Handler functions.

Main Screen

The Echo Liquid Handler software opens in the Main screen. The Main screen shows tabs for each major function and user interactive area for selecting from a list of protocols or clicking options or function keys. The first tab shows the **Protocols** window.

Below the user interactive area is the status window. This window displays every action that the Echo hardware or software performs. [Figure 3.7](#) and the information below describe the elements of the Main screen.

Figure 3.7 First window in the Echo Liquid Handler software



- **Tabs:** Each tab opens a window for a function or related group of functions.
 - **Protocols:** In the Echo Liquid Handler software, a protocol is a set of user-selected parameters (plate/fluid type, plate mapping, transfer volume, and repetition) that define a single liquid transfer procedure. The **Protocols** window lists the protocols available to run. From this window you can create, modify, run, or delete a protocol.

- **Labware:** The **Labware** window shows a list of pre-defined types of microplates. You can select these microplates during the creation of a protocol. From this window you can also create additional destination microplates.
 - **Diagnostics:** The **Diagnostics** window displays the status of the Echo Liquid Handler. From this window you can also manipulate some of the individual motor controls and perform some maintenance tasks.
 - **Calibration:** The **Calibration** window provides calibration procedures for microplate registration, power modulation, transducer focus, and barcode alignment.
 - **Advanced:** The **Advanced** window provides additional liquid transfer options and system functions, such as shutting down or restarting the instrument.
- **Function Keys:** Function keys perform tasks specific to the window in which they are displayed, such as creating, editing, or removing a protocol.
 - **Status window:** Two status windows are available: Client and Server. The Client status window shows the applications that are executed during a protocol run. The Server status window shows the individual tasks that are performed within an application.
The status windows also display specific types of errors that the system encounters during a protocol run.
 - **About and Help menu (not shown):** Right-clicking on a tab window background, will display a menu that provides two choices: About and Help.
 - **About:** Select **About** to display the software version and build numbers.
 - **Help:** Select **Help** or press the **F1** key to open the online Help file.

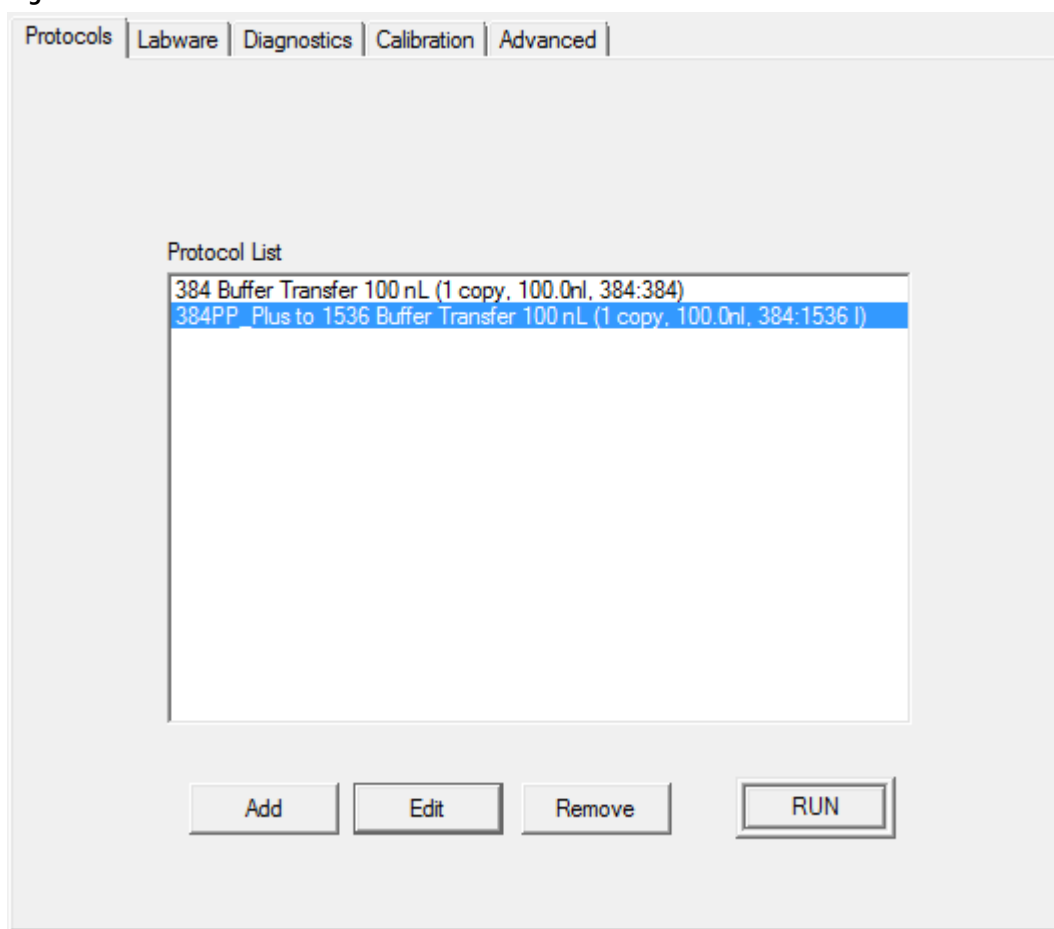
For more information about each function window, see [Echo Liquid Handler Software](#).

Protocols Window

The **Protocols** tab is the first window that opens when you start the Echo Liquid Handler software. The Protocol List displays the liquid transfer protocols that are stored in the Echo database. A tool tip displays many of the protocol parameters. From the **Protocols** window, you can perform the following tasks:

- **Add** (create) a new liquid transfer protocol definition.
- **Edit** (change) an existing protocol definition.
- **Remove** (delete) an existing protocol definition.
- **Run** (execute) a liquid transfer protocol.

Figure 3.8 Protocols window



Echo Liquid Handler software can be used to create several types of transfer protocols. Examples of protocols that can be created with the Echo software are listed in the following table and described in subsequent topics.

Table 3.4 Example Protocols

Source plate	Destination plate	Transfer map type (full)	Transfer map type (partial)
384-well	96-well	down-stacking ^a quadrant: 4 regions from 1 source plate to 4 destination plates	down-stacking interleaved: 2x2, or every other destination well
384-well	384-well	standard: 1 source plate to 1 destination plate	
384-well	1536-well	stacking ^b quadrant: 4 source plates to 4 regions on 1 destination plate	stacking interleaved: 2x2, or every other destination well

a. Down-stacking: transferring liquid from a single source plate to several destination plates.

b. Stacking: transferring liquid from several source plates to a single destination plate.

Create a Liquid Transfer Protocol

The liquid transfer protocol specifies how much fluid will be transferred from the source microplate to the destination microplate, and in what well order—a plate map that the Echo instrument uses to perform the transfer.

For example, a simple transfer protocol would transfer reagent from all source wells to the matching destination wells, replicating the contents of the source plate. More complex protocols would transfer reagent from different source plates to one or more destination microplates. The Echo Liquid Handler software provides a plate map to specify the wells that will be used in the liquid transfer.

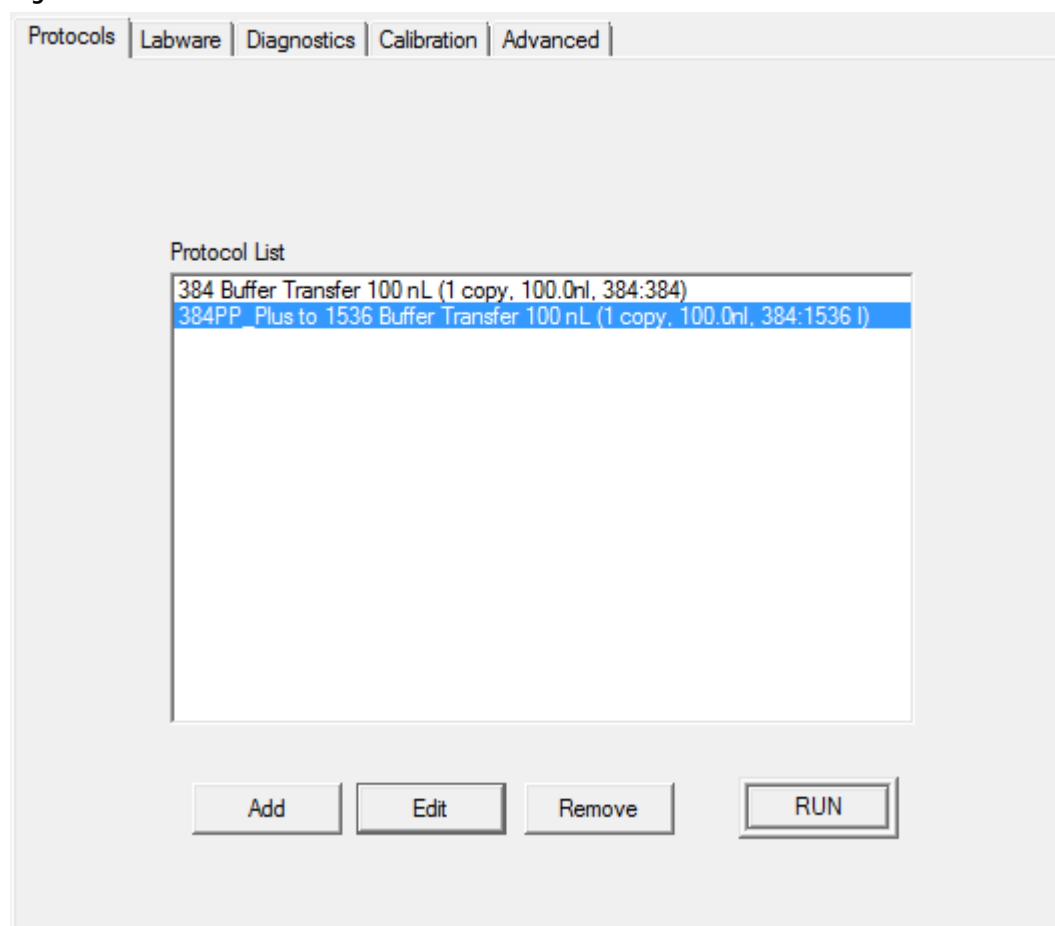
For a detailed discussion of different types of liquid transfer protocols, [What types of liquid transfers are supported?](#)

NOTE To create transfer protocols for specific applications or specialized plate configuration, such as Echo Dose-Response, you can purchase optional software applications or the Echo Software Development Kit to create your own application. For more information, see [Manual mode using the Echo application software](#).

To execute a liquid transfer using the Echo Liquid Handler software, the first step is to create a protocol. A protocol defines the source and destination microplates to use, the volume to transfer, number of transfers, and the specific wells involved. Protocols are stored in the Echo database and displayed every time you view the **Protocols** window.

From the **Protocols** window, you can click the **Add** button to begin the **Add New Protocol** wizard. After you have created the protocol, you can select it in the **Protocol List** to run, edit or remove.

Figure 3.9 Protocol List



Samples of protocols are described in the sections that follow.

- [Create a New 384:384 Protocol Definition](#)
- [Create a New 384:1536 Protocol Definition](#)
- [Create a Transfer Map](#)

Create a New 384:384 Protocol Definition

Create a new 384:384 protocol definition using the **Add New Protocol** wizard.

NOTE If the new liquid transfer protocol requires a new destination microplate definition, create it before running the **Add New Protocol** wizard. For more information, see [Manage Labware Specifications](#).

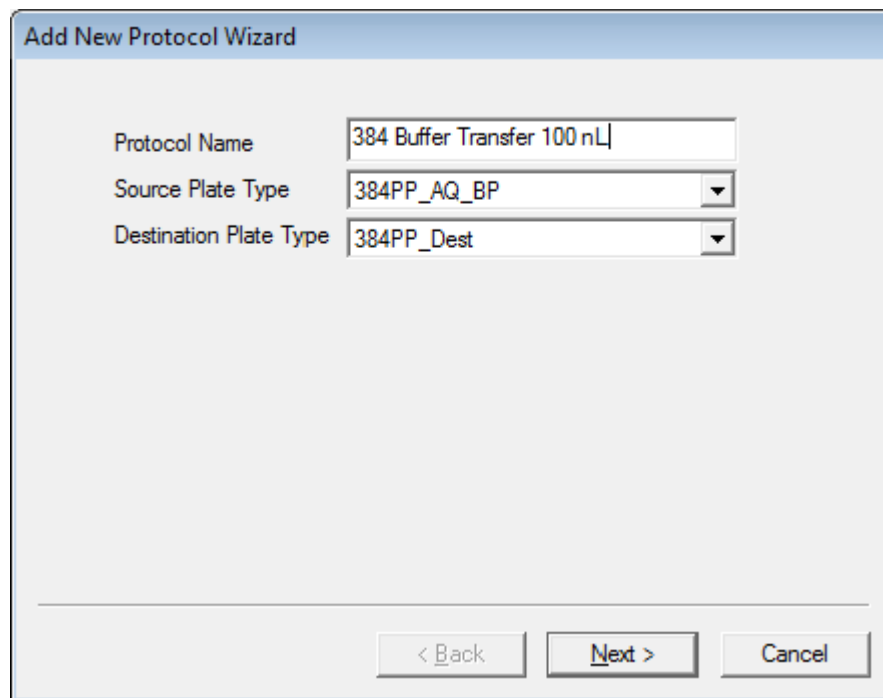
1 Click the **Add** button to start the **Add New Protocol** wizard. Enter the following information:

- **Protocol Name:** Enter a name for the new protocol. It must not already be in use.
- **Source Plate Type:** Select a source plate type from the first drop-down list.

NOTE Only Echo qualified source microplates are listed in the Source Plate drop-down list. [Contact us](#) to add more source plates.

- **Destination Plate Type:** Select a destination plate type from the second drop down list. The destination plate definition must already exist in the Echo database.

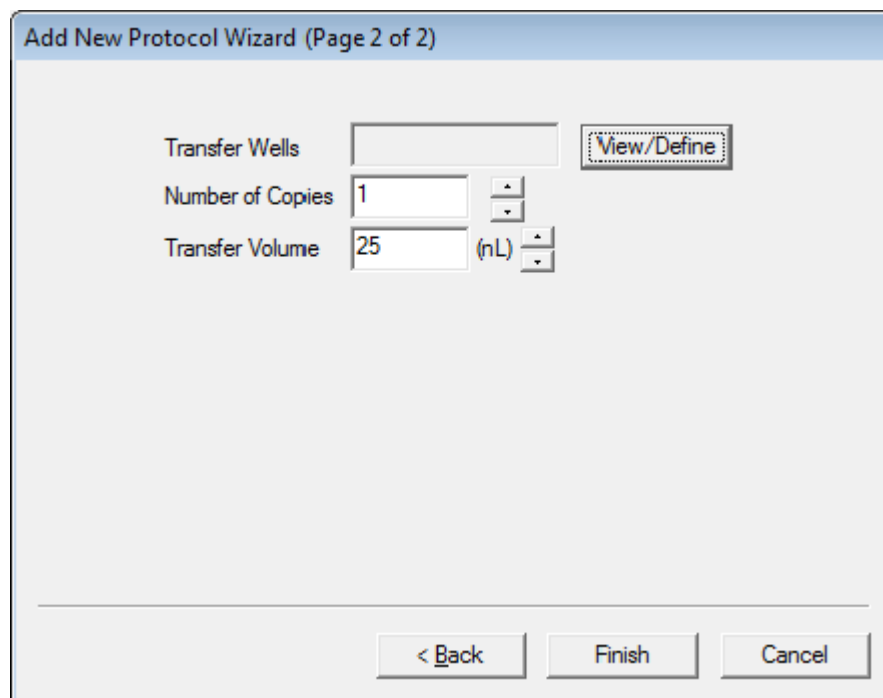
Figure 3.10 Add new protocol wizard, page 1 of 2



The dialog box is titled "Add New Protocol Wizard". It contains three input fields: "Protocol Name" with the text "384 Buffer Transfer 100 nL", "Source Plate Type" with the value "384PP_AQ_BP", and "Destination Plate Type" with the value "384PP_Dest". At the bottom, there are three buttons: "< Back", "Next >", and "Cancel".

- 2 Click the **Next** button. The second **Add New Protocol** wizard dialog box opens.

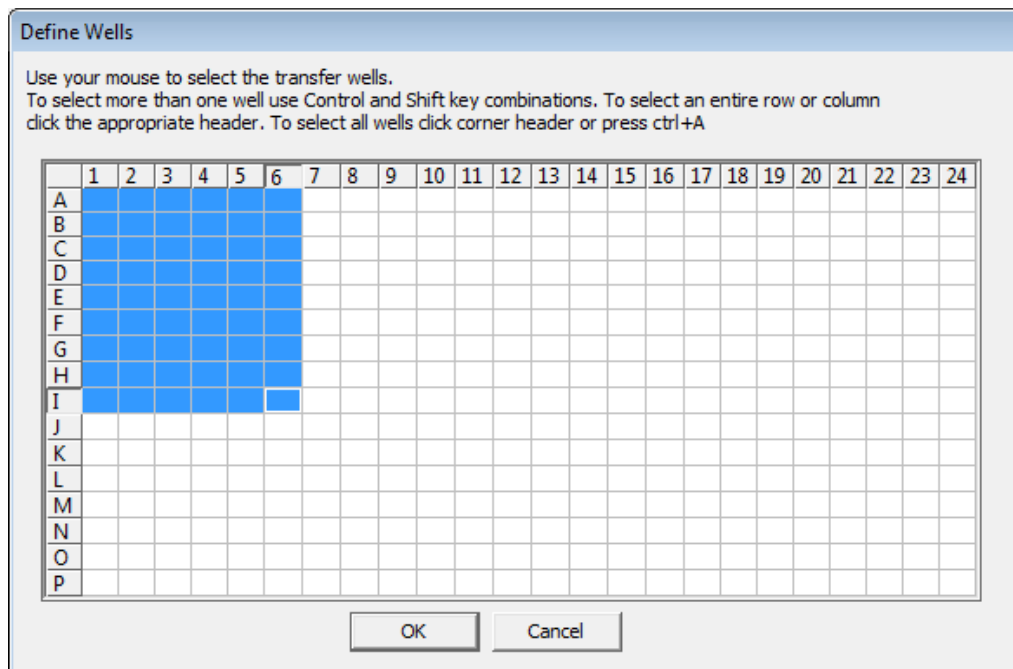
Figure 3.11 Add new protocol wizard, page 2 of 2



The dialog box is titled "Add New Protocol Wizard (Page 2 of 2)". It contains three input fields: "Transfer Wells" (empty), "Number of Copies" with the value "1", and "Transfer Volume" with the value "25" and a unit "(nL)". There is a "View/Define" button next to the "Transfer Wells" field. At the bottom, there are three buttons: "< Back", "Finish", and "Cancel".

- 3 Transfer Wells:** Click the **View/Define** button to select the wells to be transferred from the source plate.
 - Select the source plate wells that contain the reagent to be transferred. For information on how to select transfer wells, see [Create a Transfer Map](#).
 - Click the **OK** button to return to the previous screen.

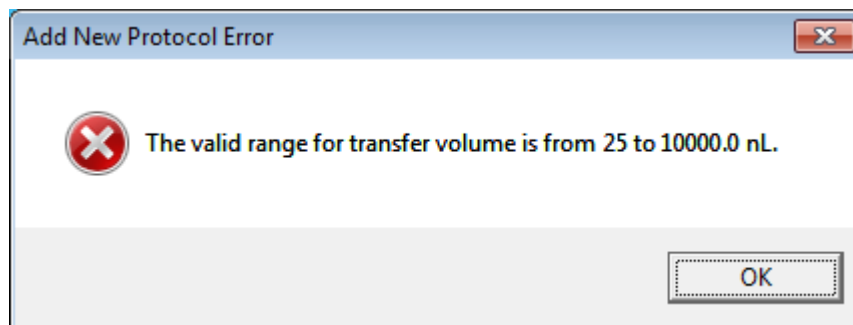
Figure 3.12 Define wells dialog box



- 4 Number of Copies:** Enter the number of times the protocol will be executed. The valid range is 1 to 10,000 copies. The operator is prompted to load and unload the source microplate and the specified number of destination microplates.

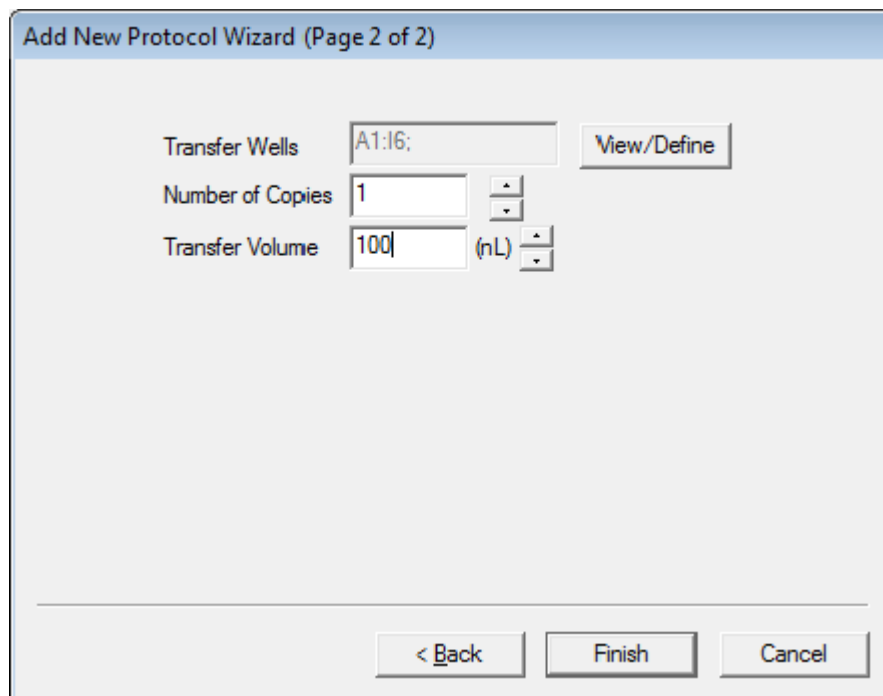
- 5 **Transfer Volume:** Enter the total volume of fluid to be transferred. The valid range is 25 to 10000 nL in increments of 25 nL. If you enter the transfer volume directly instead of using the increment/decrement buttons, remember that the value must be a multiple of the minimum transfer volume. If you type an invalid transfer volume, you will receive an error message that displays the correct transfer range.

Figure 3.13 Invalid transfer volume for 384-well plate



- 6 Click the **Finish** button to complete the new protocol.

Figure 3.14 384:384 protocol finished



Create a New 384:1536 Protocol Definition

Create a new 384:1536 protocol definition using the stacking features of the **Add New Protocol** wizard. Reagent from four 384-well source plates can be transferred to a single 1536-well destination plate.

NOTE If the new liquid transfer protocol requires a new destination microplate definition, create it before running the **Add New Protocol** wizard. See [Manage Labware Specifications](#).

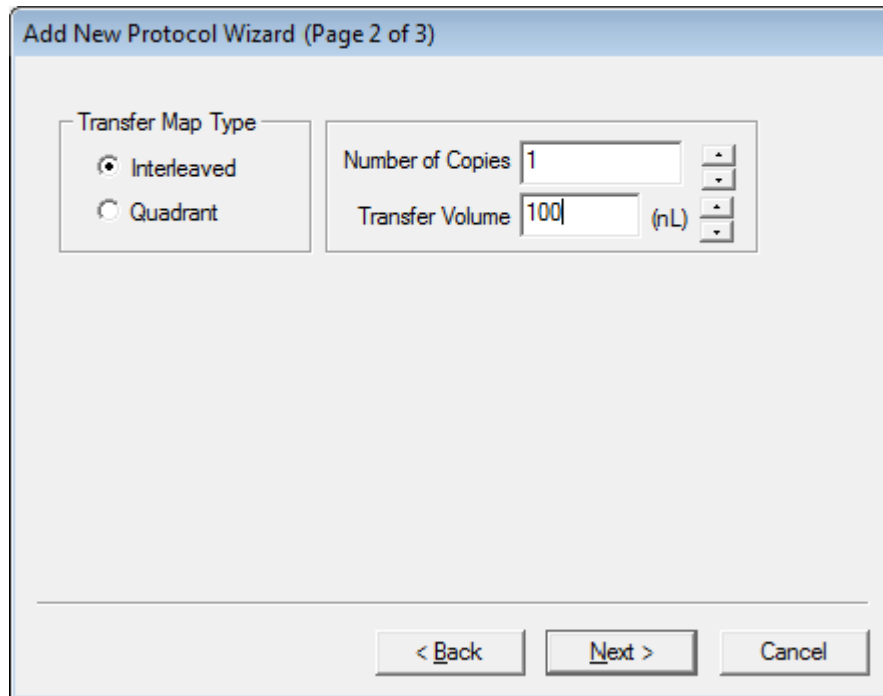
- 1 Click the **Add** button to start the **Add New Protocol** wizard. Enter the protocol name (for example, 384PP Buffer Transfer) and select the source and destination microplate types from the drop-down lists as shown below:
 - **Protocol Name:** Enter a name for the new protocol. It must not already be in use.
 - **Source Plate Type:** Select a source plate type from the first drop-down list.
 - **Destination Plate Type:** Select a destination plate type from the second drop down list. The destination plate definition must already exist in the Echo database.

Figure 3.15 Add new protocol wizard, page 1 of 3

The screenshot shows a dialog box titled "Add New Protocol Wizard". It contains three input fields: "Protocol Name" with the text "384PP_Plus to 1536 Buffer Transfer 100", "Source Plate Type" with a dropdown menu showing "384PP_Plus_AQ_BP", and "Destination Plate Type" with a dropdown menu showing "1536LDV_Dest". At the bottom of the dialog are three buttons: "< Back", "Next >", and "Cancel".

- 2 Click the **Next** button to open the second page of the **Add New Protocol** wizard dialog box.

Figure 3.16 Add new protocol wizard, page 2 of 3



The screenshot shows the 'Add New Protocol Wizard (Page 2 of 3)' dialog box. It features a 'Transfer Map Type' section with 'Interleaved' selected. To the right, 'Number of Copies' is set to 1 and 'Transfer Volume' is set to 100 nL. Navigation buttons at the bottom include '< Back', 'Next >', and 'Cancel'.

Enter the following information:

- **Transfer Map Type:** Select an interleaved or a quadrant liquid transfer protocol type. See [What types of liquid transfers are supported?](#).
- **Number of Copies:** Enter the number of times the protocol will be executed. The valid range is 1 to 10,000 copies. You are prompted to load and unload the source microplate and the specified number of destination microplates.
- **Transfer Volume:** Enter the total volume of fluid to be transferred. The valid range is dependent on the source microplate is 25 to 10000 nL in increments of 25 nL. If you enter the transfer volume directly instead of using the increment/decrement buttons, remember that the value must be a multiple of the minimum transfer volume.

- 3 Click the **Next** button to open the third **Add New Protocol** wizard dialog box.

Figure 3.17 Add new protocol wizard, page 3 of 3

Add New Protocol Wizard (Page 3 of 3)

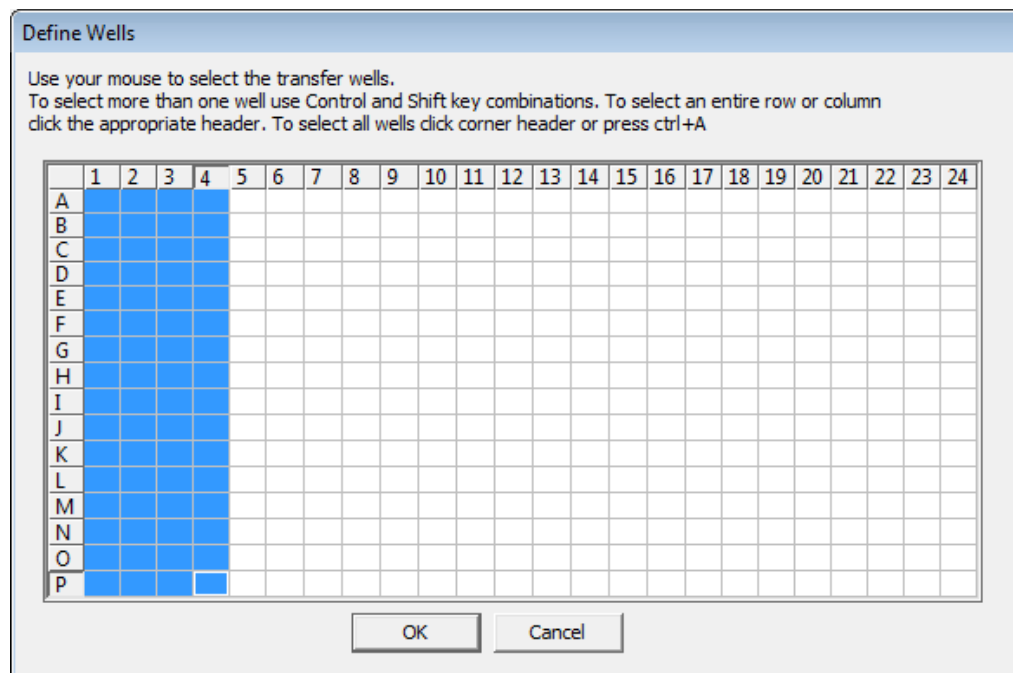
Source 1 Transfer Wells		View/Define
Source 2 Transfer Wells		View/Define
Source 3 Transfer Wells		View/Define
Source 4 Transfer Wells		View/Define

< Back Finish Cancel

You must define a fluid transfer map for each of the source microplates used.

- 4 Click the **View/Define** button to create a transfer map for the first source plate. The **Define Wells** dialog box shows the wells that are available for transfer. Select the wells you want to include in the transfer. Repeat this step for the other source plates and click the **OK** button.

Figure 3.18 Define wells in a transfer map



For an explanation on how to select wells in a transfer map, see [Create a Transfer Map](#).

- 5 Click the **Finish** button after all four transfer maps have been created.

Figure 3.19 384:1536 protocol finished

The screenshot shows a dialog box titled "Add New Protocol Wizard (Page 3 of 3)". It contains four rows, each representing a source transfer well. Each row has a text field with the value "A1:P4;" and a "View/Define" button to its right. At the bottom of the dialog, there are three buttons: "< Back", "Finish", and "Cancel".

Source	Transfer Wells	Action
Source 1	A1:P4;	View/Define
Source 2	A1:P4;	View/Define
Source 3	A1:P4;	View/Define
Source 4	A1:P4;	View/Define

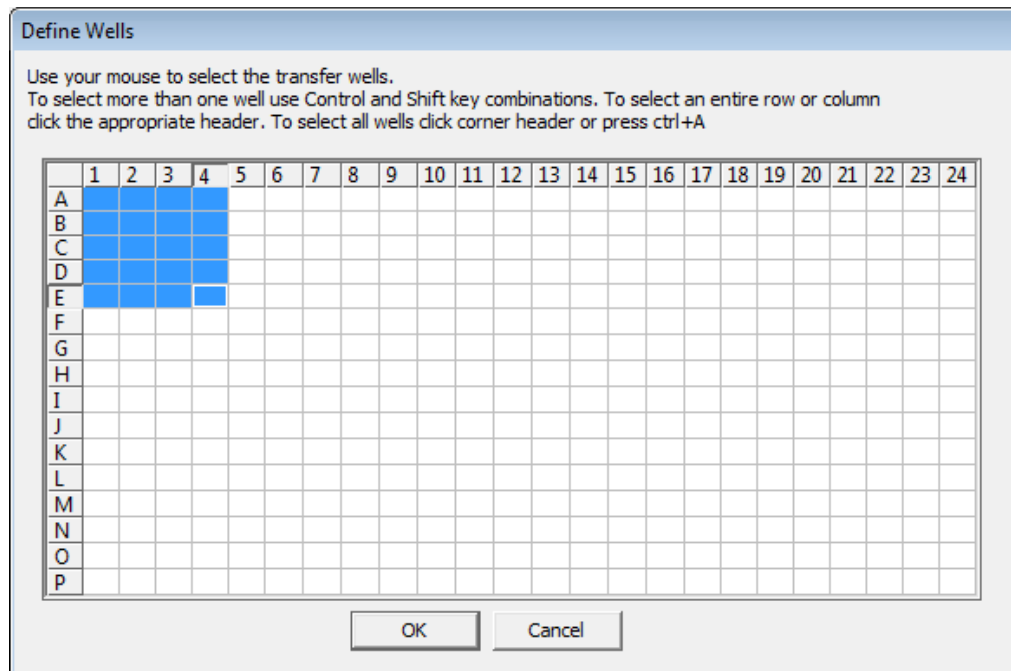
Navigation buttons: < Back, Finish, Cancel

Create a Transfer Map

Create a new 384:384 protocol definition using the Add New Protocol wizard.

When you click the **View/Define** button, the **Define Wells** dialog box opens.

Figure 3.20 Define Wells dialog box

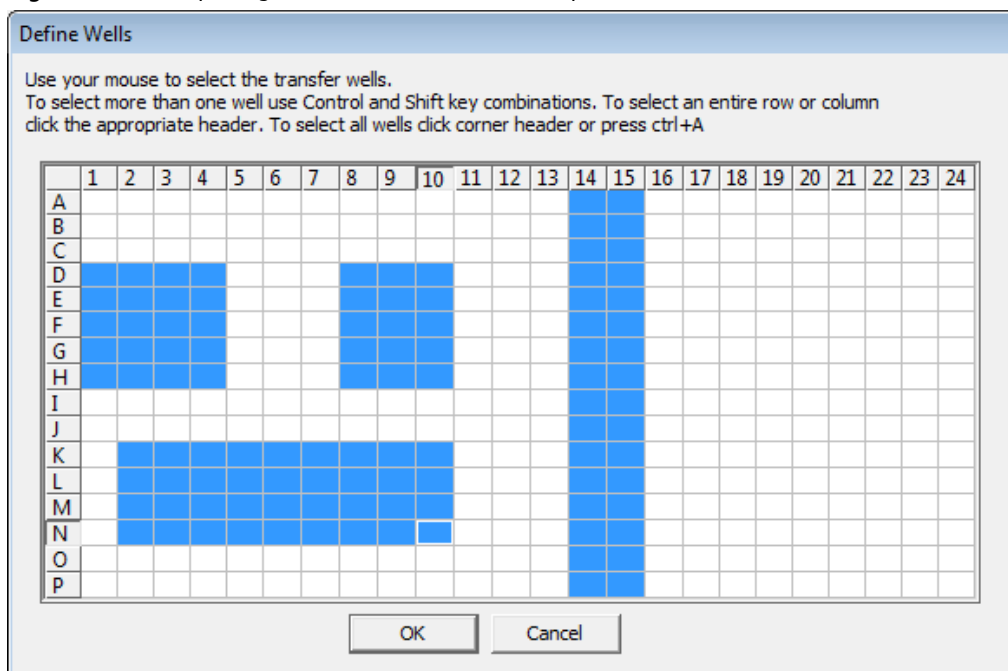


The **Define Wells** dialog box shows a simple grid that represents the microplate. Each source microplate well is represented by a grid square. The user selects the microplate wells from which fluid will be transferred.

Selected wells (highlighted in blue) will be transferred when the protocol is run. The dialog box shown above defines a liquid transfer from wells A1 through E4. There are several methods to define which wells belong in the transfer map.

- Click a single well to select it and clear all other selected grid squares.
- Hold the **Control** key down and click in individual wells. Each well is selected in turn.
- After making a well selection, hold down the **Shift** key and click in another well. All wells in a rectangle defined by the two wells are selected.
- Click on a row label or a column label. The entire row or column will be selected.
- Click and drag the mouse point to define a rectangle of wells in one move.
- If a group of wells is selected and another well (or group of wells) must also be selected, hold the **Control** key down so that the original group of wells is not cleared.
- All wells can be selected by clicking in the upper-left square (above the row labels). Another method is to press CTRL-A (if at least one well is already selected).

Figure 3.21 Multiple regions defined in a transfer map



Click the **OK** button to save the transfer map definition with this protocol.

Edit an Existing Protocol Definition

To edit an existing protocol definition, click the **Edit** button or double-click the protocol name in the protocol list. One of the following edit protocol dialog boxes will open:

Figure 3.22 Edit 384:384 protocol dialog box

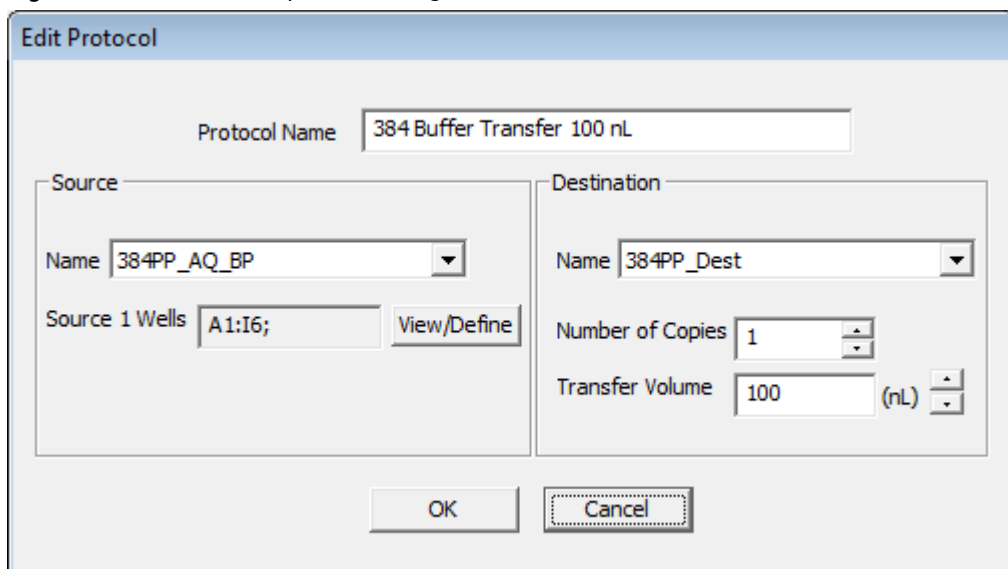


Figure 3.23 Edit 384:1536 protocol dialog box

Any parameter of a user-defined protocol can be edited; however, the destination plate type cannot be changed from 384-well to 1536-well or vice versa.

Remove an Existing Protocol Definition

If a protocol must be deleted, select the protocol name and click the **Remove** button. Confirmation of the removal is required. The protocol definition is deleted from the Echo database and from the Echo Liquid Handler software **Protocol List**.

Prepare the Microplates

Prepare the microplates as follows:

- 1 Prepare the source microplates. Consider the following factors:
 - Fluid height for a given fluid volume can vary, depending on the surface interaction of the fluid with the well walls.
 - Fluids that cling to microplate plastics will form steep menisci, pulling fluid away from the center of the wells, causing lower fluid height.
 - Fluids that interact less with the well walls will form shallow menisci, leaving more fluid in the center and greater fluid height.
 - Fluids that contain higher concentrations of protein, or higher concentrations of detergents, may also form steeper menisci. Since there is a wide variety of fluid compositions, you may find that the Echo Liquid Handler reads a different volume than what you pipetted into the source well.

- Bubbles in the fluid prevent the formation of a fluid meniscus. For optimal results, remove any bubbles in the wells and check for well-defined menisci.

NOTE Spinning down the microplate can remove bubbles and even out variations in menisci.
Use 1500 x g for aqueous samples.

- If the source microplates were made earlier and stored refrigerated or frozen, allow them to equilibrate or thaw to room temperature.
- Aqueous solutions evaporate at low volumes. For longer runs, fill wells to the maximum volume specified for the source plate type used. Volume ranges may differ for different aqueous solutions.

2 Place the plate insert onto the plate gripper (if it is not already in position). For more information, see [Source Plate Insert](#).

3 Collect the microplates that will serve as destination plates to receive the reagent. A destination microplate definition must exist or be created. For example, knowing the plate height of the destination microplate allows the Echo Liquid Handler to lower the destination microplate into very close proximity to the source microplate, improving droplet ejection accuracy and reliability.

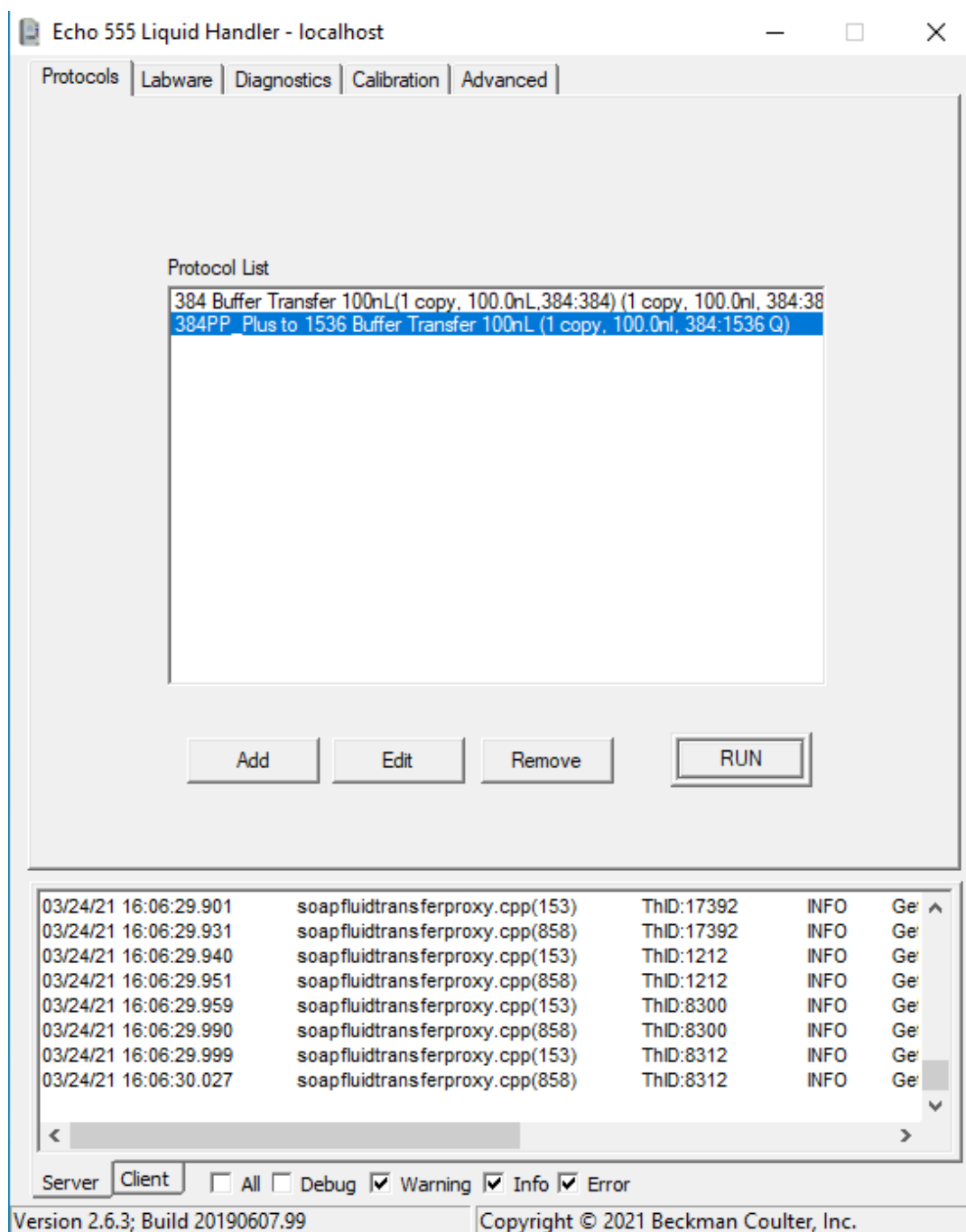
Run a Liquid Transfer Protocol

Before running the liquid transfer protocol, you will need to prepare the reagent to be transferred and set up the microplates. For information on how to set up microplates, see [Prepare the Microplates](#).

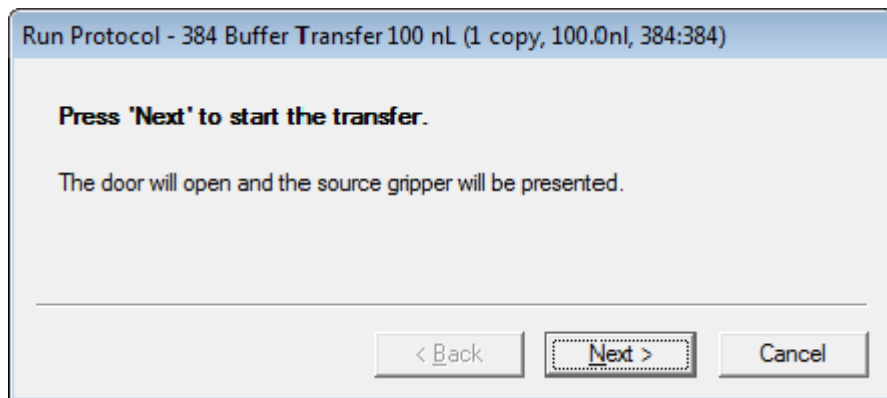
To run a liquid transfer protocol:

- 1 From the **Protocols** window, select the protocol to be run and click the **Run** button. The first of a series of screens is displayed to provide instructions to run the selected protocol.

Figure 3.24 Protocol selected to be run

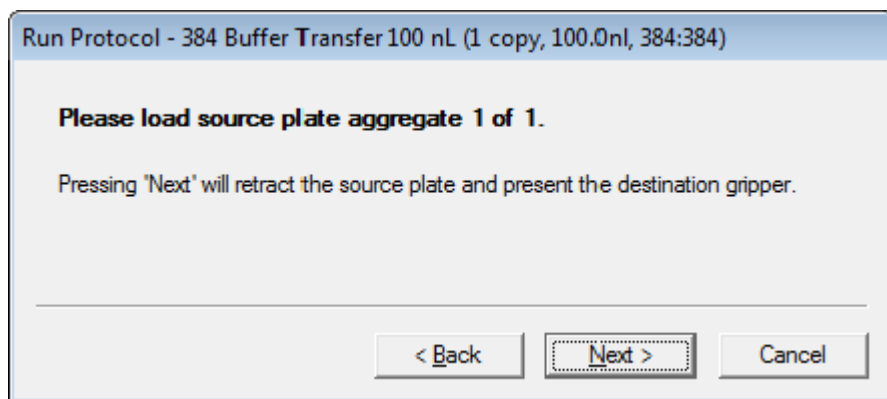


- 2 Click the **Next** button. The door will open and the source plate gripper stage will extend outside of the Echo Liquid Handler.

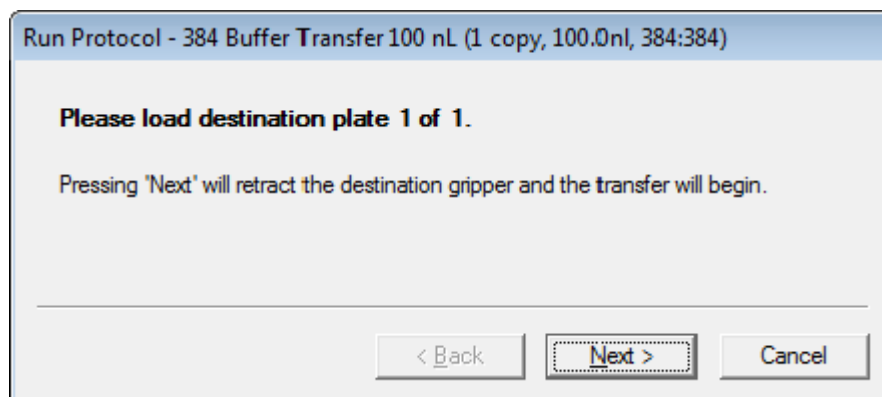


- 3 Load your source microplate with well A1 closer to the instrument's inner-left corner. Click the **Next** button.

The source plate gripper stage retracts into the Echo Liquid Handler and the destination plate gripper stage is extended outside of the Echo Liquid Handler.



- 4 Load your destination microplate with well A1 closer to the instrument's inner-left corner. Click the **Next** button.



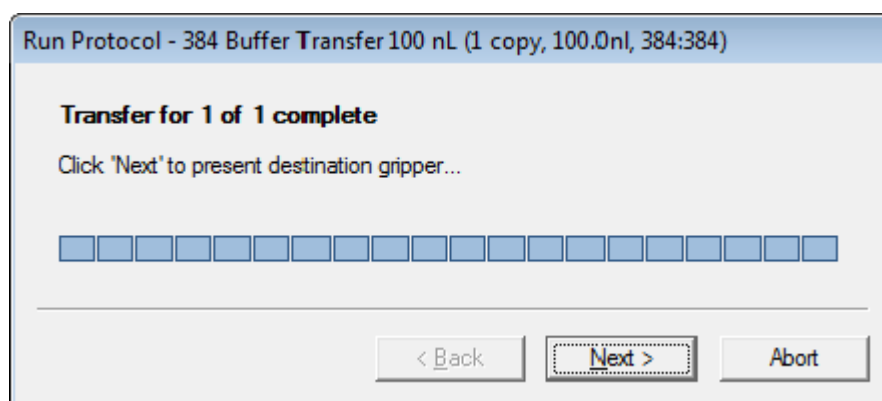
While the destination plate gripper stage retracts the microplate, the source microplate is surveyed. The Echo Liquid Handler determines the fluid composition and well fluid thickness, and then calculates the fluid volume in each well. For aqueous solutions, the fluid volume is an approximation and may vary depending on protein and surfactant concentrations, among other factors.

After the source plate survey is complete, and the destination microplate is positioned above the source microplate, the liquid transfer process begins.

Using the data contained in your destination microplate definition, the protocol definition, and the source microplate survey just performed, droplets are ejected from each specified source microplate well into the corresponding destination microplate well. A progress bar keeps you informed of the liquid transfer in progress.

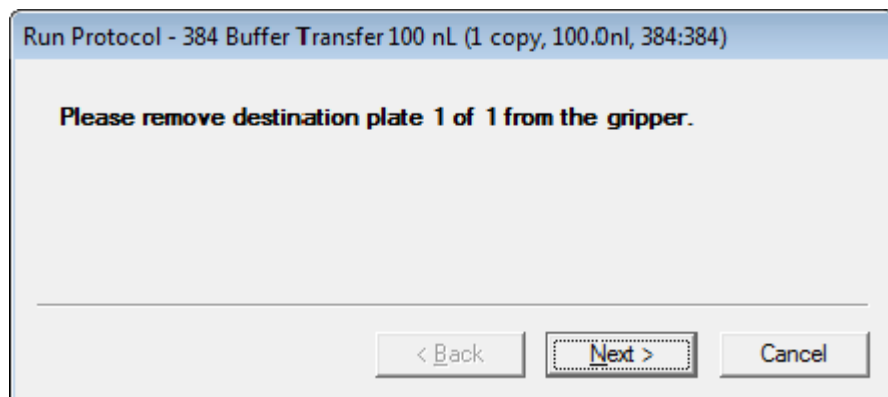
You can abort the liquid transfer process by clicking the **Abort** button.

- 5 When the liquid transfer is complete, click the **Next** button.



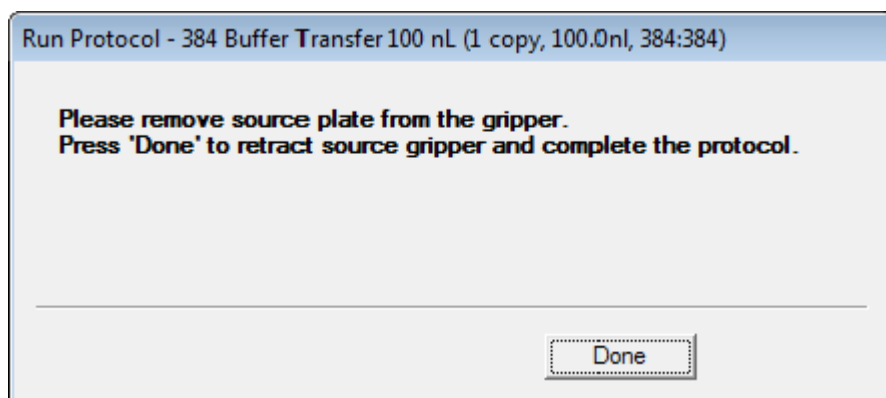
The destination plate gripper stage extends outside of the Echo Liquid Handler and reverts the plate to its upright position.

- 6 Remove the destination microplate and click the Next button.



The destination plate gripper stage retracts into the Echo Liquid Handler and the source plate gripper stage extends outside of the Echo Liquid Handler.

- 7 Remove the source microplate and click the **Done** button.

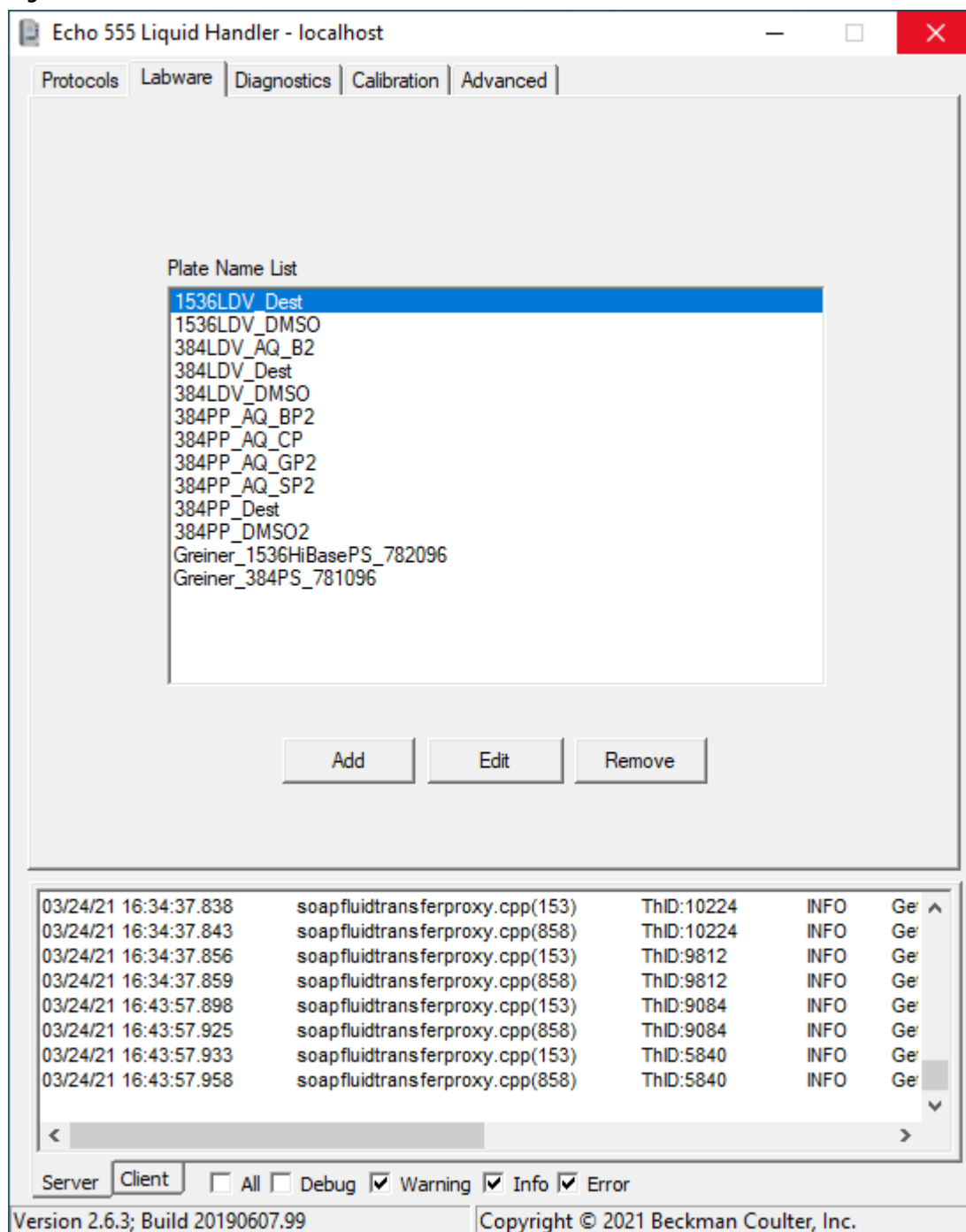


The source plate gripper stage retracts into the Echo Liquid Handler.
The liquid transfer protocol is finished.

Labware Window

The Labware window is used to manage source and destination microplate definitions.

Figure 3.25 Labware window



- **Plate Name List:** The **Plate Name List** contains all of the source and destination plates that have been defined for your system (may vary from the list in the previous figure). See [Plate Name Convention](#) for details on the plate naming convention.

- **Add:** To create a new destination plate specification, click the **Add** button. Source plate specifications cannot be added.
- **Edit:** To edit a plate specification, either select the plate name and click the **Edit** button, or double-click the plate name to open the **Plate Specification** window. Source plate specification editing is limited to selecting a barcode location including *none*. Destination plate specification editing is not restricted. See [Manage Labware Specifications](#) for information on editing the barcode.
- **Remove:** To remove an existing destination plate specification, select the plate specification name and click the **Remove** button. The selected destination plate specification will be deleted. Source plate specifications cannot be removed.

Plate Name Convention

Each plate name listed on the **Labware** tab refers to a combination of physical plate and well specifications, fluid characteristics, and other factors that enable the Echo Liquid Handler to accurately and reliably dispense as little as 25 nL of sample to every well in the microplate.

Source Plates

Beckman Coulter names every source plate with familiar plate naming convention, such as 384PP and abbreviated liquid types, such as AQ, to help operators identify the plate names. This section describes the convention we use.

Structure of the source plate name:

No. of wells + plate specs. _ liquid type _ key feature _ other features

Example 1: 384PP_AQ_BP

(384-well+polypropylene _ aqueous_buffer)

For a list of available source plate specifications, see [Supported Labware](#).

Destination Plates

For destination plates, the Echo Liquid Handler only requires the plate specifications. This includes where to place the sample and how much can it receive. In the **Plate Specification Editor**, you can also use microscope slides that are held in place with an SBS-compatible holder that is < 16 mm in height.

Structure of the destination plate name:

No of wells + plate specs_Dest

Example 1: 384PP_Dest

(384-well + polypropylene_Dest)

This destination plate can accept sample from any Echo qualified source plate.

Example 2: Greiner_384PS_781096

(vendor name, which includes 384-well + polystyrene)

In this example, the vendor name is used to describe the plate and there is no **Dest** ending. Operators can create destination labware at any time and adopt whatever is the most convenient convention for their lab. Laboratories using multiple labware types should consider formats which reduce the chance of the operator choosing the wrong destination plate, as this creates risk of plate collision during transfer.

NOTE If you are not sure whether a plate name is for a source plate or destination plate, highlight the plate name. If the **Remove** button is grayed out, the labware is a source plate.

Plate Specification Editor

Source plates require very exacting specifications to accurately transfer nanoliter volumes; therefore, they are defined specifically for the Echo instruments and tested as Echo qualified microplates. For this reason, new source plates cannot be defined by the user. For existing source plates, only the barcode location can be edited (see figure below). [Contact us](#) to add more source plates.

NOTE In Echo application software, such as Echo Dose-Response and Echo Cherry Pick, (version 1.5 or later), existing source plates can be copied and renamed, to allow for more specific identification for application workflows, and then imported into Echo Liquid Handler software. However, other plate parameters cannot be changed--except for barcode location.

Figure 3.26 Plate Specification for Source Plate

Plate Specification

Plate Name: 384PP_AQ_BP

Manufacturer: Labcyte

Lot Number: 04090130

Part Number: P-05525

Rows: 16

Columns: 24

Barcode Location: None

A1 X Offset (A): 12.13 (mm)

A1 Y Offset (B): 8.99 (mm)

X Center Spacing (C): 4.5 (mm)

Y Center Spacing (D): 4.5 (mm)

Plate Height (E): 14.4 (mm)

Flange Height (F): 2.41 (mm)

Well Width (G): 3.3 (mm)

Well Capacity (H): 50 (ul)

OK Cancel

Source plate specifications cannot be removed from the Echo Liquid Handler software or the **Plate Name List**. All source plate specifications can be used as destination plate specifications; however, no user-defined destination plate specification can be used as a source plate specification.

Manage Labware Specifications

Adding a new destination plate, or editing an existing destination plate, are virtually the same process. On the Labware tab click either Add or Edit. The Destination Plate Specification dialog box will open.

NOTE The edit window for the source plate specification looks the same, but only the barcode location can be edited.

Figure 3.27 Plate Specification for Destination Plate

The dialog box is titled "Destination Plate Specification". It contains the following fields and a diagram:

- Plate Name:** A text input field.
- Manufacturer:** A text input field.
- Lot Number:** A text input field.
- Part Number:** A text input field.
- Rows:** A text input field with the value "16".
- Columns:** A text input field with the value "24".
- Barcode Location:** A dropdown menu currently set to "None".
- A1 X Offset (A):** A text input field with the value "1" and unit "(mm)".
- A1 Y Offset (B):** A text input field with the value "1" and unit "(mm)".
- X Center Spacing (C):** A text input field with the value "4.5" and unit "(mm)".
- Y Center Spacing (D):** A text input field with the value "4.5" and unit "(mm)".
- Plate Height (E):** A text input field with the value "14.35" and unit "(mm)".
- Flange Height (F):** A text input field with the value "2.41" and unit "(mm)".
- Well Width (G):** A text input field with the value "0.01" and unit "(mm)".
- Well Capacity (H):** A text input field with the value "0.01" and unit "(ul)".

On the right side of the dialog is a schematic diagram of a microplate. It shows a 24x16 grid of wells. Various dimensions are labeled with letters A through H, corresponding to the input fields: A (X offset), B (Y offset), C (X spacing), D (Y spacing), E (plate height), F (flange height), G (well width), and H (well capacity). The diagram also shows the barcode location (None) and the plate's orientation.

At the bottom right of the dialog are "OK" and "Cancel" buttons.

- **Plate Name:** Enter a plate name to identify the new specification (required).
- **Manufacturer:** Enter the manufacturer's name.
- **Lot Number:** Enter the plate lot number identification.
- **Part Number:** Enter the manufacturer's plate part number.
- **Rows:** Enter the number of rows. The valid range is one or more.
- **Columns:** Enter the number of columns. The valid range is one or more.
- **Barcode Location:** From the drop down list, select the barcode location. The choices are **None**, **Left-Side** and **Long-Side** (front). The right-side is not supported.

NOTE Some users are more familiar with the microplate sides identified by the compass points: **Left-Side** = West and **Long-Side** = South and **Right-Side** = East.

Figure 3.28 Selecting barcode locations

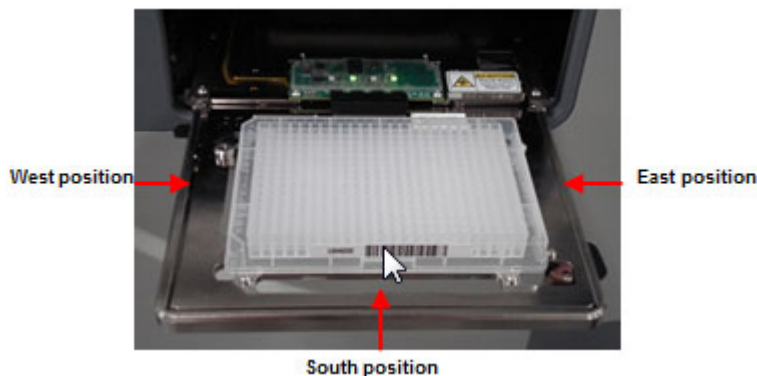
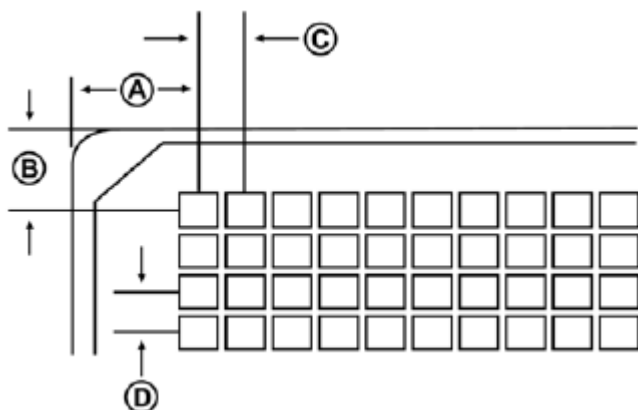


Plate Dimensions

Two illustrations identify the destination plate dimensions that must be entered. These dimensions may already be specified in the SBS standards.

Figure 3.29 Plate dimensions A, B, C, and D



A and B: Well A1 X/Y offsets. Dimensions A and B locate the center of well A1 in relation to the plate's left and top outside edges. **A** specifies the A1 well center to the left outside edge in millimeters. **B** specifies the A1 well center to the top outside edge in millimeters.

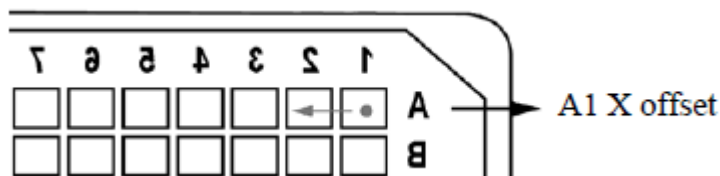
Examples: For a 384PP source plate type, **A** is 12.15 mm and **B** is 9.05 mm.

The valid range for A is 0.00 mm to 128.00 mm.

The valid range for B is 0.00 mm to 86.00 mm. Refer to ANSI/SBS 4-2004 for more information.

NOTE The Echo Liquid Handler's frame of reference for the destination is an inverted microplate. Increasing the A1-X offset will shift the inverted microplate to the right, and therefore drop placement would be further left.

Figure 3.30 Inverted destination microplate



C: X center spacing: Dimension C specifies the horizontal distance between well centers in millimeters. That is, the distance between wells A1, A2, A3, and so on.

Example: For a 384PP plate type, **C** is 4.5 mm.

The valid range for C is 0.05 mm to 9.00 mm.

Refer to ANSI/SBS 4-2004 for more information.

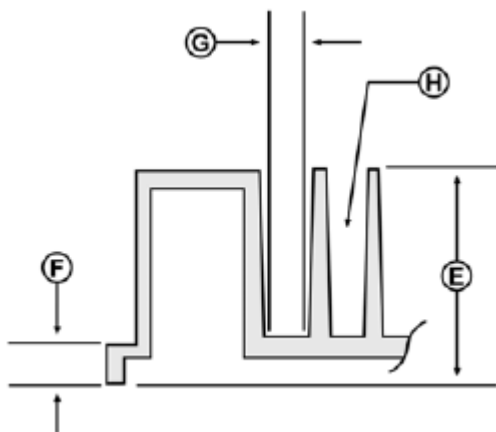
D: Y center spacing: Dimension D specifies the vertical distance between well centers in millimeters. That is, the distance between wells A1, B1, C1, and so on.

Example: For a 384PP plate type, **D** is 4.5 mm.

The valid range for D is 0.05 mm to 9.00 mm.

Refer to ANSI/SBS 4-2004 for more information.

Figure 3.31 Plate dimensions E, F, G, and H



E: Plate height: Dimension E specifies the overall height of the plate in millimeters.

Example: For a 384PP plate type, **E** is 14.4 mm.

Refer to ANSI/SBS 2-2004 for more information.

The valid range for E is 6.50 mm to 16 mm (higher plate height is not included in ANSI/SBS standards).

NOTE When using barcode labels on higher plate heights (for example, 16 mm), align the barcode label with the top of the plate to ensure proper scanning.

F: Flange height: Dimension F specifies the height of the plate's flange in millimeters. The Echo Liquid Handler supports the SBS standard short, medium, and tall flange heights. Select the correct one from the drop down list.

Example: For a 384PP_AQ_BP plate type, F is 2.41 mm.

The valid choices for F are 2.41, 6.10, or 7.62 mm.

Refer to ANSI/SBS 3-2004 for more information.

NOTE The flange height property is currently used for customer plate dimension management.

G: Well bottom width: Dimension G specifies the width of the well at its bottom in millimeters. This is not an SBS-specified dimension. It is used for source plates and is not necessary for destination plates.

Example: For a 384PP_AQ_BP plate type, G is 3.3 mm.

The valid range for G is 0.00 to 86.00 mm.

H: Well volume: Dimension H specifies the volume of the well in microliters.

Example: For a 384PP_AQ_BP, 65.0 μ L.

The valid range for H is greater than 0.0 μ L.

NOTE The destination well volume property is currently used for customer plate dimension management.

The OK button saves the new or edited specification. The **Cancel** button abandons the data that has been entered.

SBS standards: The SBS (Society for Biomolecular Sciences) standards that may be useful include:

- ANSI/SBS 1-2004: Microplates — Footprint Dimensions
- ANSI/SBS 2-2004: Microplates — Height Dimensions
- ANSI/SBS 3-2004: Microplates — Bottom Outside Flange Dimensions
- ANSI/SBS 4-2004: Microplates — Well Positions (Either singularly, or as a whole)

The SBS standards can be found at: <http://www.slas.org/education/microplate.cfm>. SBS is a subsection of SLAS (Society for Laboratory Automation and Screening).

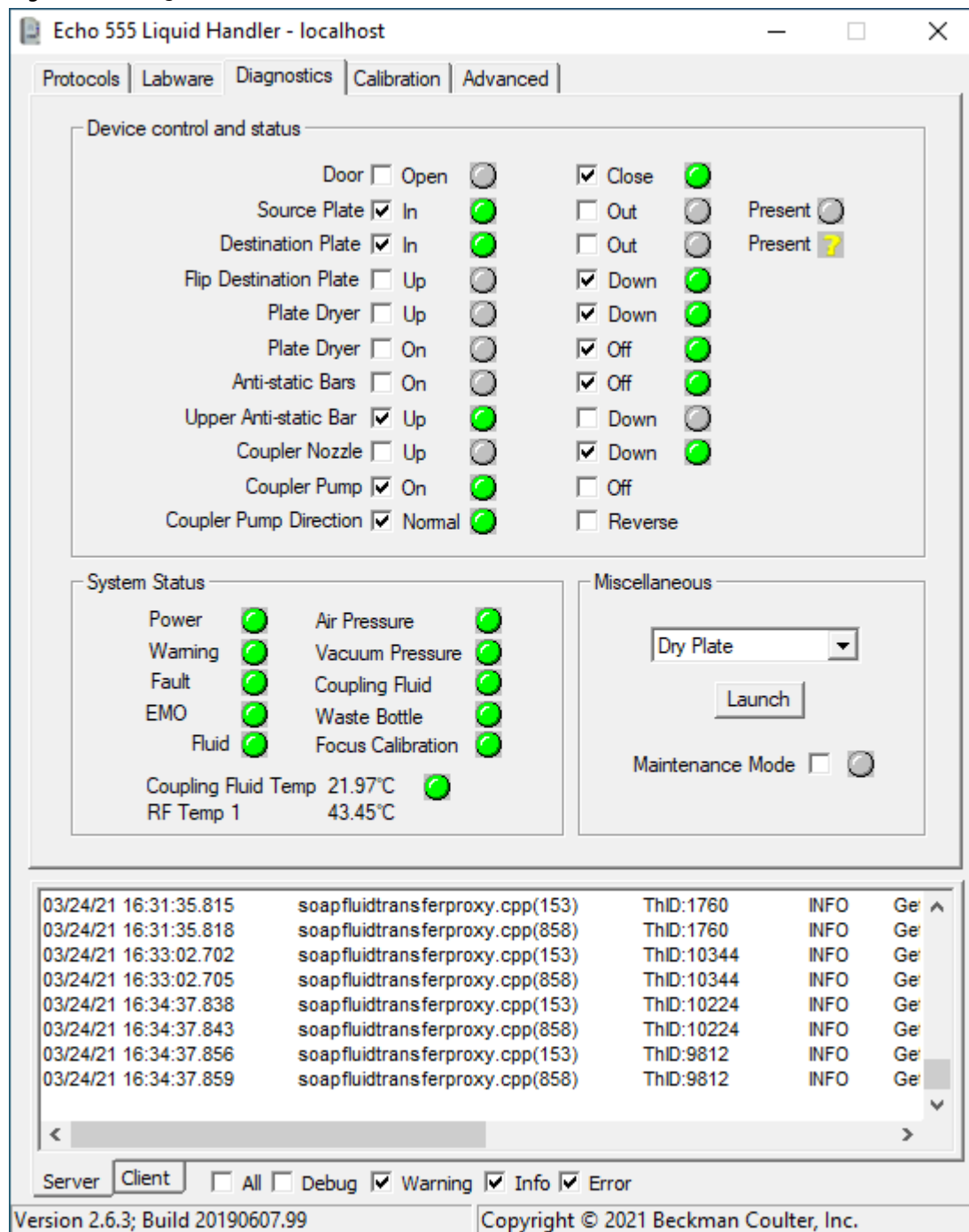
Diagnostics Window

The Diagnostics window provides the following control and monitoring options:

- In the **Device control and status** section, the user can control many of the Echo internal devices and mechanisms. The current position of those devices and mechanisms is reported by green lamp indicators. Clicking the check box next to the device initiates the action (for example, clicking Source Plate In directs the Echo Liquid Handler to retract the source plate gripper stage).
- In the **System Status** section, the user can monitor the current overall status of the Echo Liquid Handler through ten additional status indicators and two internal Echo temperature readouts.

- In the **Miscellaneous** section, the user can either activate the Echo maintenance mode or execute diagnostic procedures.

Figure 3.32 Diagnostics tab



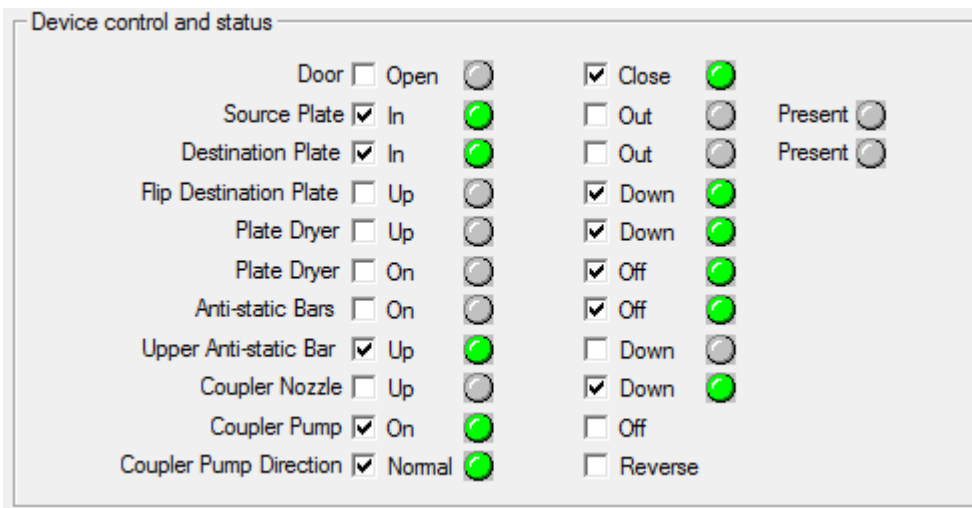
Device Control

You have access to precise Echo device control. The ability to command internal mechanism movement is useful during maintenance, troubleshooting, and diagnostic procedures. Access to device control is found in several areas of the Echo Liquid Handler software:

- The Device Control and Status section of the **Diagnostics** window uses eleven sets of checkboxes and status indicators that allow you to control the Echo Liquid Handler. They are discussed below.
- The Miscellaneous section of the **Diagnostics** window uses the diagnostic procedures drop-down list and Launch button. For more information, see [Diagnostic Procedures](#).
- The **Motion** section of the **Calibration** window uses the **Home** and **Register** buttons.

NOTE The Echo Liquid Handler will not allow device movement that would cause damage to itself. For example, if the door is closed when the source plate gripper stage is commanded to extend outside, the Echo Liquid Handler opens the door first.

Figure 3.33 Device control and status section



Door Open/Close

The Echo door can be manually opened and closed by selecting the appropriate checkbox.

If either the source or destination plate gripper stage is extended outside of the Echo Liquid Handler when the door is commanded to close, a **Close Door Error** dialog box is displayed.

Figure 3.34 Close Door Error dialog box



The associated indicator lights report the current position of the door.

Source Plate In/Out and Presence

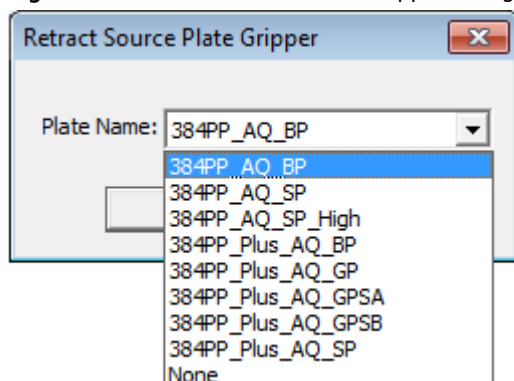
The source plate gripper stage can be commanded to extend outside or to retract back inside the Echo Liquid Handler. Select the appropriate checkbox.

If the door is closed when the source plate is commanded to extend outside of the Echo Liquid Handler, the door will be opened first.

When the source plate gripper stage is commanded to retract into the Echo Liquid Handler, the **Retract Source Plate Gripper** dialog box will open. Select the plate type being loaded or select **None**.

Two indicator lights are associated with the source plate. One light reports the current position (in/out) of the source plate gripper stage, the other light reports the presence of a microplate loaded onto the plate gripper.

Figure 3.35 Retract Source Plate Gripper dialog box



The plate presence indicator has two states:

Gray = Plate not present

Green = Plate present

Destination Plate In/Out and Presence

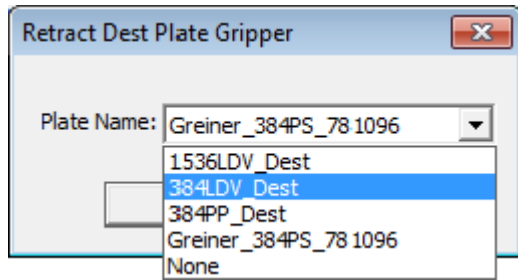
The destination plate gripper stage can be commanded to extend outside or to retract back inside the Echo Liquid Handler. Select the appropriate checkbox.

If the door is closed when the destination plate is commanded to extend outside of the Echo Liquid Handler, the door will be opened first.

When the destination plate gripper stage is commanded to retract into the Echo Liquid Handler, the **Retract Dest Plate Gripper** dialog box will open. Select the plate type being loaded or select **None**.

There are two indicator lights associated with the destination plate. One reports the current position (in/out) of the destination plate gripper stage. The second reports the presence of a microplate loaded onto the plate gripper.

Figure 3.36 Retract Dest Plate Gripper dialog box



The plate presence indicator has two states:

Gray = Plate not present

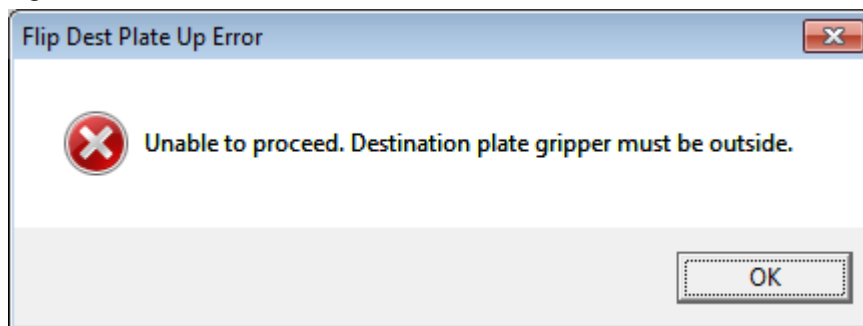
Green = Plate present

Flip Destination Plate

The Echo Liquid Handler can be commanded to flip its destination plate gripper stage into the inverted or upright positions. Select the appropriate checkbox.

If the destination plate gripper stage is still inside the Echo Liquid Handler when commanded to flip upright, a **Flip Dest Plate Up Error** will appear.

Figure 3.37 Flip Dest Plate Up Error dialog box



The associated indicator lights report the current rotational position of the destination plate gripper stage.

Plate Dryer Up/Down and On/Off

The Echo Liquid Handler can be commanded to raise or lower the plate dryer nozzle, or to turn its vacuum supply on or off. Select the appropriate checkboxes.

If necessary, the Echo Liquid Handler will move the plate dryer beneath the source plate prior to raising it.

The associated indicator lights report the current position of the plate dryer and whether its vacuum is turned on or off.

Anti-Static Bars On/Off

The Echo Liquid Handler can be commanded to turn its anti-static bars on or off at any time.

The associated indicator lights report whether the anti-static bars are turned on or off.

Upper Anti-Static Bar Up/Down

The Echo Liquid Handler can be commanded to lower or raise its upper antistatic bar.

The upper anti-static bar can be raised or lowered regardless of the door or source plate positions. If the upper anti-static bar is commanded to be lowered while the destination plate gripper stage is extended outside of the Echo Liquid Handler, an **Actuate Ionizer Down Error** will appear.

The associated indicator lights report on the position of the upper anti-static bar.

Coupling Nozzle Up/Down

The Echo Liquid Handler can be commanded to raise or lower its coupling fluid nozzle, also called the **bubbler**, at any time.

The associated indicator lights report the position of the coupling fluid nozzle.

Coupling Pump On/Off

The Echo Liquid Handler can be commanded to turn the coupling fluid pump on or off.

The associated indicator lights report whether the coupling fluid pump is turned on or off.

Coupling Pump Direction Normal/Reverse

The Echo Liquid Handler can be commanded to run its coupling fluid pump in the normal or reverse direction.

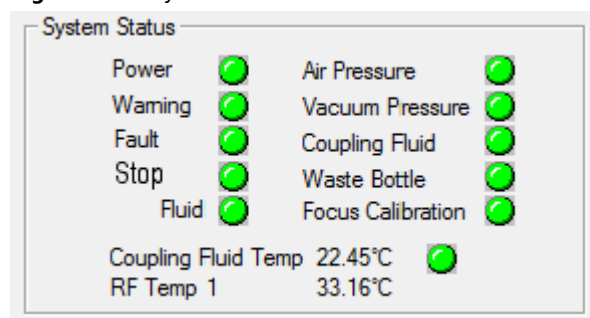
The associated indicator lights report the direction of coupling fluid pump flow.

NOTE Do not run the pump in reverse for an extended period.

Status Indicators

The **System Status** section of the **Diagnostics** window contains a vertical array of status indicators and readouts. Four of them (**Power**, **Warning**, **Fault**, and **Stop**) correspond to the similarly named indicators on the Echo status panels.

Figure 3.38 System Status section



Power Indicator

The **Power** status indicator provides more information than simply power on or power off.

Green: The Echo Liquid Handler is powered on and is ready for use.

Gray: One or more of the following conditions is true:

- The Echo Liquid Handler is not powered on.
- The Echo internal controller is not running.
- The Echo Liquid Handler is still initializing after being powered on and is not yet ready for use.

Warning Indicator

The **Warning** status indicator reports conditions that will not allow normal operation.

Gray: OK. The Echo Liquid Handler is ready for use.

Yellow: One or more of the following is true:

- The Echo stages are not homed. For more information, see [Home Calibration](#).
- The coupling fluid bottle level is low. For more information, see [Coupling Fluid Indicator](#).
- The door is neither fully open nor fully closed.
- The upper anti-static bar is neither fully up nor fully down.
- The source plate dryer nozzle is neither fully up nor fully down.
- Focus calibration is required.

Fault Indicator

The **Fault** status indicator reports events or situations that must be responded to by the operator. Normal operation may be affected or will be shortly.

Gray: OK. The Echo Liquid Handler is ready for use.

Red: One or more of the following is true:

- The user-supplied compressed air supply is <552 kPa (<80 psi). For more information, see [Compressed Air Pressure Indicator](#).
- The user-supplied vacuum pressure is <78 kPa (<15 in Hg Vac). For more information, see [Vacuum Supply Pressure Indicator](#).
- The coupling fluid temperature is outside of the warning range: 20.2°C – 24.0°C.
- A coupling fluid leak (caused by accumulation in the bottom pan) has been detected. For more information, [Fluid Leak Indicator](#).
- The Stop switch has been activated. For more information, [Stop Indicator](#).

Stop Indicator

There are two Stop switches; one on the front and one on the rear of the Echo Liquid Handler.

Gray: OK. The Stop switches are in their normal, not activated position.

Red: A Stop switch has been activated. Power has been turned off to many internal Echo electrical devices. For a full discussion of the Stop switch, when it should be used, and how to power on an Echo Liquid Handler after the Stop switch has been used, see [Stop Switch](#).

Fluid Leak Indicator

Sensors inside the Echo Liquid Handler check for coupling fluid in the bubbler catch basin or lower pan.

Green: No fluid leak has been detected.

Red: Fluid has been detected in the lower pan or excess fluid has been detected in the catch basin. The coupling fluid pump has been turned off. The user should [contact us](#).

Compressed Air Pressure Indicator

A pressure sensor inside the Echo Liquid Handler monitors the user-supplied compressed air supply.

Green: OK. Air pressure is within specifications.

Red: The user-supplied compressed air is low <552 kPa (<80 psi) or nonexistent. Check for leaks, disconnections, or for the air pressure turned off at the source.

Vacuum Supply Pressure Indicator

A pressure sensor monitors the user-supplied vacuum supply line pressure inside the Echo Liquid Handler.

Green: OK. Vacuum pressure is within specifications.

Red: The user-supplied vacuum pressure is low <78 kPa (<15 in Hg Vac) or nonexistent. Check for leaks, disconnections, or for the vacuum turned off at the source.

Coupling Fluid Indicator

A sensor monitors the level of coupling fluid in its bottle.

Green: OK. Coupling fluid is above the minimum required level.

Yellow: The coupling fluid bottle level is low (<250 mL).

NOTE When the coupling fluid falls below its recommended minimum level, bubbles may be introduced into the coupling fluid, reducing the accuracy or precision of source plate surveys and liquid transfers. Beckman Coulter recommends refilling the coupling fluid bottle as soon as possible. For more information, see [Echo Coupling Fluid Maintenance](#).

Waste Bottle Indicator

The waste bottle is not necessary for the Echo 525 Liquid Handler. The indicator will always be Green.

Focus Calibration Indicator

Periodically, the focal length of the acoustic transducer should be checked. When this period of time has expired, the **Focus Calibration** indicator turns yellow. The user should perform a focus calibration as soon as possible. For more information, see [Focus Calibration Check](#).

Green. Focus calibration has been performed recently.

Yellow. A Focus calibration should be performed as soon as possible.

Coupling Fluid Temperature and Indicator

The coupling fluid temperature inside the Echo Liquid Handler is reported in degrees Celsius. The operating range for the coupling fluid temperature is $22.1^{\circ}\text{C} \pm 0.9^{\circ}\text{C}$. The coupling fluid controls the temperature of the acoustic transducer. A correct and stable acoustic transducer temperature is required to maintain accurate and precise liquid transfers.



The coupling fluid temperature indicator reports three states:

Green. Coupling fluid temperature is OK.

Yellow. Coupling fluid temperature warning: The coupling fluid temperature is outside of the normal range: 21.2°C – 23.0°C .

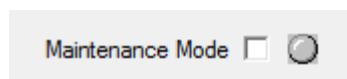
Red. Coupling fluid temperature fault: The coupling fluid temperature is outside of the warning range: 20.2°C – 24.0°C .

RF Temp 1 Temperature

The temperature inside the Echo controller is reported in degrees Celsius. Normal **RF Temp 1** temperature is between 35 – 55°C . As the reported temperature exceeds 55°C , performance could occur.

Maintenance Mode

Maintenance mode disables Echo motor control from the client software to allow you to perform maintenance procedures, such as changing fluid.



Select the **Maintenance Mode** checkbox to inhibit the execution of the following Echo processes and functions from the Echo Liquid Handler software:

- Executing fluid transfer protocols
- Door open/close
- Source microplate extend/retract
- Destination microplate extend/retract/flip
- Source microplate dryer up/down/on/off
- Anti-static bars up/down/on/off
- Coupling nozzle up/down
- Executing the dry plate diagnostic procedure
- Executing the move to well diagnostic procedure

- Executing the perform survey diagnostic procedure
- Homing the stages
- RF Power calibration
- Acoustic transducer calibration
- Barcode scanner calibration

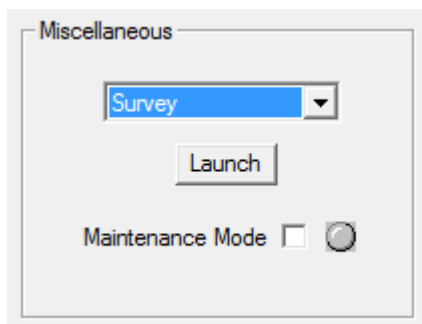
The following Echo functions continue to be available during maintenance mode:

- Creating, editing, or deleting fluid transfer protocol definitions
- Creating, editing, or deleting destination plate definitions
- Turning the coupling pump on or off, or changing its pumping direction to normal or reverse
- Executing either a hard or soft reset of the Echo controller

Always clear the Maintenance Mode checkbox when returning the Echo Liquid Handler to normal operation.

Diagnostic Procedures

In the **Miscellaneous** section, there is a drop-down list of diagnostic procedures and a **Launch** button.



The following diagnostic procedures are available:

- [Dry Plate](#)
- [Move to Well](#)
- [Diagnostic Survey](#)

Dry Plate

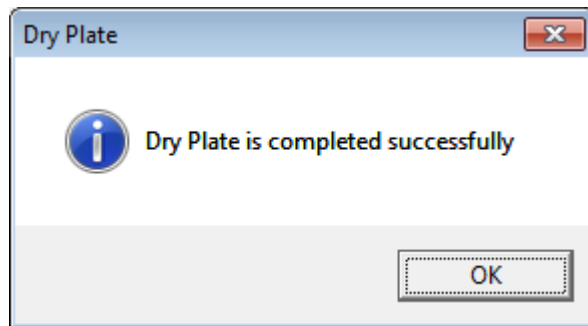
The **Dry Plate** procedure vacuums the water film off the bottom of a source plate. During typical protocol runs, the **Dry Plate** procedure is automatically executed. During diagnostic operations, **Dry Plate** is a standalone procedure and must be manually executed.

If a source plate is not present, the **Dry Plate** procedure is aborted.

During the **Dry Plate** procedure, the acoustic coupling nozzle is moved down and out of the way, and the coupling fluid pump is turned off.

The plate dryer nozzle makes a pass to ensure that all of the moisture is removed, then displays a message when it is done.

Figure 3.39 Dry Plate dialog box

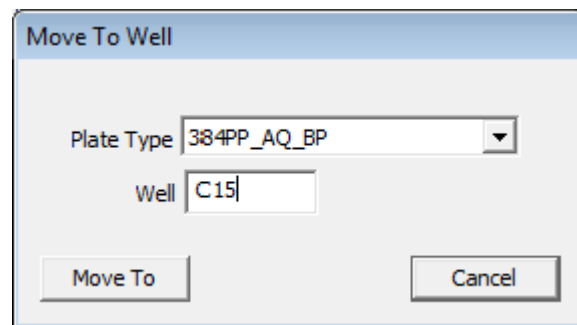


Move to Well

The **Move to Well** procedure positions the acoustic transducer directly beneath a specified well.

- 1 Select **Move to Well** and click the **Launch** button. The **Move to Well** dialog box is displayed.
- 2 Enter the row and column address of the well. Example: C15.

Figure 3.40 Move to well function



- 3 Click the **Move To** button to move the acoustic transducer directly beneath the specified well.

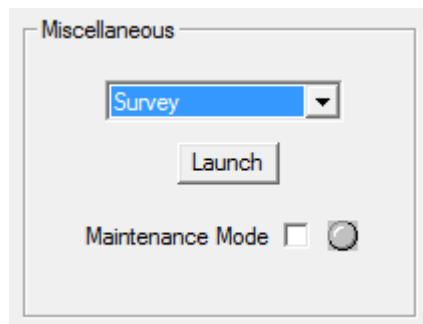
If you want to abort this function, click the **Cancel** button.

Diagnostic Survey

The Survey procedure performs an acoustic survey of the fluid in the loaded source plate.

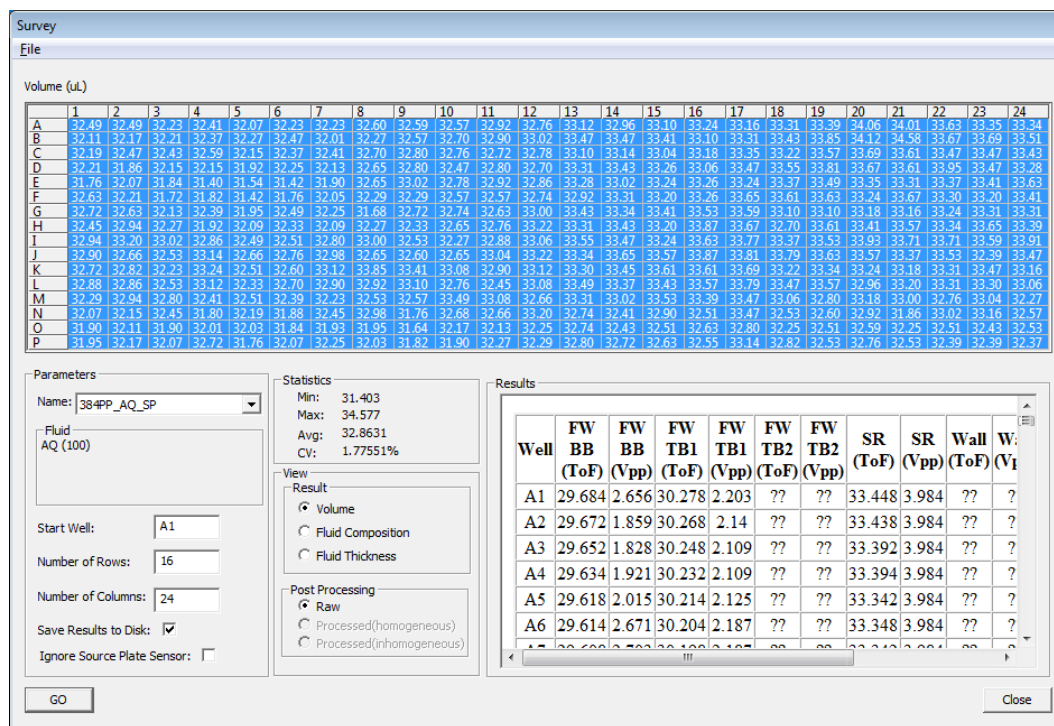
- 1 Go to the **Diagnostics** window and use the Diagnostics controls to load a source plate into the Echo Liquid Handler.
- 2 Select **Survey** from the **Miscellaneous** drop-down list.

Figure 3.41 Survey Section



- 3 Click the **Launch** button. The **Survey** window will open.

Figure 3.42 Survey Procedure



- 4 From the **Name** drop-down list, select the correct source plate type.

- 5 Enter the wells to be surveyed (default value is the entire plate). Use one of the following methods:

- Enter the values in the **Parameters** section.
 - Enter a valid starting well. Example: **A1**
 - Enter the number of rows to be surveyed. Example: **16**
 - Enter the number of columns to be surveyed. Example: **24**

- Use the cursor to select the wells in the plate map.

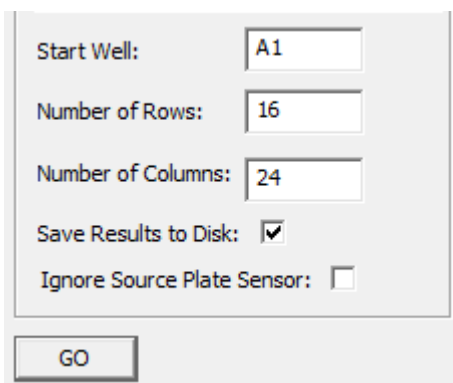
6 Set up the following options in the **Parameters** section as appropriate:

Save Results to Disk. Select this checkbox to automatically store the results of the acoustic survey in the client PC data directory (**C:\Program Files\Beckman Coulter\Medman\Data**).

Ignore Source Plate Sensor. Select this checkbox to resolve problems with fitting a source plate onto the source plate gripper stage. This option allows the Echo Liquid Handler to use a source plate without detecting its presence with the source plate sensor.

NOTE If you choose to select the **Ignore Source Plate Sensor** checkbox, a plate load error could result and no error messages will be triggered.

Figure 3.43 Diagnostic survey plate map



The image shows a software dialog box titled "Diagnostic survey plate map". It contains five input fields and two checkboxes. The "Start Well:" field is set to "A1". The "Number of Rows:" field is set to "16". The "Number of Columns:" field is set to "24". The "Save Results to Disk:" checkbox is checked. The "Ignore Source Plate Sensor:" checkbox is unchecked. At the bottom of the dialog is a "GO" button.

Start Well:	A1
Number of Rows:	16
Number of Columns:	24
Save Results to Disk:	☒
Ignore Source Plate Sensor:	☐

GO

- 7 Click the **GO** button. The acoustic survey will be performed. The acoustic transducer moves in an efficient, non-stop path beneath each specified well. Acoustic pulses are transmitted up into a well, and the resulting return data is saved for analysis.

Figure 3.44 Diagnostic survey plate parameters

The screenshot shows a software window titled 'Diagnostic survey plate parameters'. It contains several input fields and sections. The 'Parameters' section on the left includes a 'Name' dropdown set to '384PP_AQ_SP2', a 'Fluid' dropdown set to 'AQ (10)', 'Start Well' set to 'A1', 'Number of Rows' set to '16', 'Number of Columns' set to '24', 'Save Results to Disk' checked, and 'Ignore Source Plate Sensor' unchecked. The 'Statistics' section on the right displays 'Min: 31.403', 'Max: 34.577', 'Avg: 32.8631', and 'CV: 1.77551%'. Below this is the 'View' section, which contains a 'Result' subsection with three radio buttons: 'Volume' (selected), 'Fluid Composition', and 'Fluid Thickness'. At the bottom of the 'View' section is a 'Post Processing' subsection with three radio buttons: 'Raw' (selected), 'Processed(homogeneous)', and 'Processed(inhomogeneous)'. A 'GO' button is located at the bottom left of the window.

- 8 After the survey, the following options are available in the **View** section below the **Statistics** section. Select the appropriate survey type depending on the application.

Result:

- **Volume:** Displays fluid volume.
- **Fluid Composition:** Displays fluid composition based on the fluid type described in the Fluid box.
- **Fluid Thickness:** Displays well fluid thickness.

Post Processing:

- **Raw:** The measured fluid percentages are not *processed*.

NOTE Selecting processed or raw fluid percentages affects the following data:

- The data displayed in the plate map.
- The data displayed in the Statistics section.
- The data saved to a CSV file on the client PC.

The source microplate survey data is displayed in the main data grid of the **Survey** dialog box. Either fluid composition or well fluid thickness (height) will be displayed, depending on which **Result** radio button is selected. The data will either be raw, processed (homogeneous), or processed (inhomogeneous) depending on which **Post Processing** radio button is selected.

In the **Statistics** section, the minimum, maximum, average, and CV data from the survey is reported. These statistics are calculated from raw, processed (homogeneous), or processed (inhomogeneous) survey data depending on which **Post Processing** radio button is selected.

In the **Results** section, raw data collected during the survey is displayed. This information is used only by Beckman Coulter personnel during troubleshooting or system analysis.

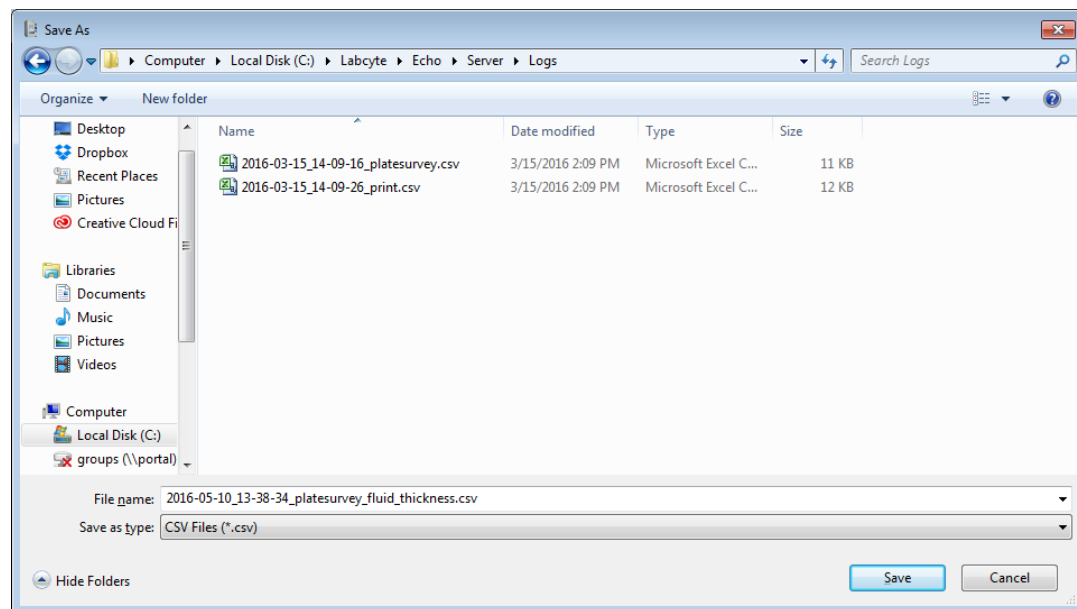
Figure 3.45 Diagnostic survey results

Well	FW BB (ToF)	FW BB (Vpp)	FW TB1 (ToF)	FW TB1 (Vpp)	FW TB2 (ToF)	FW TB2 (Vpp)	SR (ToF)	SR (Vpp)	Wall (ToF)	Wall (Vpp)
A1	29.684	2.656	30.278	2.203	??	??	33.448	3.984	??	??
A2	29.672	1.859	30.268	2.14	??	??	33.438	3.984	??	??
A3	29.652	1.828	30.248	2.109	??	??	33.392	3.984	??	??
A4	29.634	1.921	30.232	2.109	??	??	33.394	3.984	??	??
A5	29.618	2.015	30.214	2.125	??	??	33.342	3.984	??	??
A6	29.614	2.671	30.204	2.187	??	??	33.348	3.984	??	??

- 9 To save the survey data to the client PC, click the **File** button and select from the following choices:
 - Save | Fluid Composition (.csv)
 - Save | Fluid Thickness (.csv)
 - Save | Raw (.csv)

Note that **File | Save | Fluid Composition** will save raw, processed (homogeneous), or processed (inhomogeneous) survey data, depending on which **Post Processing** radio button is selected. The **Save As** dialog box is displayed.

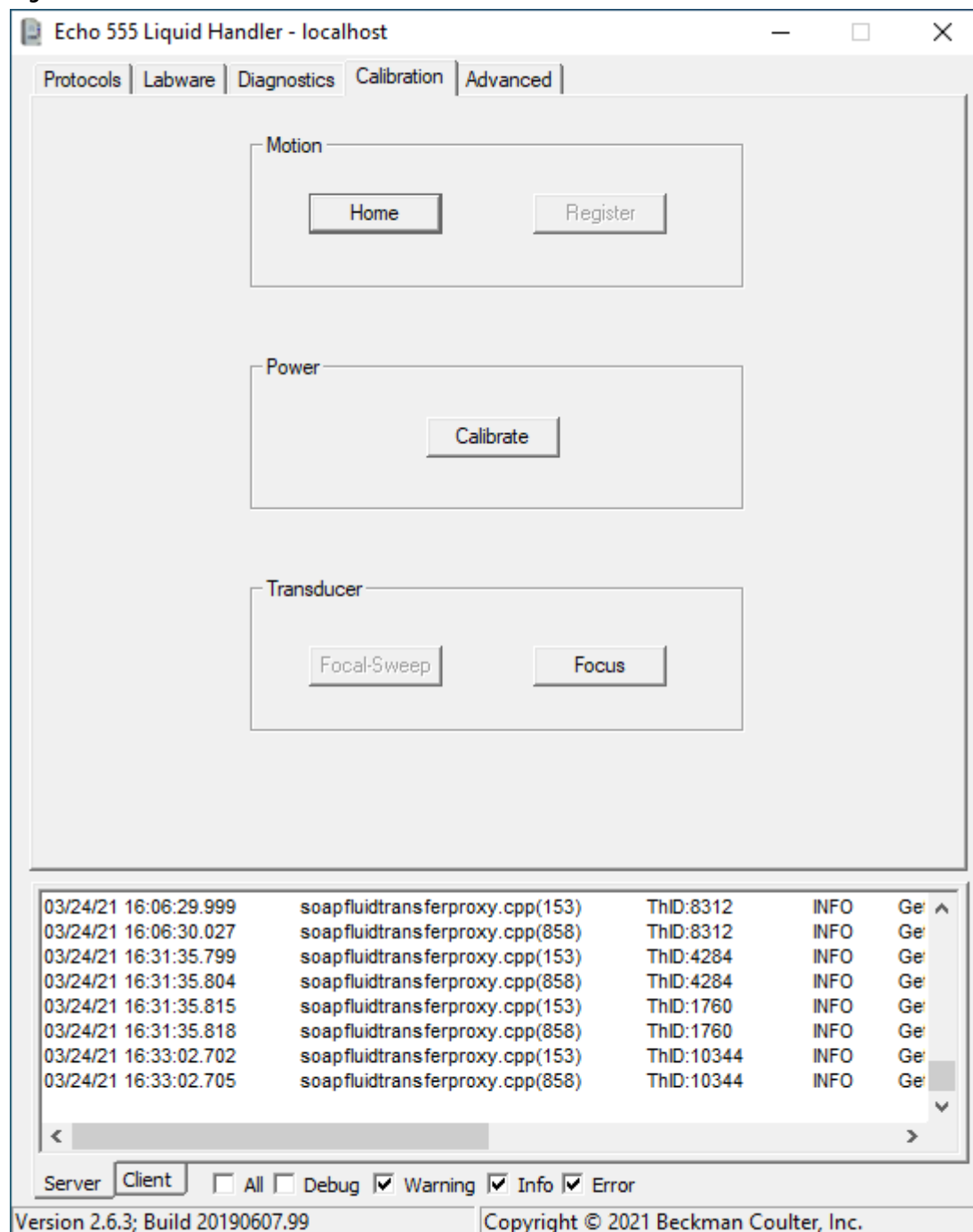
Figure 3.46 Diagnostic survey file saved



Calibration Window

Several Echo mechanisms can be user-calibrated. The following motion, power, and acoustic transducer related calibration procedures are found in the **Calibration** window.

Figure 3.47 Calibration window



Motion Calibration

Two Motion calibrations are available:

- [Home Calibration](#)
- [Register Calibration](#)

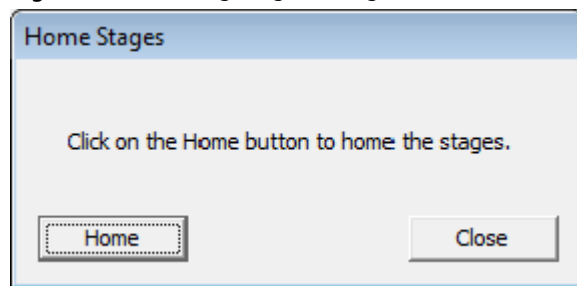
Home Calibration

The **Home** button moves each Echo stage (destination plate gripper stage, source plate gripper stage, and acoustic transducer) to the limits of its travel (X, Y, Z, or theta direction, depending on the component) to establish its absolute position.

- Destination plate gripper stage: X (left/right), Y (front/rear), Z (up/down), and theta (plate rotation).
- Source plate gripper stage: Y (front/rear).
- Acoustic transducer: X (left/right), Y (front/rear), and Z (up/down).

During the homing procedure the destination plate gripper stage extends outside of the Echo Liquid Handler to rotate safely.

Figure 3.48 Homing Stages dialog box



After homing its stages, the Echo controller knows the absolute position of each stage.

Register Calibration

The **Register** button calibrates the well position for the selected source plate and updates the Labware database. This calibration is essential to position the acoustic transducer under the well center.

NOTE Normally the register calibration will not need to be performed by a user. However, it can be useful during certain repair, diagnostic, or recovery procedures. Perform the register calibration only as directed by Beckman Coulter personnel.

If register calibration is required, use the following procedure:

- 1 Click **Register** in the **Calibration** window. The **Plate Registration** window opens.

Figure 3.49 Plate registration window

Plate Registration

Plate Type: 384PP_AQ_SP

Present Retract Register

Labware

Well Center Delta X -43.95 (um)

Well Center Delta Y 0.00 (um)

Well Spacing Delta X (um)

Well Spacing Delta Y (um)

Attitude

Plate Skew (Degrees)

Plate Pitch (Degrees)

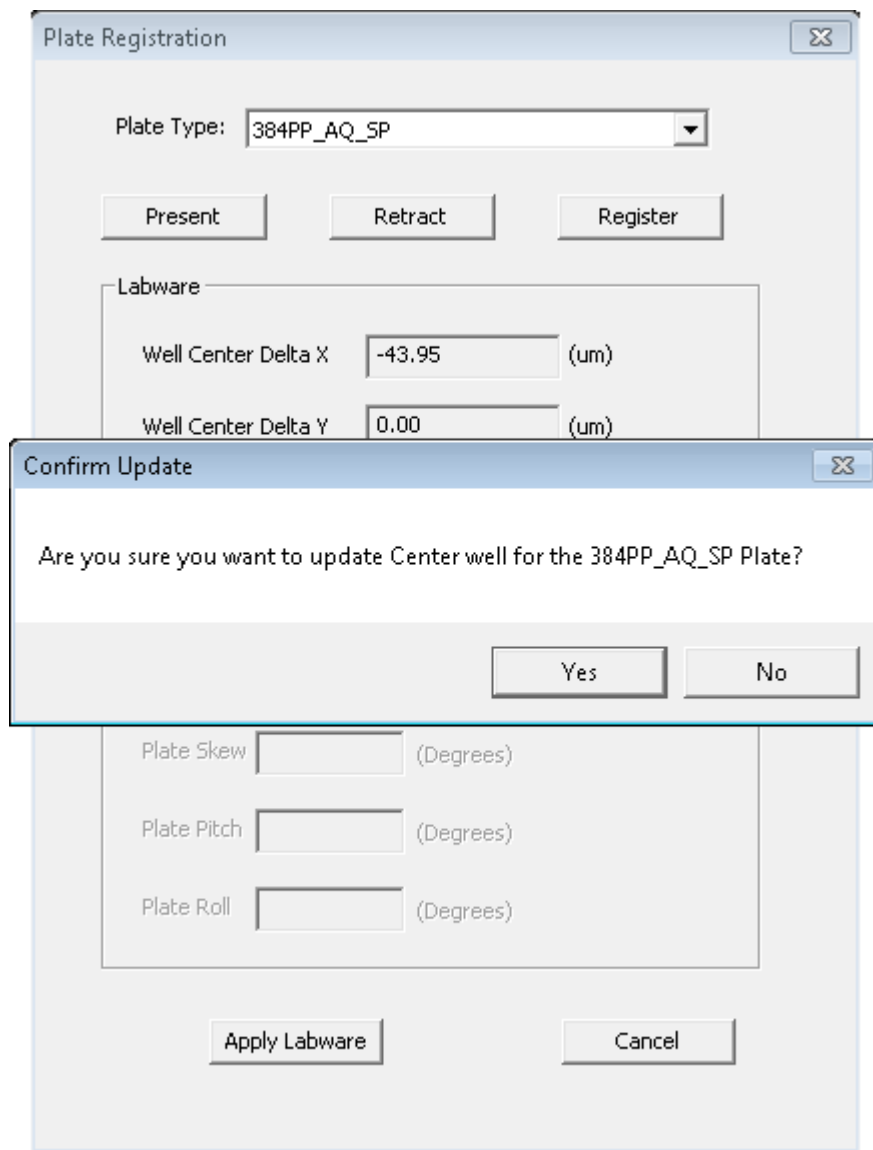
Plate Roll (Degrees)

Apply Labware Cancel

- 2 Select the source plate type from the drop-down menu.
- 3 Click the **Present** button to extend the source plate gripper stage.
- 4 Place the source plate on the plate gripper.
- 5 Click the **Retract** button to draw the plate into the instrument.

- 6 Click the **Register** button. The Echo Liquid Handler calibrates the well position and displays the new well center values.
- 7 Click the **Apply Labware** button at the bottom of the dialog box, then **Yes** in the **Confirmation Update** dialog box, to update the database.

Figure 3.50 Plate registration confirmed



Power Calibration

Proper acoustic droplet ejection relies on a calibrated RF energy source. Environmental temperature changes can affect the characteristics of the Echo RF energy pulses. Power calibration is performed automatically by the Echo Liquid Handler as part of each liquid transfer protocol.

NOTE Normally a manual power calibration will not need to be performed by a user. However, it can be useful during certain repair, diagnostic, or recovery procedures. Perform power calibration only as directed by Beckman Coulter personnel.

If manual power calibration is required, use the following procedure:

- 1 On the **Calibration** tab, click the **Calibrate** button in the **Power** section.
The **Calibrate Power** dialog box will open.

Figure 3.51 Calibrate Power dialog box reporting current values

The image shows a 'Calibrate Power' dialog box with three main sections: Reference, Power, and System Gain. The Reference section contains 'Amp: 1.6 volts' and 'Pulse Energy: 1.13801 mJ'. The Power section contains 'Amplifier Feedback: 0.999098', 'Pulse Energy: [] mJ', and 'Vpp: [] volts', with a 'Calibrate' button below. The System Gain section contains a '1' in a box and an 'Override' checkbox. At the bottom are 'OK', 'Cancel', and 'Apply' buttons.

Section	Field	Value	Unit
Reference	Amp	1.6	volts
	Pulse Energy	1.13801	mJ
Power	Amplifier Feedback	0.999098	
	Pulse Energy	[]	mJ
	Vpp	[]	volts
System Gain	Gain Value	1	
	Override	☐	

Reference

- **Amp:** The **Amp** field displays the reference tone burst amplitude.
- **Pulse Energy:** The **Pulse Energy** field displays the reference pulse energy value.

Power

- **Amplifier Feedback:** The **Amplifier Feedback** field displays the current power correction factor, and normally should be very close to 1.0.
- **Pulse Energy:** The **Pulse Energy** field will be empty until power calibration is performed.
- **Vpp:** The voltage peak-to-peak (**Vpp**) field will be empty until power calibration is performed.

- 2 Click the **Calibrate** button in the **Power** section of the **Calibrate Power** dialog box. The Echo Liquid Handler performs the following procedure:
 - The most recent power calibration record stored in the Echo database is read. This data will be used in the next step.
 - An RF pulse is generated.
 - Several RF measurements are taken.
 - A new amplifier feedback value is calculated and displayed as **Power—Amplifier Feedback**.
 - A new pulse energy value is measured and displayed as **Power—Pulse Energy**.
 - A new Vpp value is measured and displayed as **Power—Vpp**.
 - The new power calibration record is stored in the Echo database.

Figure 3.52 Calibrate Power dialog box after power calibration

Calibrate Power

Reference

Amp: 1.6 volts

Pulse Energy: 1.13801 mJ

Power

Amplifier Feedback: 0.999347

Pulse Energy: 1.1395 mJ

Vpp: 63.12 volts

Calibrate

System Gain

1 ☐ Override

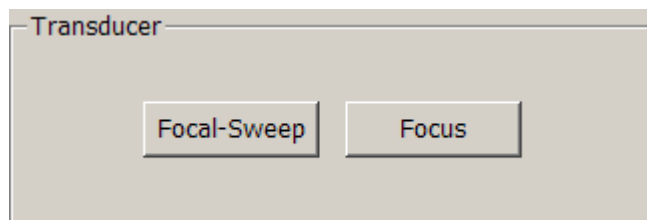
OK Cancel Apply

-
- 3 System Gain:** During normal operation, the **System Gain** value should not be changed by the user. However, the user can override the automated power calibration by adjusting the **System Gain** scalar multiplier value. The default **System Gain** value is 1.0. Select the **Override** checkbox and enter a multiplier value manually.
-
- 4** After power calibration has been performed and/or the **System Gain** parameter has been modified, there are three actions to choose from.
- OK:** The **OK** button applies the new **Amplifier Feedback** value and/or the new **System Gain** value and closes the **Calibrate Power** dialog box. Change confirmation is not requested.
- Apply:** The **Apply** button displays a dialog box asking for confirmation of the **Amplifier Feedback** and/or **System Gain** change(s). Answering **Yes** applies the changes. Answering **No** closes the confirmation dialog box without applying the change(s) and returns to the **Calibrate Power** dialog box.
- Cancel:** The **Cancel** button closes the **Calibrate Power** dialog box without taking any further action.
-

Transducer Focus Calibration

There are two acoustic transducer calibration tools:

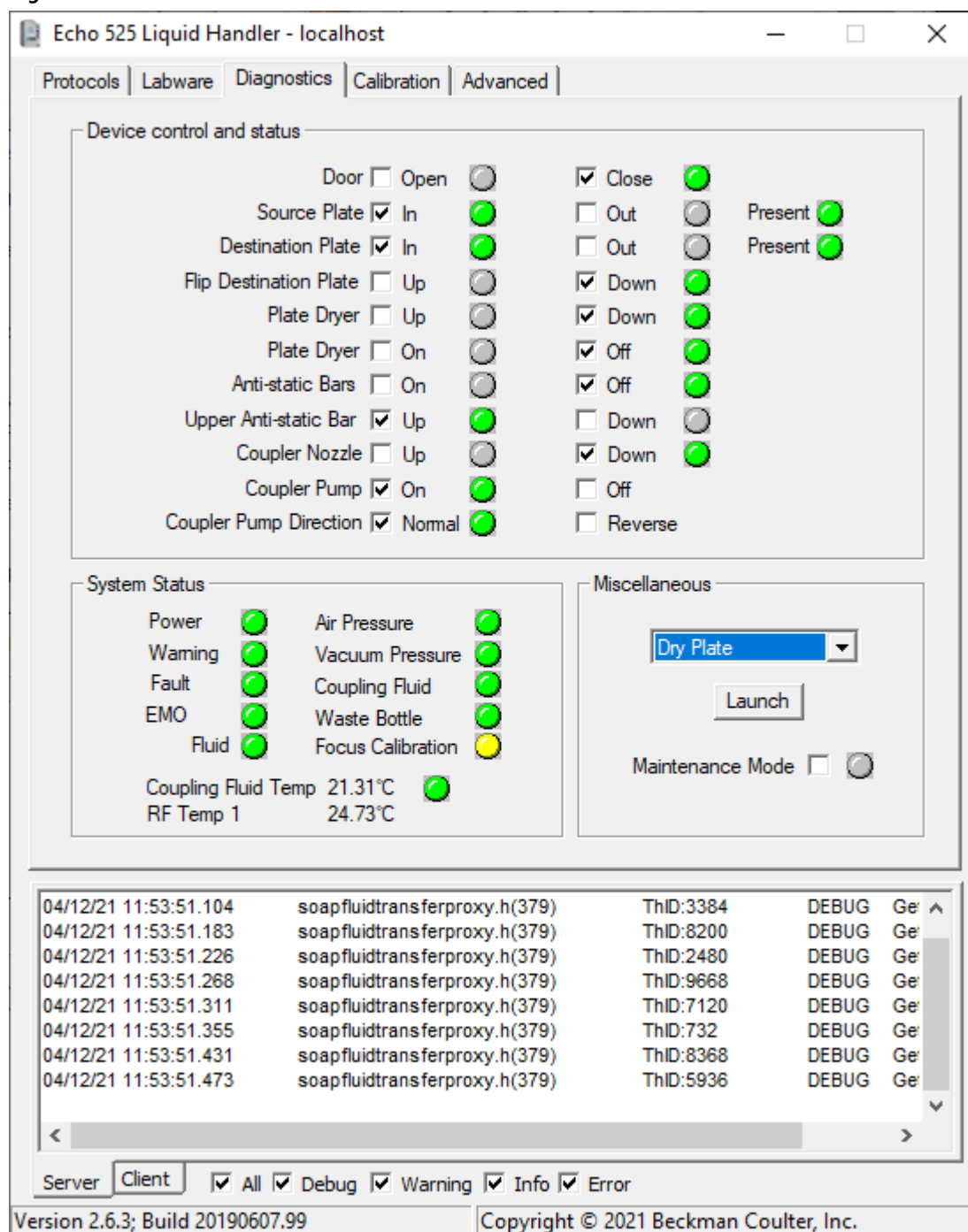
- **Focus** calibration measures the focal length of the acoustic transducer and compares it to the previous measurement. If the difference between these measurements is minimal, then the system updates its calibration database with the new focal length and the procedure is finished. If the difference is larger than a preset threshold, users should [contact us](#) to ensure the system is running properly before accepting the focal length new value.
- **Focal-Sweep** is a diagnostic tool used by Beckman Coulter personnel to measure the focal length of the acoustic transducer during a predefined vertical movement.



Focus Calibration

The Echo acoustic transducer includes a lens that focuses acoustic energy pulses for purposes of droplet ejection and well auditing. The focal length of the transducer lens is expected to slightly drift over the life of an instrument. This drift must be compensated for to ensure consistent focus position along the transducer Z-axis during well auditing and droplet ejection. Incorrect focus position during well auditing may result in a biased measurement of fluid impedance, or fluid concentration. Incorrect focus position during droplet ejection may also result in slower drops with less ideal placement.

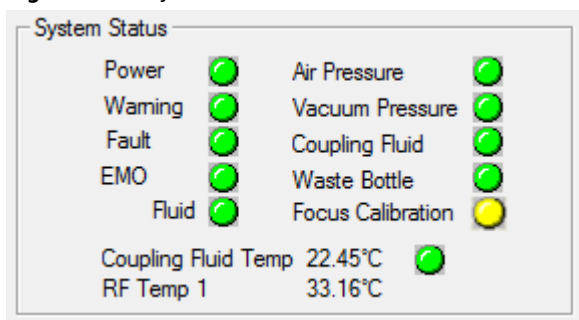
Figure 3.53 Focus Calibration



Focus Calibration Check

A focus calibration check should be performed periodically. The Echo Liquid Handler keeps track of how long it has been since the last focus calibration check was performed. When a new focus calibration check should be performed, the **Focus Calibration** indicator—on the **Diagnostics** tab—will turn from green to yellow.

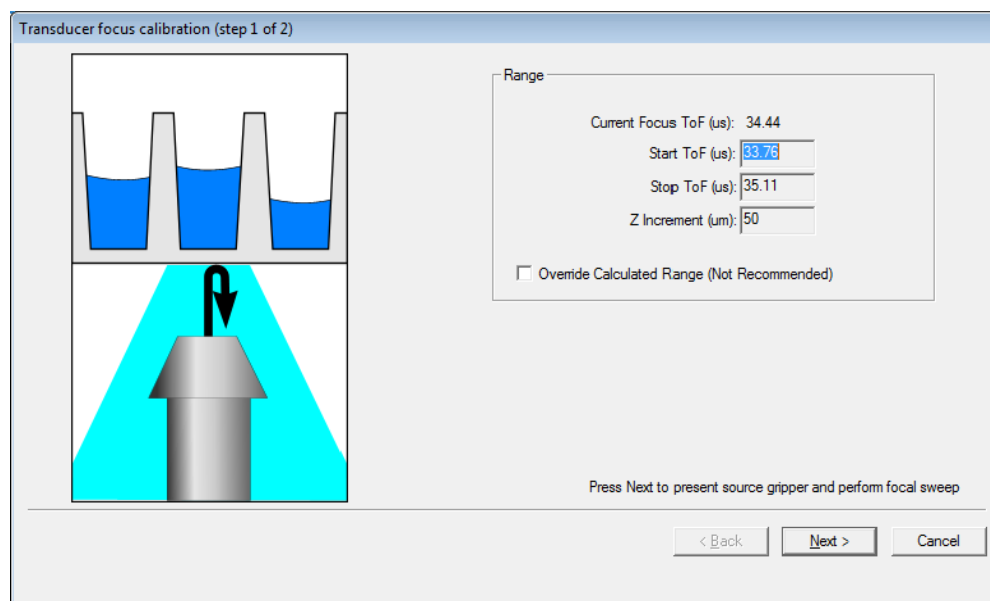
Figure 3.54 System Status section



When the Focus Calibration indicator is yellow, Beckman Coulter strongly recommends that the user execute the Focus calibration wizard as soon as possible.

- 1 In the **Transducer Focus Calibration** window, click the **Focus** button.

Figure 3.55 Transducer focus calibration step 1



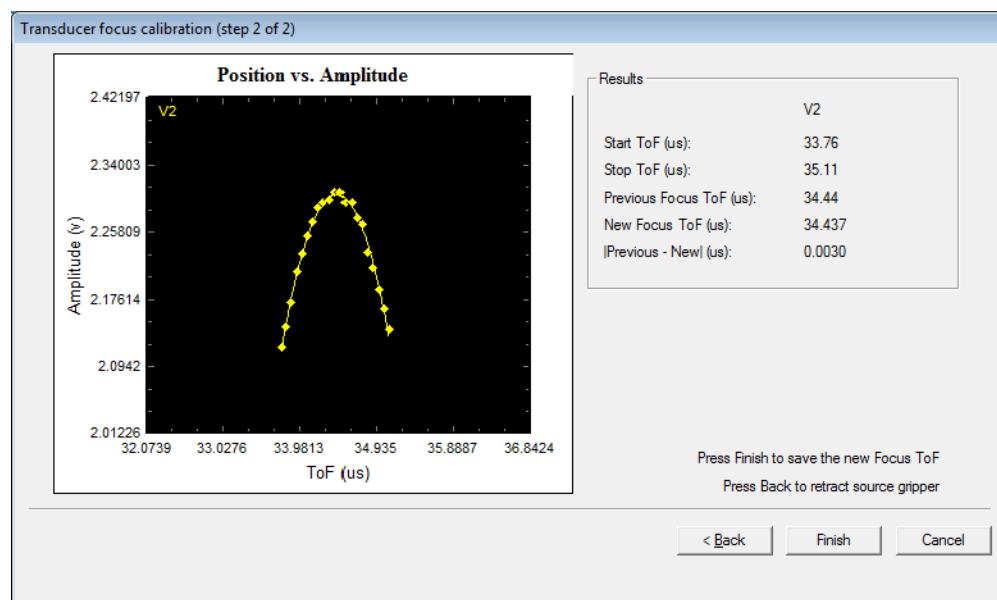
2 Accept all of the default values and do not select the **Override Calculated Range** checkbox.

3 Click the **Next** button.

The Echo door opens, the source plate gripper stage extends, and the Echo Liquid Handler performs a focal-sweep on a built-in internal registration plate. The focal-sweep uses acoustic “pings” bounced off an internal registration plate while the transducer is being moved vertically. The focal-sweep process measures the transducer’s focal length. After the focalsweep is done, the bottom of the registration plate is dried.

4 Click the **Finish** button to complete the focus calibration procedure.

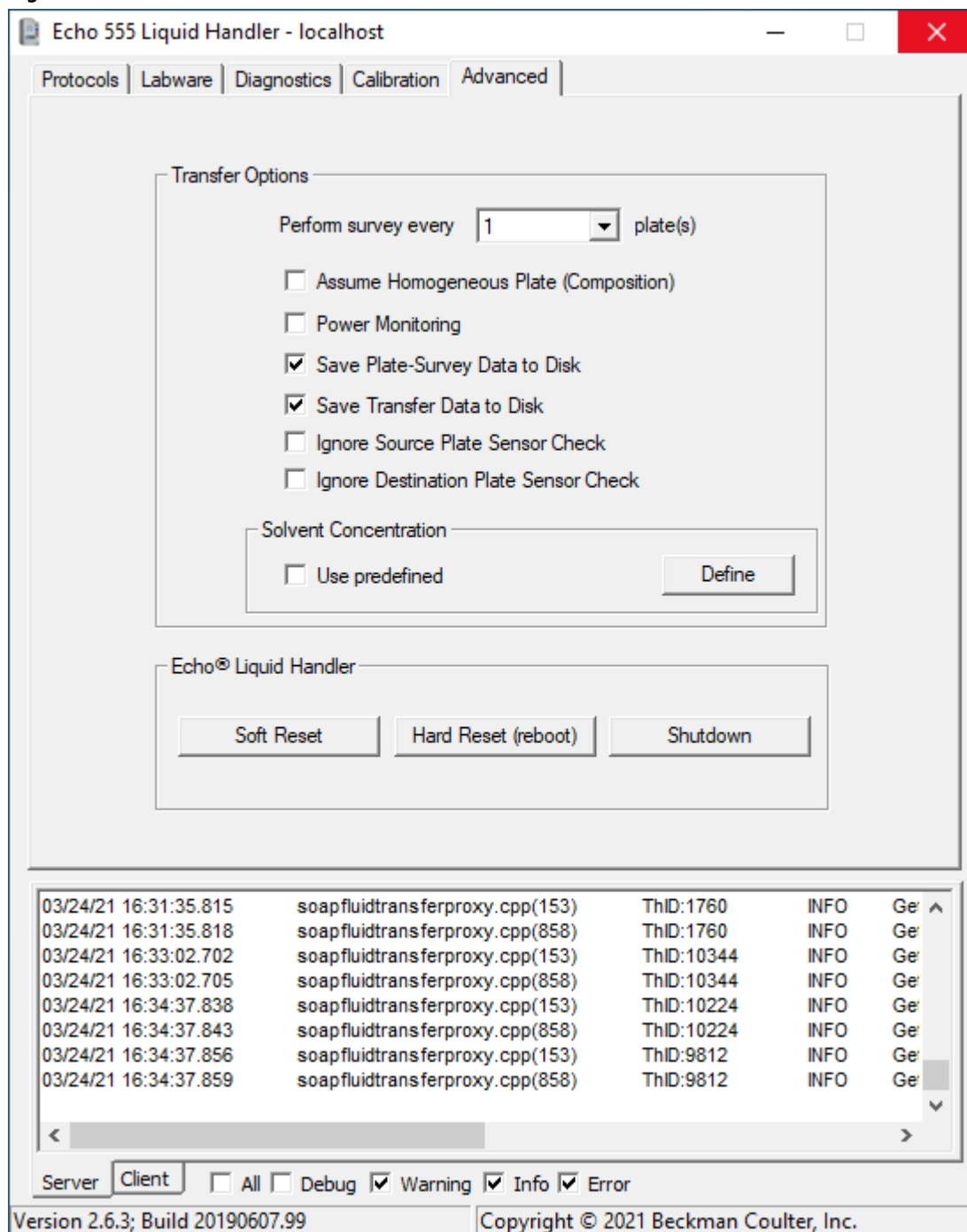
Figure 3.56 Focus calibration step 2 (new focal length calibration not required)



Advanced Window

The **Advanced** window provides additional controls that may be useful to the experienced Echo user.

Figure 3.57 Advanced Window



Advanced Liquid Transfer Controls

Each of these controls listed below affect the Echo instrument's behavior while the Echo Liquid Handler client software is being used to execute fluid transfer protocols. These commands are global in scope, but are set back to default values when the Echo Liquid Handler client and server are shut down or restarted.

- **Survey interval:** Select the interval between source plate surveys by choosing a value from the **Perform Every Survey** dropdown list.

The default setting of “every 1 plate” causes the source plate to be surveyed every time a new source or destination plate is loaded. Beckman Coulter recommends that the survey interval remain at 1 for the best transfer precision.

Default: 1

NOTE The survey interval can be set to 0; however, with this setting, the protocol will not survey the plate. Setting the survey interval to 0 turns off plate surveying which is not recommended.

- **Assume Homogeneous Plate:** When a source plate is surveyed, the Echo 525 Liquid Handler creates a map of the entire plate. This map is post-processed using a moving average filter if the **Assume Homogeneous Plate** checkbox is selected. In a case where a perfectly uniform concentration source plate is being transferred by a source plate calibration that attempts to measure the fluid concentration for every well, better liquid transfer precision can be obtained using postprocessing. Beckman Coulter recommends that this box remain unchecked for typical operation.

If the **Use Predefined** checkbox is selected, the **Assume Homogeneous Plate** feature is unavailable, and its checkbox is “grayed out.”

Default: Assume homogeneous plate off

- **Power Monitoring:** Selecting the **Power Monitoring** checkbox causes the Echo Liquid Handler to monitor the RF power used to eject each fluid droplet. Beckman Coulter recommends that power monitoring not be enabled by the user unless directed to do so by Beckman Coulter personnel. Enabling power monitoring adds data processing time to each droplet ejection and decreases liquid transfer throughput.

Default: Power monitoring off

- **Save Plate-Survey Data to Disk:** The data collected during a source plate survey is held in cache memory. It is replaced when the next source plate survey is performed. If the **Save Plate-Survey Data to Disk** checkbox is selected, the survey data will be stored on the client PC disk. The data file is stored to `<InstallDir>\Beckman Coulter\Medman\Data`. This data can be useful to Beckman Coulter personnel during diagnostic troubleshooting.

Default: Source plate survey data is not saved on the Echo controller

- **Save Transfer data to disk:** Normally, the data collected during a source plate transfer is deleted when the transfer is complete. If the **Save Transfer data to disk** checkbox is selected, the transfer data will be stored on the client PC disk. The data file is stored to `<InstallDir>\Beckman Coulter\Medman\Data`. Transfer data can be useful to Beckman Coulter personnel during diagnostic troubleshooting.

Default: liquid transfer data is not saved to the Echo controller

- **Ignore Source Plate Sensor Check:** Selecting the **Ignore Source Plate Sensor Check** checkbox bypasses the source plate present sensor. This may be useful if the source plate sensor

malfunctions so that a transfer protocol can execute without triggering a “no source plate loaded” error message.

Default: The source plate presence detect sensor is not ignored

- **Ignore Destination Plate Sensor Check:** Selecting the **Ignore Destination Plate Sensor Check** checkbox bypasses the destination plate present sensor. This may be useful when an individual destination plate is not detected by the destination plate present LED sensor, or when transferring to a target that does not fit in the destination plate gripper like the expected SBS compliant targets. When checked, a protocol can execute without triggering a “no destination plate loaded” error message.

Default: The destination plate presence detect sensor is not ignored

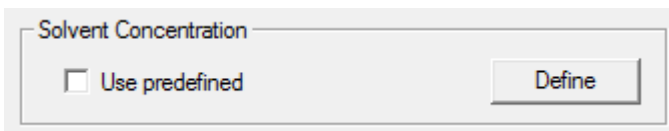
NOTE If you choose to select the **Ignore Destination Plate Sensor Check** checkbox, a plate load error could result and no error messages will be triggered.

Advanced Solvent Concentration

NOTE The **Solvent Concentration** function in the **Advanced** tab of the Echo Liquid Handler software uses units of acoustic impedance (MRayl). In cases where there are two simple solvent fluids, Water and Glycerol, fluid concentration can be correlated to acoustic impedance.

The **Advanced Solvent Concentration** feature should only be used in cases where the concentration for a source plate is known. In that case, accuracy can be improved by specifying the concentration prior to performing liquid transfers. The concentration information entered is used with each source microplate until one of the following occurs:

- **Use predefined** checkbox is cleared
- New concentration information is entered
- Echo Liquid Handler software is restarted



The Echo Liquid Handler software uses the MRayl unit of measurement for the solvent concentration value. The solvent concentration value can be calculated via a quadratic equation if the user knows the percent glycerol in the solution.

For example, for xxxx_AQ_GPx plate types with only glycerol and water, common conversions are:

Solvent Concentration Percentage (%Water/%Glycerol)	Solvent Concentration Value (MRayl)
100% Water	1.48
90% Water / 10% Glycerol	1.60
50% Water / 50% Glycerol	2.10

The solvent concentration values shown in the table) above are calculated using a quadratic formula and the percent of glycerol in the solution. The table below shows the equation and values required to calculate the solvent concentration value.

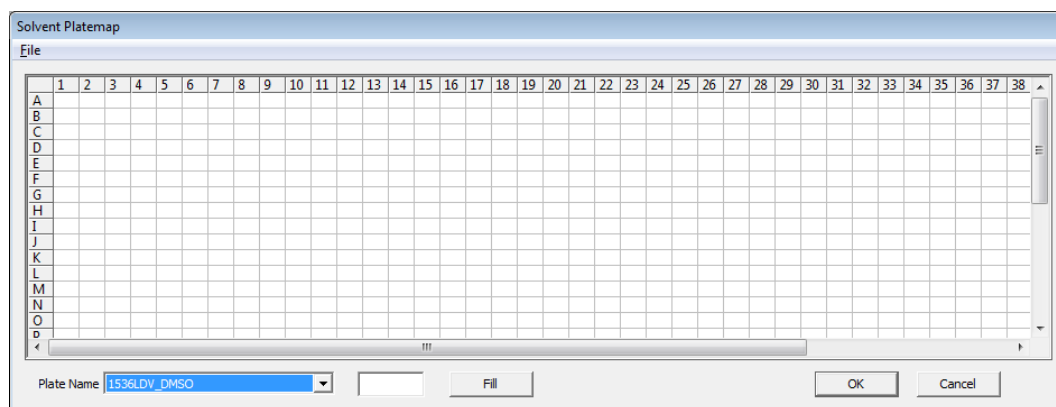
Coefficient value for x	Quadratic Equation	A	B	C
Value for Glycerol to MRayl conversion	$y = Ax^2 + Bx + C$	1.97E-05	0.01132	1.481

Use the example solvent concentration values in the tables above or the quadratic equation and corresponding values to calculate the solvent concentration value as needed below.

To predefine a solvent concentration:

- 1 Select the **Use predefined:** checkbox to allow the Echo Liquid Handler to use the predefined concentration map.
- 2 Click the **Define:** button to open the **Solvent Platemap** dialog box.

Figure 3.58 Solvent Platemap Dialog Box



NOTE Use this function carefully and only when you need to specify a fixed measurement and override the Echo measurement. An incorrect concentration will produce questionable or unexpected results.

- 3 Place the cursor in any individual cell of the plate concentration map and enter the concentration for that well. For example, if the fluid contains 90% water and 10% glycerol, enter 1.6 in the **Solvent Concentration:** textbox to the left of the **Fill** button.
- 4 Select the source microplate type for the **Plate Name** list.
- 5 Click the **Fill** button to load the concentration value entered in step 3 into each cell of the solvent concentration map.

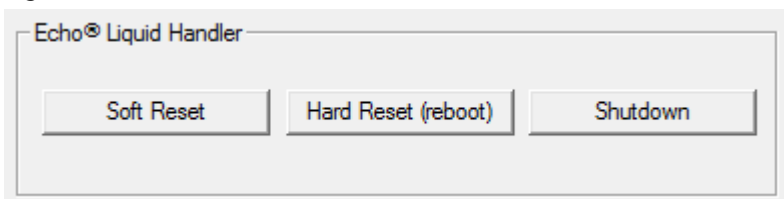
- 6 Click the **OK** button to close the **Solvent Platemap** dialog box and accept the solvent concentrations entered.

NOTE To load a predefined Solvent Platemap file in CSV format, select **File > Load**. To save a predefined **Solvent Platemap** file in CSV format, select **File > Save**.

Advanced Echo Controls

There are cases when the Echo controller must be shutdown or restarted. The Echo controller is the hardware and software installed on the Echo instrument that controls all functions of the instrument.

Figure 3.59 Echo controller restart or shutdown



CAUTION

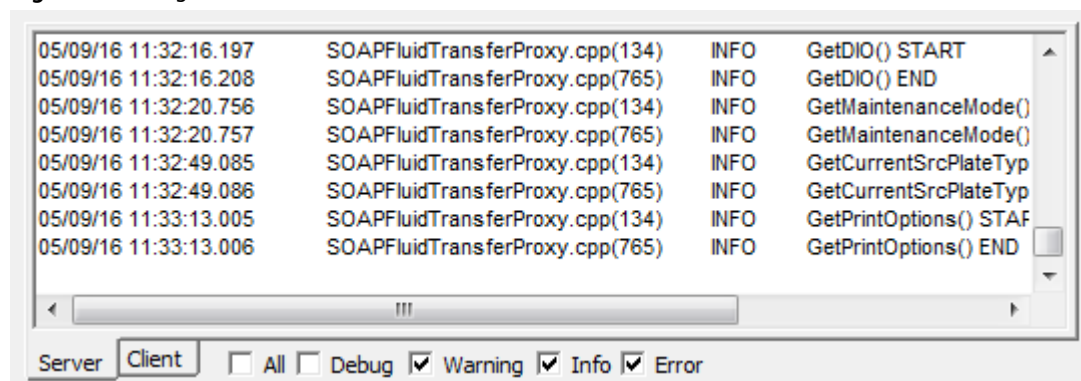
If the Echo Liquid Handler software is connected to a stub mode Echo Liquid Handler service running on the client PC, clicking the **Hard Reset** button will “reset” the client PC, and clicking the **Shutdown** button will “shutdown” the client PC.

- **Soft Reset:** Clicking the **Soft Reset** button causes the Echo service to be restarted on the Echo controller.
- **Hard Reset:** Clicking the **Hard Reset** button causes the Echo controller to reboot. After rebooting the Echo controller, any attached client computer programs must be reconnected to the Echo controller.
- **Shutdown:** Clicking the **Shutdown** button causes the Echo controller to perform its normal “shutdown” procedure. If an Echo Liquid Handler needs to be turned off, its controller should always be “shutdown” before the Echo AC power switch is turned off.

Status Window

At the bottom of the Echo Liquid Handler software window is a pair of message log windows (server and client) and a set of check boxes that select which messages are logged.

Figure 3.60 Log windows and controls



Client log messages: Messages in the client log window originate in the client PC. In addition to being displayed, the client messages are stored on the client PC. The exact location depends on the Echo Liquid Handler software installation.

The default location for the client log files is:

C:\Program Files\Beckman Coulter\Medman\Data

The most recent client log file is named:

client_localhost_MedmanGUI.txt

and older client log files are named:

client_localhost_MedmanGUI.old.0.txt, client...1.txt, client...2.txt, and so on.

The most recent ten historical client log files are stored in addition to the log file for the current session.

Server log messages: Messages in the server log window originate in the Echo Liquid Handler. Server log messages are stored in log files in the Echo controller.

NOTE During normal operation you do not need to know this information. However, if you are troubleshooting a problem, your Beckman Coulter field engineer may ask for this information.

Select Log Message Types

The types of data that will appear in the log windows can be specified by selecting one or more of the checkboxes at the bottom of the Echo Liquid Handler software window.

- **All:** All message types (debug, warning, info, and error) are displayed in the client and server log windows.
- **Debug:** Debug messages are generally not of use to Echo users. They provide detailed information to Beckman Coulter representatives.

- **Warning:** Warning messages report unexpected events. These events may not cause a functional or operational problem since the Echo Liquid Handler can recover from most situations that create a warning.
- **Info:** Info messages report the normal activity of the Echo Liquid Handler.
- **Error:** Error messages are typically serious. They may be triggered by events that cause an operation, the Echo Liquid Handler, or the Echo Liquid Handler software to fail.

NOTE Default is all message types are checked and all error messages are displayed. It is recommended to keep all error messages displayed to assist in troubleshooting in case an error arises.

Maintenance and Service

Daily maintenance consists of flushing and replacing the coupling fluid bottle, checking for leaks in the instrument, and positioning of the microplate insert.

Scheduled user maintenance consists of purging the fluid system, replacing the water filter, washing the bottles, and updating the focus transducer calibration.

All user maintenance procedures are explained in the following sections:

- Maintenance Schedule
 - Daily Maintenance
 - Echo Maintenance Alerts
 - Scheduled Maintenance
- Maintenance Procedures
 - Echo Coupling Fluid Maintenance
 - Clean and Refill Materials Required
 - Purge Echo Coupling Fluid
 - Clean and Refill the Coupling Fluid Bottle
 - Purge the Fluid Circuit
 - Water Filter Maintenance
 - Clean the Anti-Static Bars
- Extended Non-Use and Storage
 - Maintenance During Extended Non-Use
 - Preparation for Storage
- Maintenance Alerts
- Setup Problems

Maintenance Schedule

Echo user maintenance consists of the following:

- [Daily Maintenance](#)
- [Echo Maintenance Alerts](#)
- [Scheduled Maintenance](#)
 - [Every Two Weeks](#)
 - [Once Per Month](#)
 - [One Year Preventative Maintenance](#)

Daily Maintenance

Perform the following checks once a day and the corresponding procedures as needed:

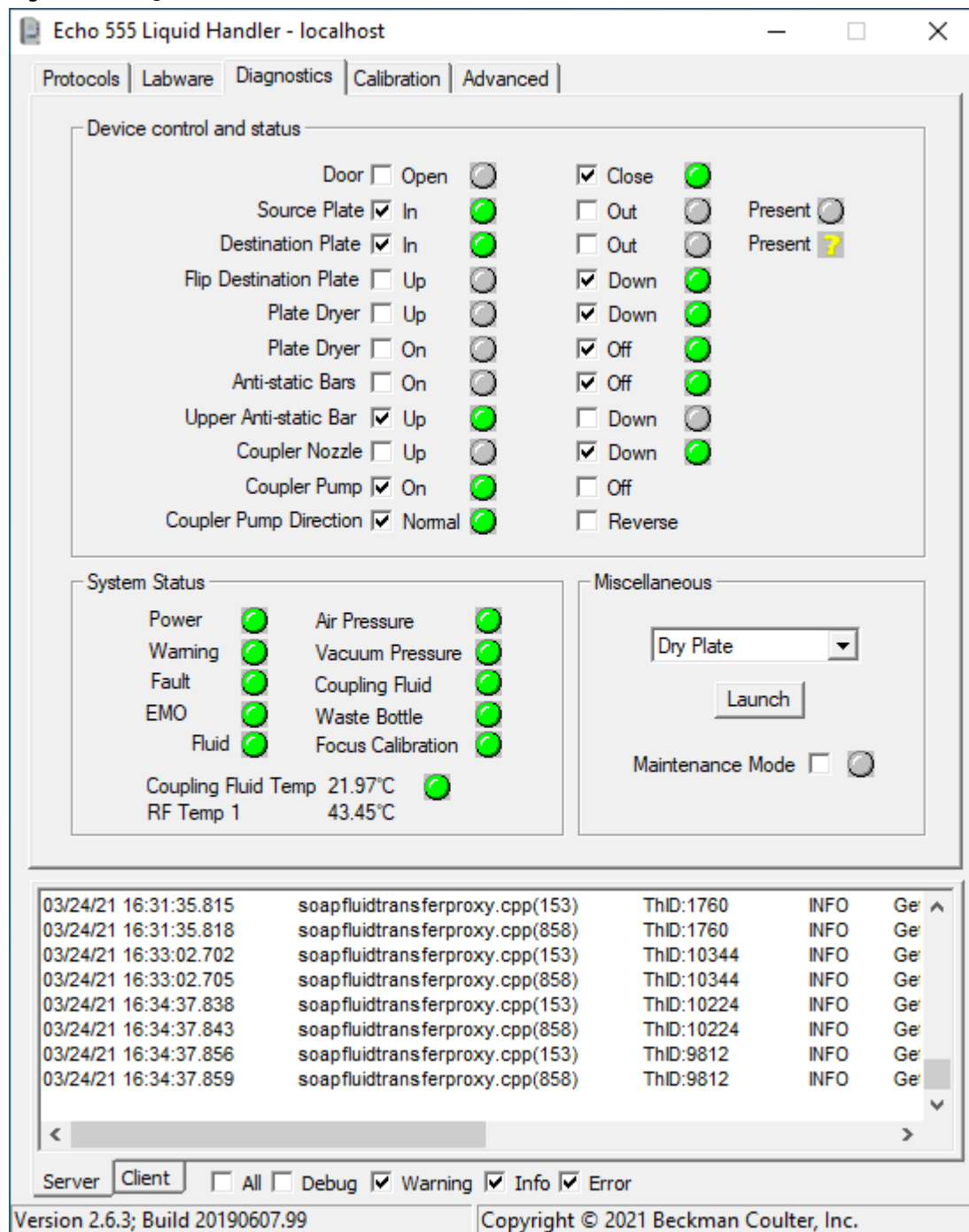
- 1 Check the coupling fluid bottle level daily.
 - If the coupling fluid level is at 350 mL or less, clean and refill the coupling fluid bottle. For more information, see [Echo Coupling Fluid Maintenance](#).
 - If the coupling fluid is cloudy, purge and replace the coupling fluid. [Contact us](#) for further instructions. For more information, see [Clean and Refill the Coupling Fluid Bottle](#).

Echo Maintenance Alerts

The Echo Liquid Handler contains internal checks to ensure that it performs liquid fills under optimal conditions. If, for example, the coupling fluid temperature is outside the normal range (21.2°C – 23.0°C), a yellow warning light appears on the Echo front and back panels. If the coupling fluid temperature continues to rise or fall outside of the warning range (20.2°C – 24.0°C), a red fault light appears.

When you see the warning or fault lights, click the **Diagnostics** tab in the Echo Liquid Handler software to view the specific alert.

Figure 4.1 Diagnostic window



The following table lists the normal maintenance alerts that a user would see, as well as the respective corrective procedures.

Perform the following Echo maintenance procedures as needed:

Table 4.1 Echo Maintenance Procedures

Maintenance Alert/Cause	Procedure
Warning light is yellow - The fluid level is low in the coupling fluid bottle. - The coupling fluid temperature is outside of the normal range: 21.2°C–23.0°C.	- Add more fluid. See Echo Coupling Fluid Maintenance. - Check the chiller setting, it should be at 22°C. See Coupling Fluid Temperature and Indicator.
Fault light is red - The user-supplied compressed air supply is low (< 80 PSI) or nonexistent. - The coupling fluid temperature is outside of the warning range: 20.2°C – 24.0°C. - The user-supplied vacuum pressure is low (< 15 in. Hg Vac) or nonexistent. - The Stop switch has been activated.	- Increase air pressure. See Compressed Air Pressure Indicator. - Check the chiller setting, it should be at 22°C. See Coupling Fluid Temperature and Indicator. - Increase vacuum pressure. See Vacuum Supply Pressure Indicator. - See Stop Switch.

Scheduled Maintenance

Beckman Coulter recommends that the following maintenance procedures be performed on a regular basis. Maintenance promotes accurate, precise, and reliable fluid transfers.

- [Every Two Weeks](#)
- [Once Per Month](#)
- [One Year Preventative Maintenance](#)

Every Two Weeks

Once every two weeks, or earlier if the coupling fluid level becomes low, the Echo user should perform the following preventive maintenance procedures:

- Purge the coupling fluid circuit; clean the coupling fluid bottle and refill with 1 L of Type 1 Ultrapure Water. For more information, see [Echo Coupling Fluid Maintenance](#).
- Perform focus calibration as indicated by the **Focus Calibration** warning light on the **Diagnostics** tab of the Echo Liquid Handler software. For more information, see [Focus Calibration](#).

NOTE Use the recommended amount of Type 1 Ultrapure Water.

Once Per Month

Once per month, the Echo user should perform the following procedures:

- Clean the anti-static bar emitter points and ground reference surfaces with a soft bristled, dry, nylon toothbrush. For more information, see [Clean the Anti-Static Bars](#).
- Check the water filter, follow maintenance procedure if necessary. For more information, see [Water Filter Maintenance](#).

- Inspect and clean the grid on the destination plate gripper. For more information, see [Clean the Destination Plate Gripper Grid](#).
- Inspect the coupling fluid tubing for biofilm growth. If growth is present, replace the tubing and purge the system. Some yellow discoloration is acceptable, however, heavy discoloration indicates a problem. Replace the tubing and purge the system. For more information, see [Purge the Fluid Circuit](#).

One Year Preventative Maintenance

Beckman Coulter recommends annual PM of the system by a trained Beckman Coulter Field Service Engineer. This maintenance will replace high use parts, confirm system performance, and clean or check all critical components.

Maintenance Procedures

WARNING

Do not attempt to service or repair the internal Echo mechanisms yourself. The electrical, laser, and mechanical systems must be maintained by trained personnel. Other than the user-level maintenance procedures described, all service and repair must be performed by Beckman Coulter field engineers. If you have questions regarding what may be serviced by an Echo user, please [contact us](#).

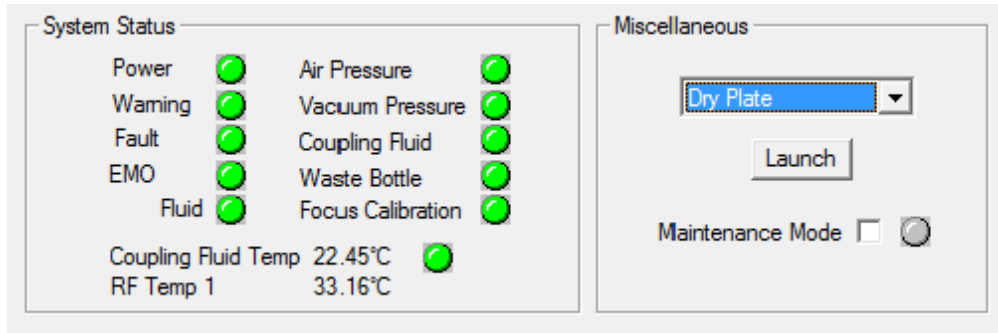
Echo Coupling Fluid Maintenance

The Echo coupling fluid couples the energy from the acoustic transducer to the bottom of the source plate. Bubbles in the tubing (from very low fluid level) or contamination in the fluid can reduce the accuracy or precision of source plate surveys and fluid transfers. The coupling bottle should be purged and refilled immediately when this occurs. Maintaining clean coupling fluid at the proper fill level ensures a high level of performance in the Echo Liquid Handler.

Purge and Refill the coupling fluid bottle when one of the following occurs:

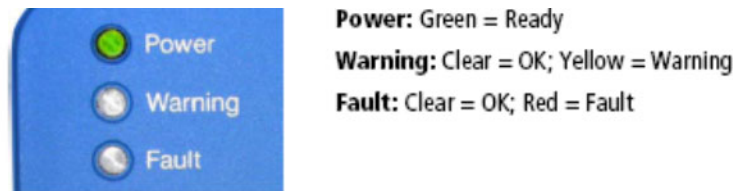
- **Coupling Fluid indicator** on the Echo Liquid Handler software **Diagnostics** tab is yellow, indicating that the coupling fluid has dropped to the **refill required** level. For more information, see [Coupling Fluid Indicator](#).

Figure 4.2 Diagnostic tab showing coupling fluid level is low



- LCD panel **Warning** indicator has turned yellow as a result of the low coupling fluid level. For more information, see [Fault Light](#).

Figure 4.3 LCD Panel with power, warning, and fault indicator lights



- Echo ActiveX events report that the coupling fluid has dropped to the **refill required** level. Refer to the *Echo Integration Manual*.
- Fluid appears cloudy.
- Fluid transfer accuracy or precision has been affected by coupling fluid contamination.
- Two weeks have passed since the last coupling fluid refill.

NOTE During periods of heavy duty cycle use, refilling the coupling fluid bottle will be necessary more frequently than once every two weeks. It is acceptable to skip the complete fluidic circuit purge as long as it is performed at least every second week.

Clean and Refill Materials Required

The following materials are required to refill the coupling fluid bottle:

- Type 1 Ultrapure Water, sufficient to fill the 1 L bottle to ~900mL
- Gloves for protection when handling the fluids
- Paper towels or shop cloths to deal with any unexpected fluid leaks
- An empty, clean 1000 mL coupling fluid bottle (square bottle catalog number ECHO-AL15-S)

The fluidic system will be emptied, purged, and refilled several times, therefore take note of the following caution:

 CAUTION

When working with the Echo coupling fluid system and turning its coupling fluid pump on and off, make sure that the vacuum line is connected and working before turning the coupling fluid pump back on. If the vacuum line is disconnected or the vacuum system is not operating correctly, when the coupling fluid pump is turned on, the coupling fluid can flood the bottom of the system.

Purge Echo Coupling Fluid

 CAUTION

When turning the pump on and off for the Echo coupling fluid system, ensure the vacuum line is connected and working before turning the pump back on. If the vacuum line is disconnected or the vacuum system is not operating correctly when the pump is turned on, the coupling fluid can flood the bottom of the system.

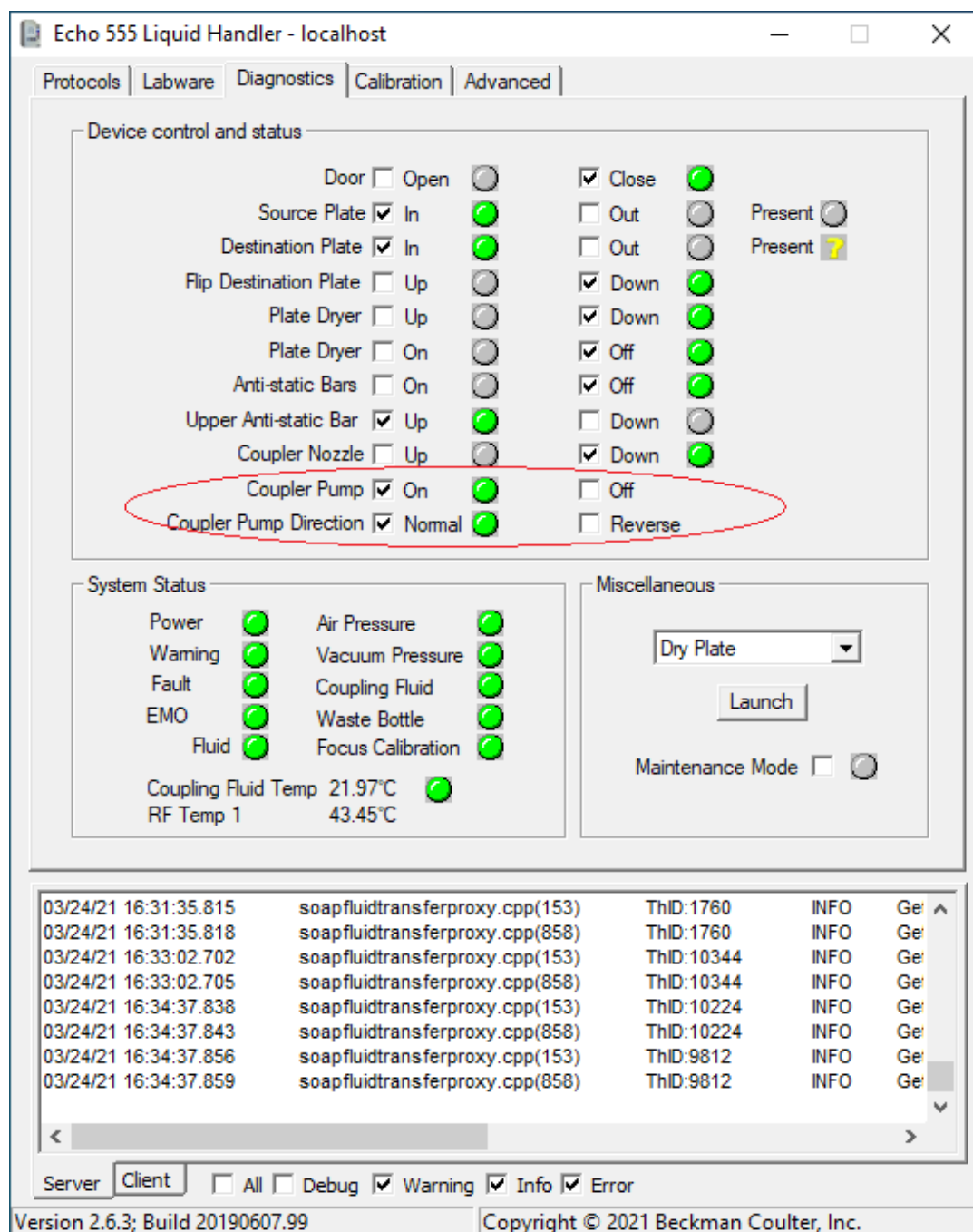
Follow the steps below to purge the coupling fluid bottle:

-
- 1 Ensure that no fluid transfer or diagnostic procedures are under way.

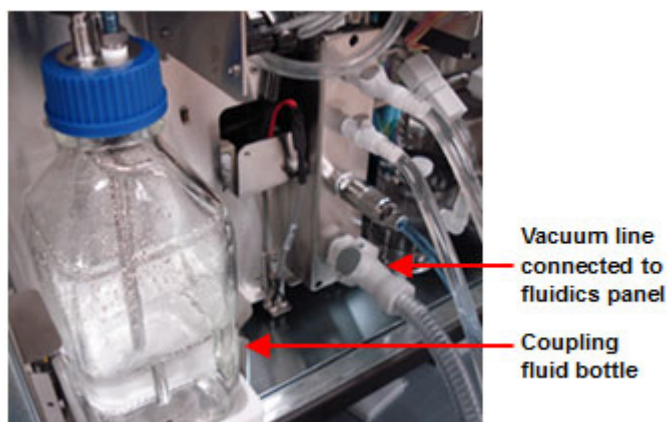
- 2 Turn off the vacuum and coupling fluid pump.
 - Turn off the coupling fluid pump through the **Diagnostics** tab of the Echo Liquid Handler software.
 - Select the checkbox for **Coupler Pump Off**.

NOTE The surge tank will add a few seconds to stopping the vacuum.

Figure 4.4 Diagnostic tab highlighting coupler pump



- 3 Select the checkbox for **Coupler Pump Direction Reverse**.
- 4 Select the checkbox for **Coupler Pump On**. The coupling fluid inside the Echo fluidic circuit will be pumped back into the coupling fluid bottle. Allow the pump to run in reverse for a few minutes so that the coupling fluid drains from the lines.
NOTE The fluid returning to the coupling fluid bottle will raise the water level and may potentially overflow the coupling fluid bottle. It is recommended to keep watch on the water levels to prevent overflow.
- 5 Once the coupling fluid has been purged, select the checkbox for **Coupler Pump Off**.
- 6 Inspect the bottle, bottle cap and seal ring for cracks, other damage, or foreign material that would cause a vacuum leak. Replace if necessary.
- 7 Unscrew the cap on the coupling fluid bottle and remove the bottle from the bottle caddy and empty the purged coupling fluid.



- 8 Visually inspect the used coupling fluid. It should not be cloudy or visually contaminated with algae or other substances.

**WARNING**

If there is significant contamination, and/or signs of corrosion in the coupling fluid tubing, in the debubbler, at the nosecone, or anywhere else, please [contact us](#).

- 9 Select the checkbox for **Coupler Pump Direction Normal**.

Clean and Refill the Coupling Fluid Bottle

Follow the steps below to clean and refill the coupling fluid bottle:

- 1 Clean the coupling fluid bottle and metal tubes.
 - a. Add Alconox or hand soap and water to the bottle.
 - b. Scrub the bottle with a plastic bristle bottle brush.
 - c. Thoroughly rinse the bottle to ensure there is no soapy residue. Use Type 1 Ultrapure Water for the final rinse.
 - d. Allow the bottle to dry, if possible, or alternate with another 1000 mL bottle.
- 2 Inspect the bottle, bottle cap and seal ring for cracks, other damage, or foreign material that would cause a vacuum leak. Replace if necessary.
- 3 Inspect the coupling fluid tube and attached flexible tubing for the presence of bubbles. If you see bubbles, you will need to purge, then recycle the fluid through the system after you complete this procedure. For more information, see [Purge the Fluid Circuit](#).
- 4 Fill the coupling fluid bottle with 900 mL of Type 1 Ultrapure Water.
- 5 Return the cap and its attached tubing to the coupling fluid bottle.
- 6 Attach the cap securely to ensure a tight seal for vacuum (hand tighten) and return the refilled coupling fluid bottle to the bottle caddy.



Before turning on the coupling fluid pump, ensure the following:

- **Vacuum line is connected**
- **Vacuum system is operating correctly**
- **Cap on the fluid bottle is tightly sealed**

Otherwise, the coupling fluid can flood the bottom of the system.

Purge the Fluid Circuit

Follow the steps below to purge the fluid circuit:

- 1 Turn off the coupling fluid pump.

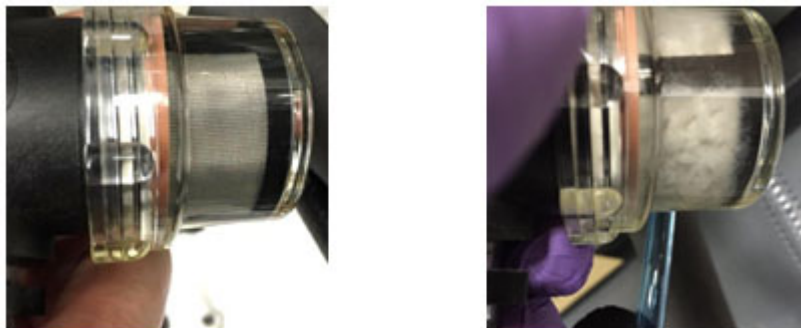
- 2 In the Diagnostic window of the Echo Liquid Handler software, select the reverse coupling fluid pump direction (**Coupling Pump Direction Reverse**). For more information, see [Coupling Pump Direction Normal/Reverse](#).
- 3 Turn on the coupling fluid pump via the pump power switch. The coupling fluid inside the Echo fluidic circuit will be pumped back into the coupling fluid bottle.
NOTE The fluid returning to the bottle will raise the water level; therefore, watch for potential overflow in the coupling fluid bottle.
- 4 Turn off the coupling fluid pump.
- 5 Return the coupling fluid pump direction to normal. Select **Coupling Pump Direction Normal**.
- 6 Unscrew the cap on the coupling fluid bottle and remove the bottle from the bottle caddy.

Water Filter Maintenance

During plate survey and fluid transfer, the coupling fluid is exposed to dust and particles from the air or from the bottom of the source microplates. The inline water filter on the chiller tubing filters out dust and particles before the coupling fluid returns to the transducer.

To ensure that the coupling fluid is filtered effectively, Beckman Coulter will replace the water filter at the annual Preventative Maintenance. If the water filter traps excessive material, it may become clogged or shed trapped particles before the annual Preventative Maintenance is due. In that case, the water filter element should be cleaned immediately.

Figure 4.5 Water filter in good condition (left) versus water filter that needs cleaning (right)



The water filter disassembled is made up of three parts: clear bowl, black housing, and stainless steel water filter element.

Figure 4.6 Water filter disassembled



Tools and materials needed:

- Lint-free swab (P/N 001-11152, ITW-Textwipe TX708A or STX708A), if needed.
- Gloves
- Type 1 Ultrapure Water

Follow the steps below to maintain the water filter:

- 1 Purge the fluidics.
 - a. Select **Reverse** for the **Coupler Pump Direction** from the **Diagnostics** window.
 - b. Once there is a steady stream of bubbles from the intake tube inside the coupling fluid bottle, turn the **Coupler Pump** to **Off** from the **Diagnostics** window.
- 2 Put the gloves on.
- 3 Disassemble the water filter.
 - a. Unscrew and remove the clear water filter bowl (do not remove the housing from the tubing).
 - b. Take note of the installed position and remove the stainless steel mesh water filter element.

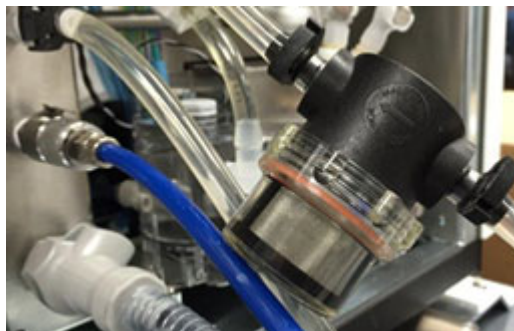
NOTE Handle the water filter element by the black plastic cage only and do not touch the steel mesh.

-
- 4 Rinse the element and bowl under flowing tap water. If the buildup does not rinse off at first, use a lint-free swab to gently wipe the water filter element to loosen the residue material and rinse again.



NOTE Make sure to wipe both the inside and the outside of the water filter element and be careful not to damage the steel mesh.

-
- 5 Perform a final rinse with Type 1 Ultrapure Water before reassembling the water filter.
-
- 6 Insert the water filter element into the housing in its original position.
-
- 7 Ensure the orange gasket is seated in the bowl and then screw it back onto the housing.
-
- 8 Ensure the water filter is oriented with the clear bowl downwards as shown below.



-
- 9 From the **Diagnostics** window, set the **Coupler Pump Direction** to **Normal** and the **Coupler Pump** to **On**.

-
- 10** Inspect the water filter for leaks as the lines get refilled and tighten the bowl if necessary.

NOTE If a clean spare water filter (P/N 001-11032) is available, it is recommended to replace the existing water filter element and bowl with the new one. The user should still clean the old water filter element and bowl using the steps above and dry and store the parts for future use.



The following items should be avoided:

- Aggressive cleaning agents such as hypochlorite bleach, acids, and alkalis
- Organic solvents, including alcohols
- Abrasives or sharp-edged tools
- Heat as the water filter is not rated to be autoclavable

Clean the Anti-Static Bars

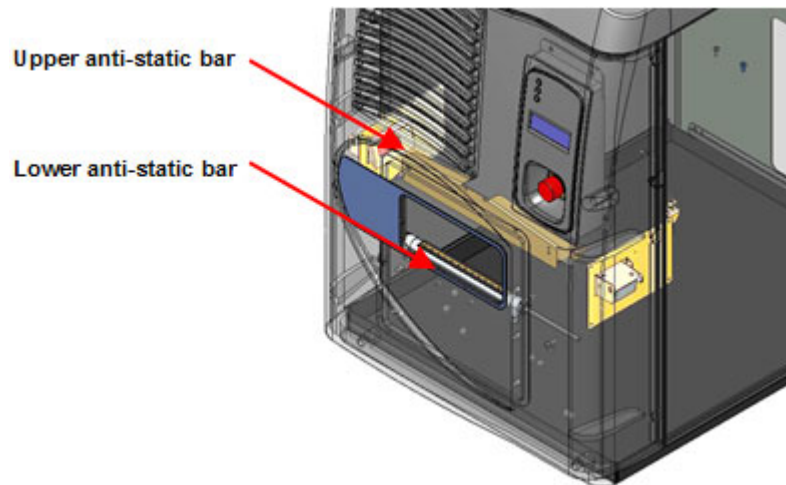
The Echo Liquid Handler uses two anti-static bars to neutralize any static charge on the source and destination plates. The antistatic bars are just inside the door, one right below and the other right above the door opening.

Over time, anti-static bars may accumulate dust or other contaminants on their emitter pins and ground reference surfaces. This accumulation could result in droplets being inaccurately ejected into the destination plate wells (for example into the corners or onto the sides of a well). Periodic cleaning will maintain proper anti-static bar operation.

Once a month, dry brush the anti-static bars using the following procedure:

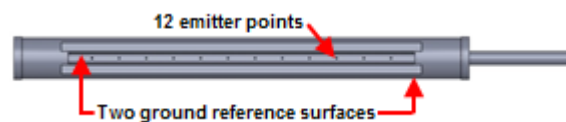
-
- 1** Turn off the Echo carriage motors by pushing the Stop switch.
-
- 2** Open the door by clicking **Door Open** in the Diagnostic window.
-
- 3** Turn off the anti-static bars by clicking **Anti-Static Bars Off** in the Diagnostic window.
-
- 4** Locate the two anti-static bars.
-

Figure 4.7 Anti-static bar location



- 5 Gently clean the emitter points and ground reference surfaces on both anti-static bars with a dry, soft-bristle, nylon toothbrush.

Figure 4.8 Anti-static bar areas requiring cleaning



NOTE Leave the upper anti-static bar in either its raised or lowered position—either position is OK.

- 6 Turn on the Echo carriage motors by turning the Stop switch counterclockwise and releasing it.

Clean the Destination Plate Gripper Grid

The grid on the destination plate gripper is charged with an electrical current during fluid transfer. The electrical field overrides any static charge that may reside in the destination plate to ensure that the droplets transferred from the source plate wells are directed upward into the center of the destination wells and not diverted to the side of the wells.

The grid should be inspected for particles and cleaned monthly.

Tools needed:

- Compressed air or vacuum with brush

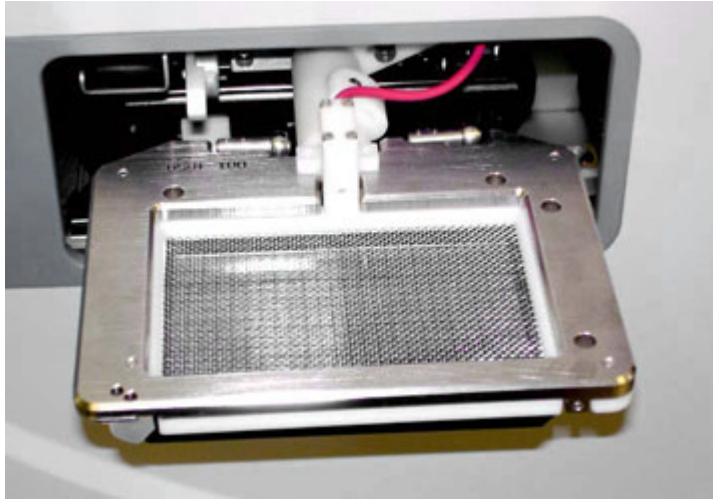
Follow the steps below to clean the destination plate gripper grid:

- 1 Display the **Diagnostics** window in the Echo Liquid Handler software.

-
- 2 Click **Door Open** to open the door.

 - 3 Click **Destination Plate Out**. The software extends the destination plate gripper and automatically turns off the electrical current.

Figure 4.9 Destination plate gripper extended



-
- 4 Gently remove any dust or particles on the grid with compressed air or vacuum with brush.

 - 5 Click **Flip Destination Plate Down** and repeat the previous step to clean the grid.

 - 6 Click **Destination Plate In** and select **None** from the Plate Name drop-down menu in the Retract Dest Plate Gripper dialog box. The software retracts the destination plate gripper.
-

Cycle Fluid Through Echo System

Follow the steps below to cycle fluid through the Echo system:

CAUTION

The chiller does not need to be running for this procedure, however, do not cycle coupling fluid through the Echo Liquid Handler that is below 22°C or above ambient room temperature. Extreme temperatures can damage the acoustic transducer.

- 1 Turn on the coupling fluid pump. The coupling fluid will be pumped into the Echo Liquid Handler. After three to five minutes, verify that the coupling fluid is returning to the coupling fluid bottle and that it does not contain a large number of bubbles.
- 2 To completely purge the Echo fluidic circuit, repeat the purge, clean, and refill procedure two more times. For more information, see [Purge the Fluid Circuit](#) and [Echo Coupling Fluid Maintenance](#).
- 3 After filling the fluidic circuit, the coupling fluid bottle will be partially empty. Turn the coupling fluid pump off, and add coupling fluid so that the bottle contains 900 mL of coupling fluid. Make sure that the J-shaped tube isn't covered by the new fluid level.
- 4 Turn on the coupling fluid pump.
- 5 Check the **Coupling Fluid** status on the Echo Liquid Handler software **Diagnostics** window. The indicator should be green.

Extended Non-Use and Storage

The Echo Liquid Handler is designed to be used on a regular basis (daily or within a week). Regular use keeps the acoustic transducer wet and provides consistent liquid transfer results.

The acoustic transducer must remain wet to retain the high degree of precision and accuracy that is required for nanoliter volume transfer. If the transducer is allowed to dry out, the focal length can change. Prolonged drying of the transducer may result in an extended repair.

If you do not plan to use the Echo Liquid Handler for longer than two weeks, perform one of the following options:

- If the Echo Liquid Handler remains connected to the power source, chiller, air and vacuum lines, then perform the maintenance procedure described in topic [Maintenance During Extended Non-Use](#).
- If the Echo Liquid Handler will be disconnected and stored for an indefinite period of time, then the instrument must be prepared for storage. For more information, see [Preparation for Storage](#).

Maintenance During Extended Non-Use

The following procedure assumes that the Echo Liquid Handler is still connected to the power source, chiller, air and vacuum lines.

- 1 Leave the coupling fluid pump on to provide a continuous flow of coupling fluid to the Echo transducer. Purge and replace the coupling fluid every two weeks. For more information, see [Purge Echo Coupling Fluid](#).
- 2 Perform scheduled maintenance at two-week and one month intervals.
- 3 [Contact us](#) to schedule six-month maintenance. For more information, see [Maintenance Schedule](#).

Preparation for Storage

[Contact us](#) to arrange for the storage of the Echo Liquid Handler. Include an estimate of how long the instrument will be stored and where it will be stored.

The Beckman Coulter service engineer may replace the coupling fluid with fresh water and seal the nose cone to keep the acoustic transducer wet during storage.

When you are ready to return the Echo to full operation, [contact us](#). The Beckman Coulter service engineer will determine what assembly or testing steps are required to ensure that the instrument is operating correctly.

NOTE If you plan to store the Echo Liquid Handler in a different facility, follow the moving procedures in the topic, [Instrument Relocation](#).

⚠ CAUTION

Do not store the Echo Liquid Handler outside of the storage temperature range: 5°C – 45°C (41°F – 113°F). Temperatures outside of this range can damage the instrument.

Maintenance Alerts

During normal use, the Echo Liquid Handler may prompt that it needs attention. Refer to the following maintenance alerts.

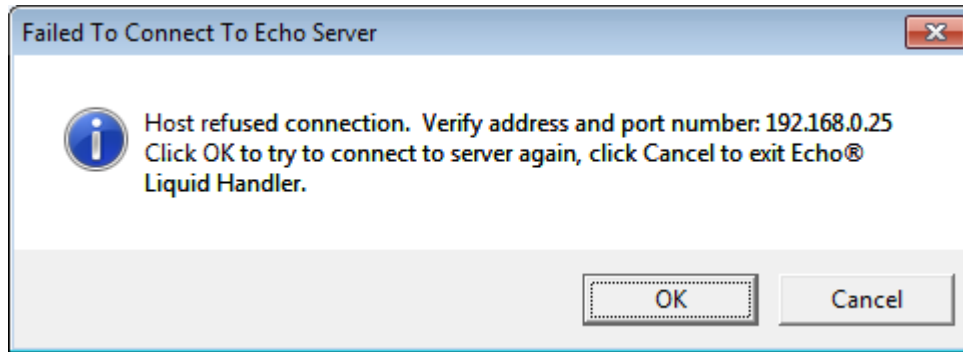
Table 4.2 Echo Maintenance Alerts

Maintenance Alert	Procedure
Warning light is yellow. Possible causes:	See Status Indicator Lights.
The Echo stages (acoustic transducer, source plate, and destination plate) are not homed.	Perform Home calibration. See Home Calibration.
The fluid level is low in the coupling fluid bottle.	Add more fluid. See Echo Coupling Fluid Maintenance.
The coupling fluid temperature is outside of the normal range: 21.2°C–23.0°C.	Check the chiller setting, it should be at 22°C. See Coupling Fluid Temperature and Indicator.
The door is neither fully open nor fully closed.	Check for obstruction. Check compressed air pressure, it could be too low. See Compressed Air Pressure Indicator.
The upper anti-static bar is neither fully up nor fully down.	Check compressed air pressure. See Compressed Air Pressure Indicator.
The source plate dryer nozzle is neither fully up nor fully down.	Check compressed air pressure. See Compressed Air Pressure Indicator.
A focus calibration check needs to be performed.	Perform focus calibration check. See Focus Calibration Check.
Fault light is red. Possible causes:	See Status Indicator Lights.
The user-supplied compressed air supply is low (< 80 PSI) or nonexistent.	Increase air pressure. See Compressed Air Pressure Indicator.
The user-supplied vacuum pressure is low (< 15 in Hg Vac) or nonexistent.	Increase vacuum pressure. See Vacuum Supply Pressure Indicator.
The Stop switch has been activated.	See Stop Switch.
A coupling fluid leak has been detected.	See Fluid Leak Indicator.
LCD message indicates user assistance needed.	Follow instructions on the LCD screen.
Client PC indicates a problem.	This message is generated by custom programming. See your System Administrator.

Setup Problems

If the Echo Liquid Handler software cannot connect with the Echo Liquid Handler, the following message will appear:

Figure 4.10 Connection failure message



This message is commonly seen and is not a cause for alarm. Possible causes for the connection failure include:

- The Echo Liquid Handler has not been turned on.
- The Echo Liquid Handler has been turned on, but it has not completed its initialization.
 - Check the gripper stage homing sequences, particularly the theta rotation of the destination gripper stage.
 - Check the door opening sequence.
- The Ethernet cable is not connected between the computer and the Echo Liquid Handler.
- The Echo Liquid Handler software is not configured (IP address or hostname) to connect to the instrument.
- The Echo Liquid Handler is failing to communicate.

Check for the cause, attempt to resolve the problem, and try to launch the software again. If the message persists, [contact us](#).

Replacing the Fuse

NOTE Perform this maintenance procedure only as needed.

The fuse protects the electrical components of the instrument from power surges. It does not require routine maintenance but may require replacement if the instrument does not start up.

To replace the fuse:

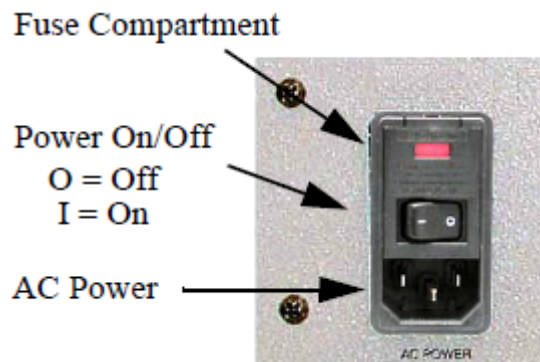
- 1 Turn off the Echo Liquid Handler.

**WARNING**

Risk of damage to the instrument. To prevent damage to the instrument electronics, wait at least 10 seconds before unplugging the power cord after shutting down the instrument.

- 2 At the back of the instrument, unplug the power cord from the instrument and the power inlet.
- 3 Find the black rectangular fuse holder directly above the power cord receptacle. The fuse holder looks like a drawer and displays a picture of the fuse, see [Figure 4.11](#).

Figure 4.11 AC power and fuse compartment



- 4 Find the slot approximately 1/16 inch below the fuse holder. Insert a flat-head screwdriver vertically into this slot and slide the fuse holder toward you.
- 5 Remove the fuse from the holder and replace it with the same type and rating as the old fuse.
 - 100-120V Rated Unit: F10A, 250V
 - 200-230V Rated Unit: F5A, 250V
- 6 Reinstall the fuse holder by pushing it back into the fuse receptacle.
- 7 Reconnect the power cord at the rear of the instrument, plug in the other end of the power cord to an outlet, and start up the instrument.

Instrument Specifications

Each Echo Liquid Handler conforms to the specifications listed below.

- [Communications](#)
- [Fluid Transfer](#)
- [Labware](#)
- [Electrical](#)
- [Ratings](#)
- [Physical](#)
- [Environmental](#)
- [Client PC \(minimum requirements\)](#)
- [Optional Hardware](#)

Communications

Server connection: Echo Liquid Handling Platform (Server Version 2.6.x)

Network connection: 10/100/1000 BaseT

Network protocol: TCP/IP

User account: Beckman Coulter (The client PC must have a Beckman Coulter account, with administrator privileges, that is accessible by Beckman Coulter Service and Support to service the Echo Liquid Handler system.)

Fluid Transfer

Drop transfer resolution: 25 nL

Volume transfer range:

25 nL to 5 µL (one well to one well)

25 nL to 45 µL (one well to many wells)

25 nL to Working Range (one to many wells)

NOTE Actual transfer range is dependent on fluid type and assay plate.

Table 5.1 Fluid Transfer Ranges by Plate Table

Plate	Maximum	Minimum	Working Range
384PP	65 µL	20 µL	45 µL
384PP Plus	65 µL	20 µL	45 µL
384LDV Plus	14 µL	4.5 µL	9.5 µL
6RES	2800 µL	250 µL	2550 µL

Transfer Accuracy: <10% deviation from target volume

Transfer Precision: <8% CV

Labware

Source Labware Compatibility:

- 6RES (001-11101)
- 384PP (001-14555)
- 384PP Plus (001-14622)
- 384LDV Plus (001-13070)

Destination Labware Compatibility: All Echo qualified microplates and most ANSI-compliant/SBS-standard microplates in 96-well and 384-well format that are 8-16 mm in height and fully skirted are compatible. Use of 1536-well plates as destination plates is application dependent.

Electrical

There are four electrical configurations of the Echo Liquid Handler:

Table 5.2 Electrical Configurations for the Echo Liquid Handler

Voltage	Frequency	Power	Fuse
100–120 V	50Hz/60Hz	8 A	115 VAC, F10 A, (P/N 001-3966)
200–230 V	50Hz/60Hz	5 A	250 VAC, F5 A, (P/N 001-3967)

NOTE The electrical requirements listed above do not account for chiller power requirements.

Overvoltage Category II

Voltage Fluctuations of up to +/-10%

Ratings

Noise Ratings

The noise ratings for the Echo Liquid Handler are below:

Noise Rating	64 dBA
--------------	--------

Power Ratings

The power ratings for the Echo Liquid Handler are below:

Power Rating	600W without the chiller
Heat Rating	600W without the chiller

Physical

- **Weight:** 128 kg (283 lbs)
- **Dimensions:**
 - **Width:** 53.9 cm (21.2 in)
 - **Depth:** 68.3 cm (26.9 in)
 - **Height:** 92.5 cm (36.4 in)
- **Operating space envelope (minimum):**
 - Width: 61 cm (24 in) with bottle caddy in back
 - Depth: 99 cm (39 in) including 30.5 cm (12 in) of exhaust space behind the instrument.
 - Height: 97 cm (38.2 in)

NOTE For more information, see [Site Requirements](#).

- **Clearance:**
 - **Top:** It is recommended to have 25.4 cm (10 in) above the instrument to remove the top cover for servicing.

NOTE The instrument can be installed with a minimum of 2.5 cm (1 in) if there is sufficient space to lift the top and slide it all the way forward. [Contact us](#) for additional details.
 - **Front:** It is recommended to have 40.6 cm (16 in) to allow sufficient clearance to load and unload microplates by hand or by robot.
 - **Side:** It is recommended to have 121.9 cm (48 in) minimum on left and right sides to allow for serviceability. The Echo Liquid Handler should have sufficient space to be rotated, otherwise, it will need to be removable for service.

- **Rear:** It is recommended to have 30.5 cm (12 in) minimum behind the instrument to allow for cables, hoses, tubing, and maintenance access.

NOTE Additional space for the client PC, coupling fluid chiller (if it is on the work surface), any robotics in the system, and microplates must also be considered. The coupling fluid bottle and caddy fit within the rear clearance.

Environmental

Pollution Degree

Pollution Degree: 2

Altitude

Altitude: Up to 2000m

Site Requirements

- **Operating environment:**
 - Temperature, operating: $21^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($70^{\circ}\text{F} \pm 9^{\circ}\text{F}$)
 - Relative humidity: 10–80%, non-condensing
- **Compressed air source:**
 - Clean, filtered, oil-free, dry air at 552 kPa (80 PSI) minimum, 1034 kPa (150 PSI) maximum
 - Maximum consumption by Echo Liquid Handler does not exceed 1 cfm at 150 PSI

- **Vacuum source (2 options):**

Vacuum returns the coupling fluid to the supply bottle and dries source plates before they are unloaded. Customer must provide a fitting that connects 3/8 in ID, 5/8 in OD tubing to either house vacuum or vacuum pump. The supplied vacuum line is HercoBraid, 9.5 mm (3/8 in) ID, 9.5 mm (5/8 in) OD (RyanHerco P/N 0512-072).

Vacuum source should have the following specifications:

- House supply: Minimum 200 Torr (266 mbar, 22 in Hg Vac) minimum pumping speed $8.0 \text{ m}^3/\text{hr}$
- Standalone vacuum with surge tank (10 L): 100 Torr (133 mbar, 26 in Hg Vac), minimum pumping speed $2.0 \text{ m}^3/\text{hr}$

NOTE The 10 L surge tank comes standard with the Echo Liquid Handler to ensure consistent vacuum.

- **Coupling fluid:** 1 L Type 1 Ultrapure Water
- **Coupling fluid Temperature:** $22.1^{\circ}\text{C} \pm 0.9^{\circ}\text{C}$ ($71.8^{\circ}\text{F} \pm 1.6^{\circ}\text{F}$)

- **Mounting surface (minimum):** Sturdy, level, water-resistant mounting surface with cross-bracing or welded joints is required. It must be capable of supporting a minimum of 128 kg (283 lbs) weight with sufficient surface area to accommodate the Echo Liquid Handler in a minimum operating envelope. If the mounting surface is a table top, legs without wheels are preferred. If the legs have wheels, they should be locked.

User Supplied Equipment Requirements

The user must provide the following items:

Hardware	Compressed air fitting compatible with 0.170 in ID / 0.250 in OD tubing between the compressed air supply and the Echo Liquid Handler tubing (Beckman Coulter provides the compressed air line and fitting with the Echo Liquid Handler)
	Vacuum fitting that connects 3/8 in ID, 5/8 in OD tubing to either house vacuum or a vacuum pump. The supplied vacuum line is HercoBraid, 3/8 in ID, 5/8 in OD (RyanHerco P/N 0512-072)
Client PC	See CHAPTER 1, Client PC specifications .

NOTE A Client PC can be purchased directly from Beckman Coulter. For information on the Client PC available from Beckman Coulter, see [CHAPTER 1, Client PC specifications](#).

NOTE If you are integrating the Echo Liquid Handler into an automated system and need to install the Client + Server software onto a workstation, it must contain an Intel Core i5 processor or better.

NOTE If you are setting up an Echo 525 Liquid Handler that will be using tubes, a capper/decapper is required before Beckman Coulter Service and Support can install or service the instrument.

Client PC (minimum requirements)

See [CHAPTER 1, Client PC \(Sold separately by Beckman Coulter\)](#).

Software specifications:

- **Echo software applications (optional):** Echo Plate Reformat, Echo Dose-Response, Echo Cherry Pick, Echo Array Maker, Echo Plate Audit, Echo Combination Screen.

Optional Hardware

Table 5.3 Barcode Reader(s)

Compatible barcode reader formats	Readable bar width (mm)
CODE 39	0.19–1.0
ITF	0.19–1.0
INTERLEAVED 2 of 5	0.19–1.0
CODABAR	0.19–1.0
UPC/EAN	0.19–1.0
CODE 128	0.25–1.0
COOP 2 of 5	0.19–1.0
CODE 93	0.25–1.0

NOTE The readable bar width expresses the range in which the width of thin barcode bars (narrow bar width) is readable.

A decorative blue abstract graphic in the top right corner, consisting of overlapping, wavy, translucent lines that create a sense of depth and movement.

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Related Documents

Beckman Coulter Echo documentation consists of the following publications:

- *Echo Array Maker Quick Start Guide*
- *Echo Combination Screen User Guide*
- *Echo Combination Screen Quick Start Guide*
- *Echo Cherry Pick User Guide*
- *Echo Cherry Pick Quick Start Guide*
- *Echo Plate Reformat User Guide*
- *Echo Plate Reformat Quick Start Guide*
- *Echo Plate Audit User Guide*
- *Echo Plate Audit Quick Start Guide*
- *Echo Dose-Response User Guide*
- *Echo Dose-Response Quick Start Guide*
- *Echo 21CFR11 Compliance Manager User Guide*
- *Echo 21CFR11 Compliance Manager Quick Start Guide*
- *Echo 21CFR11 Compliance Manager Admin User Guide*
- *Echo 21CFR11 Compliance Manager Admin Quick Start Guide*
- *Echo 525 Series Liquid Handler User Guide*
- *Echo Software Applications Integration Guide*
- *Echo Liquid Handler Software Integration Guide*
- *Tempo Automation Control Software User Guide*
- *Access Dual Robot System User Guide*
- *Glossary of Symbols*

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