thermoscientific

Thermo Scientific

TriPlus RSH

User Guide

Robotic Sample Handling

P/N 31709620 Tenth Edition   January 2017

Thermo Fisher
SCIENTIFIC

For Research Use Only. Not for use in diagnostic procedures.

thermoscientific

Part of Thermo Fisher Scientific

TriPlus RSH User Guide, PN 31709620, Tenth Edition

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The manual is well organized.	1	2	3	4	5
The manual is clearly written.	1	2	3	4	5
The manual contains all the information I need.	1	2	3	4	5
The instructions are easy to follow.	1	2	3	4	5
The instructions are complete.	1	2	3	4	5
The technical information is easy to understand.	1	2	3	4	5
Examples of operation are clear and useful.	1	2	3	4	5
The figures are helpful.	1	2	3	4	5
I was able to operate the system using this manual.	1	2	3	4	5

fold

If not, please comment below. Attach additional sheets if necessary.

_____   _____
_____   _____
_____   _____
_____   _____
_____   _____
_____   _____
_____   _____
_____   _____

Customer Registration Card

Register now…and receive all the privileges associated with being a Thermo Fisher Scientific product user including customer support, application reports, and technical reports.

MY ORGANIZATION IS: **(Check only one)**
- ❏ Commercial (for profit) lab
- ❏ Government lab
- ❏ Hospital/Clinic
- ❏ Industrial lab
- ❏ Research Institute
- ❏ University/College
- ❏ Veterinary
- ❏ Other_____

MY PRIMARY APPLICATION IS: **(Check only one)**
- ❏ Analytical
- ❏ Biomedical
- ❏ Clinical/Toxicology
- ❏ Energy
- ❏ Environmental
- ❏ Food/Agricultural
- ❏ Forensic/Toxicology
- ❏ Pharmaceutical
- ❏ Research/Education
- ❏ Other_____

MY PRIMARY JOB FUNCTION IS: **(Check only one)**
- ❏ Administration
- ❏ Lab management
- ❏ Operator
- ❏ Other_____

fold

Name _____ Title_____
Company _____
Address _____
City/State _____ Postal Code _____
Country _____
Telephone _____ Ext. _____
Serial Number _____ Date purchased _____

Fold and mail or e-mail to:

Editor, Technical Publications
Thermo Fisher Scientific S.p.A.
Strada Rivoltana km 4
20090 Rodano (MI)
Italy

Editor, Technical Publications
Thermo Fisher Scientific CMD GC-GC/MS
2215 Grand Avenue Parkway
Austin TX 78728-3812
Unites States of America

Declaration

Manufacturer: **Thermo Fisher Scientific**

Thermo Fisher Scientific is the manufacturer of the instrument described in this manual and, as such, is responsible for the instrument safety, reliability and performance only if:
* installation
* re-calibration
* changes and repairs

have been carried out by authorized personnel and if:
* the local installation complies with local law regulations
* the instrument is used according to the instructions provided and if its operation is only entrusted to qualified trained personnel

Thermo Fisher Scientific is not liable for any damages derived from the non-compliance with the aforementioned recommendations.

Thermo Fisher Scientific S.p.A.
Strada Rivoltana, 20090 Rodano - Milan - Italy — Tel: +39 02 950591 - Fax: +39 02 9505276

Regulatory Compliance

Thermo Fisher Scientific performs complete testing and evaluation of its products to ensure full compliance with applicable domestic and international regulations.
Thermo Fisher Scientific declares, under sole responsibility, that the product as originally delivered complies with the requirements of the following applicable European Directives and carries the CE marking accordingly:
* Low Voltage Directive:2006/95/EC
* EMC Directive:2004/108/EC
* Machinery Directive: 2006/42/EC

… and conforms with the following product standards:

Safety

This device complies with:
* IEC61010-1:2010 3rd Edition | IEC/EN 61010-1 3rd Edition
* ANSI/UL 61010-1:2004 2nd Edition | CAN/CSA C22.2 No. 61010-1:2004 2nd Edition.
* EN 61010-2-010:2003 | EN 61010-2-051:2003 | EN 61010-2-081:2001+A1:2003 | EN 61010-2 101:2003

Electromagnetic Compatibility

This device complies with:
* IEC 61326-1:2nd Edition | EN 61326-1:2013 | CISPR 11:5th Edition
* EN 61000-6-2:2005 | IEC 61000-6-2:2nd Edition| IEC 61000-6-3:2nd Edition am1 | EN 61000-6-3:2007 + A1:2011
* Conducted Emission, Subpart B. FCC part 15, §15.107(a) and §15.109(a)

Laser Class 1

The selected Class 1 Laser for the TriPlus RSH module Barcode Reader complies with the following regulations:

- 21 CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001
- EN60825-1:1994 + A1:2002 + A2:2001
- IEC60825-1:1993 + A1:1997 + A2:2001

FCC Compliance Statement

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

CAUTION Read and understand the various precautionary notes, signs, and symbols contained inside this manual pertaining to the safe use and operation of this product before using the device.

Notice on Lifting and Handling of
Thermo Scientific Instruments

For your safety, and in compliance with international regulations, the physical handling of this Thermo Fisher Scientific instrument *requires a team effort* to lift and/or move the instrument. This instrument is too heavy and/or bulky for one person alone to handle safely.

Notice on the Proper Use of
Thermo Scientific Instruments

In compliance with international regulations: Use of this instrument in a manner not specified by Thermo Fisher Scientific could impair any protection provided by the instrument.

Notice on the Susceptibility
to Electromagnetic Transmissions

Do not use radio frequency transmitters, such as mobile phones, in close proximity to the instrument.

thermoscientific

WEEE Directive
2012/19/EU

Thermo Fisher Scientific is registered with B2B Compliance (B2Bcompliance.org.uk) in the UK and with the European Recycling Platform (ERP-recycling.org) in all other countries of the European Union and in Norway.

If this product is located in Europe and you want to participate in the Thermo Fisher Scientific Business-to-Business (B2B) Recycling Program, send an email request to weee.recycle@thermofisher.com with the following information:

- WEEE product class

- Name of the manufacturer or distributor (where you purchased the product)

- Number of product pieces, and the estimated total weight and volume

- Pick-up address and contact person (include contact information)

- Appropriate pick-up time

- Declaration of decontamination, stating that all hazardous fluids or material have been removed from the product

For additional information about the Restriction on Hazardous Substances (RoHS) Directive for the European Union, search for RoHS on the Thermo Fisher Scientific European language websites.

IMPORTANT This recycling program is **not** for biological hazard products or for products that have been medically contaminated. You must treat these types of products as biohazard waste and dispose of them in accordance with your local regulations.
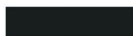
Directive DEEE
2012/19/EU

Thermo Fisher Scientific s'est associé avec une ou plusieurs sociétés de recyclage dans chaque état membre de l'Union Européenne et ce produit devrait être collecté ou recyclé par celle(s)-ci. Pour davantage d'informations, rendez-vous sur la page www.thermoscientific.fr/rohs.

WEEE Direktive
2012/19/EU

Thermo Fisher Scientific hat Vereinbarungen mit Verwertungs-/Entsorgungsfirmen in allen EU-Mitgliedsstaaten getroffen, damit dieses Produkt durch diese Firmen wiederverwertet oder entsorgt werden kann. Weitere Informationen finden Sie unter www.thermoscientific.de/rohs.

Contents

Preface

This manual describes the features and the components of the Thermo Scientific™ TriPlus RSH™ (Robotic Sample Handling) integrated sampling system. Inside, you find all of the informations necessary for the routine operations of your sampling system. This includes operating procedures, sample injection techniques, diagrams, and the description of the major components.

This User Guide is intended for frequent or new TriPlus RSH users who are experienced at using automated systems to run existing analytical methods.

Note The TriPlus RSH must be installed and set up properly before the Operating Instructions can be used.

This manual is organized as follows:

- Chapter 1, "Getting Familiar with Your TriPlus RSH," provides informations to familiarize with the TriPlus RSH.

- Chapter 2, "TriPlus RSH Basic Informations," provides basic informations to start the TriPlus RSH, and for using the Handheld Controller.

- Chapter 3, "Setup Menu Item," describes the options of the **Setup Menu** operated either with the Virtual Handheld Controller, or directly using the installed Handheld Controller.

- Chapter 4, "Maintenance Menu Items," describes the options of the **Maintenance Menu** operated either with the Virtual Handheld Controller, or directly using the installed Handheld Controller.

- Chapter 5, "Service Menu Item," describes the options of the **Service Menu** operated either with the Virtual Handheld Controller or directly using the installed Handheld Controller.

- Chapter 6, "Analytical Troubleshooting," gives a quick overview of possible causes and recommended actions which can be taken to eliminate an erratic behavior.

- Appendix A, "Multi Headspace Extraction (MHE)." describes the principles and the use of the Multi Headspace Extraction (MHE).

About Your System

Thermo Fisher Scientific systems operate safely and reliably under carefully controlled environmental conditions. If the equipment is used in a manner not specified by the manufacturer, the protections provided by the equipment might be impaired. If you maintain a system outside the specifications listed in this guide, failures of many types, including personal injury or death, might occur. The repair of instrument failures caused by operation in a manner not specified by the manufacturer is specifically excluded from the Standard Warranty and service contract coverage.

Power Rating

TriPlus RSH
- 100/240 Vac +/-10%; 50/60 Hz; 5 A max; 200 VA (400 VA when two Power Modules are required).

Detailed instrument specifications are in the Product Specification or Product Brochure.

Contacting Us

Thermo Fisher Scientific provides comprehensive technical assistance worldwide and is dedicated to the quality of our customer relationships and services.

Use http://www.thermofisher.com address for products information.

Use http://www.gc-gcms-customersupport.com/WebPage/Share/Default.aspx address to contact your local Thermo Fisher Scientific office, or affiliate GC-GC/MS Customer Support.

Related Documentation

In addition to this guide, Thermo Scientific™ provides the following documents for the TriPlus RSH.

- *TriPlus RSH Safety Guide*, PN 31709600

- *TriPlus RSH Preinstallation Requirements Guide*, PN 31709610

- *TriPlus RSH User Guide*, PN 31709620

- *TriPlus RSH Hardware Manual*, PN 31709640

To suggest ways we can improve the documentation, follow this link to complete our Reader's Survey.

Safety Alerts and Important Information

Make sure you follow the precautionary notices presented in this manual. The safety and other special notices appear in boxes.

Special Notices

Notices includes the following:

IMPORTANT Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the system.

Note Emphasizes important information about a task.

Tip Helpful information that can make a task easier.

Safety Symbols and Signal Words

All safety symbols are followed by **WARNING** or **CAUTION**, which indicates the degree of risk for personal injury, instrument damage, or both. Cautions and warnings are following by a descriptor, such as **BURN HAZARD**. A **WARNING** is intended to prevent improper actions that could cause personal injury. Whereas, a **CAUTION** is intended to prevent improper actions that might cause personal injury, instrument damage, or both. You can find the following safety symbols on your instrument, or in this guide:

Symbol	Descriptor
	BIOHAZARD: Indicates that a biohazard *will*, *could*, or *might* occur.
	BURN HAZARD: Alerts you to the presence of a hot surface that *could* or *might* cause burn injuries.
	ELECTRICAL SHOCK HAZARD: Indicates that an electrical shock *could* or *might* occur.
	FIRE HAZARD: Indicates a risk of fire or flammability *could* or *might* occur.
	EXPLOSION HAZARD. Indicates an explosion hazard. This symbol indicates this risk *could* or *might* cause physical injury.
	FLAMMABLE GAS HAZARD. Alerts you to gases that are compressed, liquefied or dissolved under pressure and can ignite on contact with an ignition source. This symbol indicates this risk *could* or *might* cause physical injury.

GLOVES REQUIRED: Indicates that you must wear gloves when performing a task or physical injury *could* or *might* occur.

CLOTHING REQUIRED. Indicates that you should wear a work clothing when performing a task or else physical injury *could* or *might* occur.

BOOTS REQUIRED. Indicates that you must wear boots when performing a task or else physical injury *could* or *might* occur.

MATERIAL AND EYE HAZARD. Indicates you must wear eye protection when performing a task.

HAND AND CHEMICAL HAZARD: Indicates that chemical damage or physical injury *could* or *might* occur.

HARMFUL. Indicates that the presence of harmful material *will, could, or might* occur.

INSTRUMENT DAMAGE: Indicates that damage to the instrument or component *might* occur. This damage might not be covered under the standard warranty.

LIFTING HAZARD. Indicates that a physical injury *could* or *might* occur if two or more people do not lift an object.

MATERIAL AND EYE HAZARD: Indicates that eye damage *could* or *might* occur.

READ MANUAL: Alerts you to carefully read your instrument's documentation to ensure your safety and the instrument's operational ability. Failing to carefully read the documentation *could* or *might* put you at risk for a physical injury.

TOXIC SUBSTANCES HAZARD: Indicates that exposure to a toxic substance could occur and that exposure *could* or *might* cause personal injury or death.

LASER HAZARD. Indicates that exposure to a laser beam *will, could,* or *might* cause personal injury.

RADIOACTIVE HAZARD. Indicates that the presence of radioactive material *could or might* occur.

For the prevention of personal injury, this general warning symbol precedes the **WARNING** safety alert word and meets the ISO 3864-2 standard. In the vocabulary of ANSI Z535 signs, this symbol indicates a possible personal injury hazard exists if the instrument is improperly used or if unsafe actions occur. This symbol and another appropriate safety symbol alerts you to an imminent or potential hazard that *could cause personal injury*.

Instrument Markings and Symbols

Table 1 explains the symbols used on Thermo Fisher Scientific instruments. Only a few of them are used on the TriPlus RSH, which are annotated with an asterisk below.

Table 1. Instrument Marking and Symbols (Sheet 1 of 2)

	Symbol	Description
	⎓	Direct Current
*	∿	Alternating Current
	⎓∿	Both direct and alternating current
	3∿	Three-phase alternating current
	⏚	Earth (ground) terminal
	⏚	Protective conductor terminal
	⏛	Frame or chassis terminal
	⏚	Equipotentiality
*	❘	On (Supply)
*	◯	Off (Supply)
	▣	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION (Equivalent to Class II of IEC 536)
	⊟	Fuse
*	⚠	Instruction manual symbol affixed to product. Indicates that the you must refer to the manual for specific **WARNING** or **CAUTION** information to avoid personal injury or damage to the product.
	⚡	Caution, risk of electric shock
*	♨	Caution, hot surface
*	☣	Caution, biohazard
*	☢	Caution, Laser beam

Table 1. Instrument Marking and Symbols (Sheet 2 of 2)

	Symbol	Description
*		Symbol in compliance to the Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE) placed on the European market after August, 13, 2005.

Safety Information and Warnings

This safety guide raises awareness of potential safety issues and general points for consideration for Thermo Fisher Scientific representatives during installation, and repair of the TriPlus RSH, or parts of it (following the life cycle principle), as well as for the end user TriPlus RSH in the lab during the learning phase, and in routine work.

IMPORTANT Read this section first before operating the TriPlus RSH.

General Considerations

- Before a unit is put to use, consult the TriPlus RSH User Guide and related documents under all circumstances.

- Changes or modifications to this unit not expressly approved by the party responsible for compliance, could void your's authority to operate the equipment.

- Be aware that if the equipment is used in a manner not specified by the manufacturer, the protective and safety features of the equipment might be impaired.

- The repair of instrument failures caused by operation in a manner not specified by the manufacturer is expressly excluded from the standard warranty and service contract coverage.

- When for technical reasons it is necessary to work on instrument parts which might involve a potential hazard (moving parts, components under voltage, and so on.) contact the Thermo Fisher Scientific authorized representative. In general, this type of situation arises when access to the parts is only possible using a tool. When you perform a maintenance operation, you must have received proper training to carry out that specific task.

Electrical Hazards

Every analytical instrument has specific hazards. Be sure to read and comply with the following pre-cautions. They ensure the safe and long-term use of your TriPlus RSH.

The installation over-voltage category is Level II. The Level II category pertains to equipment receiving its electrical power from the local level, such as an electrical wall outlet.

Connect the TriPlus RSH only to instruments complying with IEC 61010 safety regulations.

The power line and the connections between the TriPlus RSH and other instruments, used in the configuration setup of the total analytical system, must maintain good electrical grounding. Poor grounding represents a danger for the operator, and might seriously affect the performance of the instrument.

Do not connect the TriPlus RSH to power lines that supply devices of a heavy duty nature, such as motors, refrigerators and other devices that can generate electrical disturbances.

Use only fuses of the type and current rating specified. Do not use repaired fuses, and do not short-circuit the fuse holder. The supplied power cord must be inserted into a power outlet with a protective earth (ground) contact. When using an extension cord, make sure that the cord also has an earth contact.

If the supplied power cord does not fit the local electrical socket and a replacement or adapter has to be purchased locally, make sure that only a certified power cord is used. Any power cord used must be certified by the appropriate local authorities.

Pay attention not to leave any cable connecting the TriPlus RSH and the chromatographic system, or the power cord close to heated zone, such as the injector or detector heating blocks, or the GC hot air vents.

Always replace any cable showing signs of damage with another one provided by the manufacturer. Safety regulations must be respected.

Do not change the external or internal grounding connections. Tampering with or disconnecting these connections could endanger you and damage the TriPlus RSH. The instrument is properly grounded in accordance with these regulations when shipped. To ensure safe operation, you do not must make any changes to the electrical connections or the instrument's chassis.

Do not turn the instrument on if you suspect that it has incurred any type of electrical damage. Instead, disconnect the power cord and contact a Thermo Fisher Scientific representative for a product evaluation. Do not attempt to use the instrument until it has been evaluated. Electrical damage might have occurred if the TriPlus RSH shows visible signs of damage, exposure to any liquids or has been transported under severe stress.

Damage can also result if the instrument is stored for prolonged periods under unfavorable conditions: for example, subjected to heat, moisture, and so on. Ensure that the power supply/controller unit is always placed in a clean and dry position. Avoid any liquid spills in the vicinity.

Before attempting any type of maintenance work, always disconnect the power cords from the power supply(ies) if optional devices are installed. Capacitors inside the instrument might still be charged also if the instrument is turned off.

To avoid damaging electrical parts, do not disconnect an electrical assembly while power is applied to the TriPlus RSH. After the power is turned off, wait approximately 30 seconds before you disconnect an assembly.

The instrument includes a number of integrated circuits. These circuits might be damaged if exposed to excessive line voltage fluctuations, power surges or electrostatic charges, or both.

Never try to repair or replace any components of the instrument without the assistance of a Thermo Fisher Scientific representative. There are no operator-serviceable or replaceable parts inside the power supply(ies) or in the TriPlus RSH. If a power supply is not functioning, contact a Thermo Fisher Scientific representative.

The power supplies for the TriPlus RSH, the Temperature Controlled Drawer have the symbols **I/O** on the label for the power switch to indicate ON/OFF. If a Temperature Controlled Drawer is installed in combination with a TriPlus RSH, a second power supply is active in the complete system. Turning OFF the two power supplies, or pulling the two power cords in an emergency, stop the entire TriPlus RSH.

It is important that the power supply(ies) is in a location where the power ON/OFF switch is accessible and easy to operate, and where it is possible to unplug the AC power cord from the power supply/wall outlet in case of emergency.

Laser Safety Information

Safety Warning for Laser Class 1 Product.

CLASS 1 LASER PRODUCT
LASER KLASSE 1
APPAREIL À LASER DE CLASSE 1

WARNING The installed Laser device is a Class 1 Laser Product.
Class 1 Laser devices are not considered to be hazardous when used for their intended purpose. The following statement is required to comply with US and international regulations.

CAUTION Use of controls, adjustments or performance of procedures other than those specified herein might result in hazardous laser light exposures.

The selected Class 1 Laser for the TriPlus RSH module Barcode Reader complies with the following regulations:

- 21 CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001

- EN60825-1:1994 + A1:2002 + A2:2001

- IEC60825-1:1993 + A1:1997 + A2:2001

The software contains a built-in safety time limit such that the laser scanning mechanism cannot be operated in AIM mode for more than 5 continuous seconds.

Other Hazards

To avoid injury and possible infection through contamination during TriPlus RSH operation, keep your hands away from the syringe.

Do not operate the TriPlus RSH without the safety guard. The safety guard must be installed for safe operation. Do not place any objects inside the area of the safety guard. Keep away from the area around the safety guard during operation of the TriPlus RSH.

Danger of crushing to fingers and hands. To avoid injury keep your hands away from moving parts during operation. Turn off the power to the TriPlus RSH if you must reach inside a mechanically powered system with moving parts.

To avoid injury, observe safe laboratory practice when handling solvents, changing tubing, or operating the TriPlus RSH. Know the physical and chemical properties of the solvents you use. See the MSDS (Material Safety Data Sheets) from the manufacturer of the solvents being used.

When using the TriPlus RSH, follow the generally accepted procedures for quality control and method development.

When using the TriPlus RSH in the field of chromatographic analysis, if a change is observed in the retention of a particular compound, in the resolution between two compounds, or in the peak shape, immediately determine the reasons for the changes. Do not rely on the separation results until you determine the cause of a change.

Do not operate on the instrument components that form part of the work area of the TriPlus RSH when it is in motion.

Use caution when working with any polymer tubing under pressure:

- Always wear eye protection when near pressurized polymer tubing.

- Do not use polymer tubing that has been severely stressed or kinked.

- Do not use polymer tubing, in particular no PEEK or Tefzel tubing when using tetrahydrofuran (THF), dimethylsulfoxide (DMSO), chlorinated organic solvents, concentrated mineral acids such as nitric, phosphoric or sulfuric acids, or any related compounds.

Do not use vials without a sealing cap, or microtiter or deepwell plates without a plate seal. Vapor phase from organic solvents can be hazardous and flammable. Acidic vapor phase can cause corrosion to critical mechanical parts.

When sample vials have to undergo heating and agitation, it is important to consider the glass quality. Use high quality glass only. Remember that depending on the application conditions, high pressure can build up in the vial. Whenever a temperature greater than 60 °C is applied, consider the vapor pressure of the solvent used to ensure that no excessive pressure builds up. This is important when using a temperature above 100°C and especially at the maximum temperature of 200 °C. Be aware that solid materials can also contain volatile compounds such as water (humidity) which could cause build-up of excess vapor pressure.

Do not reuse headspace vials. During the process of washing the vial, micro-cracks can form which will weaken the glass wall and increase the chances of the vial breaking.

In case of a single fault situation where the temperature control of the Agitator fails, there is the potential danger that the device will heat up in an uncontrolled manner until it reaches the cut-off temperature of the over temperature fuse, in this case, 240 °C. Based on this single fault scenario, when working with flammable solvents, ensure that the solvent used has a flash point which is 25 °C higher than the maximum potential temperature (240 °C) of the Agitator.

When filling-up a standard reservoir or replacing a solvent such as a washing solvent, remove the solvent reservoir bottle from the system to avoid a possible spill over the instrument. Depending on the physical, chemical or hazardous properties of the solvent, use the appropriate protective measures for handling.

Working with Toxic or other Harmful Compounds

WARNING Before using hazardous substances (toxic, harmful, and so on), please read the hazard indications and information reported in the applicable Material Safety Data Sheet (MSDS). Use personal protective equipment according to the safety requirements.

Before using dangerous substances (toxic, harmful, and so on) read the hazard indications and information reported in the Material Safety Data Sheet (MSDS) supplied by the manufacturer, referring to the relevant CAS (Chemical Abstract Service) number. The TriPlus RSH requires the use of several chemical products with different hazard characteristics, which are present in vials and syringes. Before using these substances or replacing the syringe, please read the hazard indications and information reported in the MSDS supplied by the manufacturer referring to the relevant CAS number.
When preparing the samples, please refer to local regulations for the ventilation conditions of the work room.

All waste materials must be collected and eliminated in compliance with the local regulations and directives in the country where the instrument is used.

Biological Hazards

In laboratories where samples with potential biological hazards are handled, you must label any equipment or parts thereof which might become contaminated with biohazardous material. The appropriate warning labels are included with the shipment of the instrument. It is your responsibility to label the relevant parts of the instrument.

When working with biohazardous materials, it is your responsibility to fulfill the following mandatory requirements:

- Instructions on how to safely handle biohazardous material must be provided.

- Operators must be trained and made aware of the potential dangers.

- Personal protective equipment must be provided.

- Instructions must be provided on what to do in case the operators are exposed to aerosols or vapors during normal operation (within the intended use of the equipment) or in case of single fault situations such as a broken vial. The protective measures must consider potential contact with the skin, mouth, nose (respiratory organs), and eyes.

- Instructions for decontamination and safe disposal of the relevant parts must be provided.

It is your responsibility to handle hazardous chemicals or biological compounds (including, but not limited to, bacterial or viral samples and the associated waste), safely and in accordance with international and local regulations.

Maintenance

Any external cleaning or maintenance must be performed with the TriPlus RSH turned off and the power cord disconnected. Avoid using solvents and spraying on electrical parts. For the removal of potentially dangerous substances (toxic, harmful, and so on) read the hazard indications and information reported in the MSDS (Material Safety Data Sheet) supplied by the manufacturer referring to the relevant CAS (Chemical Abstract Service) number. Use proper protective gloves.

When working with hazardous materials such as radioactive, biologically hazardous material, and so on, it is important to train all operators how to respond in case of spills or contamination.

Depending on the class of hazardous material, the appropriate measures have to be taken immediately. Therefore, the chemicals or solvents needed for decontamination have to be on hand.

Any parts of the equipment which can potentially be contaminated, such as the sample vial rack, syringe tool, wash module, and so on, must be cleaned regularly. The waste solvent from cleaning and any hardware which requires to be disposed of has to be properly eliminated with all the necessary precautions, abiding by national and international regulations.

When preparing for decontamination, ensure that the solvent or chemical to be used will not damage or react with the surface, dye (color) of the instrument, table or other nearby objects. If in doubt, please contact your Thermo Fisher Scientific representative to verify the compatibility of the type or composition of solvents with the TriPlus RSH.

Disposal

Do not dispose of this equipment or parts thereof unsorted in municipal waste. Follow local municipal waste regulations for proper disposal provisions to reduce the environmental impact of waste electrical and electronic equipment (WEEE). European Union customers: Call your local customer service representative responsible for the TriPlus RSH for complimentary equipment pick-up and recycling.

WARNING   The customer has to ensure that the TriPlus RSH has not been contaminated by any hazardous chemical or biological compounds including (but not limited to) bacteria or viruses.
Any part which had direct contact with the analytical sample must be identified and must undergo an appropriate decontamination procedure prior to shipping for disposal. Potentially dangerous components are: Syringes, Vials and Well Plates. Any critical parts sent for disposal must be handled according to national laws for hazardous compounds. The customer and the service engineer are fully responsible for enforcing these requirements. Thermo Fisher Scientific will hold the representative, customer responsible, or both, if these regulations are not observed.

Getting Familiar with Your TriPlus RSH

This chapter provides information to familiarize with the TriPlus RSH.

Contents

Instrument Basics

The TriPlus RSH, offers you great flexibility in various applications. A unique automated Tool changer is provided, increasing throughput and allowing sample preparation steps before the injection cycle.

The new versatility and seminal technical aspects are highlighted.
The TriPlus RSH has several advantages for use and provides greater flexibility and security for routine and research applications, including:

- System Setup using the Virtual Handheld Controller software (or optional Handheld Controller).

- Guided teaching wizards for Tools and Modules.

- The future-oriented **Servo motor** — a new control concept for motors with a high intelligence, providing high security on X-,Y-, and Z-positioning at any time.

- The communication Bus increases the flexibility for adding so-called **Active modules** and controlling these modules in a bidirectional manner. A self-detection mode simplifies the addition of a module to the TriPlus RSH configuration.
  The bidirectional communication allows control of the module at any given time or position. Data stored in a log file not only gives you a high degree of security but also facilitates the tractability of cycle performance, providing easy access to essential information which might be requested by inspection authorities.

- A unique ATC Station allows an automated change of Tools (syringes with different volumes or different Tool Types) for advanced sampling preparation, liquid handling (dilutions), derivatization steps or any other time-consuming repetitive step. This added versatility alongside the increase in throughput are significant benefits for you.

- New optional hardware modules, for example the Vortexer, for efficient phase mixing, expands the range of applications and adds to the system versatility.

- A large range of syringe volumes is available for liquid or gaseous sample injection for different GC-injector types (split/splitless, on-column, and so on.) and GC-columns (from micro capillary to packed columns) enhancing the available options for you.

- A large range of vial sizes or microtiter plates which can be used in various tray holders.

- Vial bottom sensing allows aspiration of the very last drop in a vial.

- Barcode reader with dual scan module for barcode identification in any position.

- Wide range of predefined cycles for advanced liquid handling.
  The TriPlus RSH can be set up and configured using either the Handheld Controller or the Virtual Handheld Controller (PC software).

  The options and parameters are identical, but the handling differs between the Handheld Controller (Scroll Wheel and **Enter** button) and the normal control within the software. The setup procedure is described in the sections "Service Menu Item" on page 193.

Definition of Terms, Naming Conventions, and Start Screen Icons

This section details the definition of the terms, the naming conventions used in this manual, and the Start Screen icons visualized on the Handheld Controller.

See the related topics:

- "Definition of Terms" on page 3
- "Naming Conventions" on page 6
- "Start Screen Icons" on page 7

Definition of Terms

- **TriPlus RSH System** — The brand name for the entire System product family.
  The product family includes not only the TriPlus RSH instruments but also the various optional modules.

- **TriPlus RSH** — A generic term referring to the TriPlus RSH system.
  TriPlus RSH is more used in combination with the basic unit with X- and Y-axes, Head (Z-axis), and Power installed.

- **Module** — A generic term used to refer to both active and passive modules.

- **Active Module** — A module which is controlled by the BUS connector via active control. An active module requires a device firmware which is part of the RSH Firmware. An active module is recognized when connected to the BUS, it can be de-activated but not deleted.

- **Passive Module** — A static module, e.g. a non-temperature programmable tray holder, does not require any control or checks through the BUS. A passive module requires an object template which is part of the RSH Firmware. A specific device firmware is not required. A passive module cannot be deactivated but it can be deleted.

- **Composite Module** — An active module consisting of one or more devices which also communicate with the BUS, but in slave functionality. A typical example is the RSH Head (Z-axis).

- **Device** — A single active module communicating with the BUS but in slave functionality. Each device requires a device firmware which is part of the RSH Firmware.

- **Motor** — Generic term for the new generation of motors used for the axes.
  The motor uses the logic of a servo-motor with electronic and software control.
  The various motors are specified with the suffix of where the motor is applied, such as motor-X, or motor-Z.

- **Base** — The combination of the X- and Y-Axes, with or without the electronics installed.

- **Head** — Consist of Z-axis, the Needle Guide Motor, and the Plunger Motor. The cover is part of the entire unit as well.

- **Tool** — Generic term for the holder of a syringe or SPME fiber. Different Tools are used:

  A Tool consists of the lower and upper needle guides, the electronic identification, heating and purge gas connections if required, and the coupling pivots for the Tool itself. A Tool is designed for a specific syringe type tailored for the application (Liquid, Headspace, SPME, SPME Arrow or ITEX DHS), with a specific glass barrel outer diameter and needle length.

- **Control Software** — The entire software package of the operating system, application software, configuration, and various device firmware. The file extension is *.**pack**.

- **RSH Firmware** — Starting with software version 2.0 the **Control Software** is renamed to **Firmware**. The definition is identical as described above with **Control Software**

- **Device Firmware** — The software for an active module. The device firmware is part of the **RSH Firmware**.

- **Activity** — The lowest level of command available with the RSH Firmware. Activities depend on the Application Software version, and are downloaded to the program from the TriPlus RSH when the initial connection is made, and updated during the run time on a regular basis.

  Activities are grouped in classes:

  - **Public**: Activities available to build a custom specific script.

  - **Private**: Activities not available to build a script. They are necessary for internal control, and for the integration of the TriPlus RSH into another Chromatography Data System (CDS).

A Script is built by linking **Activities** together in a sequence.

- **Script** — Created by building a sequence of TriPlus RSH operations, which are linked by a series of Activities. A Script can be a Method depending on the functionality built-into the script.

- **Cycle** — Consists of the specific operations necessary to process one sample. The cycle operations are repeated for each sample within a job (sequence). Cycles are designed for specific applications.

- **Method** — A Method is an executable procedure defined by the Sample Control software. For the operator, certain parameters can be modified in order to define how the samples are processed.

- **Method Parameters** — Associated with the cycle operations. User-assigned parameter values define how a processing operation is performed. A zero parameter value will disable a cycle operation. Cycle parameters are application-specific.

- **Objects** — Data structures describing the properties of physical modules, such as Tray Holder, Agitator, Motors, and so on.

- **Module Type** — Unique identification of a module, defines the machine object description of the combining device.

- **Module ID** — Unique identification of a module.

- **Tray Holder** — Holds one or more trays. Each tray holder has a reference position (X-, Y-, Z-coordinates), that defines its location. A tray holder is a passive module.

- **Slot** — The physical place where a Tray can be positioned in the Tray Holder.

- **Sample Tray** — Generic term. A tray can be a **rack** for holding vials, or a well plate for deepwell plates, or microtiter plates. A tray holds multiple samples. Trays are defined by designating the tray type, and the Tray Holder. Tray names are used to identify the sample source within a Job.

- **Well Plate** — A generic term used for all types of well plates. The most common well Plates are deepwell plates, or microtiter plates. The well plates have a standardized footprint. The tray holder drawers are designed to accept well plates. Passive tray holders for the TriPlus RSH have three slots, each one designed with the footprint dimensions of a Well Plate.

- **Tray Type** — Generic term. A Tray Type can be a Tray for vials or a plate for well plates. A Tray Type defines the pattern and sampling sequence of sample locations within a Tray.

- **Vial Type** — The physical dimensions of a Vial and parameters required for automation, such as Needle Penetration Depth or Penetration Speed, are described by the various item parameters of the Vial Type.

- **Cap Type** — Describes the material of the vial cap, which in turn determines whether or not a vial can be transported.

- **Needle Guide Type** — Selectable parameter in the software class **Tools**. Selects the required Tool that is mounted to the Lower Needle Guide of the Tool. For example, you can select the large magnetic ring for transporting 10/20 mL vials or the Foil Cutter for use with sealed Well Plate.

- **Temperature Controlled Drawer** — An active Tray Holder with drawer system. It is temperature controllable.

- **Liquid Cooled Tray Holder** — A passive module controlled through external liquid circulation bath.

Naming Conventions

This section provides the standard naming convention for TriPlus RSH Trays and Tray Types. Following these conventions will allow the TriPlus RSH to be pre-configured for certain applications, will simplify software backups and application development, and will improve technical support and training.

An example of naming convention id detailed in Table 1.

Table 1. Example of Tray Types Naming Convention

Tray Type	Tray Description
Vial Tray 15 (VT15)	Tray with same footprint as Well Plate; 15 positions (3 x 5).
	Pattern: Regular for 10 and 20 mL vials with OD 22.5 mm and height 46/76 mm.
Vial Tray 54 (VT54)	Tray with same footprint as Well Plate; 54 positions (6 x 9).
	Pattern: Regular for 2 mL vials with OD 12 mm and height 32 mm.
Vial Tray 70 (VT70)	Tray with same footprint as Well Plate; 70 positions (7 x 10).
	Pattern: Regular for 0.7-0.8 mL vials with OD 7.5 mm and height 40 mm. Viewing window in position 68 for needle penetration check.
Vial Tray 60 (R60)	Tray with footprint for entire Tray Holder (passive Tray Holder with 3 Slots). 60 positions (6 x 10).
	Pattern: Staggered+ for 10 and 20 mL vials with OD 23, and height 46/76 mm. Viewing window in position 60 (for needle penetration check).
Vial Tray 32 (R32)	Tray with footprint for Liquid Cooled Tray Holder; 32 positions (4 x 8).
	Pattern: Regular for 20 mL vials with OD 22.5 and height 76 mm.
DWP96	Well Plate Type. Deep Well Plate DW96. 96 positions (8 x 12).
	Pattern: Regular.
	Plate Height: 43.0 mm; Well Cavity Depth: 39.0 mm; Well Cavity Diameter: 7.0 mm.
MTP96	Well Plate Type. Microtiter Plate MT96. 96 positions (8 x 12).
	Pattern: Regular.
	Plate Height: 14.6 mm; Well Cavity Depth: 10.9 mm; Well Cavity Diameter: 7.0 mm.
MTP384	Well Plate Type. Microtiter Plate MT384. 384 positions (24 x 16).
	Pattern: Regular.
	Plate Height: 14.4 mm; Well Cavity Depth: 11.5 mm; Well Cavity Diameter: 3.7 mm.

Start Screen Icons

Table 2 lists the Start Screen icons visualized on the Handheld Controller according to the Tools, modules and stations installed on the TriPlus RSH.

Table 2. Start Screen Icons (Sheet 1 of 3)

Icon	Description
Tool and Tool Change Station	
	LS Tool, Syringe tool for liquid Injections
	HS Tool; Headspace Tool
	SPME Fiber Tool; Tool for SPME Fiber Holder
	SPME Arrow Tool; Tool for SPME Arrow Holder
	ITEX DHS Tool
	Dilutor Tool
	ATC Station; Active module for automated Tool change.
	TR Station
Active Module	
	Agitator
	Vortexer
	Heatex Stirrer
	SPME Fiber Conditioning Station / SPME Arrow Conditioning Station
	Barcode Reader
	Temperature Controller Drawer

Table 2.   Start Screen Icons (Sheet 2 of 3)

Icon	Description
	OC Injector (On-column Injector)
	Fast Wash Module
	Dilutor Syringe Module
Passive Module	
	Tray Holder (rectangular)
	Liquid Cooled Tray Holder
	Standard Wash Station (5x10 mL Vials)
	Large Solvent Wash Station (2 x 100 mL bottles and 1 Waste Position)
	Solvent Station (Solvent reservoir station for 3 x 100 mL bottles)
	Tray, rectangular (Tray to hold vials with volume from 1 to 40 mL)
	Vials, set of vials
	Vial, single vial (Vial Type CV)
	Solvent Reservoir Bottle (Vial Type SR)
	Injector (GC Injector)
	MHE Station
Synchronization and Signals	
I/O	Input and Output Signals
	Input Signal

Table 2. Start Screen Icons (Sheet 3 of 3)

Icon	Description
	Output Signal
	Chromatographic System. Specifies synchronization of Input and Output Signals, Cryo Trap, and Delay Time for a Fake Injection for an analytical system.
General Icons	
	TriPlus RSH System
	Head (Injection unit)

Definitions of Active and Passive Hardware Modules

This section details the definitions of the hardware modules.

Active Versus Passive Module

An **Active module** is defined as a module that sends or receives specific commands and checks. The control communication is done via the **BUS** serial protocol for all active devices.

A typical example is the motor for the X-Axis which has to be accelerated to a certain speed and stopped after a defined travel distance. The motor records the position at every point of its trajectory and is reported back to the processor via the BUS using the X-motor (Servo motor X-axis).
Another example is an Agitator/Incubator where the temperature and motor for sample agitation have to be controlled and monitored.

A **Passive** module is a static device. Typical examples are non-temperature programmable Tray Holders, a TR Station, or a Standard Wash Station.

You can easily distinguish the difference between **active** and **passive** devices by checking for any serial connectors at the device.

See the example in Figure 1, which shows the passive module **TR Station** on the left, and the active module **ATC Station** for three **Tools** on the right. Every Active Module has two connectors for daisy chaining to the next module.

Figure 1. Example of Passive and Active Modules
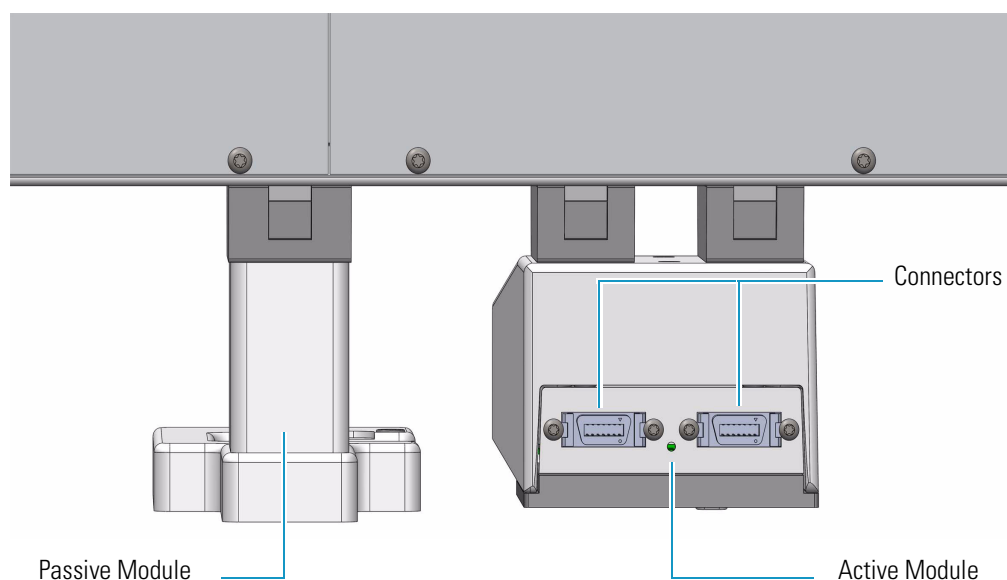
At the level of the RSH Firmware, it is important to understand other differences between the two classes of modules:

- **Active module** — The device firmware is always included in (or is part of) the basic RSH Firmware. When the module is connected to the BUS, the device is recognized and made available for use via serial control. A module **ID#** is automatically provided and stored. Loading or activating a specific firmware object is not necessary.

  An active device can be de-activated but not deleted. A deactivation is done by disconnecting the serial cable. The device ID# is stored. If the device is re-activated later, the same device ID# will be re-assigned.

  > **Note** It is possible to delete an active device in the **Service** access level.

- **Passive module** — The template of a passive module is included in (or part of) the basic RSH Firmware. Using the Handheld Controller, add the module by selecting **Options | Setup | Modules**.
  A dialog guides you through the screens to define the various Attributes and Parameters. After the newly-defined module is stored, it is available for further setup definitions such as teaching the positions.

  A module **ID#** is automatically provided and stored as long as the device is in operation. Loading or activating a specific device firmware is not possible for a Passive module.

  A passive module cannot be deactivated but it can be deleted. The module ID# will not be stored. If the same device is re-activated later, another module ID# will be randomly provided.

Active Versus Composite Module

The term **Active module** is used for a module which communicates with the BUS. An Active module can consist of one or more devices which also communicate with the **Active** versus **Composite module**.

The term **Active module** is used for a module which communicates with BUS. An Active module can consist of one or more devices which also communicate with the BUS but in slave functionality. A typical example is the **TriPlus RSH Head** (Z-axis) which contains three different motors, each of them connected to the BUS.

A **Composite module**, such as the TriPlus RSH, is composed of several devices.

Note This differentiation is not important for the routine use of the TriPlus RSH. You must understand this difference when a device must be replaced, for example a motor-Z as part of the TriPlus RSH Head.

The TriPlus RSH System

The TriPlus RSH is an integrated sampling system based on three axes X,Y and Z, constituted by a basic body on which a series of components are installed. See Figure 2.

Figure 2.   TriPlus RSH Schematic View
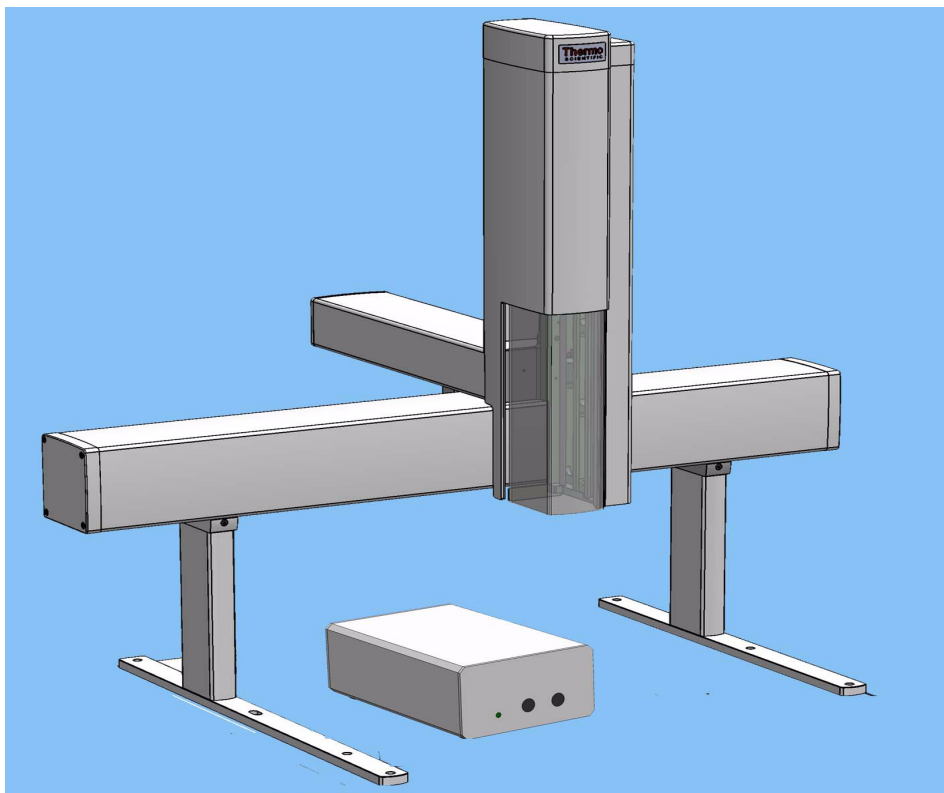
The components are chosen by the operator according to their own analytical demands.

Choosing the appropriate components, TriPlus RSH sampler may be configured for Liquids **LS**, Headspace **HS**, or **SPME** and **SPME Arrow** Solid Phase Micro Extraction, or **ITEX DHS** In-tube/Dynamic Headspace Extraction.

Besides, TriPlus RSH can perform sampling preparation by using the optional single or multi **Dilutor Module.**

Crossrails

The crossrails constitutes the primary structure up on which the sampling unit components are installed according to the configuration of the sampler.

The two sliding crossrails constitute the X and Y axes of the sampler. See Figure 3.
They are connected to one another through a mechanism that manages the movements of the system by both a motorized truck and a tray located in every crossrail.

Figure 3. Crossrails X and Y
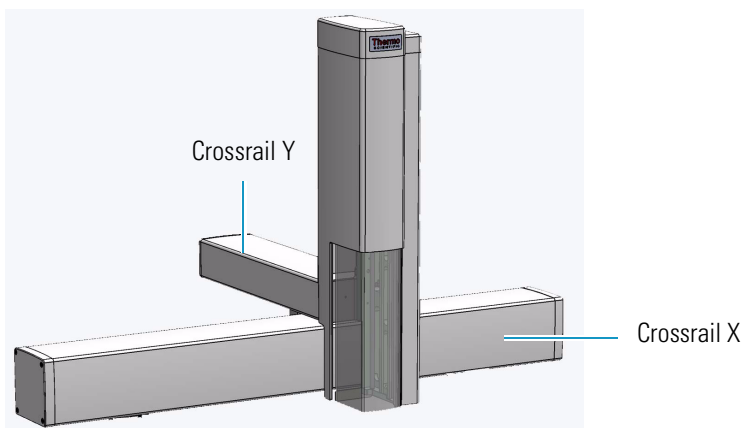
Crossrail X

It represents the X-axis of the system and is the structure bearing the sampling units components. It consists of the following sections:

- **Front-upper section** — The part of the crossrail on which the crossrail Y slides.

- **Lower section** — Includes the slots to connect the sampler support and the components.

- **Back section** — Includes the Control Interface for the connection of the sampling unit to the power module, the GC, and the components installed. See the section "Control Interface" on page 15. It includes the inlet port for the connection of the syringe flushing gas.

- **Internal section** — Contains the main low voltage electronics boards. It also manages the movement along the crossrail X.

Two different lengths of the X-axis are available: **850 mm** (Standard) and **1200 mm** (Extended).

Crossrail Y

It represents the Y-axis of the system. It is connected to the crossrail X through the motorized truck. Crossrail Y motors carry out the movements of the Head (Z-axis).

It consists of the following sections.

- **Front section** — Includes the guides and the electric connections for the Head installation.

- **Lower section** — The part that slides along the crossrail X.

Head

It represents the Z-axis of the system. It consists of a vertical structure fixed on the crossrail Y which guides the movements along the X and Y axes. See Figure 4.

Figure 4.   Head
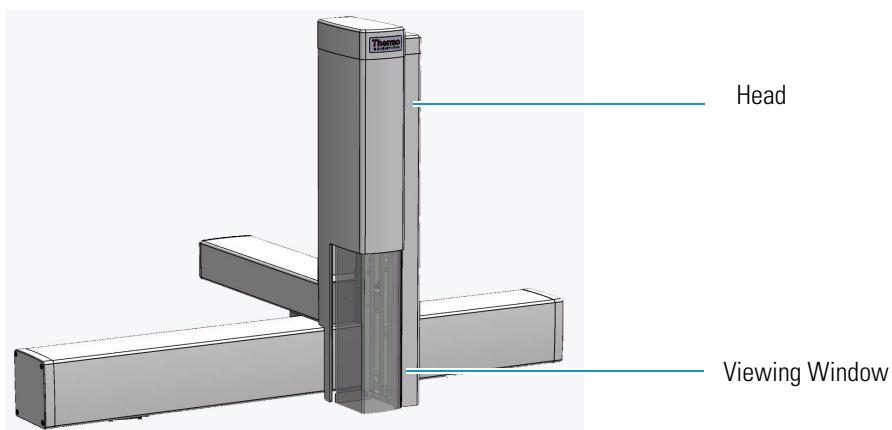
A viewing window is provided on the front side for allowing access to the injection device. See Figure 5.

Figure 5.   Injection Device
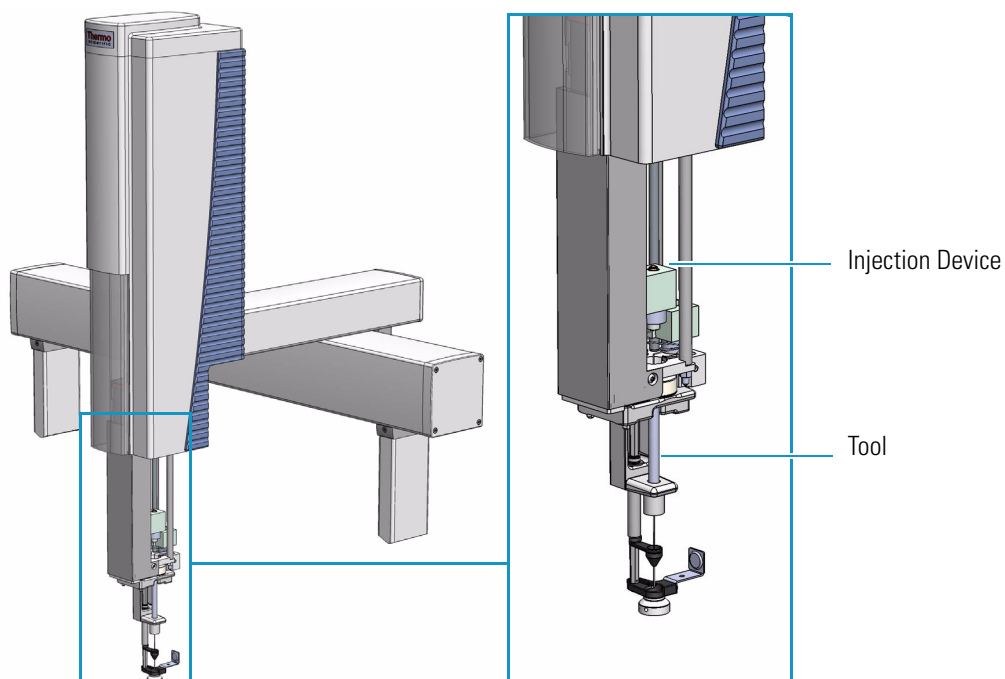
The injection device includes an active needle guide and a coupling plate to couple/uncouple the RSH Tools.

Control Interface

The back part of the crossrail X includes the following components as shown in Figure 6.

Figure 6. Control Interface
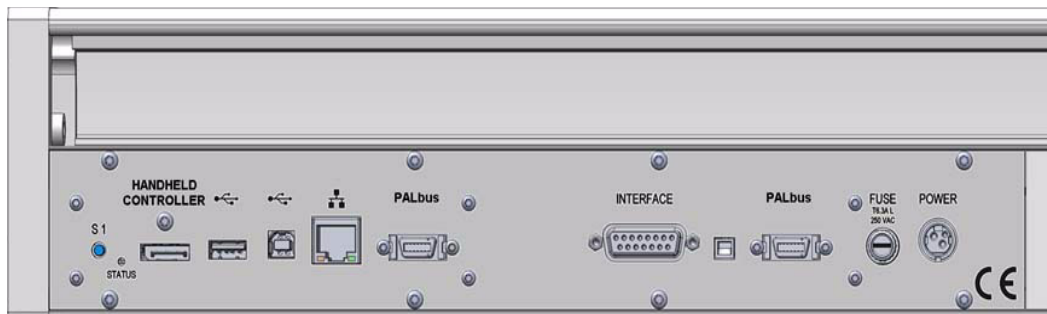
- **Status** — This LED (*Light Emission Diode*) provides indications on the instrument operating conditions showing a solid or blinking light.
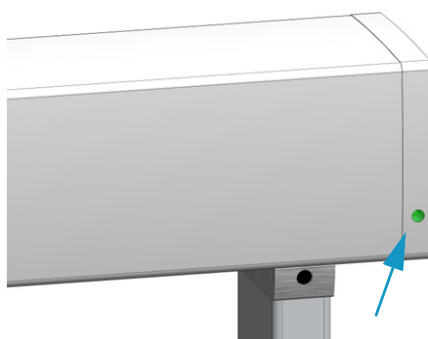
The LED light on the right side cover of the X-axis shows the identical status as the Status Light displayed on the Handheld Controller. See Table 3.

See also the section "Menu Screen Status Bar Symbols" on page 65, and to the section **System Status LED at Status Bar or at X-Axis Side Cover** in the chapter **Troubleshooting** of the *TriPlus RSH Hardware Manual*.

Table 3. Status LED Lights (Sheet 1 of 2)

Symbols	Description
🟢	**Green status light, blinking:** TriPlus RSH is working (moving). Execution mode. The Handheld Controller is partially blocked to specific actions.
	Green status light, steady on: TriPlus RSH is ready in Standby. Idle Mode.
🟡	**Yellow status light, blinking:** RSH Firmware is booting.
	Yellow status light, steady on: A problem has been detected which cannot be resolved by the robotic system.
	Examples: Bent needle (mechanical problem), missing Tool, and so on. detected at the moment of sample execution. A software run-time error can also cause a status light change to **steady-on yellow**.

Table 3. Status LED Lights (Sheet 2 of 2)

Symbols	Description
	Blue status light, blinking: The TriPlus RSH is in the process of software **Update** or **Backup**. (For the processes **Copy Backup** and **Restore** the Status light remains **green**). **Blue status light, permanent:** TriPlus RSH is in a safe state (power reduced to a minimum) and requires manually moving the Head to the **Teach Point**. **Note:** If an error is detected at the same time that an action is required according to the **Blue Status Light,** then by default the yellow status light will dominate.

- **S1** — Reset button to restore the factory default settings without knowing the IP Address.

- **HANDHELD CONTROLLER** — A 20-pin port connector for the connection between the TriPlus RSH and the Handheld Controller.

- **USB Host** — USB Type A connector for the connection of the USB Stick only for service purposes.

- **USB Device/Client** — USB Type connector for the connection to an USB device or USB client.

- **Ethernet** — RJ45 Ethernet cable connects the TriPlus RSH directly to a computer, and a LAN (Local Area Network) for the network connection of the TriPlus LAN sampler.

- **BUS** — Two Mini Delta Ribbon 14-pin connectors for the connection to the CPU board and the components installed on the sampler.

- **INTERFACE** — DSB 15-pin female connector for the connection between the sampler and the GC.

- **FUSE** — Housing for the fuse T6.3; 250 VDC. See Table 4.

Table 4. Fuses Parameters

Parameter	Value
Rated Current	6.3 A
Rated Voltage	250VAC
Fuse Dimensions	5 x 20 mm

- **POWER** — KYon KPJX-3S-S connector receives 36 V from the Power Module.

TriPlus RSH Tools

The TriPlus RSH requires more information and intelligence on the level of Tools than just the syringe identification numbers as used with common samplers. The capability to use a Tool for one task, store the Tool away and select a second Tool for the next task in the cycle sequence necessitates knowledge of the geometry of the syringe and holder. The location of the syringe holder is tracked at any point in time with a unique number.

Specific Tools are:

- **LS Tool** — Used for liquid injection with a metallic plunger typically used for GC technique or with a polymer plunger used for syringes with a larger volume than 10 µL or for gaseous samples. The syringe is in the Tool holder, and the entire assembly is called LS Tool. See the section "LS Tool" on page 18.

- **HS Tool** — Used for headspace injection. The entire assembly consists of a gas-tight syringe with a side hole for purging, the syringe heater and the syringe holder. See the section "HS Tool" on page 22.

- **SPME Fiber Tool** — Automates the SPME Fiber holder. See the section "SPME Fiber Tool" on page 24.

- **SPME Arrow Tool** — Automates the SPME Arrow Fiber holder. See the section "SPME Arrow Tool" on page 26.

- **ITEX DHS Tool** — Used for In-tube/Dynamic Headspace extraction technique. See the section "ITEX DHS Tool" on page 28.

- **Dilutor Tool** — Used exclusively with the Dilutor Module. See the section "Dilutor Tool" on page 31

Figure 7 shows the available Tools, which are clearly labeled.

Figure 7. Example Tools Identification
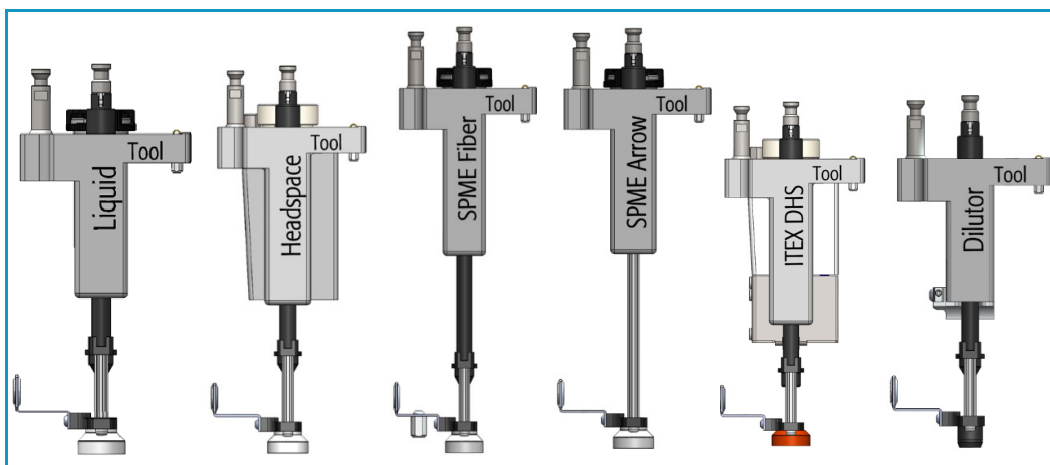
LS Tool

The LS Tool is used for liquid sample injection.

The LS Tool includes:

- A LED to shows if the Tool is correctly placed on the Tool Station and to illuminate the syringe to easier show the scale or air bubbles
- A cover on the back helps with reading the syringe scale
- A bayonet coupling makes syringe changes faster - Improved guidance of the lower needle guide

The LS Tool is a single block, easy to use to install a syringe. See Figure 8.

Figure 8. LS Tool
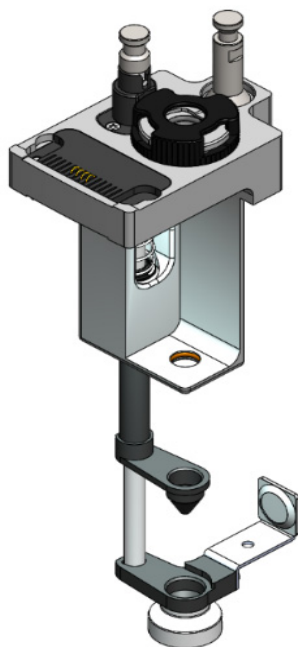
The syringe flange is supported by an O-ring (support bearing). See the example of Figure 9.

Figure 9. Support Bearing

Supporting Bearing
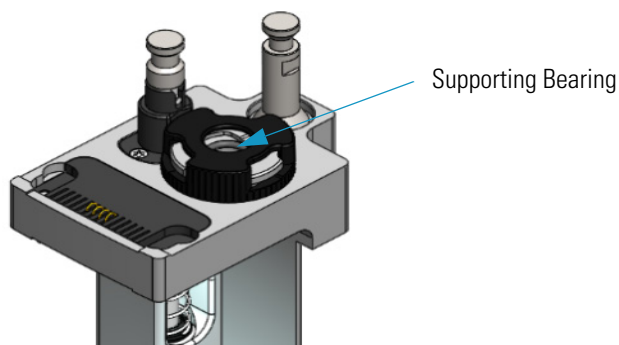
At the lower part of the block a second O-ring is installed which guides the syringe glass barrel and prevents direct metal contact. See the example of Figure 10.

Figure 10. O-Ring
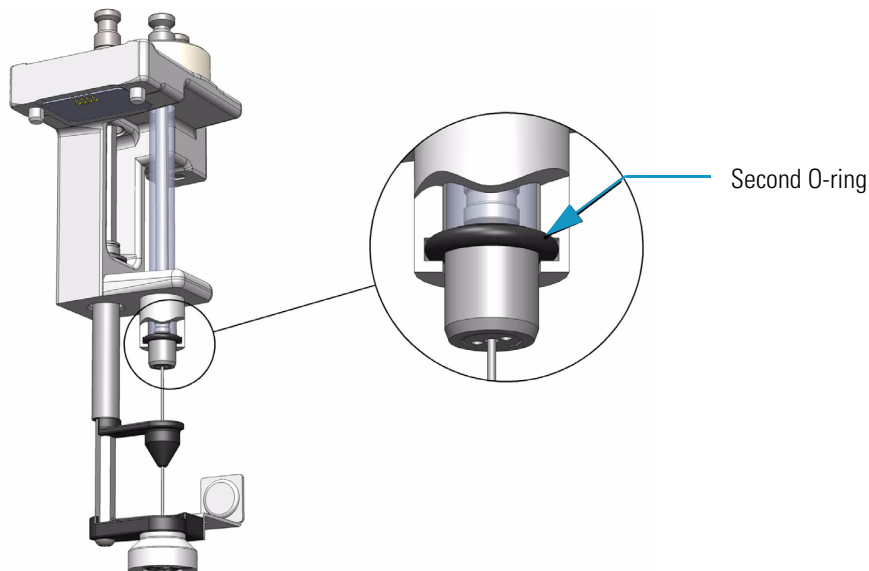
Second O-ring

The Magnet Adapter Ring is used to transport 10-20 mL vials for example from a Tray to the Agitator/Incubator.

The lower needle guide has the Drawer Magnet installed, fixed with two screws. The magnet is required to open and close the Temperature Controlled Drawer. See the example of Figure 11.

Figure 11. LS Tool - Magnets

Drawer Magnet
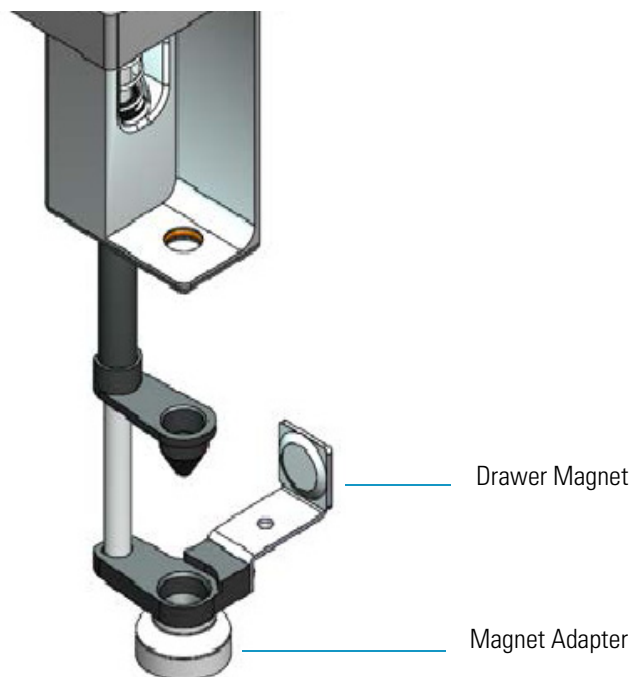
Magnet Adapter

⚠️ **ATTENTION** If 2 mL vials with a magnetic cap are used, the Magnet Adapter ring must be removed. The 2 mL vials will be transported by the four magnets on the bottom of the Tool.

Three LS Tools are available. The LS Tools must be selected according to the required syringe as detailed in Table 5.

Table 5. List of Syringes for LS Tools

LS Tool	Syringes Type	Syringe Volume
D7/57	7 mm diameter syringe barrel with 57 mm needle length.	0.5 µL, 1.0 µL, 5.0 µL, 10 µL, 25 µL, 50 µL, 100 µL
D7/85	7 mm diameter syringe barrel with 85 mm needle length	0.5 µL, 1.0 µL, 5.0 µL, 10 µL, 25 µL, 50 µL, 100 µL volumes
D8/57	8 mm diameter syringe barrel with 57 mm needle length	250 µL, 500 µL, 1000 µL volumes
D8/85	8 mm diameter syringe barrel with 85 mm needle length	250 µL, 500 µL volumes
D18/57	18 mm diameter syringe barrel with 57 mm needle length	10000 µL volume

The syringe plunger can be metallic or polymeric.

- Syringes with a metallic plunger are used typically for the gas chromatographic technique where ideally organic solvents, such as alkanes, ketones, esters or alcohols, are used.

- Syringes with a polymeric plunger are used for gaseous sampling.

Note The metallic plunger type is not recommended for sample solutions which contain matrix particles, or a solvent which does not form a solvent film in between the syringe plunger and the glass barrel surface.

The metal can bite into the glass which will destroy the plunger. Examples of critical solvents to watch out for are mixtures of water and an organic solvent as water and ethanol, or DMSO (dimethyl sulfoxide). For such applications, we recommend using a syringe with a polymer plunger.

Liquid Syringe (LS) Tools are full compatibility with Thermo Injector technology. See Table 6.

Table 6. LS Tool - Injector Compatibility

Injector
TRACE GC Ultra SSL Injector and TRACE 1300 Series GC TSI Injector
• Splitless injection — 85 mm needle length LS Tool
• Split injection — 57 mm needle length LS Tool
• Large Volume splitless — 57 mm needle length LS Tool
TRACE 1300 Series GC SSL Injector
• SSL injector — 57 mm needle length LS Tool
OC injector
• Conventional injection — 85 mm needle length LS Tool
• Large volume injection — 85 mm needle length LS Tool
PTV injector
• Conventional injection — 57 mm needle length LS Tool
• Large volume injection — 57 mm needle length LS Tool
• Large volume with programmable depth — 85 mm needle length LS Tool
PKD injector
PKD injector — 57 mm needle length LS Tool

ATTENTION Syringe needles length of 85 mm and bevel tip needle are not suggested for automated **Bottom Sensing**, because of the high risk of needle bending.

Bottom sensing makes sure that small volumes can be injected out of few µL of sample (for example 1 µL out of 5 µL)

Bottom sensing   Needle retraction
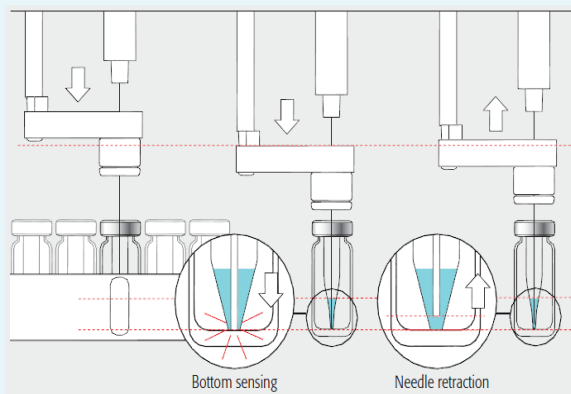
HS Tool

The Headspace Tool (HS Tool) is used for headspace injections. The HS Tool is provided as a single block, easy to use to install a syringe and the purge gas line. See Figure 12.

Figure 12. HS Tool
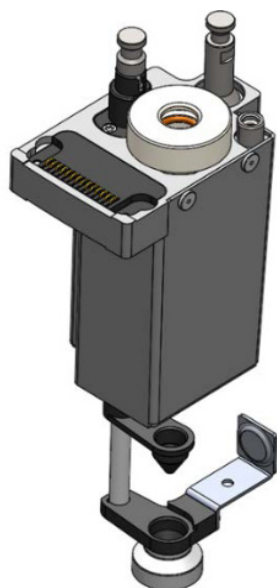
The syringe temperature is controlled from 40 °C up to 150 °C, in 1 °C steps. The syringe is flushed with inert gas flow through X-Y-Z-axis. Besides the coupling pivots for the needle guide and the Tool, the purge gas connector is directly installed on the cover plate of the Tool. The syringe flange is supported by the polymer counterpart to the retaining nut. In the heating cylinder there are two O-rings which seal the gas flow to enable a syringe purge. It is recommended to replace these O-rings during preventative maintenance.
Figure 13 shows the cut-out of the HS Tool visualizing the Purge Gas Flow and the Sealing O-ring.

Figure 13. HS Tool Cut-out
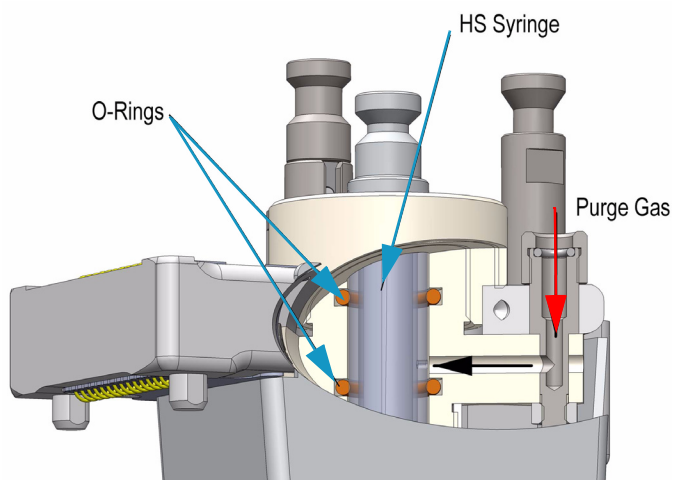
The Magnet Adapter Ring is used to transport 10-20 mL vials, for example from a Tray to the Agitator/Incubator. The lower needle guide has the Drawer Magnet installed, and fixed with two screws. The magnet is required to open and close a Temperature Controlled Drawer. See Figure 14.

Figure 14. HS Tool - Magnets
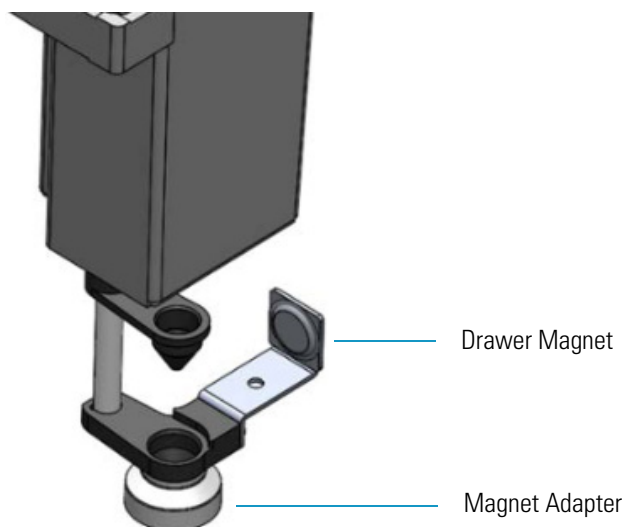
Three different HS Tools are available according to the headspace syringe volume See Table 7.

Table 7. List of Syringes for HS Tool

HS Tool	Syringe
Headspace Syringe Tool for 1.0 mL Syringe	1.0 gas tight headspace syringe 23 gauge, 65 mm length needle
Headspace Syringe Tool for 2.5 mL Syringe	2.5 gas tight headspace syringe 23 gauge, 65 mm length needle
Headspace Syringe Tool for 5.0 mL Syringe	5.0 gas tight headspace syringe 23 gauge, 65 mm length needle

SPME Fiber Tool

The **SPME Fiber Tool** for Solid Phase Micro Extraction are a dedicated devices adapted for the SPME Fiber Holder. Currently, there are two different fiber lengths commercially available: **10 mm** and **20 mm.** Both types can be adapted with the SPME Tool. The TriPlus RSH System software allows setting the fiber extension length to the necessary distance.

> **Note** The use of the **Agitator/Incubator is strongly suggested.**
>
> **CAUTION** The SPME Fiber Conditioning Module **cannot be** used with the SPME Arrow Tool.

Figure 15 shows the SPME Fiber Tool with the holder mounted and a SPME Fiber holder with the fiber installed in the positions **Standby** and **Exposed**.

Figure 15. SPME Fiber Tool

Standby Position

Exposed Position

Fiber Exposed
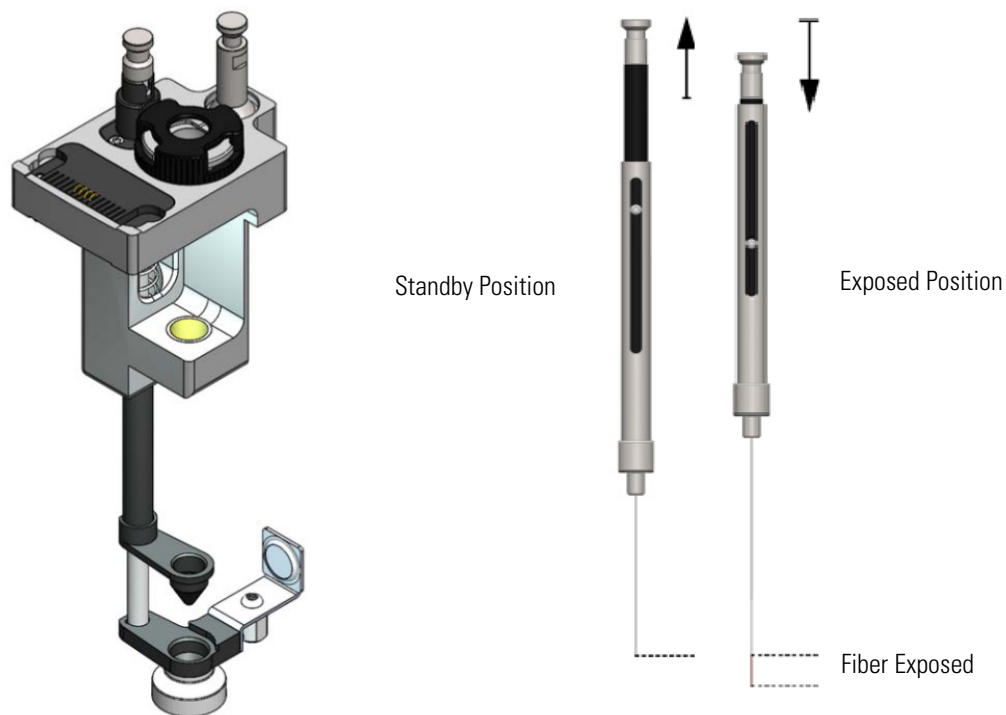
The SPME Fiber Tool includes:

- A LED to shows if the Tool is correctly placed on the Tool Station

- A bayonet coupling makes syringe changes faster - Improved guidance of the lower needle guide

The holder is fixed in position by the SPME Fiber Tool adapter and the retaining nut. No O-rings are necessary to fix or protect the SPME Fiber holder. A dedicated magnet is required for the SPME Fiber Tool. See Figure 16.

Figure 16. SPME Fiber Tool - Magnet
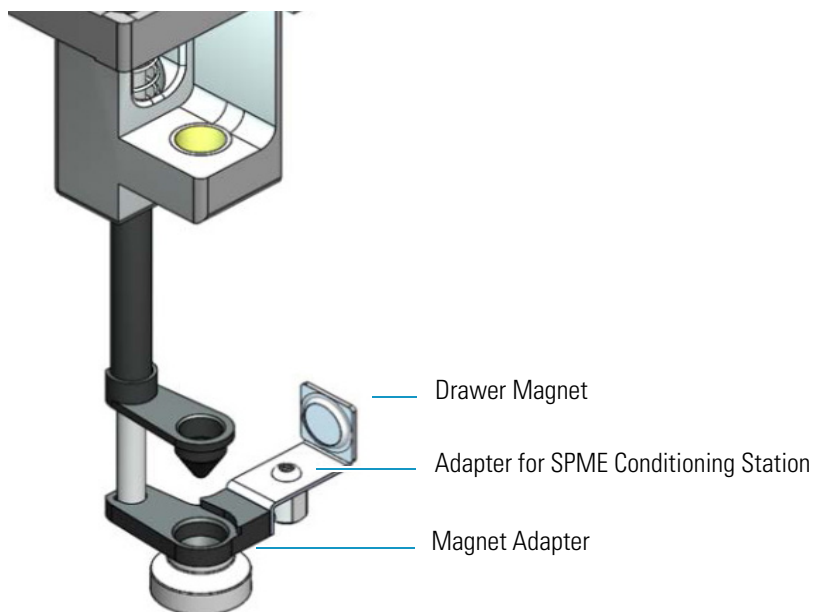
Drawer Magnet

Adapter for SPME Conditioning Station

Magnet Adapter

The Magnet Adapter Ring is used to transport 1020 mL vials for example from a Tray to the Agitator/Incubator.

An adapter is present to automatically activate the gas flow on the SPME Conditioning Station.

The lower needle guide has the Drawer Magnet installed and fixed with two screws. The magnet is required to open and close a Temperature Controlled Drawer.

SPME Arrow Tool

The SPME Arrow Tool is a dedicated Tool adapted for the SPME Arrow Fiber Holder.

> **IMPORTANT** The use of the **Agitator/Incubator** and the **Heatex Stirrer** with the SPME Arrow is essential. The use of the SPME Arrow Conditioning Station is strongly suggested.
>
> **Note** The SPME Arrow Conditioning Station can also be used with the SPME Fiber Tool

Figure 17 shows the SPME Arrow Tool with the holder mounted and a SPME Arrow holder with the fiber installed in the positions **Standby** and **Exposed**.

Figure 17.   SPME Arrow Tool

SPME Arrow Tool and Holder

Exposed Position

Standby Position
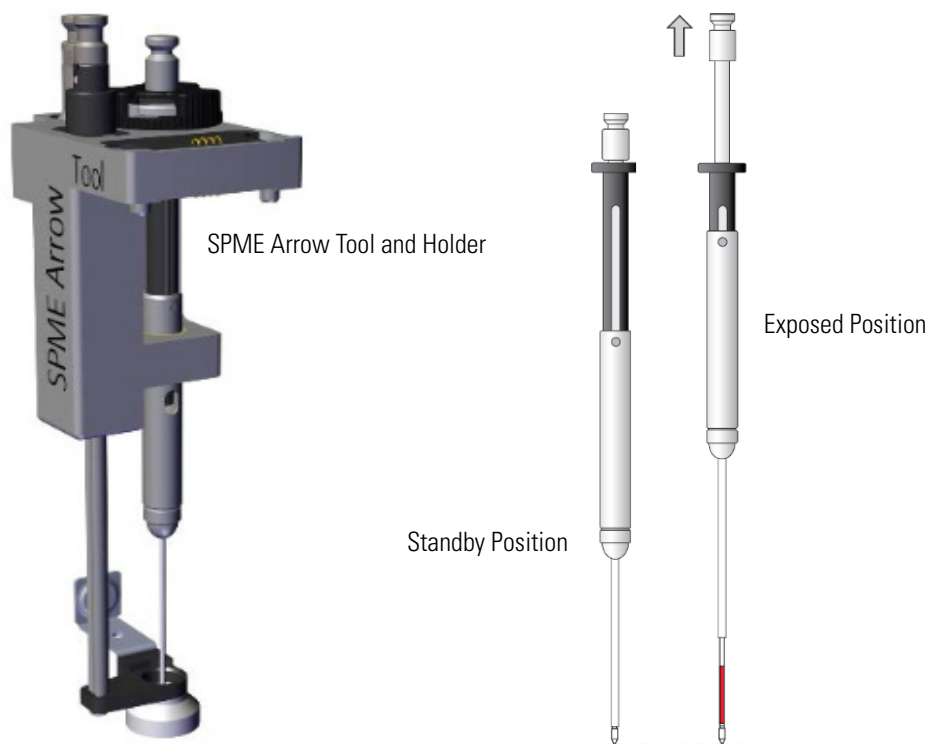
The SPME Arrow Tool includes:

- A LED to shows if the Tool is correctly placed on the Tool Station

- A bayonet coupling makes syringe changes faster - Improved guidance of the lower needle guide

The holder is fixed in position by the retaining nut. No O-rings are necessary to fix or protect the SPME Arrow holder.

A Check-Window on the SPME Arrow fiber holder allows a fast and easy identification of the type of the SPME Arrow fiber installed. See Figure 18.

Figure 18. SPME Arrow Holder

Fiber types are color coded, while fiber thickness is distinguished by the number of the notches on the threaded joint.

The Magnet Adapter Ring is used to transport vials for example from a Tray to the Heatex Stirrer. The lower needle guide has the Drawer Magnet installed, fixed with two screws. The magnet is required to open and close a Temperature Controlled Drawer. See Figure 19.

Figure 19. Magnet Adapter Ring
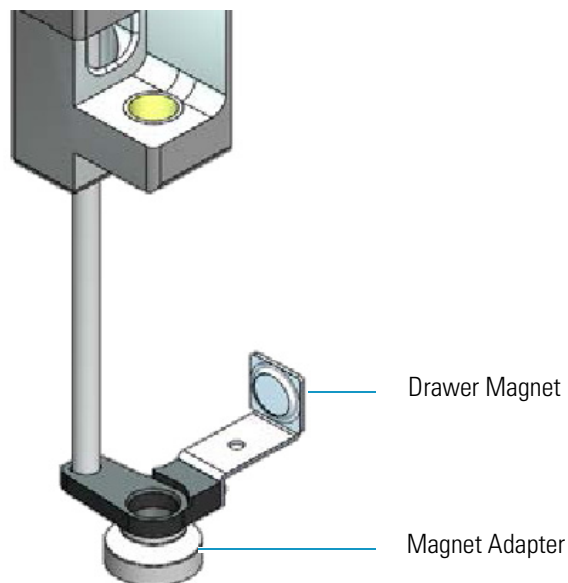
ITEX DHS Tool

The ITEX DHS Tool consists of a dedicated gas-tight syringe with an adapter for a replaceable side-hole needle, a heated syringe cartridge, a trap desorber heater and a trap cooling fan. See Figure 20.

Figure 20. ITEX Tool

Plunger for ITEX Syringe

ITEX Syringe Barrel

ITEX Trap
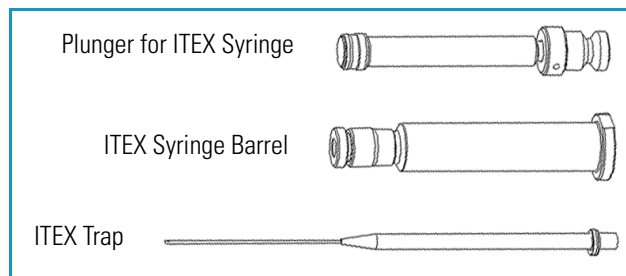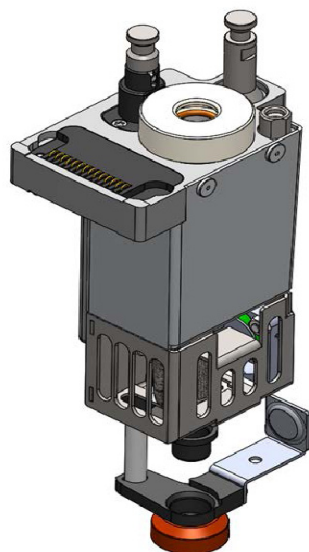
WARNING - BURN HAZARD The ITEX DHS Tool can operate at a maximum temperature of 200 °C.

Operating at this temperature, its outer surface will reach about 70 °C. Do not touch the outside of the ITEX DHS Tool. Always let the ITEX DHS Tool cool down before you touch it, or before you remove the Syringe.

Besides the coupling pivots for the needle guide and the Tool, the purge gas connector is directly installed on the cover plate of the Tool.

The syringe flange is supported by the polymer counterpart to the retaining nut.

In the heating cylinder there are two O-rings which seal the gas flow to enable a syringe purge. It is recommended to replace these O-rings during preventative maintenance.

Figure 21 shows the cut-out of the ITEX DHS Tool visualizing the Purge Gas Flow and the Sealing O-ring.

Figure 21. ITEX DSH Tool Cut-out (1)
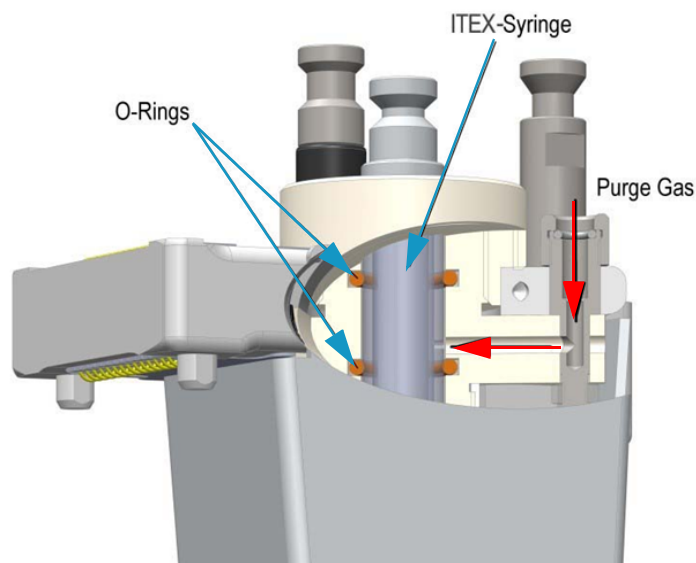
The heating and cooling functionality for the Trap is integrated in the lower part of the Tool. See Figure 22.

Figure 22. ITEX DHS Tool Cut-out (2)
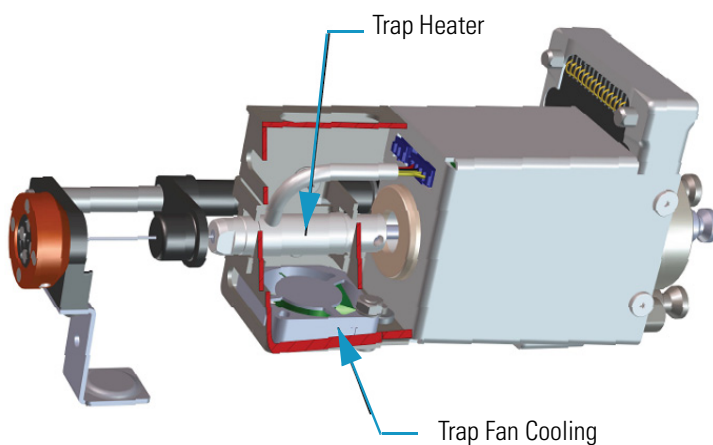
The purge gas adapter mounted on the ITEX DHS Tool couples with the adapter from the Head. The coupling is sealed with an O-ring installed in the ITEX DHS Tool Purge Gas Adapter. See Figure 23.

Figure 23. ITEX Tool Purge Gas Adapter
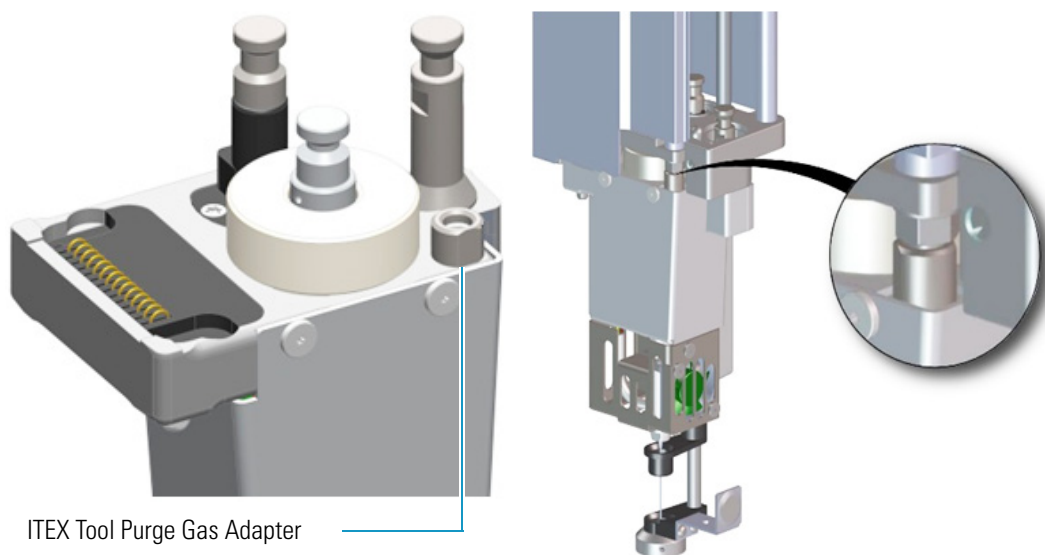
ITEX Tool Purge Gas Adapter

The Magnet Adapter Ring is used to transport vials, for example from a Tray to the Agitator/Incubator. The lower needle guide has the Drawer Magnet installed, and fixed with two screws. The magnet is required to open and close a Temperature Controlled Drawer. See Figure 24.

Figure 24. ITEX Tool - Magnets

Drawer Magnet

Magnet Adapter
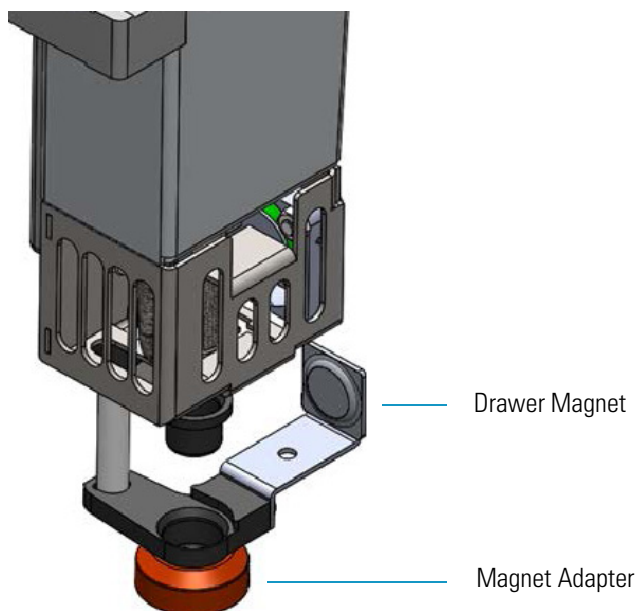
Dilutor Tool

The Dilutor Tool is part of the Dilutor Module. See Figure 25.

Figure 25. Dilutor Tool
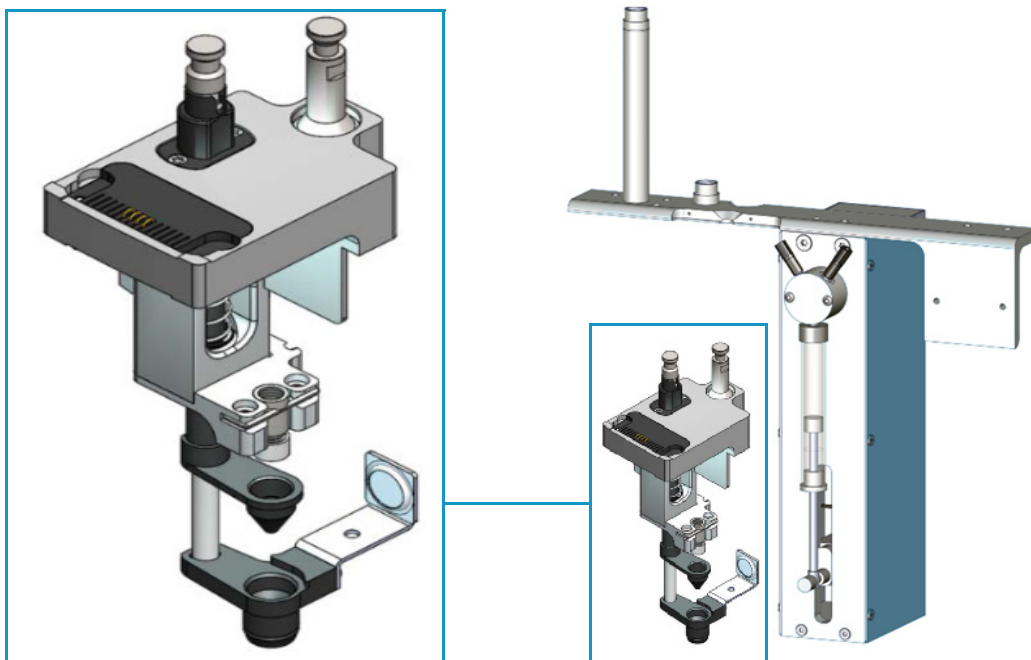
The Dilutor Tool allow an efficient and precise addition of solvent and reagents. Carryover is minimized since the sample does not get in contact with the syringe and the sample tubing can be washed in backflush mode.

The Dilutor Module is described in the section "Dilutor Module" on page 62.

TriPlus RSH Tool Stations

This section provides a description of the following Tool Stations:

- "TR Station" on page 32
- "ATC Station" on page 33

TR Station

This passive module contains a single slot for an injection Tool. See Figure 26 and Figure 27.

Figure 26. TR Station
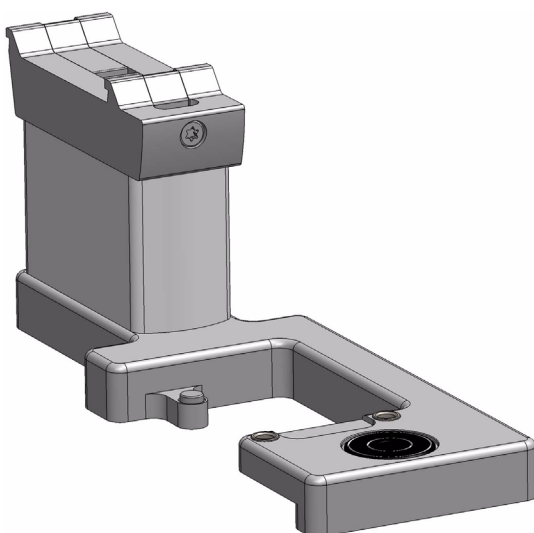
Figure 27. TR Station with a Tool
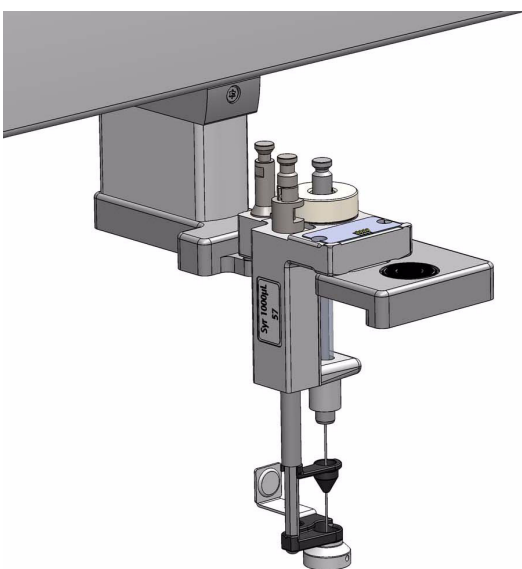
ATC Station

This active module containing three slots for Tools allows you to change an injection Tool automatically for specific needs. See Figure 28 and Figure 29.

Figure 28. ATC Station
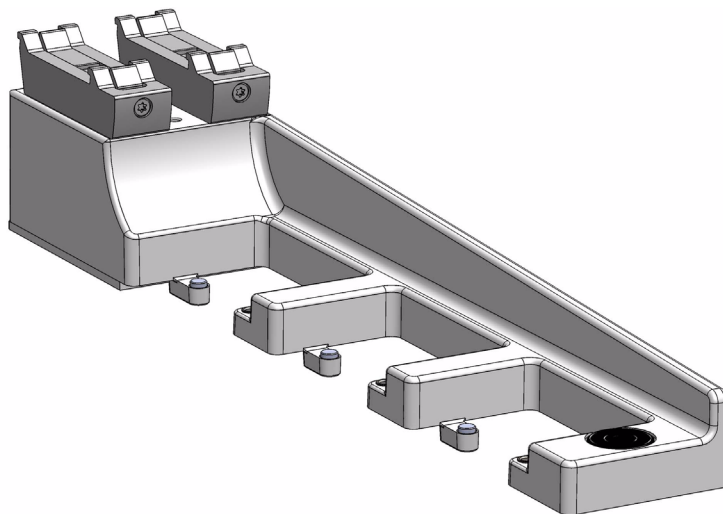
Figure 29. ATC Station with Tools
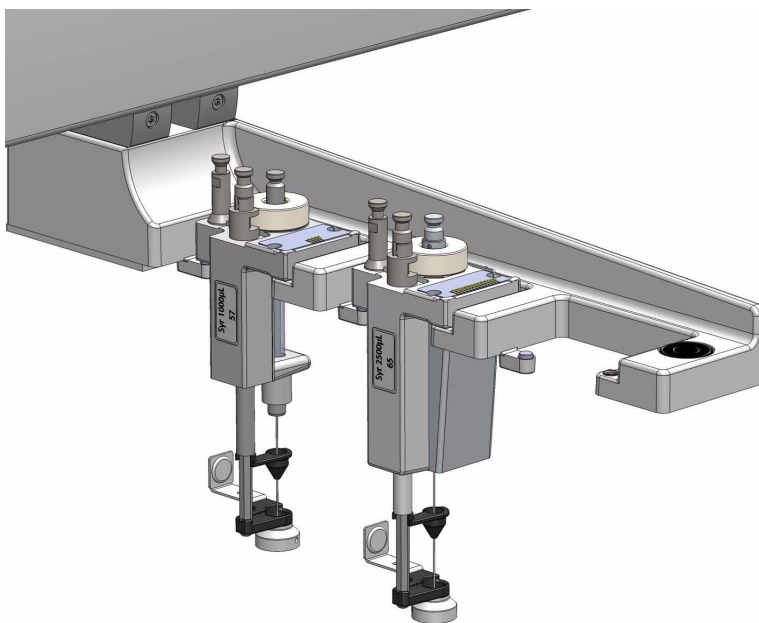
TriPlus RSH Tray Holders

This section provides a description of the following Tray Holders:

- "Standard Tray Holder" on page 34

- "Liquid Cooled Tray Holder" on page 35

- "Temperature Controlled Drawer" on page 36

Standard Tray Holder

The Standard Tray Holder can accommodate up to three VT15, VT54 or VT70 sample trays, one in each slot positions, or a sample tray R60 which spreads over the three slot positions. See Figure 30.

Figure 30. Standard Tray Holder
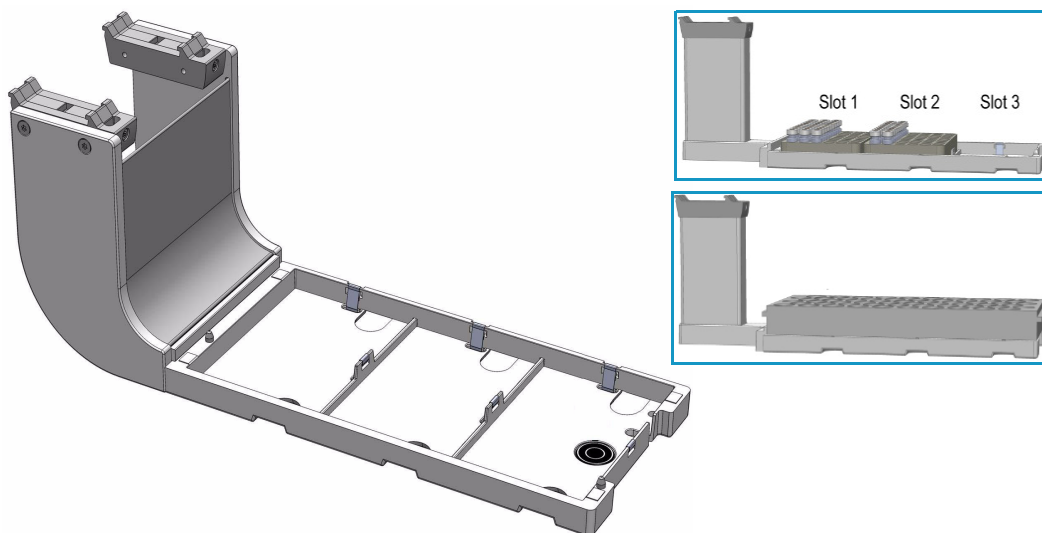
Up to four Standard Tray Holders can be simultaneously installed on the standard X-axis (850 mm length), and up to six on the extended X-axis (1200 mm length).

The Standard Tray Holder specifications are:

- **Sample Capacity** — 162 x 2 mL vial or 60 x 10-20 mL vial or 210 x 0.5-0.7 mL vial

- **Vial Size** — 0.3, 0.5, 0.7, 2.0, 2.5, 10, and 20 mL and micro volume non-standard vials

- **Electrical Connectors** — None

The Standard Tray Holder is also compatible to accommodate 96-position Deep Well Plates (DW 96), 96-position Microtiter Plates (MT 96), and 384-position Microtiter Plates (MT 384)

The Standard Tray Holder dimensions and mass are detailed in Table 8.

Table 8. Standard Tray Holder - Dimensions and Mass

Length	Dimension in mm (in.)
Width	134 (5.28)
Depth	375 (14.76)
Height	103 (4.06)
Compartment Width/Depth/Height	110/220/46 (4.33/8.66/1.81)
Mass	**Dimension in kg (lbs)**
Standard Tray Holder	2.50 (5.51)

Liquid Cooled Tray Holder

The Liquid Cooled Tray Holder is a passive module for an external re-circulating bath. See Figure 31.

Figure 31. Liquid Cooled Tray Holder
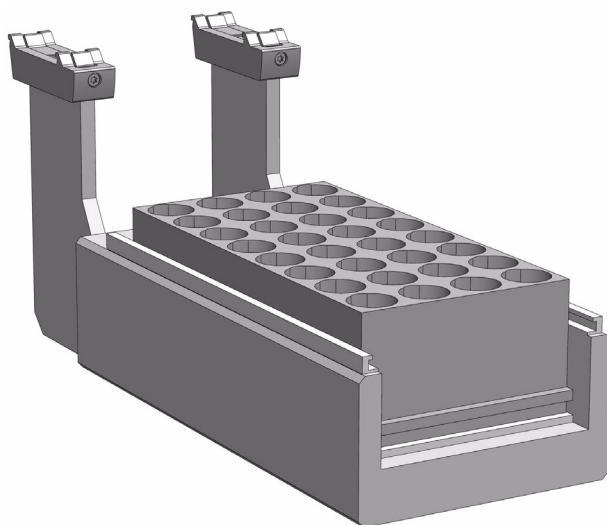
In the bottom section of the Tray Holder, there is an open tube. The **¼-in.** hose connections for this tube can be seen at the back of the unit. Liquid from an external bath is circulated into the Tray Cooler through this tube; the liquid can be either heated or cooled.

CAUTION The Liquid Cooled Tray Holder operates within a temperature range from +4 °C to 70 °C.

The Liquid Cooled Tray Holder specifications are:

- **Sample Capacity** — Holds one tray for 32 vials capacity of 10 mL and 20 mL vials.

- **Temperature Control** — Through an external liquid circulation bath, not provided.

- **Connection Tube Dimensions** — Stainless steel tube, OD 8 mm (0.3-in.), and ID 6 mm (0.24-in.) open tube for hose connection.

- **Electrical Connectors** — None

The Liquid Cooled Tray Holder dimensions, mass, operating and environmental requirements are detailed in Table 9 and Table 10.

Table 9. Liquid Cooled Tray Holder - Dimensions and Mass

Length	Dimension in mm (in.)
Width	134 (5.28)
Depth	375 (14.76)
Height	103 (4.06)
Compartment Width / Depth / Height	110 / 220 / 46 (4.33 / 8.66 / 1.81)
Mass	**Dimension in kg (lbs)**
Liquid Cooled Tray Holder	2.50 (5.51)

Table 10. Liquid Cooled Tray Holder - Operating Environmental Requirements

Parameter	Requirements
Maximum relative humidity	80%, non-condensing
Vibration	Negligible
Static electricity	Negligible

Temperature Controlled Drawer

The Temperature Controlled Drawer is a temperature controlled sample tray that keeps the analytical sample below or above the ambient temperature. See Figure 32.

It is an active module with a single drawer containing two slots for positioning Vial Trays or Well Plates. The module is equipped with a Peltier element which allows it to be heated to 40 °C or cooled to +4 °C. A separated power supply is also included.

⚠️ **WARNING** It is mandatory to use a second Power Module. Do not use the same power supply as used for the TriPlus RSH. See the chapter **Installation of the TriPlus RSH System** in the *TriPlus RSH Hardware Manual* for details.

Figure 32. Temperature Controlled Drawer

Power Module
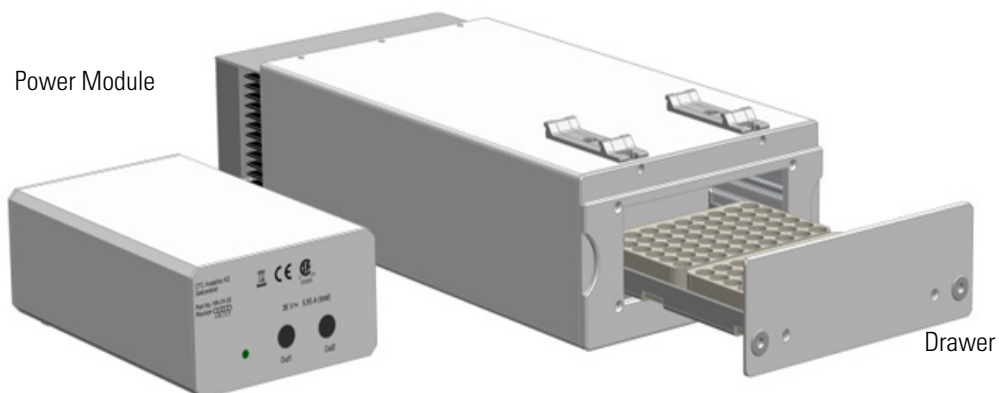
Drawer

The position of the drawer is recognized by a sensor, and translated from the software in the following descriptions. See Figure 33.

Figure 33. Two Positions of Temperature Controlled Drawer

Drawer Closed

Drawer Opened
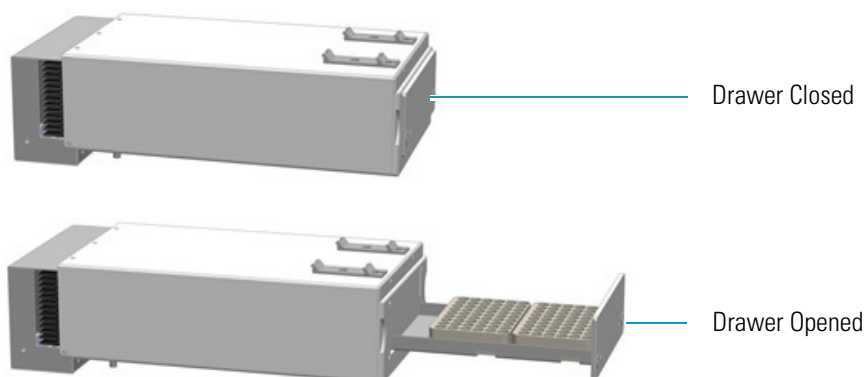
Note An **Opening** drawer status indicates an undefined status, or could also signal a defective PCB or sensor. Check whether the status changes after manually opening and closing the drawer.

CAUTION This module can adapt to sample tray made for different vial sizes. When the different racks are used, consider the different vial heights and ensure that the Drawer Magnet, attached to the lower needle guide, does not catch at the front row of vials from behind the tray.

The Temperature Controlled Drawer specifications are:

- **Sample Capacity** — Accommodate two different sample trays.

  Compatible VT70, VT54, and VT 15 (10 mL vials only).

- **Total vial height** — 47 mm (including cap)

- **Temperature Control** — From 4 °C – 40 °C in 0.1 °C increments.

- T**emperature Cooling** — The specification for the Temperature Controlled Drawer temperature cooling is defined as:

  Cooling time = 60 minutes to obtain a 14.0 °C ΔT

  where ΔT = Room temperature – Drawer temperature

- **Electrical Connectors** — Two BUS connectors for daisy chaining and a connector for external power supply.

The Temperature Controlled Drawer dimensions, mass, operating and environmental requirements are detailed in Table 11 and Table 12.

Table 11. Temperature Controlled Drawer - Dimensions and Mass

Length	Dimension in mm (in.)
Temperature Controlled Drawer	
Width	197 (7.78)
Depth	425 (16.73) including cable connector
Height	103 (4.06)
Power Supply	
Width	135 (5.31)
Depth	215 (8.46)
Height	75 (2.95)
Mass	**Dimension in kg (lbs)**
Temperature Controlled Drawer	3.57 (7.87)
Power Supply	1.30 (2.87)
Associated cables (3 pieces)	0.50 (1.10)

Table 12. Temperature Controlled Drawer - Operating Environmental Requirements

Parameter	Requirements
Operating temperature range	4 to 40 °C
Maximum relative humidity	80%, non-condensing
Bench space	At least 50 mm (2-in.) at the back space for air circulation. Access to power switch(es) and power cords.
Vibration	Negligible
Static electricity	Negligible
Altitude limitations	3000 meters above sea level

Temperature Control

The cooling/heating capacity of a temperature control device based on the Peltier technique is always relative to room temperature. The maximum temperature difference that can be reached between the device and ambient temperature is limited. The Temperature Controlled Drawer can attain a minimum of 14 °C (ΔT) below ambient temperature or better.

The displayed temperature represents the temperature in the compartment and not necessarily the sample temperature. To verify the temperature independently, insert a temperature probe at the front of the compartment by removing one plastic screw from the front cover. Position the probe in the middle of the drawer where the Tray separator projects upwards.
Tape the probe to the metal plate of the drawer.

To maintain the efficiency of the Peltier element overtime, it is suggested to set a standby temperature close to ambient temperature when the control drawer is not used for prolonged time.

If the drawer is set for working at low temperature, it is suggested to cool the sample tray first in a refrigerator before placing it into the Temperature Controlled Drawer. This shortens the cool-down time and avoids temperature fluctuation.

Temperature Alarm

A fuse to prevent overheating is built in for unattended automated runs. The Peltier element will turn off automatically at +72 °C ± 5 °C.

Temperature Stability

It is recommended observing the following guidelines:

- Switch on the Temperature Controlled Drawer at least 30 minutes before an analytical operation at +10 °C or 75 minutes before an operation at +4 °C.
- For high-throughput analyses – at a typical cycle time of 60 seconds or less per analysis – leave the drawers open between the injections.

Condensation Build-up

Condensation build-up is directly related to the ambient temperature and humidity (dew point). Long-term tests have shown very little condensation build-up in an environment with relative humidity up to 60% and ambient temperatures of 22 ±2 °C.

Condensation at the bottom of the compartments will be channeled to the drain outlet labeled **Condensation Drain**. The outlet is plugged with a paper filter. This helps to evaporate the collected water in the drain line using the excess heat from the Peltier element.

A drain line from the outlet to a reservoir bottle is not necessary under normal conditions.

In case of a laboratory environment with high temperature and humidity, a flow of clean and dry oil-free air or nitrogen could be used to dry the compartment. For the purpose connect the corresponding gas line to the Swagelok® fitting (1/8-in.) at the back of the **Temperature Controlled Drawer** labeled **Purge Gas**. A flow of about 300-400 mL/min is required to keep the compartments moisture-free.

Note If a purge gas is used, make sure that a two-stage safety pressure regulating device is installed between the gas supply and the Temperature Controlled Drawer.

WARNING Do not use any flammable or explosive gas such as hydrogen.

If using an application that produces an acidic vapor phase, use the same gas line connection to flush a stream of inert gas, such as nitrogen or helium, into the compartments. A stream of a few mL/min can help to avoid corrosion of the rolls. Checking the lines regularly for condensation build-up is recommended.

It is good practice to clean the inside of the Temperature Controlled Drawer when changing analytical samples. Dry out the Temperature Controlled Drawer at ambient temperature at regular intervals. Open the drawers from 1 to 5 cm to allow air circulation. The compartment drying frequency depends greatly on the ambient conditions.

TriPlus RSH Washing Stations

This section provides a description of the following Washing Stations:

- "Standard Wash Station" on page 41
- "Large Volume Wash Station" on page 42
- "Large Solvent Station" on page 43
- "Fast Wash Station" on page 43

Standard Wash Station

The Standard Wash Station is shown in Figure 34.

Figure 34. Standard Wash Station
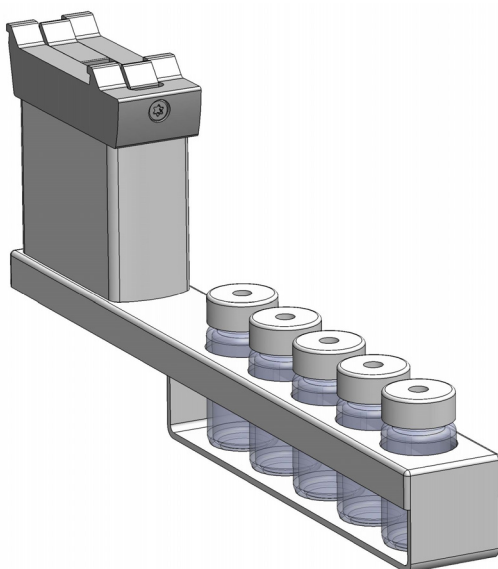
Contains five 10 mL vials;

- 4 x Wash Vials and 1 x Waste Vial.

The configuration within the Standard Wash Station can be flexible; for example

- 2 x Wash Vials and 2 x Wash Vials dedicated for Internal Standard, Reagent, and so on, and a Waste Vial.

When the size of the Waste Vial is too small in size to accept 4 x 20 mL wash solvent, replace the Vial in the waste position with a waste adapter. See Figure 35.

Figure 35. Standard Wash Station with Waste Adapter
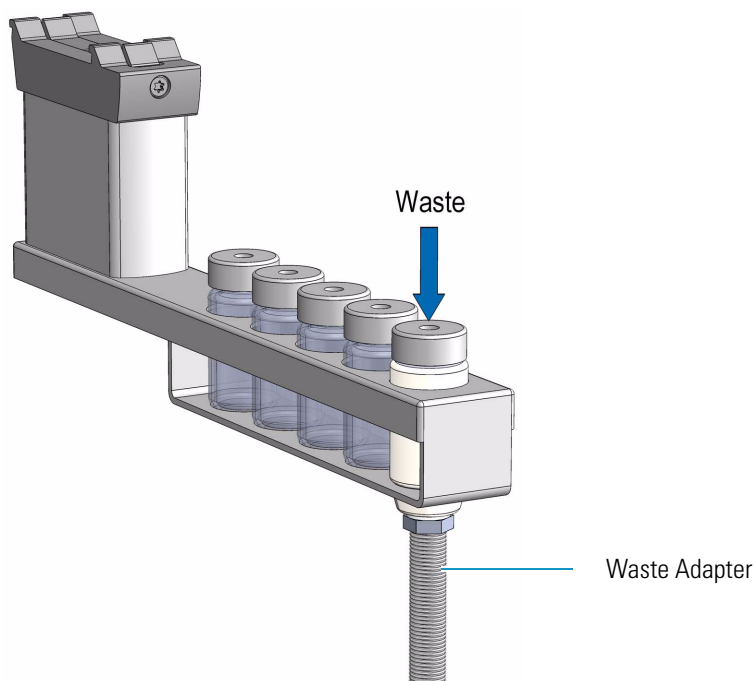
Large Volume Wash Station

The Large Volume Wash Station is shown in Figure 36.

Figure 36. Large Volume Wash Station
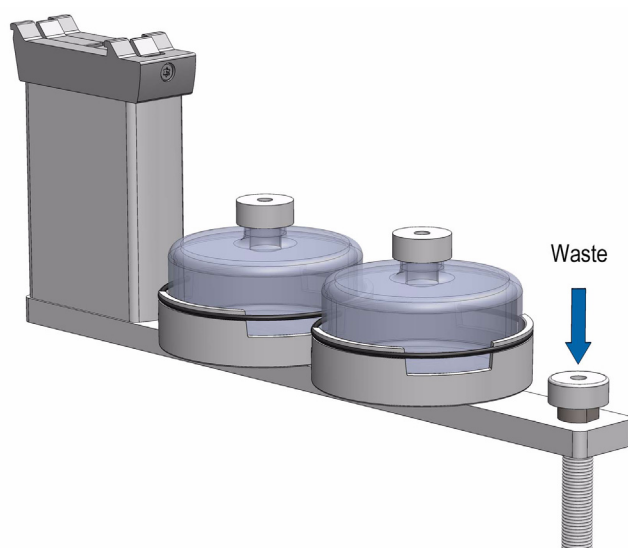
Contains two 100 mL bottles and one vial for waste port for diverting waste to large reservoir.

Large Solvent Station

The Large Solvent Station is shown in Figure 37.

Figure 37. Solvents Station
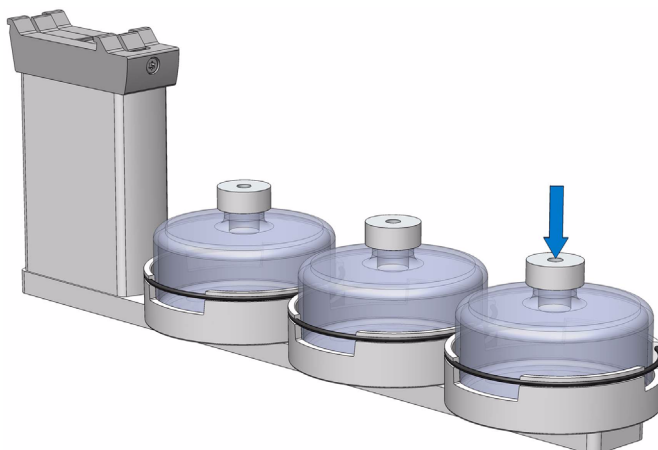
Contains three 100 mL bottles.

Fast Wash Station

The Fast Wash Station is shown in Figure 38.

Figure 38. Fast Wash Station
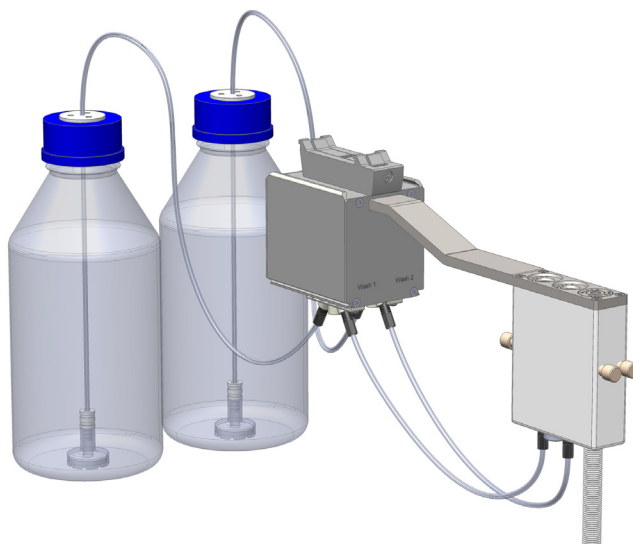
The Fast Wash Station is an active module. Communication and control of the station is provided through the BUS from the system. Two Micro Pumps actively deliver the required flow of two different wash solvents.

The syringe is washed by inserting the needle into a glass liner; the provided wash solution is aspirated and dispensed. The needle is washed outside during this process.

The dispensed solvent passes from the overfilled liner into an internal flow channel to the waste outlet. This wash process can be repeated.

The wash solvent can also be changed by moving the syringe to the second wash port and starting the wash process over again. The advantage of this station is that the head does not need to move to the waste position to eject the wash solvent.

The Fast Wash Station dimensions, mass, operating, and environmental requirements are detailed in Table 13 and Table 14.

Table 13. Fast Wash Station - Dimensions and Mass

Length	Dimension in mm (in.)
Width	60 (2.36)
Depth	315 (16.73) Including cable connectors [380 (15.0)]
Height	135 (5.3) Including cable connectors [185 (7.3)]
Associated Cables (two pieces)	0.15 (0.33)
Mass	**Dimension in kg (lbs)**
Fast Wash Station	0.750 (1.65)
Solvent reservoir kit	1.30 (2.87) Including two 1000 mL bottles

Table 14. Operating Environmental Requirements

Parameter	Requirements
Operating temperature range	4 to 40 °C
Maximum relative humidity	80%, non-condensing
Bench space	Consider bench space for the two 1000 mL bottles, or by your request.
Altitude limitations	3000 m above sea level

Heating/Shaking Modules and Stations

This section provides a description of the following Heating/Shaking Modules and Stations:

- "Agitator/Incubator Module" on page 45
- "Vortexer Module" on page 47
- "Heatex Stirrer Module" on page 49
- "SPME Conditioning Station" on page 51
- "SPME Arrow Conditioning Station" on page 53

Agitator/Incubator Module

The Agitator/Incubator is an active module used for heating and shaking the sample. See Figure 39.

Figure 39. Agitator/Incubator Module
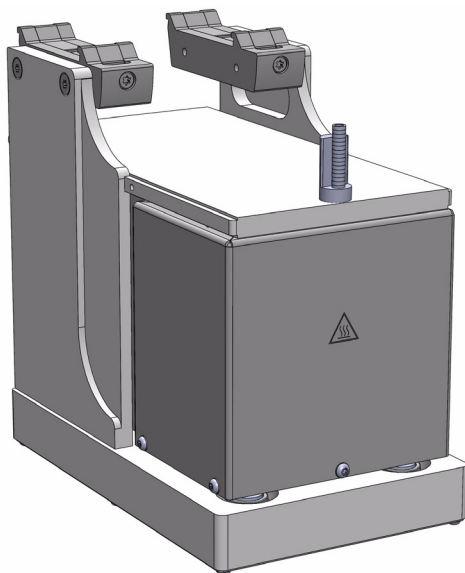
The Agitator/Incubator specifications are:

- **Sample Capacity** — Six heated vial positions for 2 mL, 10 mL, and 20 mL vials. Magnetic caps are required.

    - Adapters for 2 mL vials and 10 mL vials are available.

- **Temperature Control** — From 30 °C to 200 °C in 1 °C increments.

- **Agitation** — Orbital interval shaking, speed selectable from 250 to 750 rpm.

- **Electrical Connectors** — Two BUS connectors for daisy chaining.

The Agitator dimensions, mass, operating and environmental requirements are detailed in Table 15 and Table 16.

Table 15. Agitator /Incubator - Dimensions and Mass

Length	Dimension in mm (inches)
Width	114 (4.45)
Depth	180 (7.09)
Height	176 (6.93)
Mass	Dimension in kg (pounds)
Agitator (with cable and 6x10 mL vial spacers)	2.38 (5.25)

Table 16. Agitator - Operating Environmental Requirements

Parameter	Requirements
Operating temperature range	4 to 40°C
Maximum relative humidity	80%, non-condensing
Vibration	Negligible
Static electricity	Negligible

The main function of the Agitator/Incubator is to speed up the formation of the equilibrium between two phases which can be used for applications such as static headspace, or SPME/APME Arrow (*Solid Phase Micro Extraction*), or ITEX DHS (*In-tube/Dinamic Headspace Extraction*). The Agitator/Incubator can also be used for chemical derivatization reactions, liquid/liquid extractions, and so on. Temperature and shaking parameters can be individually controlled.

WARNING -BURN HAZARD The Agitator/Incubator can operate at a maximum temperature of 200 °C. Operating at this temperature, its outer surface will reach approximately 70 °C. When the Agitator is heated, do not touch the outside surface, do not reach into it; do not try to remove vials manually from it. The vials will be at the selected operating temperature, and there is a danger of burns.

Use only high quality vials compatible with the operating temperature. Consider the high pressure that can build up in the vial and the vapor pressure of the solvent when a temperature greater 60 °C is applied. Do not reuse headspace vials.

CAUTION We suggest the use of vials furnished by Thermo Fisher Scientific.
If vials of other suppliers are used, it is your responsibility to verify their compatibility with the applications.

Vortexer Module

The Vortexer is an active module which used for intensive shaking (orbital interval shaking) at ambient temperature. See Figure 40. Its main application is the automated liquid/liquid extraction of two immiscible solvent phases. An emulsion is temporarily formed which will break after the shaking stops. Only one vial at time can be treated. Shaking speed can be selected. The temperature control of the module is not possible.

Figure 40. Vortexer Module
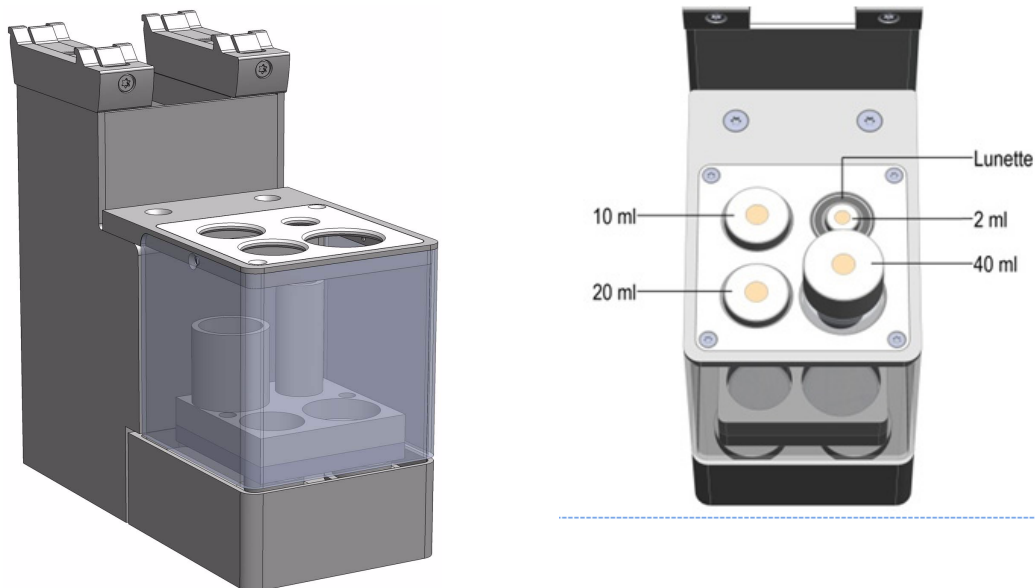
The Vortexer specifications are:

- **Agitation** — Orbital interval shaking, speed selectable from 250 to 2000 rpm.

- **Sample Vial Dimensions** — 2, 10, 20, and 40 mL. Magnetic caps are required.

- **Sample Capacity** — 1 vial treated at once

- **Electrical Connectors** — Two BUS connectors for daisy chaining

The Vortexer dimensions, mass, operating, and environmental requirements are detailed in Table 17 and Table 18.

Table 17. Vortexer - Dimensions and Mass

Length	Dimension in mm (in.)
Width	82 (3.23)
Depth	180 (7.09)
Height	177 (7.0)
Mass	**Dimension in kg (lbs)**
Vortexer (with cable)	2.10 (4.63)

Table 18. Operating Environmental Requirements

Parameter	Requirements
Operating temperature range	Ambient, no control
Maximum relative humidity	80%, non-condensing
Vibration	To be tested
Static electricity	Negligible

Use quality glass vials suitable for the applications. Use only one vial at time for mixing and do not reuse headspace vials

CAUTION We suggest the use of vials furnished by Thermo Fisher Scientific.
If of other suppliers are used, it is your responsibility to verify their compatibility with the applications. Do not wash and recycle used vials;

WARNING It is mandatory using the mixer with the installed protective cover. During the mixing step it is important to keep the TriPlus RSH Head always above the vial to avoid an uplift of the vial caused by the spin.

The recommended application for the Vortexer is liquid/liquid extraction. If a solid material is mixed with a liquid at high speeds, this will likely cause cracking of the vial.

Heatex Stirrer Module

The Heatex Stirrer is an active module which mixes samples rapidly applying a cycloid shaped mixing pattern without the need for stir bars. See Figure 41.

Figure 41. Heatex Stirrer Module
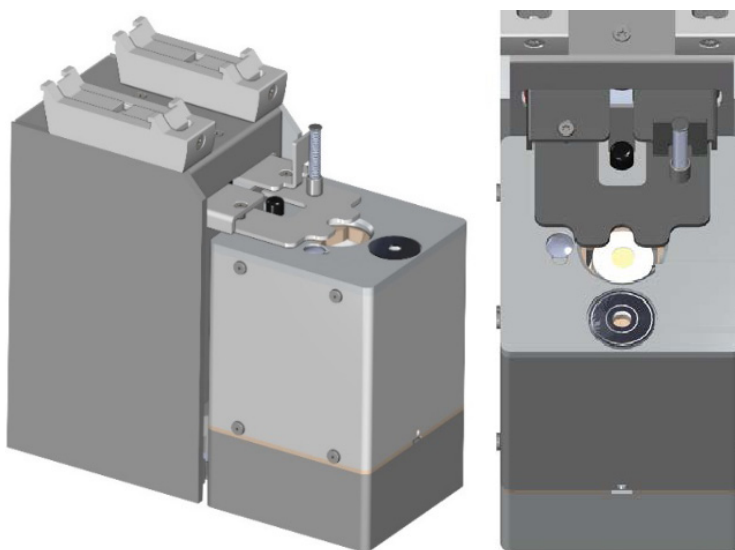
Motion of a liquid (orange) when applying a cycloidal mixing pattern (yellow). The entire volume of the liquid is mixed efficiently. The integrity of the SPME Arrow fiber (red) is not compromised.

Cycloidal Mixing
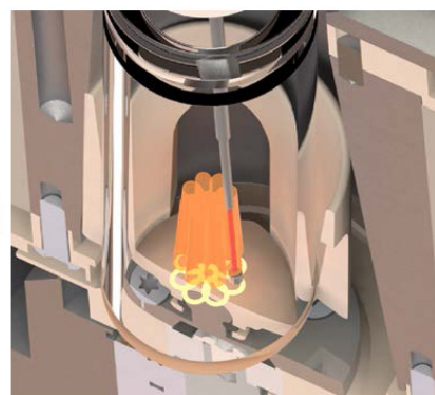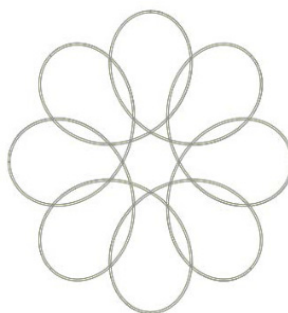
For SPME headspace and immersion sampling, the special design ensures that the delicate fiber is not damaged. The temperature can be set in the range of 40 to 150 °C.

The Heatex Stirrer specifications are:

- **Agitation** — Cycloid shaped mixing, speed selectable from 0 to 1600 rpm (0 to 200 cycloidal loops).

- **Sample Vial Dimensions** — 20 mL Vial diameter 23 ± 0.5 mm, height 78 mm including magnetic cap (2 mL and 10 mL Vials can be used with adapter inset)

- **Sample Capacity** — 1 vial

- **Electrical Connectors** — Two Bus connectors for daisy chaining

- **Firmware** — Version 2.4 or higher

The Heatex Stirrer dimensions, mass, operating and environmental requirements are detailed in Table 19 and Table 20.

Table 19. Heatex Stirrer - Dimensions and Mass

Length	Dimension in mm (inches)
Width	85 (3.35)
Depth	188 (7.40)
Height	177 (7.0)
Mass	Dimension in kg (pounds)
Heatex Stirrer (with cable)	2.60 (5.73)

Table 20. Heatex Stirrer - Operating Environmental Requirements

Parameter	Requirements
Operating temperature range	4 to 40 °C
Maximum relative humidity	80%, non-condensing
Static electricity	Negligible

Use quality glass vials suitable for the applications. Use only one vial at time for mixing and do not reuse headspace vials.

CAUTION We suggest the use of vials furnished by Thermo Fisher Scientific.
If of other suppliers are used, it is your responsibility to verify their compatibility with the applications. Do not wash and recycle used vials;

SPME Conditioning Station

The SPME Conditioning Station is an optional device used for the SPME (Solid Phase Micro Extraction) technique. It conditions or cleans a fiber between chromatographic runs. See Figure 42.

Figure 42. SPME Conditioning Station
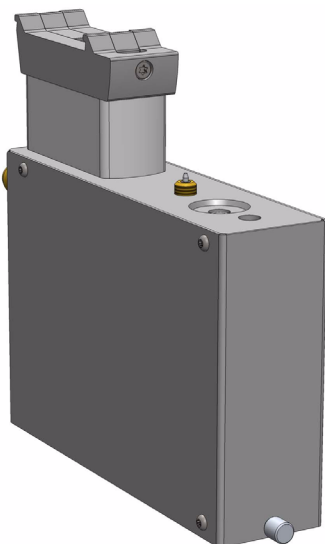
The SPME Conditioning Station specifications are:

- **Temperature Control** — From 30 °C to 350 °C selectable in 1°C increments.

- **Electrical Connectors** — Two BUS connectors for daisy chaining.

The SPME Conditioning Station dimensions, mass, operating and environmental requirements are detailed in Table 21 and Table 22.

Table 21. SPME Conditioning Station - Dimensions and Mass

Length	Dimension in mm (in.)
Width	44 (1.73)
Depth	190 (7.48)
Height	160 (6.30)
Mass	**Dimension in kg (lbs)**
SPME Conditioning Station (with Cable)	1.08 (2.38)

Table 22. SPME Conditioning Station - Operating Environmental Requirements

Parameter	Requirements
Operating temperature range	4 to 40 °C
Maximum relative humidity	80%, non-condensing
Vibration	Negligible
Static electricity	Negligible

WARNING The SPME Conditioning Station operates at a maximum temperature of 350 °C. Operating at this temperature, the outer surface will reach approximately 70 °C. Do not touch the outside of the SPME Conditioning Station.

A flow of inert gas protects the fiber from degradation when it is exposed to elevated temperatures. The temperature for conditioning or cleaning can be selected.
A spare fiber can be conditioned in the front well to ensure that a spare fiber is always ready for use. The front position is designed to condition a spare SPME Fiber. See Figure 43.

Figure 43. Spare Fiber Inserted in Front Position
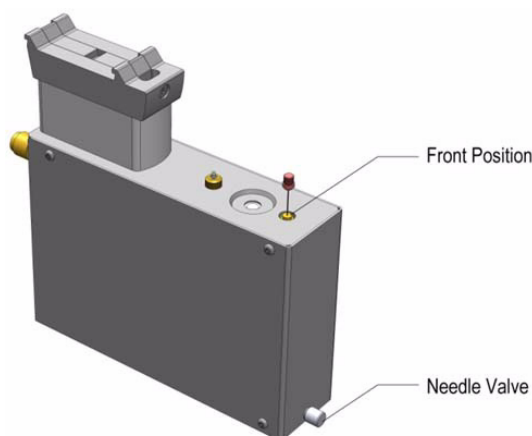
The fiber is manually placed into the hole, and brought to the exposed position. If this second position is used, open the needle valve for gas flow in the second channel (front).
The needle valve is the metallic knob in front of the conditioning module. After the spare fiber has been removed from the front position, close the needle valve in front of the conditioning station (metallic knob).

Note Saving gas, letting gas flow unrestricted through this open, second channel reduces the gas flow in the channel for the automated conditioning. This could result in damage to the fiber, as it will not be protected by inert gas.

It is not only a matter of saving gas, but letting gas flow unrestricted through this open, second channel would reduce the gas flow in the channel for the automated conditioning. This could result in damage to the fiber, as it is not be protected by inert gas.

SPME Arrow Conditioning Station

The SPME Arrow Conditioning Module is an optional device used for the SPME (Solid Phase Micro Extraction) technique in combination with the SPME Arrows. Its purpose is to condition a SPME Arrow or clean an Arrow between chromatographic runs. See Figure 44.

Figure 44. SPME Arrow Conditioning Station
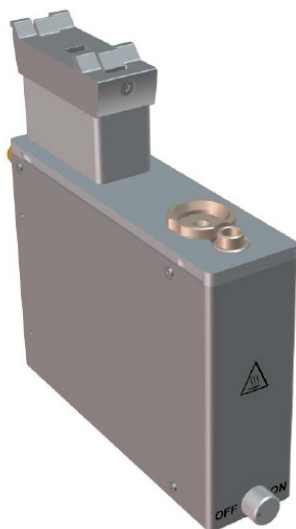
The SPME Arrow Conditioning Station specifications are:

WARNING The SPME Arrow Conditioning Module can be operated at maximum temperature of 350 °C. When operated at this temperature, the outer surface will reach approx. 70 °C. Do not touch the outside of the SPME Arrow Conditioning Module.

- **Temperature Control** — From 30 °C to 350 °C selectable in 1°C increments.

- **Electrical Connectors** — Two BUS connectors for daisy chaining.

- **Firmware** — Version 2.4 or higher

The SPME Arrow Conditioning Station dimensions, mass, operating and environmental requirements are detailed in Table 23 and Table 24.

Table 23. SPME Conditioning Station - Dimensions and Mass

Length	Dimension in mm (in.)
Width	44 (1.73)
Depth	190 (7.48)
Height	166 (6.54)
Mass	**Dimension in kg (lbs)**
SPME Arrow Conditioning Station (with Cable)	1.20 (2.65)

Table 24. SPME Conditioning Station - Operating Environmental Requirements

| Parameter	Requirements
Operating temperature range	4 to 40 °C
Maximum relative humidity	80%, non-condensing
Vibration	Negligible
Static electricity	Negligible

A flow of inert gas protects the Arrow from degradation when it is exposed to elevated temperatures. The temperature for conditioning or cleaning can be selected. A spare Arrow can be conditioned in the front well to ensure that a spare Arrow is always ready for use.See Figure 45.

Figure 45. Spare Fiber Inserted in front Position
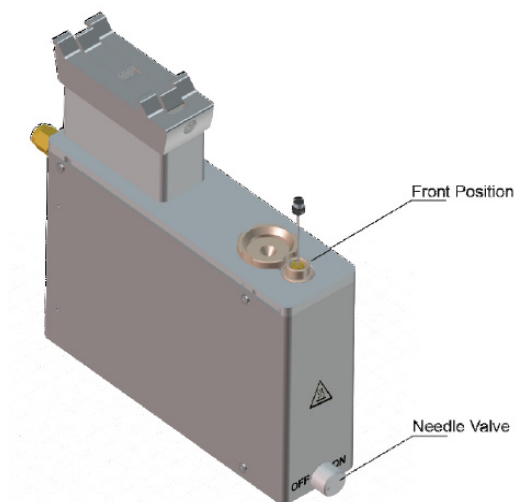
TriPlus RSH Optional Modules

This section provides a description of the following Optional Modules:

MHE Station

The MHE (Multiple Headspace Extraction) Station is an add-on passive module to extend the range of headspace applications. It consists of a venting Tool (MHE Adapter) combined with a MHE Adapter Holder. See Figure 46.

Figure 46. MHE Station

MHE Adapter Holder   MHE Adapter   Needle
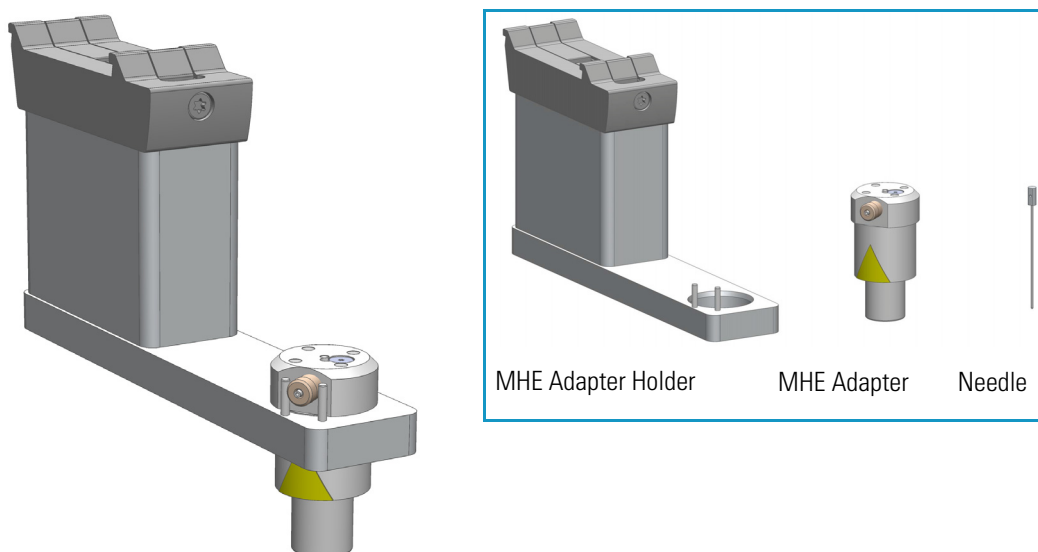
The MHE adapter and MHE Adapter Holder dimensions, mass, operating, and environmental requirements are detailed in Table 25, Table 26 and Table 27.

Table 25. MHE Adapter - Dimensions and Mass

Length	Dimension in mm (in.)
Width	25 (1.0)
Height	51 (2.0)
Mass	**Dimension in kg (lbs)**
MHE Adapter	0.027 (0.06) without vent tubing

Table 26. MHE Adapter Holder - Dimensions and Mass

Length	Dimension in mm (in.)
Width	35 (1.4)
Depth	150 (5.9)
Height	110 (4.3) with MHE Adapter inserted
Mass	Dimension in kg (lbs)
MHE Adapter Holder	0.285 (0.63) without vent tubing

Table 27. Operating Environmental Requirements

Parameter	Requirements
Operating temperature range	4 to 40 °C
Maximum relative humidity	80%, non-condensing
Latitude limitations	3000 meters above sea level

Naming Convention

MHE Adapter — The MHE Adapter, equipped with a built-in needle, is used as the Tool to release the pressure from the vial.
The MHE Adapter is also equipped with a vent outlet connector for connecting a vent line. In cases toxic gases are released from the vial, the venting line can be positioned into a neutralizing agent or to a fume hood to protect the operator and the environment.

MHE Needle — The MHE Needle is a dedicated needle used for the MHE Adapter only. Length: 46 mm, Gauge 22, Point style 5 (side hole needle tip).

MHE Adapter Holder — Parks the MHE Adapter in between the cycles, or in standby position.

> **CAUTION** The MHE Venting Adapter contains a spring-loaded white insert to protect the needle. Use caution when handling the white insert; the needle can pierce skin.

> **Note** The MHE Adapter has a threaded gas vent outlet, allowing an optional OD 1/16.in waste tube to be attached. This optional gas venting tube can be used for applications requiring hazardous or toxic gases. The pressure setting for the MHE technique is 1.0 to 1.5 bar (about 15 psi). If your system was previously used for static headspace applications, you may need to adjust your pressure regulator.

> **Note** For details about the **Multi Headspace Extraction**, see the Appendix A, "Multi Headspace Extraction (MHE)."

Barcode Reader

The Barcode Reader is an active module used to decode and read codes applied in horizontal bars on vials of 1 to 20 mL volume. See Figure 47.

Figure 47. Barcode Reader
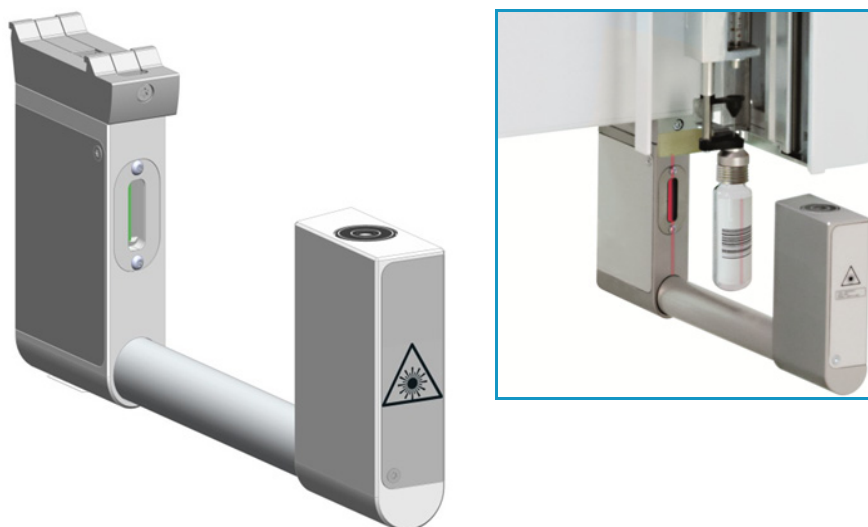
The Barcode Reader specifications are:

- **Vial Sizes** — 2 mL, 10 mL, and 20 mL

- **Electrical Connectors** — Two BUS connectors for daisy chaining.

The Barcode Reader dimensions, mass, operating and environmental requirements are detailed in Table 28 and Table 29.

Table 28. Barcode Reader - Dimensions and Mass

Length	Dimension in mm (in.)
Width	30 (1.18)
Depth	273 (10.75)
Height	128 (5.04)
Mass	**Dimension in kg (lbs)**
Barcode Reader Module (with cable)	0.83 (1.83)

Table 29. Barcode Reader - Operating Environmental Requirements

Parameter	Requirements
Maximum relative humidity	80%, non-condensing
Vibration	Negligible
Static electricity	Negligible

The Barcode Reader consists of two scanners. The vial with the barcode label is positioned in the middle. The distance between the two scanners is optimized by the scan angle. The two scanners are activated one after another.

- If the first scanner can read and decode the barcode symbols, the second scanner is not activated.

- If the first one fails, the second scanner is activated, and if the barcode is positively interpreted the process is ended.

When both scanners cannot read the barcode, an error exception is run. The error handling itself is part of the CDS software and in most cases you can select one of the following options:

- Continue with sample handling but stamp the field **Sample ID** with an error comment **BC not readable**.

- Stop the process of data handling, stop the entire **Sample List**.

This approach of using two scanners confers the advantage that the vial with the barcode label does not require to be oriented directly towards the scanner. Respecting the minimum length of 18 mm for the barcode allows the vial be positioned randomly in the vial tray and the barcode label will be successfully interpreted.

Barcode Labels

The Barcode labels should be made of polyester and not paper. Polyester can withstand high temperatures and the barcode lines will be printed clearly.

- **Label Width** — The minimum length of the barcode is 18 mm if used with a 20 mL vial. This dimension refers to the actual barcode length and not the label itself. Adapt the label accordingly. When possible use larger dimensions for reliable processing of the barcodes.

- **Maximum tilt of the barcode label**: ±20°.

- **Minimal barcode density (minimal width of a bare or a space)**: 5 mil (0.005") / 0.127 mm.

Place the barcode label on the vial such that the barcode bars are horizontally positioned. The allowed area for the placing of the label is given in Figure 48.

Figure 48. Examples of Barcode Label Positioning and Label Size
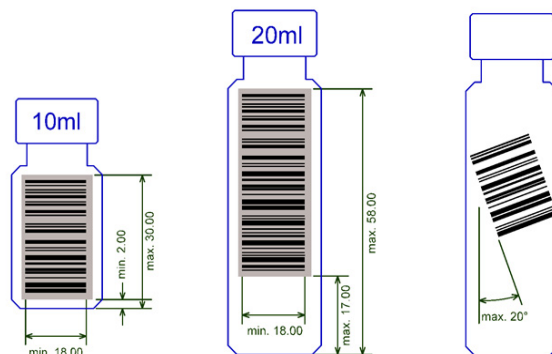
The Barcode Reader reads a barcode label from an individual vial, but it is not able to scan and treat multiple units of information, as would typically be received from a Multiple Well Plate.

Supported Types of Barcode Symbols

The following barcode types can be decoded. See Table 30.

Prerequisites are:

- Horizontal scan line
- 1D scanner

Table 30. Barcode Symbologies (Sheet 1 of 2)

Barcode Type	Description	Min Length	Max Length	Barcode Symbology
Key for Barcode Symbologies				Bar Code Data Start-/Stopcharacter Checkdigit
UPC-A	Universal Product Code, 12 numerical digits. 11 usable digits +1 check digit.	12	12	UPC Version A 0 12345 67890 5
UPC-E	Universal Product Code, Zero-compressed UPC code, 7 numerical digits. 6 usable digits + 1 check digit.	6	6	UPC Version E 0 123456 5
EAN-8	Derived from the longer European Article Number (EAN-13), 8 numerical digits. 7 usable digits + 1 check digit.	7	7	EAN8 4018 2735
EAN-13	European (International) Article Number, 13 numerical digits. 12 usable digits + 1 check digit.	12	12	EAN13 0 725272 720776
Code-128	High density barcode for alphanumerical codes, supporting all 128 ASCII characters.	1	Unlimited	Code 128 Alphanum

Table 30. Barcode Symbologies (Sheet 2 of 2)

| Barcode Type	Description	Min Length	Max Length	Barcode Symbology
EAN-128/GS10128	Alpha-numerical codes, supporting all 128 ASCII characters.	1	48	EAN128 / GS1-128 ‖‖‖‖‖‖‖‖ EAN128
Code 39 (3 of 9)	Alphanumeric code, consisting of uppercase letters (A-Z), numeric digits (0-9) and some special characters (-, ., $, /, +,%, and space).	1	Unlimited	3 of 9 (Code 39) ‖‖‖‖‖‖‖ TEC-IT
2 of 5 Interleaved	Numerical characters.	1	Unlimited	2 of 5 Interleaved ‖‖‖‖‖‖‖ 012345
ISBT 128	Used for labeling of human blood.	1	Unlimited	Application specific barcodes

Safety Information

The installed laser device is a Class 1 Laser Product.

WARNING Class 1 laser devices are not considered to be hazardous when used for their intended purpose. The following statement is required to comply with international regulations: Use of controls, adjustments or performance of procedures other than those specified herein might result in hazardous laser light exposures.

Figure 49 shows the laser warning label and the location of the laser aperture.

Figure 49. Laser Warning Label and Laser Aperture

CLASS 1 LASER PRODUCT
LASER KLASSE 1
APPAREIL À LASER DE CLASSE 1
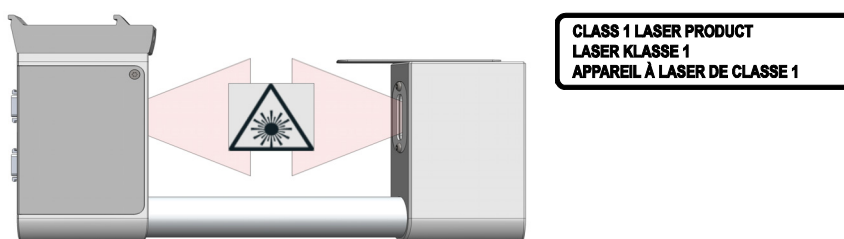
The selected Laser Class 1 for the module Barcode Reader complies with the following regulations:

- 21 CFR1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.
- EN60825-1:1994 + A1:2002 + A2:2001
- IEC60825-1:1993 + A1:1997 + A2:2001

The software contains a built-in safety time limit such that the laser scanning mechanism cannot be operated in AIM mode for more than 5 continuous seconds.

Electronic Box for OC Injector Actuator

The OC Injector Actuator, not provided with the TriPlus RSH, is a combination of the On-column Injector and the Actuator to open and close the rotary valve of the On-Column injector. The device consists of an electronic box and the BUS daisy chain cable. See Figure 50.

The OC Injector is an active module where the OC Electronic Box is connected to the BUS connector while the cable from the GC Injector is connected to the Box.

Figure 50. OC Electronic Box
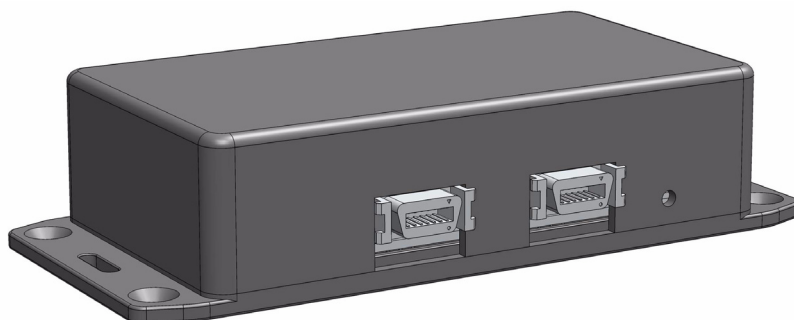
The electronic module is laid out to activate the OC Actuator. A specification is not applicable. The Electronic Box for OC Injector Actuator - dimensions, mass, operating and environmental requirements are detailed in Table 31 and Table 32.

Table 31. Electronic Box for OC Injector Actuator - Dimensions and Mass

| Length	Dimension in mm (in.)
Width	44 (1.73)
Depth	190 (7.48)
Height	160 (6.30)
Mass	**Dimension in kg (lbs)**
OC Electronic Box (with cable)	1.08 (2.38)

Table 32. Electronic Box for OC Injector Actuator - Operating Environmental Requirements

Parameter	Requirements
Maximum relative humidity	80%, non-condensing
Vibration	Negligible
Static electricity	Negligible

Dilutor Module

The Dilutor Module is an optional device for the TriPlus RSH System. Its main purpose is typically solvent handling, such as adding a solvent for dilution, a reagent for derivatization, spiking with an internal standard, and so on. Another widely used application is sampling an exact volume of an aliquot and pipetting it into another vessel for further processing. See Figure 51.

Figure 51. Dilutor Module
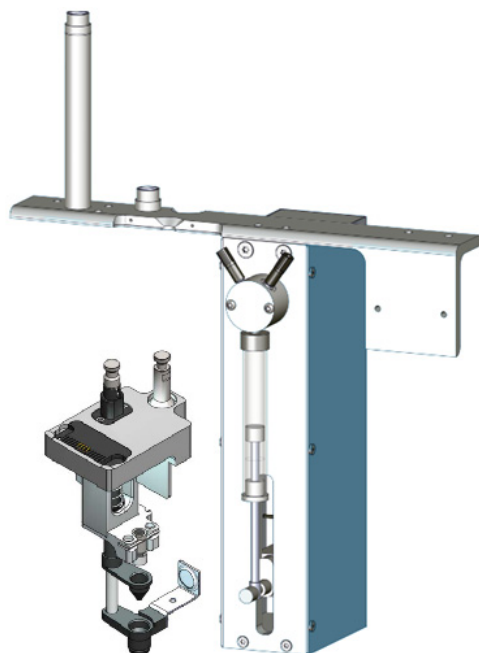
Two versions are available:

Single Dilutor
With a Single Solvent valve for 1/4-in.-28 fittings

Multi Dilutor
With a Multi Solvent ceramic valve for 1/4-in.-28 fittings

Naming Conventions

Naming conventions for the Dilutor Module and its parts are listed below:

- **Dilutor Module** — Describes the entire assembly of the Module.
- **Dilutor Syringe Module** — Active module carrying the Dilutor Syringe and the Dilutor Valve.
- **Dilutor Tool** — Describes the Tool itself as part of the Dilutor Module.
- **Dilutor Valve** — It is placed on the Dilutor Syringe Module and one of its ports is connected to the Dilutor Syringe. Two types are available:
  - Single Solvent PTFE Valve
  - Multi Solvent Ceramic Valve
- **Mounting Bracket** — Fixes the Dilutor Module to the X-Axis of the TriPlus RSH. Contains two holders for the Guiding Wire.
- **Solvent Reservoir Kit** — Consists of one reservoir bottle (1 L) with tubing (PFA) and one glass frit with a pore size of 40 µm.

- **Transfer Tubing Kit** — Connects the Dilutor Module and Dilutor Tool. Consists of the PFA Tubing, the Guiding Wire and connection fittings.
- **Guiding Wire** — The Wire integrated into the Transfer Tubing.

Specifications

The specifications of the Dilutor Module are:

- **Dilutor Module** — Single Dilutor or Multi Dilutor
- **Dilutor Valve** — Single Solvent valve for ¼-in.-28 fittings for Single Dilutor; 7-port (6+) Ceramic (Alumina) valve for ¼-in.-28 fittings for Multi Dilutor
- **Maximum Permissible Pressure** — 3 bar (300 kPa; 43.5 psig)
- **Dilutor Syringe** — 1 mL, Scale 60 mm; Optional 0.1 mL, 5 mL, 10 mL
- **Transfer Tubing** — PFA tubing ID 0.787 mm (1/32") / OD 1.58 mm (1/16") Including Connection Fittings and Guiding Wire Length of transfer tubing: 1530 mm
- **Needle** — Gauge 22, Pst 3, Length 51 mm; Optional Gauge 23, Pst AS, Length 51 mm
- **Solvent Reservoir Kit** (1 piece for Single Dilutor; 5 pieces for Multi Dilutor) — 1000 mL borosilicate glass including:
  - Glass Filter, 40 µm pore size (1000-SV)
  - Aspiration Tubing (PFA)
- **Wetted Parts** — Tubing from Reservoir Bottle to Dilutor Syringe Module.

  Tubing: PFA

  Frit: Glass Filter

  Dilutor Syringe Module: Syringe: Borosilicate Glass

  Valve 3-port: PTFE / Kel-F

  Valve 7-port: Ceramic (Alumina)

  Transfer tubing from Pump to LCP Tool: Tubing: PFA

- **Electrical Connectors** — Two BUS connectors for daisy chaining; M12, 4 position, male, reserved for future use.
- **Firmware** — Version 2.1.0 or higher

The Dilutor Module dimensions, weights, operating and environmental requirements are detailed in Table 33 and Table 34.

Table 33. Dilutor - Dimensions and Mass

Length	Dimension in mm (inches)
Width	115 (4.52); 175 (6.89) including cable connectors
Depth	260 (10.24)
Height	430 (16.93) 550 (21.65) including transfer tubing

Mass	Dimension in kg (lbs)
Dilutor Syringe Module	1.31 (2.89)
Mounting Bracket	0.220 (0.49)
Associated Cable	0.15 (0.33)
Solvent Reservoir Kit	Aspiration Kit: 0.06 (0.13) Reservoir Bottle 1000 mL: 0.58 (1.28)
Total Weight of Single Dilutor	2.32 (5.11)
Total Weight of Multi Dilutor	4.88 (10.76)

Table 34. Dilutor - Operating Environmental Requirements

| Length	Dimension in mm (inches)
Operating Temperature Range	4 to 40 °C
Maximum Relative Humidity	80%, non-condensing
Bench Space	Consider bench space for the Wash Solvent reservoir bottles, size 1000 mL (or as required by customer)
Altitude Limitations	3000 meters above sea level

Handheld Controller

This section provides a description of the Handheld Controller.

Menu Screen

Different menu screens are displayed, depending on the TriPlus RSH operating state and the particular function being accessed by the operator. All menu screens have the same basic format. The uppermost line is the **Status bar** where the selected section, the status and time are displayed.

The **Content Area** shows the list of selected items. The **Function Keys** are located in the **Menu Bar**. See Figure 52.

Figure 52. Main Screen

Status Bar

Content Area

Menu Bar with Function Keys
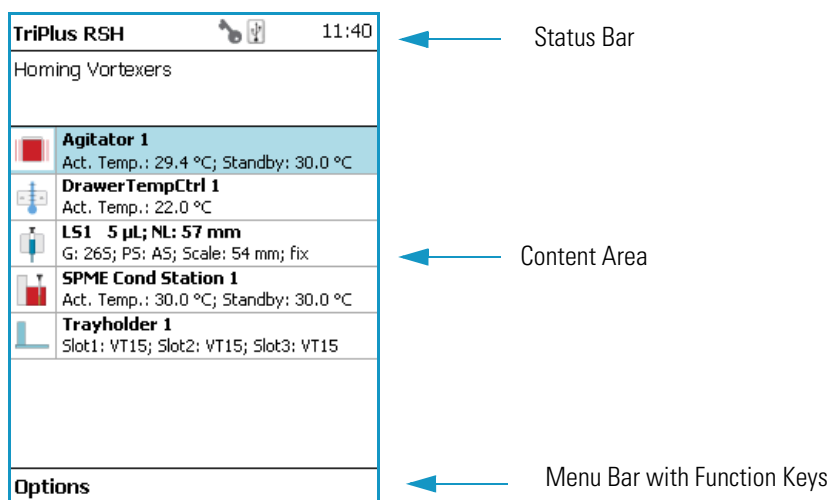
> **Note** Start Screen displays the installed Tools, the Active Modules and the Passdive Modules.

Menu Screen Status Bar Symbols

The following symbols can be displayed in the Menu Screen Status Bar. See Table 35.

Table 35. Menu Screen Status Bar Symbols (Sheet 1 of 2)

| Symbols	Description
🟢	**Green status light, blinking:** TriPlus RSH is working (moving). Execution mode. The Terminal is partially blocked to specific actions. **Green status light, steady on:** TriPlus RSH is ready in Standby. Idle Mode.
🟡	**Yellow status light, blinking:** RSH Firmware is booting. **Yellow status light, steady on:** A problem has been detected which cannot be resolved by the robotic system. *Examples:* Bent needle (mechanical problem), missing Tool, and so on. detected at the moment of sample execution. A software run-time error can also cause a status light change to **steady-on yellow**.
🔵	**Blue status light, blinking:** The TriPlus RSH is in the process of software **Update** or **Backup**. (For the processes **Copy Backup** and **Restore** the Status light remains **green**.) **Blue status light, permanent:** TriPlus RSH is in a safe state (power reduced to a minimum) and requires manually moving the Head to the **Teach Point**. **Note:** If an error is detected at the same time that an action is required according to the **Blue Status Light,** then by default the yellow status light will dominate.

Table 35. Menu Screen Status Bar Symbols (Sheet 2 of 2)

Symbols	Description
⇩	**USB Symbol**: A USB device is connected to control.
✉	**Message** (Envelope): A system message is pending. *Example*: Error message after software upgrade or after a device has been disconnected. In **User Access Level** the message symbol is displayed only. To view and process the system message(-s) the operator has to change the access level to **Extended User**.
🔑	**Key** is the indicator for the access level **Extended User**.
🔧	**Flat Wrench** is the indicator for the access level **Service User**.

Function Keys and Buttons

Options for a particular menu are assigned to the corresponding function key on the left side. See Figure 53.

Figure 53. Handheld Controller Buttons
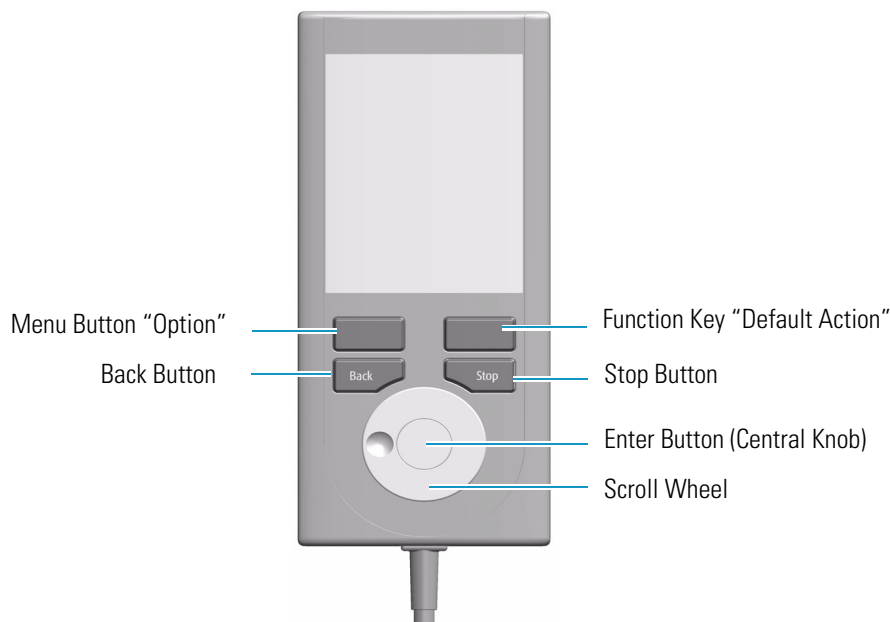
- The Menu Button **Option** on the left side opens a pull-up menu, and is a dynamic allocatable key.
- The Function Key on the right side is reserved for **Default Actions**, such as **Ok**, **Next**, and so on.
- Pressing the **Back** button returns to the previous menu. If the Back button is pressed continuously, the cursor will jump back to the home screen (Start Page).

• Pressing the **Stop** button stops the ongoing activity at the first possibility. The behavior is closer to stop the run, but the stop itself occurs after an activity has completed its tasks, for example the filling of a syringe.

> **Note** The term **Stop** usually relates to the controlled end of a process, for example finishing a sample from the sample list. The automated run is paused and the user has the possibility to interfere with, make corrections to, continue with or stop the run completely. The **Stop** button used with the TriPlus RSH can terminate the process during the run.

Scroll Wheel and Enter Button

Rotate the outer knob to scroll through items in a menu. To select a highlighted item, press the **Enter** button (central knob). Use the outer knob to scroll through the available options for that item or to change a numeric value. Press the inner knob again to enter the displayed option.

The inner knob is also used for other operations that require an Enter function to continue or complete an operation.
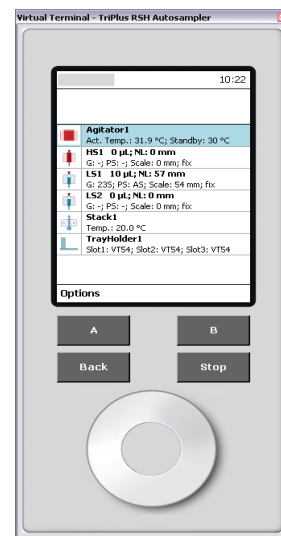
Handheld Controller Versus the Virtual Handheld Controller

With every TriPlus RSH, Virtual Handheld Controller Software is provided. This software replaces the actual hardware, the Handheld Controller. However, the Handheld Controller is still available as an option. See Figure 54.

Figure 54. Handheld Controller and Virtual Handheld Controller

Handheld Controller

Virtual Handheld Controller

The functionality of both the hardware **Handheld Controller** and the **Virtual Handheld Controller** software are basically the same. Menus, selection of modules, definition of attributes, or feeding parameter values are identical. The only difference is the handling.

When using the Handheld Controller, use the Scroll Wheel, Enter button, Menu Buttons, and so on. If the software Virtual Handheld Controller is running, the keyboard functions are used.

> *For example:* when the position of a module is defined as the X-, Y-, Z-, the values are changed by moving the arrow key up and down.

To open a pull-up menu, use the **Enter** key and the menu items, where for example a name has to be given. You receive the same context menu to enter a number or character. See Figure 55.

Figure 55. Example Context Menu to Enter a Password
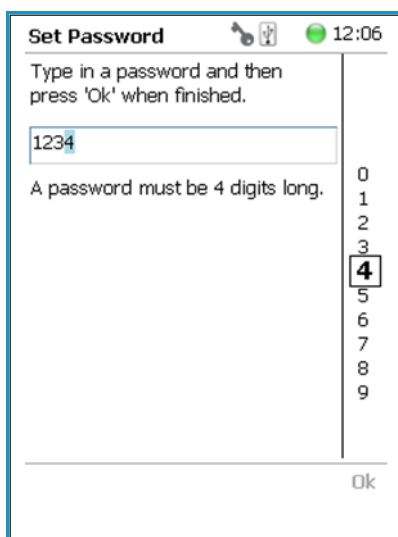
Use the mouse cursor to select the name. Do not use the standard keyboard keys to select the name.

TriPlus RSH Basic Informations

Basic informations are provided for the different **Access Levels** to start the TriPlus RSH, and for using the Handheld Controller. The use of the Handheld Controller is similar to the Virtual Handheld Controller, and the PC software-based Handheld Controller.

Contents

- Starting the TriPlus RSH

- Access User, Extended and Service Levels

- Local Strips

- Setup, Installation, and Maintenance Menu Items

- Help Menu Item

- About Menu Item

- Shutdown Menu Item

- Operation of the TriPlus System in Combination with Other Chromatography Data Systems

Starting the TriPlus RSH
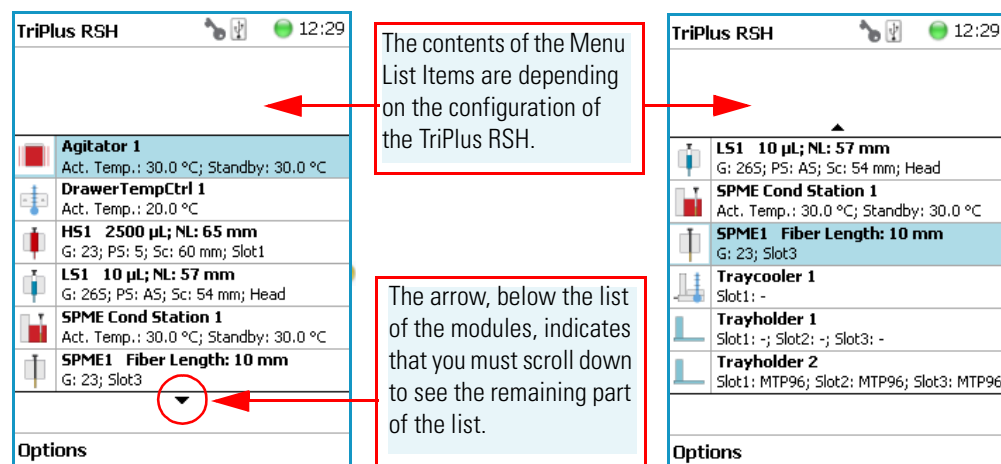
This section describes how to start the TriPlus RSH.

> **IMPORTANT** Before starting the TriPlus RSH, make sure that the sampler and all the modules are properly already installed.
> A syringe of the appropriate type, or several syringes (Tools), named using the appropriate Method, must be installed in the TR Station or ATC Station, and positioned in the slot.

How to Start the TriPlus RSH

1. Turn on the power and observe the software loading process. The following Start Screen appears. See the example of Figure 56.

Figure 56. Example of Start Screen

The contents of the Menu List Items are depending on the configuration of the TriPlus RSH.

The arrow, below the list of the modules, indicates that you must scroll down to see the remaining part of the list.

If any error occurs during the start-up process, the Start Screen shows a blinking **Envelope** in the **Status Line** as an indicator of a Pending Message, a Service Issue, or both. See Figure 57.

Figure 57. Indicating Messages
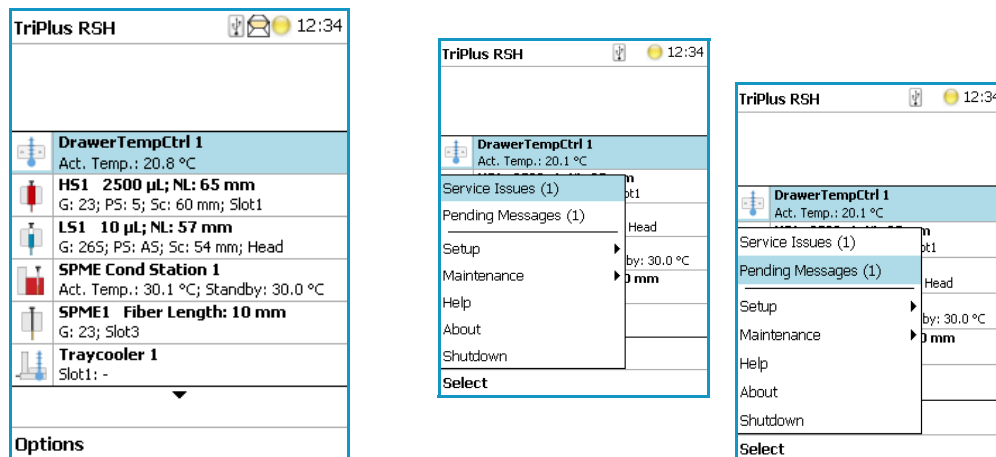
The envelope symbol indicates that a message pending or a **Service Issue** is found. When powered up, the TriPlus RSH is always in the **User access level.** In this level, the message symbol is visible in the status line, but you have no access to verify or acknowledge the error. Changing the Access Level to **Extended User**, you can see details of the messages by selecting each message line and pressing **Enter**.

See the example of Figure 58:

Figure 58. Example of Agitator Missing in Extended User Level
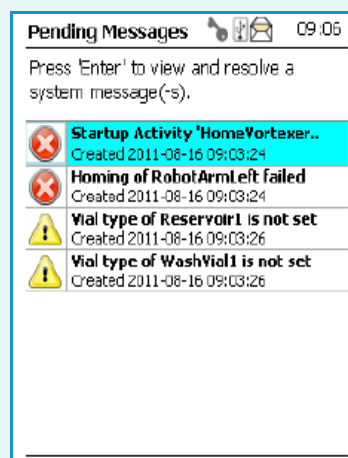

Pending Message
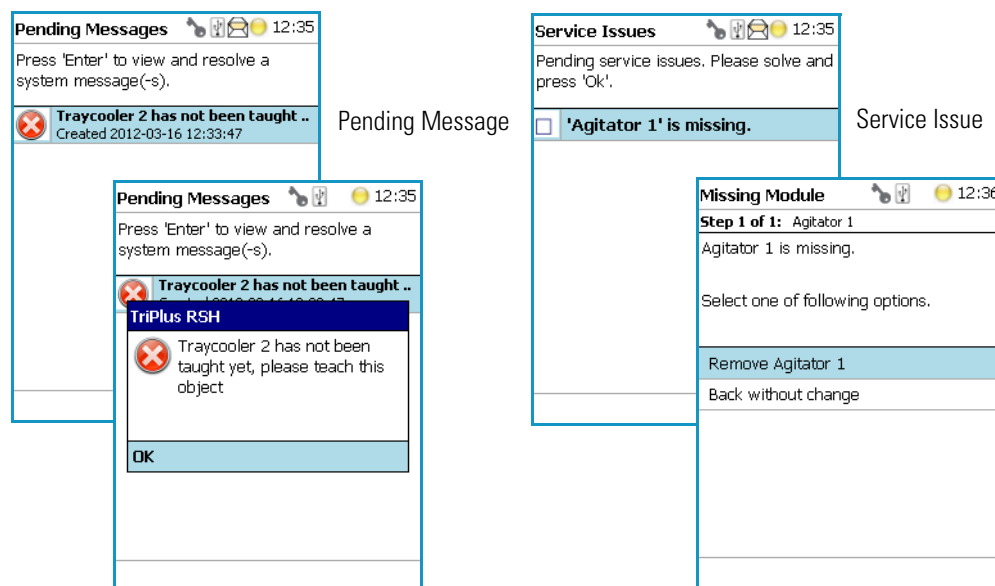
Service Issue

- The **Pending Message** in the example of shows that the reconnected **Traycooler 2** has not been taught yet.

- The message retrieved from the **Service Issue** provides self-explanatory options for resolving the problem. The Service Issue in the example shows that the Agitator is missing.

2. To retrieve the message proceed as follows:

   a. Change the Access Level to **Extended User**.

   b. Select **Options** to access the pull-up menu for further information.

   c. Select the menu item **Pending Message** to receive detailed information on the error message.

A common reason for an error is typically when a **BUS cable** is not connected from one to another active module. During the boot-up procedure, the presence of all active modules is verified. If one or more modules are not found, (or it is not possible to check functions such as **Homing**), an error is recorded. See the example in Figure 59.

When an error is observed, check all connections, try to eliminate the source of the problem, then restart the TriPlus RSH.

The example in Figure 59 shows the resulting errors when the Vortexer cable is not connected, and the homing could not be performed. All the subsequent boot-up checks failed.

Figure 59. List Items of Pending Messages

The Pending Message accompanied by the **Exclamation Mark** warning symbol indicating that a module has not been completely configured. After resolving the Service Issues, the Pending Messages, or both, restart the system. Select **Maintenance | Check Configuration**. Activating this item the entire system is checked for any open issues. If all of them are resolved, the green status light will be displayed.

See also the information provided by the error message or consult the chapter **Troubleshooting** in the *TriPlus RSH Hardware Manual*.

Short-cuts from Startup Screen

> **Note** Selecting a menu list item from the startup screen provides direct access, and offers the same functionality as when selecting the item using the path **Menu Button |Options | Setup | RSH Modules**.

The following steps are required to use the short-cuts:

1. Position the cursor on the list item at the Start Screen for which you wish to check certain parameters.

2. Press the **Enter** button to open the dialog for the selected item.

3. Selecting the **Options** pull-up menu, a list of specific tasks is provided, limited to the typical needs for routine work.

> **Note** The section "Setup Menu Item" on page 83 details the parameters that can be modified. Parameters which have read-only access are often self-explanatory and are usually only mentioned in the listing.

Access User, Extended and Service Levels

The RSH Firmware is designed with three different **Access Levels**. Each level accesses own discrete items and sections of the software. The purpose of this distinction is to display only specific items and sections of the software for each level. Settings which require to be changed rarely, such as those set during installation of the TriPlus RSH, are hidden for level 1 users (**User Level**), and displayed at level 2 (**Extended User Level**).

The distinction between **User Level** and **Extended User Level** contributes to the user friendliness of the TriPlus RSH.

Besides being user-friendly, the distinction allows the **Extended User Level** to be reserved for a person responsible for the system, or for a specific group of users. This protection enhances the reliability of the system and the lab environment in which the TriPlus RSH is used. Accidental changes can be minimized or avoided.

A **Service Level** is reserved for the Field Service Engineers. This level is mainly used during the installation phase or when servicing the TriPlus RSH. Accessing the **Service Level** requires a software key provided only for trained and authorized service engineers.

For details see the following sections:

- "User Level" on page 73
- "Extended User Level" on page 74
- "Service Level" on page 75
- "Changing Access Level" on page 75
- "Example of Differences in Access Levels" on page 77

IMPORTANT Please note that the TriPlus RSH is always started in the **User** access level. If the **Extended User** mode is required, you must change the access level. See the section "Changing Access Level" on page 75.

User Level

The **User Level** is the normal working level recommended for routine use. This level is assigned as the default level.

The system must be completely installed, tested, and verified for the use in combination with the required GC system. When these prerequisites are fulfilled, and a routine run is to be started, the TriPlus RSH is completely controlled by the Thermo Scientific™ Chromatography Data System (CDS) as Chromeleon, Xcalibur, ChromQuest, or Chrom-Card.

With the **User Level**, specific menu items are specially marked as shown in the example of the Agitator **Options** pull-up menu. See the example in Figure 60.

Figure 60. Example of User Level Options Pull-up Menu

You check parameters through the **Virtual Handheld Controller** or **Handheld Controller** (Terminal). All other functionality, such as the number of samples, how to treat a sample, the injection technique and so on, are under the control of the CDS.

Extended User Level

The **Extended User Level** provides the same basic functionality as the **User Level** but certain parameters of the RSH Firmware can be controlled, such as those that may be used for new modules, X-,Y-,Z-axes position teaching, changing a sync signal, and so on.

It is highly recommended to operate the TriPlus RSH in the **User Level** and to activate the **Extended User Level** only for special cases. Compared to the routine **User Level**, the **Extended User** access level provides the experienced operator more possibilities to interact with the TriPlus RSH. The distinction between the access levels enables the interface to be simplified for routine work, while providing the possibility to fine-tune the TriPlus RSH according to the specific requirements of your particular applications.

With the **Extended User Level**, specific menu items are specially marked as shown in the example of the Agitator **Options** pull-up menu. See the example in Figure 61.

**Figure 61.** Example of Extended User Level Options Pull-up Menu

Service Level

The **Service Level** provides full access to the TriPlus RSH. This level is reserved for qualified service engineers only. This level will be required for installation or any major repairs such as replacing a device (active module). To open the **Service** access level, a software key is necessary. This key is provided on a Service USB Stick which is handed over to trained service engineers. The various menu items, accessible with **Service** rights, are described in the chapter "Setup Menu Item" on page 83.
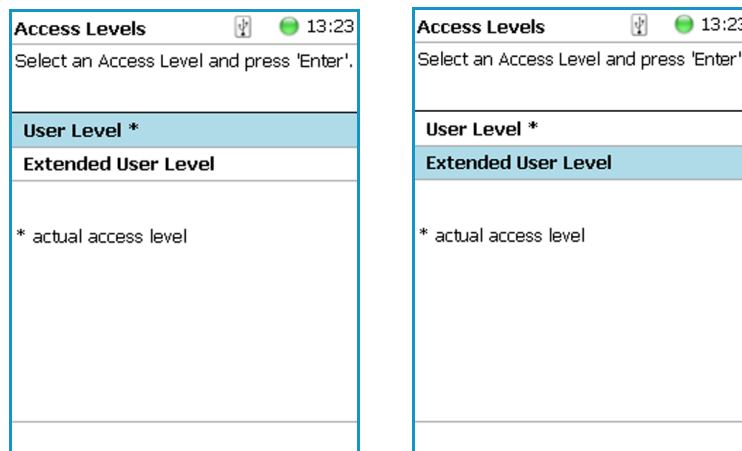
Changing Access Level

Using the **Virtual Handheld Controller** the Access levels can be changed by pressing the two characters **A** and **B** simultaneously at the keyboard. See Figure 62.

Figure 62. Virtual Handheld Controller and Virtual Handheld Controller

A and B Buttons
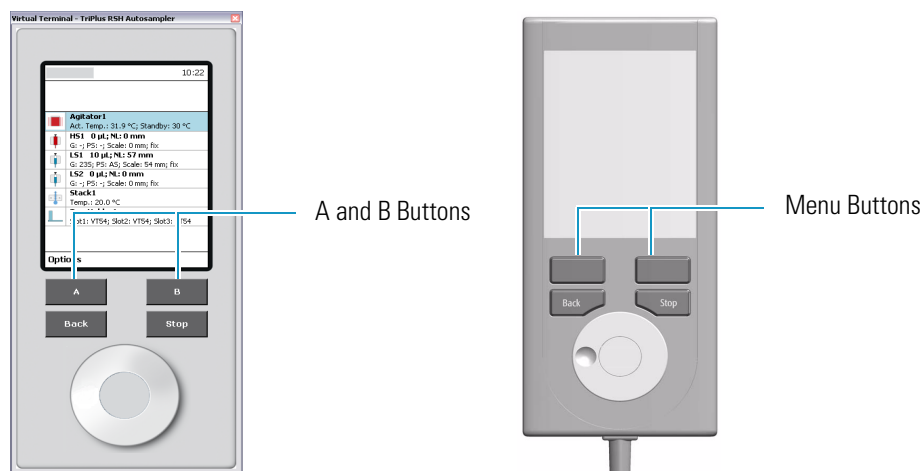
Menu Buttons

If the TriPlus RSH is equipped with a Handheld Controller, press the two **Menu Buttons** simultaneously (see Figure 62) to access the screen shown in Figure 63. The **User Access Level** is the default level.
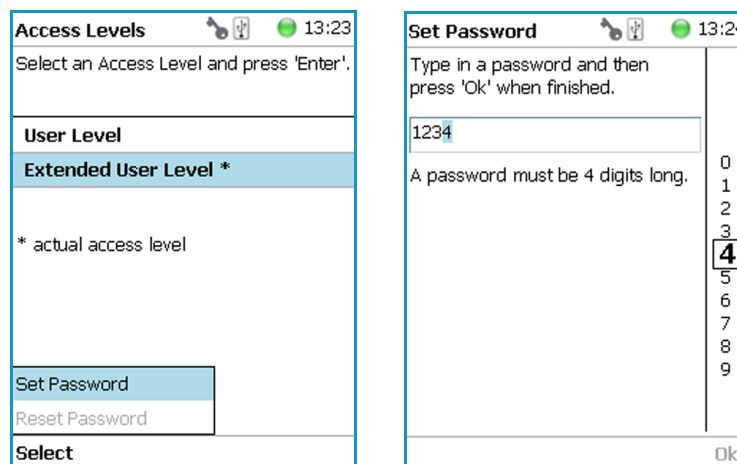
Figure 63. Changing Access Level

❖ **To change access level**

4. Select the required level and press **Enter** to activate it. The asterisk indicates the current active level.

5. When the **Extended User Access Level** is selected, a password can be set. See Figure 64.

Figure 64. Selecting Extended User Level and Setting a Password

6. Select **Set Password** from the pull-up menu.

    a. Place the cursor on the first digit and press the **Enter** button. A pop-up menu opens providing numerals from 0 to 9 for selection.

    b. Accepting the password by pressing **Ok** stores it. The password can be changed or reset as long as you are working under the **Extended User Level**. See Figure 65.

When the **User** level is active and you wish returning to the **Extended User Level**, follow the dialog shown in Figure 65.

Figure 65. Entering Another Password to Access Extended User Level
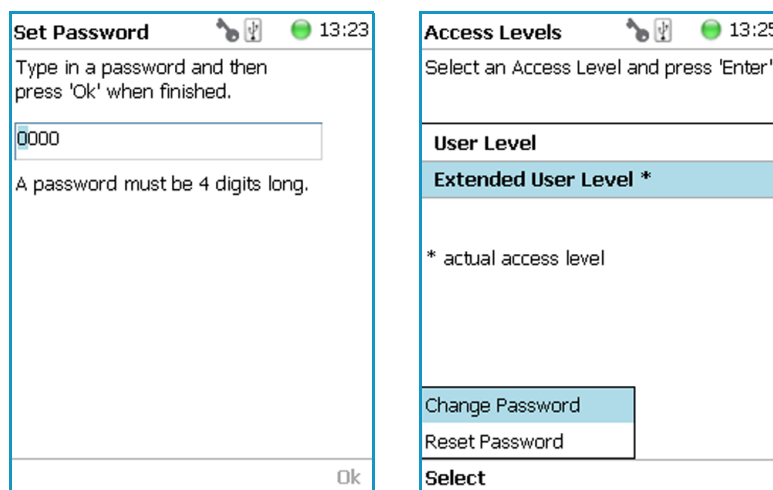
Note that **Ok** is grayed-out (inactive) as long as the correct password is not entered.

> **Note** If a password is forgotten, restore the **RSH Firmware**. See the chapter **TriPlus RSH Firmware** in the *TriPlus RSH Hardware Manual*. Use a backup file which does not yet contain the password. Be aware that changes made to the TriPlus RSH or any changes in settings made after the installation of the backup file to recover the forgotten password will no longer be active.

A password cannot be set when operating under the **User Level**.

The **Service Level** is only accessible with the software key, provided with a **Service USB Stick**.

> **Note** If the Handheld Controller (or Virtual Handheld Controller) is not in use, a time-out function begins. After 60 minutes of inactivity the software reverts automatically to the default **User Level**.

Example of Differences in Access Levels

The main difference between the two access levels is that the menu item **Service** is not available in the **User** level. See Figure 66.

Figure 66. Differences in Access Levels
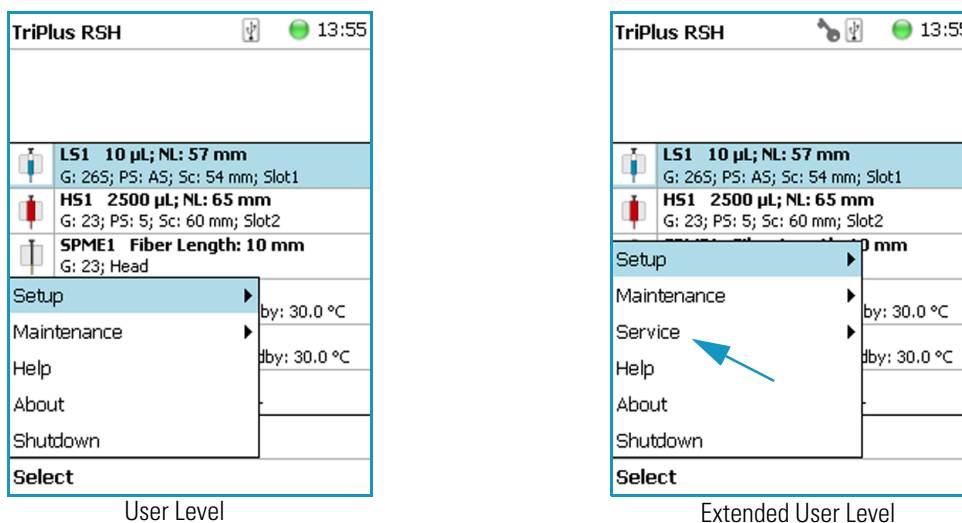
User Level   Extended User Level

> **Note** If the Handheld Controller (or the Virtual Handheld Controller) is not in use, a time-out function begins. After 30 minutes of inactivity the software reverts automatically to the default **User Level**.

Local Strips

The functionality of the Local Scripts is thought for customers whose Chromatographt Data System (CDS) does not support the TriPlus RSH System. Using local scripts it is possible to create, edit and execute Jobs using different methods based on templates. The templates are provided for different injection techniques like ITEX, Headspace or SPME.
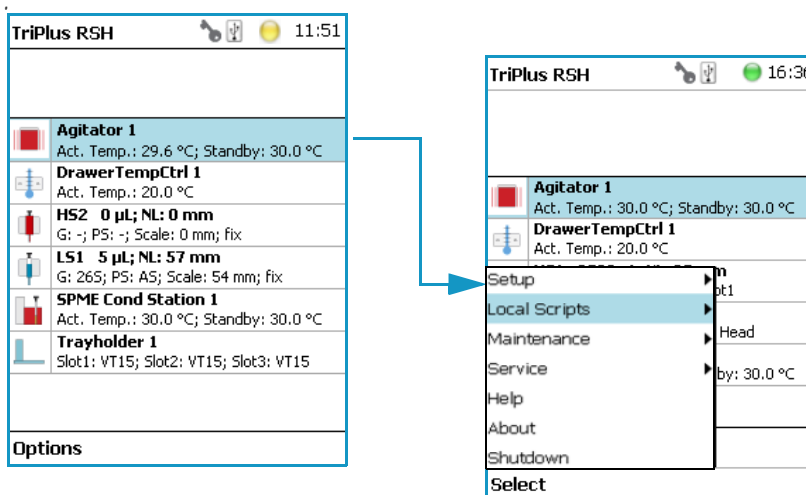
The non-editable templates, called **Scripts** are managed within the **Scripts** menu. Scripts can be deleted and additional scripts can be imported from a connected USB Stick.

- **Methods** can be created based on a certain script. A method is a copy of a script with an editable set of parameters. Methods, for their part, are used by **Jobs**.

- A **Job** processes a configurable number of samples according to the parameters of the referenced method. Jobs can be created and started within the **Job Queue** menu. It is also possible to copy or delete Jobs and to change the order of the Jobs within the Job Queue.

The **Local Scripts** function is available under the **Options** pull-up menu.

Press the **Options** to open the pull-up menu and select the menu item **Setup**. See Figure 67.

Figure 67. Start Screen Options Pull-up Menu

Select the menu item **Local Scripts** to access to the following sub-menu:

- **Scripts Menu** — Shows the available Scripts for the different injection techniques: **Headspace Injection**, **ITEX Advanced**, **Liquid Injection** and **SPME Injection**. Scripts can be deleted and additional scripts can be imported from a USB Stick.

- **Methods Menu** — Shows the available Methods. Each method is a copy of a corresponding script. In contrast to the scripts, the parameters of a method can be edited. New methods can be created, existing ones can be copied or deleted. A new method is created based on a present script.

- **Job Queue Menu** — Creates a job based on a method. New jobs can be created, existing ones can be copied, or deleted. The order of the present jobs within the queue can be changed. The jobs can be moved upwards or downwards within the list. It is possible to start the processing of the complete queue or of a single job. It is also possible to start processing only a part of the queue top down, beginning with a certain job. To create a new job see the following procedure:

❖ **To create a new job**

1. In **Job Queue** menu choose **New Job** and select a method.

2. Enter a name for the new Job and press **New**.

3. Press **Enter** to edit a parameter and press **Run** when finished.

4. Adapt the parameters **First Sample Index** and **Last Sample Index**, defining the total number of samples to be processed during this job and select a predefined vial tray, if required.

To start a **JobQueue**, a part of a job queue or a single job, open the Job Queue Pull up menu.

Start will start the whole JobQueue, **Start Job 2** will start only the selected Job, and **Start from Job 2** will start the JobQueue top down, beginning with the selected job. Once started, the actual task of the Job or Job Queue is displayed in the upper part of the screen.

# Setup, Installation, and Maintenance Menu Items

The description of the options of the RSH Firmware operated either with the Virtual Handheld Controller, or directly using the installed Handheld Controller are detailed in the following chapters:

- Chapter 3, "Setup Menu Item."
- Chapter 4, "Maintenance Menu Items."
- Chapter 5, "Service Menu Item."

Help Menu Item

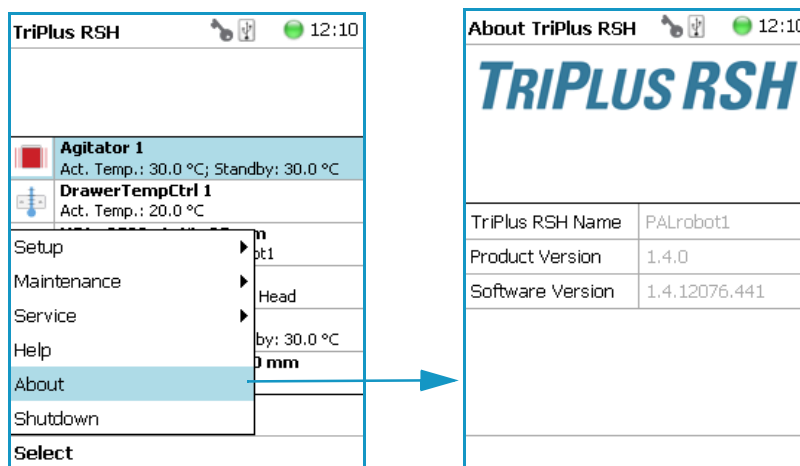Figure 68 shows the rudimentary Handheld Controller functions.

Figure 68. Menu Item Help
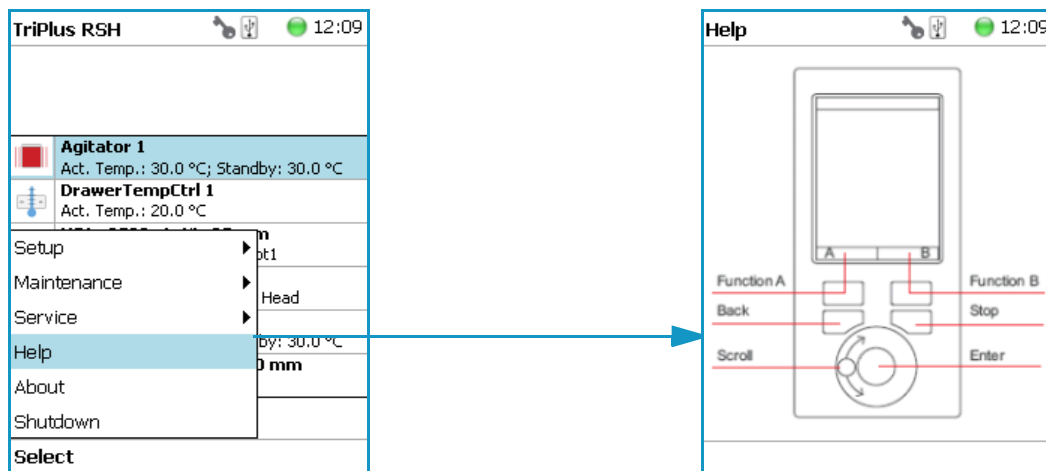
About Menu Item

This item visualizes the name of the instrument, the product version and the software version currently installed on the TriPlus RSH. See Figure 69.
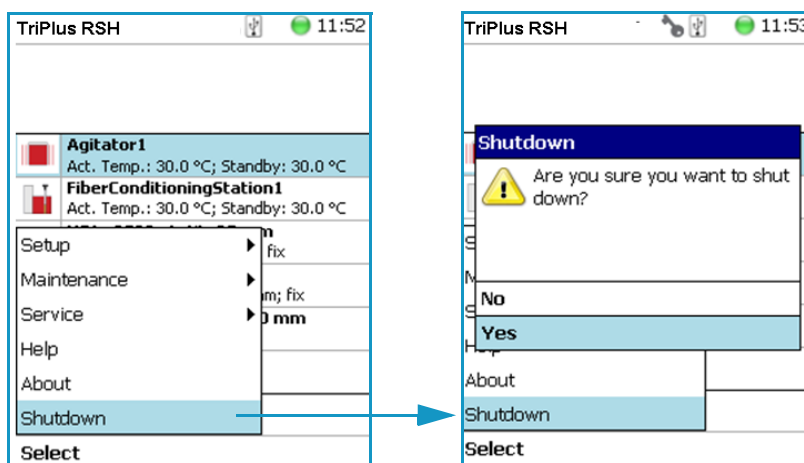
Figure 69. Menu Item About

Shutdown Menu Item

The menu item **Shutdown** gives the operator the possibility to shut down the TriPlus RSH in a controlled manner. See Figure 70.

Figure 70.   Menu Item Shutdown

The main advantage of this automated shutdown is that the Tool is parked. If the system is shut down by simply turning off the power supply, the slider will move very slowly downwards. Parts of the Tool, particularly the syringe needle, can touch the bench surface, or any other object. This can damage the syringe needle.

The following steps are automatically performed during a controlled Shutdown:

- The Head moves to an empty position of the ATC Station, engages and remains in this position.
- If a TR Station is part of the TriPlus RSH configuration, the Head moves to the single slot.
- The software shuts down, closes the application and disables the axes.

After the TriPlus RSH has completed the shutdown procedure, it is necessary to turn off the power supply.

To restart the TriPlus RSH after the shutdown process, toggle the switch of the power supply, turn it off, wait about 30 seconds, then turn on the power of the system.

Operation of the TriPlus System in Combination with Other Chromatography Data Systems

A software driver is used f or operation of the TriPlus RSH with a Thermo Scientific™ Chromatography Data System (CDS). The specific requirements for operating the integrated System within the CDS are outlined by the supplier of the CDS software.

Setup Menu Item

This chapter describes the options of the **Setup Menu** operated either with the Virtual Handheld Controller, or directly using the installed Handheld Controller.

Contents

**Note** Items highlighted in **green** are only visible in the access level **Extended User**.

Starting Setup Menu Item

The **Setup** function is available under the **Options** pull-up menu. The **Extended User Level** provides limited higher functionality in **Setup** than in the restricted **User Level**.

The menu items are listed in alphabetical order.

Press the **Options** button to open the pull-up menu and select the menu item **Setup**. See Figure 71.

Figure 71.   Start Screen Options Pull-up Menu
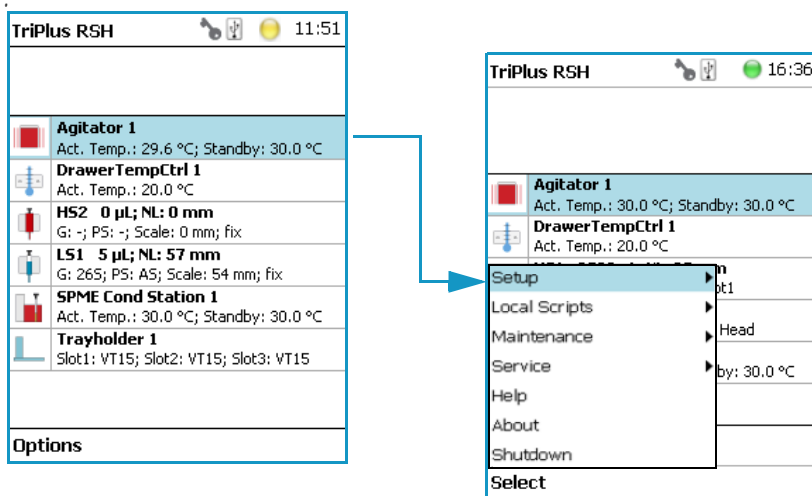
Setup Menu Item Modules

Select the menu item modules to open the list of all installed active and passive modules. See Figure 72.

Figure 72. List of Active and Passive Modules
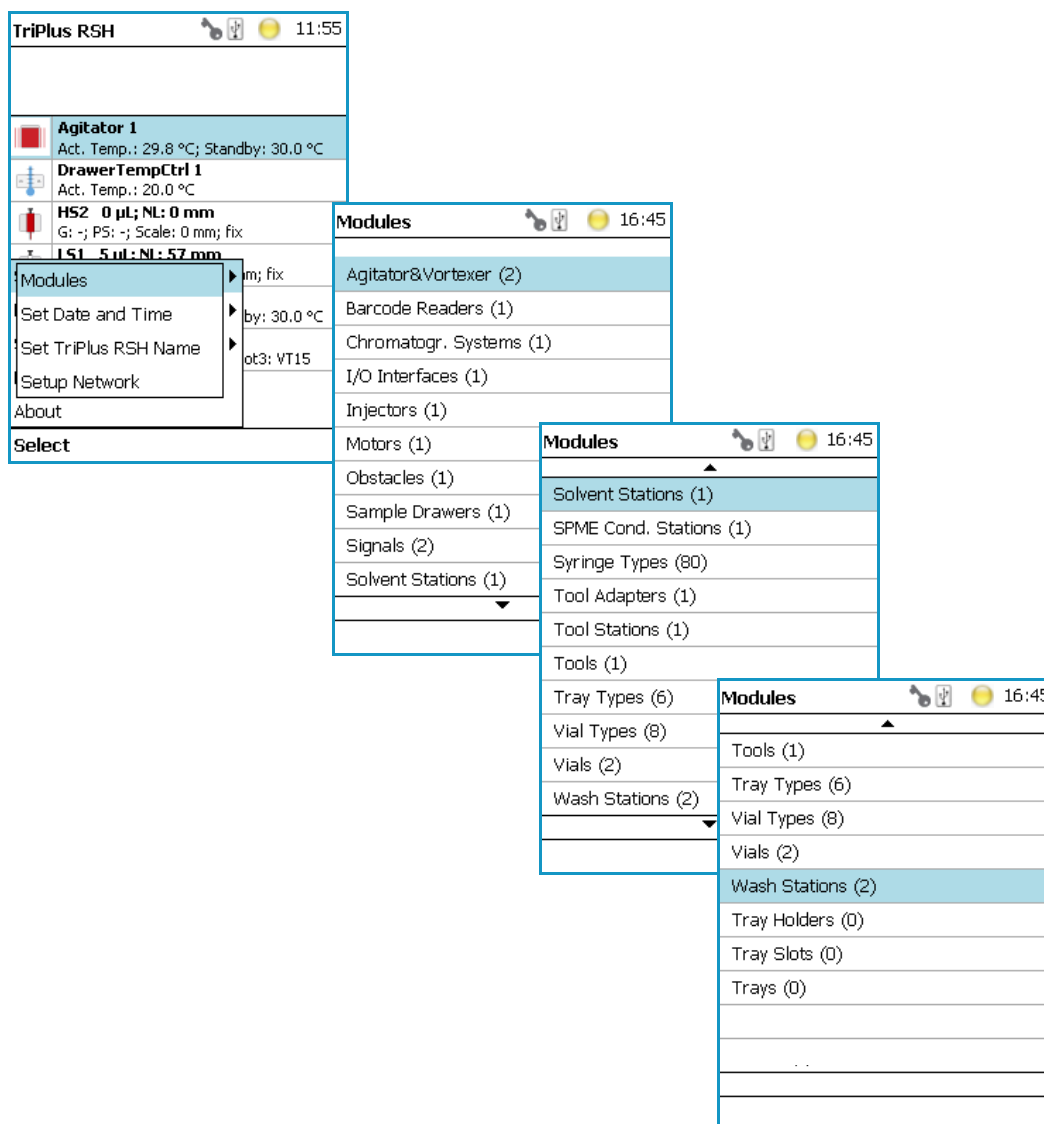
For details, see to the following sections:

- "Agitator/Incubator Module" on page 87

- "Vortexer" on page 91

- "Heatex Stirrer" on page 93

- "Barcode Reader" on page 95

- "Chromatograph System" on page 96

- "Input/Output Interface" on page 107

- "Injectors" on page 110

- "OC Actuator" on page 112

- "Motors" on page 114

- "Obstacle" on page 118

- "Sample Drawers (Temperature Controlled Drawer)" on page 120

- "Tool Stations" on page 123

- "TR Station" on page 123

- "ATC Station" on page 124

- "Signals" on page 126

- "Solvent Stations" on page 129

- "SPME Conditioning Station" on page 132

- "SPME Arrow Conditioning Station" on page 134

- "Syringe Types" on page 136

- "Tool Adapters" on page 139

- "Tools" on page 141

- "Tray Holders" on page 148

- "Tray Types" on page 153

- "Trays" on page 164

- "Vial Types" on page 167

- "Vials" on page 170

- "Wash Stations" on page 175

- "Tray Slots" on page 180

Agitator/Incubator Module

Selecting the list item **Agitator & Vortexer**, the following parameters are available for modification. See Figure 73.

Figure 73. Agitator Parameters
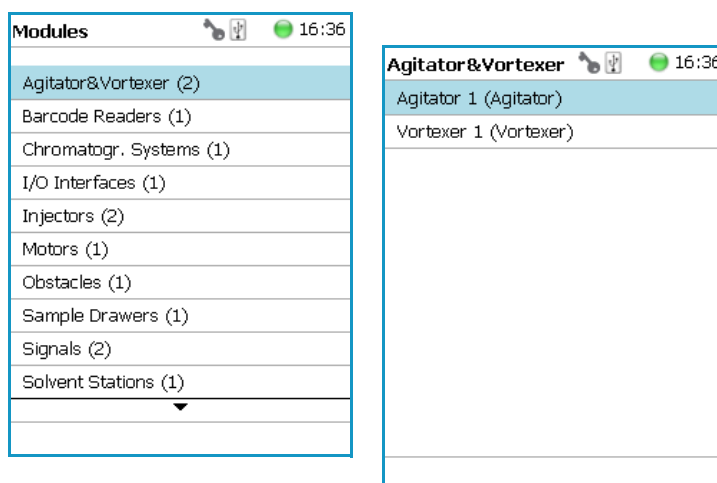
Select **Agitator**, then press **Enter** to edit a parameter. See Table 36.

Table 36. Agitator/Incubator Parameters (Sheet 1 of 2)

Item	Description
Actual Temperature	Reads out the actual temperature of the module; read-only function.
Max Temperature	Sets the upper temperature limit. The Maximum Temperature which can be set is 200 °C.
Min Temperature	Sets the minimal temperature limit.
Standby Temperature	The Standby Temperature can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**. The Standby Temperature is activated when the TriPlus RSH is powered up. In routine use, the Standby Temperature is activated after a job has been terminated. The Standby Temperature is typically lower than the application temperature. See the note below.
Vial Type Pos. 1	The Vial Type for **Position 1** is displayed. Read-only. *The Vial Type can be set with the task* **Setup Modules**.
Vial Type Pos. 2	The Vial Type for **Position 2** is displayed. Read-only. *The Vial Type can be set with the task* **Setup Modules**.

Table 36. Agitator/Incubator Parameters (Sheet 2 of 2)

Item	Description
Vial Type Pos. 3	The Vial Type for **Position 3** is displayed. Read-only. *The Vial Type can be set with the task **Setup Modules**.*
Vial Type Pos. 4	The Vial Type for **Position 4** is displayed. Read-only. *The Vial Type can be set with the task **Setup Modules**.*
Vial Type Pos. 5	The Vial Type for **Position 5** is displayed. Read-only. *The Vial Type can be set with the task **Setup Modules**.*
Vial Type Pos. 6	The Vial Type for **Position 6** is displayed. Read-only. *The Vial Type can be set with the task **Setup Modules**.*
Cover Plate Type	Select the cover plate (lid) used for the Agitator installed. • **Not specified** If defined as **NotSpecified** an execution of the run is prohibited. • **Standard**: The lid must be opened for access. • **Perforated**: Syringe or SPME needle can be inserted through the holes in the lid.
Actual Position	Reads out the position of the Agitator. Read-only.
Stdby Temp Control	If switched off, the module will not go to standby temperature if idle.
Temp Gain	The coefficient used, if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only.
Temp. Offset	The Offset temperature used, if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.

Note A job is often described as a sample list or sequence which is treated in a certain order. A job can also contain a single sample, often seen in method development work. In such cases, you set the Standby Temperature to the same temperature used for the application. Dropping the temperature during runs can be time-consuming and disruptive.

Agitator/Incubator Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 37.

Table 37. Agitator/Incubator Pull-up Menu Options

Item	Description
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done under the **Extended User Level** but not under **User Level.**
Setup Module	Allows the selection of the **Cover Plate Type**, to reserve one or more vials as a source vial (e.g. for a reagent), and to define the Vial Type for the 6 positions. See the section "List Items Agitator/Incubator Reserved Positions and Vial Type" on page 90.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, teaching.
Activate Standby Temperature	Activates the newly-set Standby Temperature.
Check Agitator	Starts the spinning motion of the Agitator. It is used to test the Agitator function, or the spinning speed for particular application. Settings are: • **Options**: On; Off; Home • **Speed**: Select the required speed, range from 250 rpm to 750 rpm Press **Run** to start the Agitator To stop the motion, press **Options** again, select **Check Agitator** and set the parameter **Options** to **Off**. Press **Run**.

List Items Agitator/Incubator Reserved Positions and Vial Type

With the list item **Setup Module** it is possible to reserve one or more positions in the Agitator/incubator for a source vial as required by a specific application, for example to provide an internal standard solution, a reagent solution for a derivatization, or any other solution. Possible reserved positions for source vials begin at **Vial Position 6** and count backwards. In this manner, the first positions are made available for the sample vials.

The vial size can be selected for the remaining free positions and can be selected separately for the reserved vial(-s).

> **Note** Only one vial size can be selected for the reserved vials. The consequence is that during routine applications the vial **overlapping** will be possible only within the free available sample vial positions to optimize the productivity.

The behavior of the following two **Activities** is summarized as follows:

- **Transport Vial** activity — Allowed for available free sample vial positions and for reserved vial positions.

- **Move To Object** activity — Allowed for reserved vial positions only.

The reason for this limitation is because in the **overlapping mode** the sample vial position is managed by the scheduler.

You can change the **Vial Type** at any time during a routine application selecting the menu item **Agitator**, scrolling down to the list item **Vial Type** and selecting another **Vial Type**.

Examples of **Free available** and **Reserved Vial Positions** are visualized in the following images:
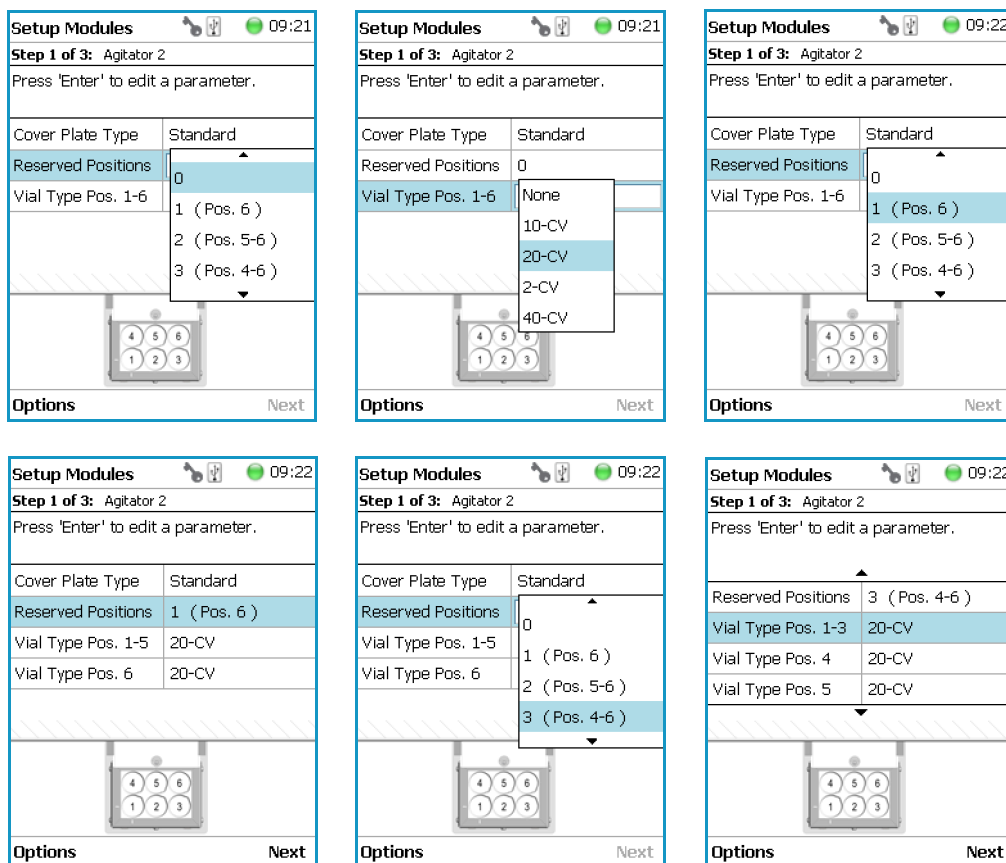
Vortexer

Selecting the list item **Agitator & Vortexer**, the following parameters are available for modification. See Figure 74.

Figure 74. Vortexer Parameters
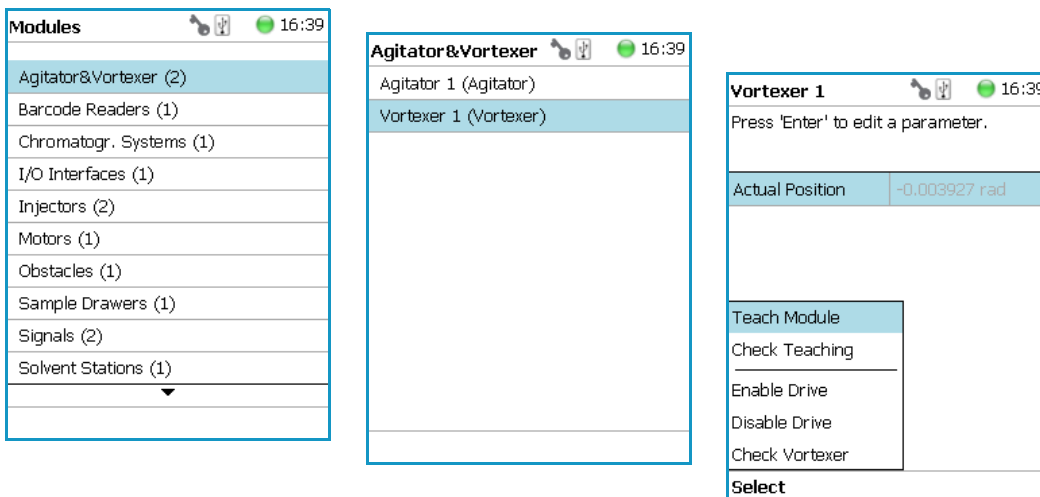
Select **Vortexer**, then press **Enter** to edit a parameter. See Table 38.

Table 38. Vortexer Parameters

Item	Description
Actual Position	Reads out the position of the Agitator; read-only function.

Vortexer Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 39.

Table 39. Vortexer Pull-up Menu Options

Item	Description
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, Z-axes can be defined again, for teaching.
Enable Motor	Enables the motor of the vortexer.
Disable Motor	Disables the motor of the vortexer.
Check Vortexer	Starts the spinning motion of the Vortexer. It is used to test the mixer function or the spinning speed for a particular application. Settings are: **Option** — On; Off; Home **Speed** — Select the required speed, range from 250 rpm to 2500 rpm Press **Run** to start the Vortexer. To stop the motion, press **Options** again, select **Check Vortexer** and set the parameter **Option** to **Off**. Press **Run**.

Heatex Stirrer

Selecting the list item **Agitator & Vortexer**, the following parameters are available for modification. See Figure 75.

Figure 75. Vortexer Parameters
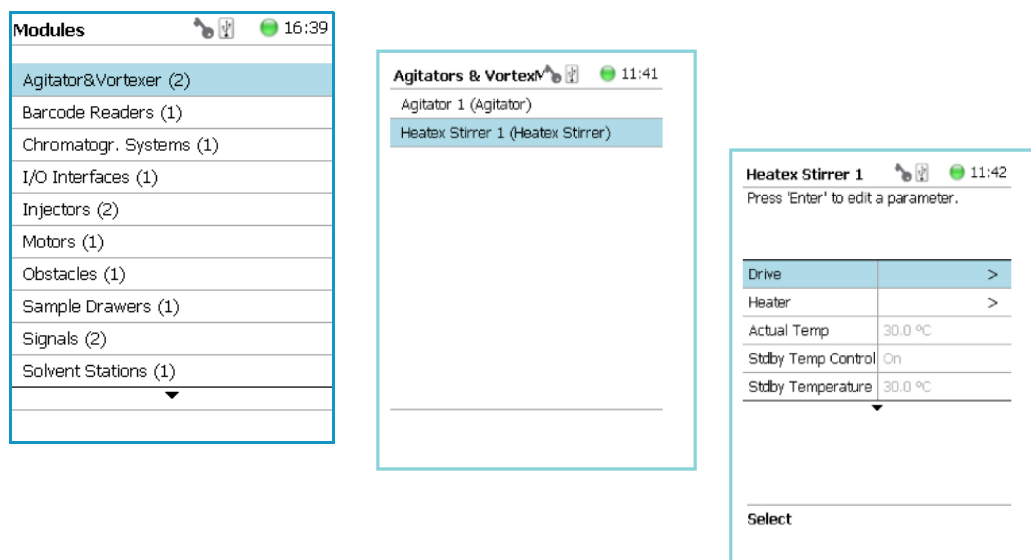
Select **Heatex Stirrer**, then press **Enter** to edit a parameter. See Table 40.

Table 40. Heater Stirrer Parameters (Sheet 1 of 2)

Item	Description
Actual Position	Actual Position
Actual Temp	Shows the actual temperature. Read-only.
Max Temperature	Sets the maximum temperature
Min Temperature	Sets the minimum temperature
Stby Temp Control	If switched off, the module will not go to standby temperature if idle. Read-only - editable in submenu **Heater**
Standby Temperature	The Standby Temperature can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**. The Standby Temperature is activated when the TriPlus RSH is powered up. In routine use, the Standby Temperature is activated after a job has been terminated. The Standby Temperature is typically lower than the application temperature.

Table 40. Heater Stirrer Parameters (Sheet 2 of 2)

Item	Description
Temp Setpoint	Shows the actual target temperature. Read-only.
Temp.Gain	The coefficient used, if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only.
Temp.Offset	The Offset temperature used, if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.
Vial Type	Specifies the type of the used vial.

Heatex Stirrer Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 41.

Table 41. Heater Stirrer Options Pull-up Menu

Item	Description
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done under the Extended **User Level** but not under **User Level**.
Teach Module	The positions of the X-, Y-, and Z-Axes can be defined again, for teaching. See sub-menu **Heater**.
Enable Drive	Enables the Heatex motor. See sub-menu **Heater**.
Disable Drive	Disables the Heatex motor. See sub-menu **Heater**.
Activate Standby Temperature	Activates the newly set standby temperature. See sub-menu **Heater**.
Check Stirrer	Starts the spinning motion of the Heatex Stirrer. It is used to test the mixer function or the spinning speed for particular application. Settings are: • **Option** — On; Off • **Speed** — Select the required speed, range from 250 rpm to 1600 rpm Press **Run** to start the Heatex Stirrer To stop the motion, press **Options again**, select **Check Heatex Stirrer** and set the parameter **Option** to **Off**. Press **Run**.

Barcode Reader

Selecting the list item **Barcode Reader**, the following parameters are available for modification. See Figure 76.

Figure 76. Barcode Reader Parameters
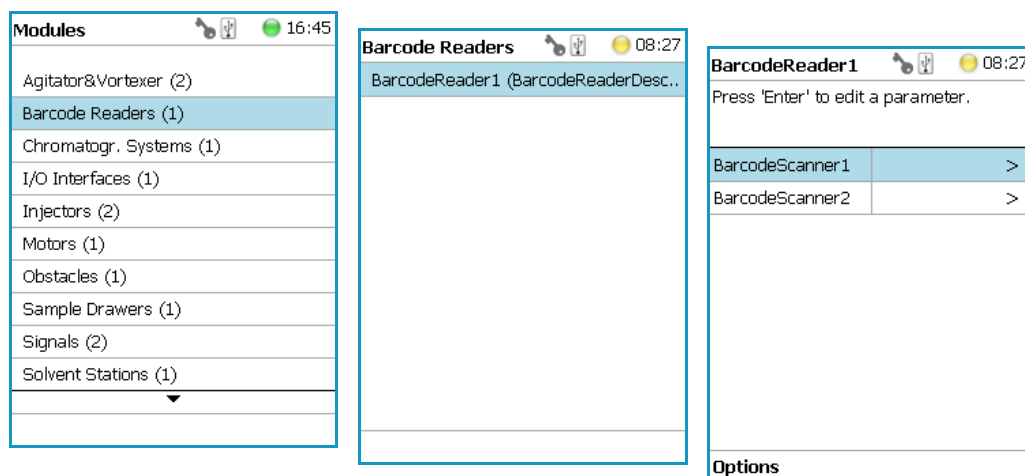
Press **Enter** to edit a parameter. See Table 42.

Table 42. Barcode Reader Parameters

Item	Description
Scanner	Select Scanner #1 or #2.
Beep After Decode	A beep tone can be activated after positive decoding of the barcode.

Barcode Reader Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 43.

Table 43. Options Menu Item Check Teaching (Sheet 1 of 2)

Item	Description
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.

Table 43. Options Menu Item Check Teaching (Sheet 2 of 2)

Item	Description
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, teaching.
Scan Barcode	Checks the Barcode Reader. Hold a barcode label in the beam of the laser and activate **Scan Barcode**. A beep tone signals a successful reading

Chromatograph System

The **Chromatograph System** is a bundle of **Input and Output Signals** dedicated for a chromatographic system. This bundle must be configured and can be assigned to a specific chromatographic system for routine use. This minimizes erroneous functions and simplifies the user interface.

This is the last step in the setting up and synchronization of **Input/Output Signals** between the TriPlus RSH system and the external device. See also the section "Input/Output Interface" on page 107, and the section "Signals" on page 126.

Selecting the list item **Chromatograph System**, the following parameters are available for modification. See Figure 77.

- **GC1** = Name for GC System No.1

- **(GC)** = Class description GC System

Figure 77. Chromatography System - Selection and Parameters
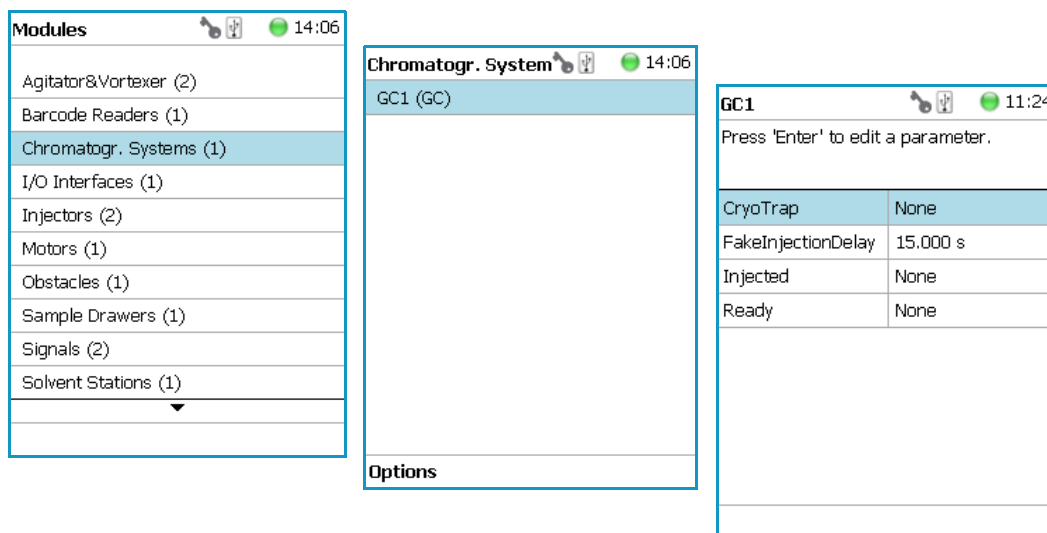
Press **Enter** to edit a parameter. See Table 44.

Table 44. Chromatography System Parameters

Item	Description
Cryo Trap	Sets start signal for the Cryo Trap, Output signal required.
Fake Injection Delay	Sets the delay time until the start of a fake injection. A fake injection performs a start of the chromatographic system, without injection of a sample.
Injected	Sets start signal for the chromatographic system, for example GC System1. Output Signal is required.
Ready	A ready signal from another device is expected as an Input Signal.

Note The synchronization between the TriPlus RSH and any chromatographic system has to be checked for each particular system configuration. The setting of the synchronization signal has to be matched with the pin allocation of the synchronization cable.
The original cable are labeled. Check the labels first before connecting. This is especially important with the Y-cable configurations where two GC units are connected to a single TriPlus RSH.

Chromatograph System Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 45.

Table 45. Chromatography System Pull-up Menu Options

Item	Description
New Chromatograph System	Creates a new Chromatograph System.
Copy GC	Copies the Chromatograph System, GC1 as the example.
Delete GC	Deletes the Chromatograph System; GC1 as the example.

Dilutor

Setting Up the Dilutor Syringe Module

**Note** There are two different ways to access the steps for setting up the Dilutor Syringe Module.

- Using the **Options** menu from the Start Screen. See "First Path" on page 98.
- Selecting the menu item **Dilutor x** from the Start Screen. See "Second Path" on page 99.

First Path

Use the **Options** Pull-up menu under the Start Screen.

Select the access level **Extended User** then navigate to the Start Screen. See Figure 78.

Figure 78. Dilutor Module Start Screen and List Items (1)

The last two figures reflect the List Items of a Dilutor, while the Dilutor Valve is not yet specified.

In the case of a Single Solvent Valve two Fluid Ports are configurable

In the case of a 7-port Valve six Fluid Ports, are configurable.
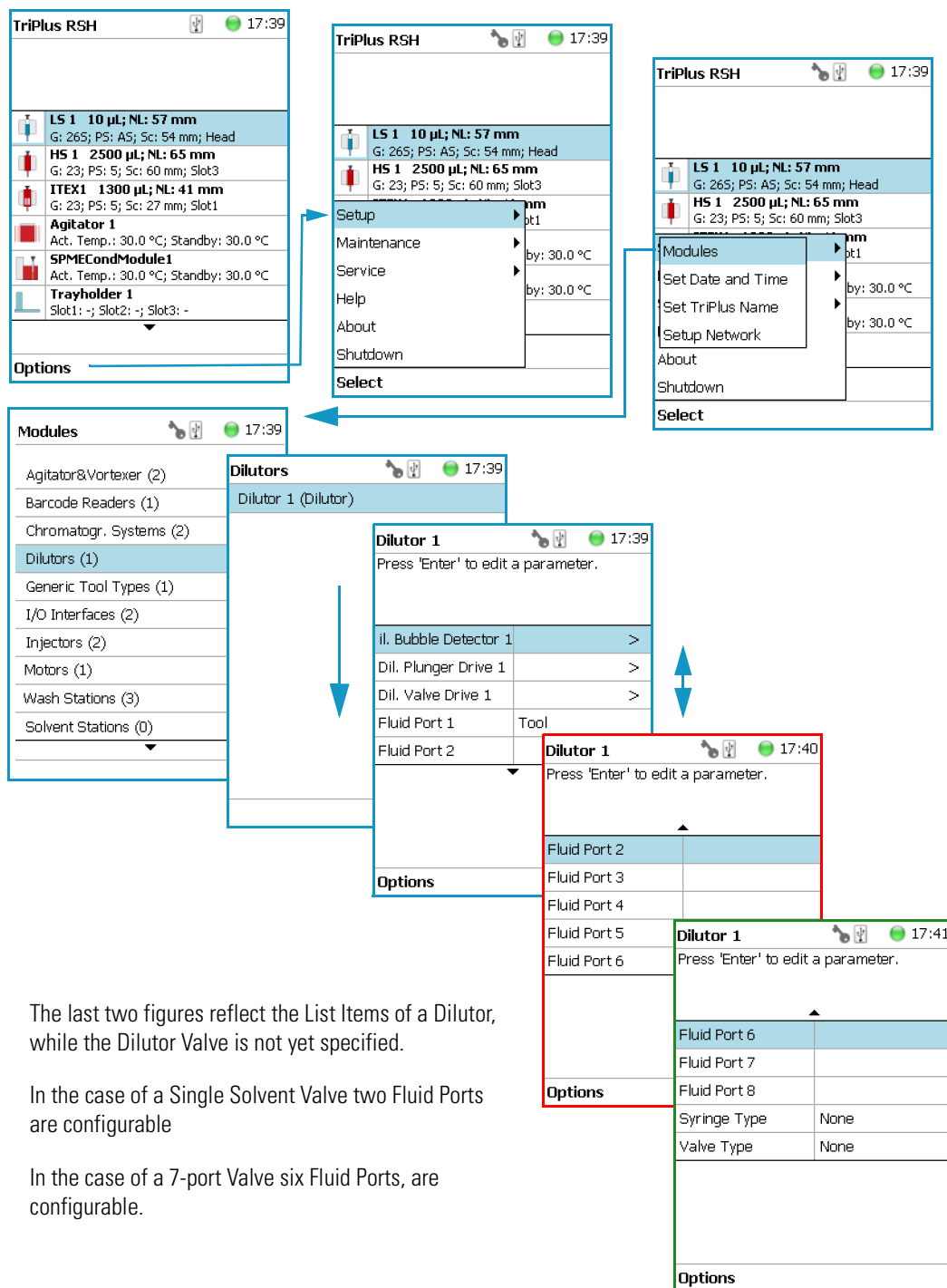
Second Path

The Dilutor Syringe Module List Items are accessible directly from the Start Screen. See Figure 79.

Figure 79.   Dilutor Module Start Screen and List Items (2)
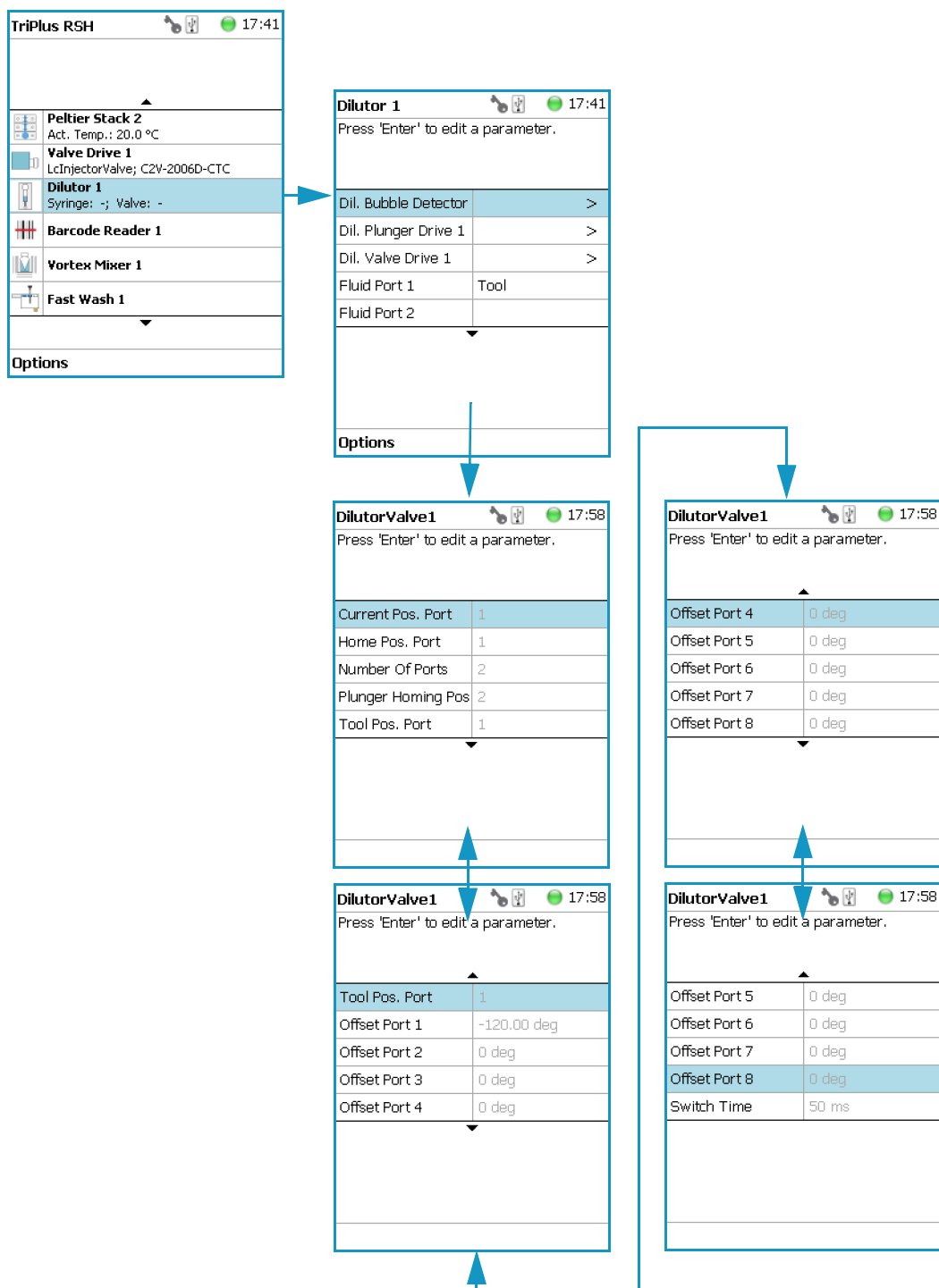
Dilutor Module Parameters

Table 46 lists the Dilutor Module parameters.

Table 46. Dilutor Module Parameters

Item	Description
Dil. Bubble Detector	Updates the parameters of the Bubble Detector.
Dil. Plunger Drive	The actual position of the Plunger in µm. Read-only parameter.
Dil. Valve Drive	Shows the Actual Position in degree and the Valve Type of the Dilutor Valve. Read-only parameter.
Fluid Port 1 - 8	Specifies a name for each liquid at the corresponding port. The number of Fluid Ports corresponds to the number of ports of the Dilutor Valve installed.
Syringe Type	Selects the type of the Syringe in the Dilutor Syringe Module.
Valve Type	Selects the Type of the Dilutor Valve in the Dilutor Syringe Module.
Dilutor Valve	Shows some read-only parameters of the Dilutor Valve.
Current Pos. Port	The currently selected port.
Home Pos. Port	The port defined as Home Position.
Number of Ports	The number of ports.
Plunger Homing Pos.	The port used for homing the plunger.
Tool Pos. Port	The port the Dilutor Tool is connected to.
Offset Port 1-8	The offset in degrees for each port.
Switch Time	Define the time for switching between the ports.

Options Menu Items for Dilutor (x)

Selecting **Options** pull-up menu, the following tasks are opened. See Table 47 and Figure 80.

Table 47. Dilutor Module Pull-up Menu Options (Sheet 1 of 2)

Item	Description
Change Syringe	The plunger of the Dilutor is moved down to enable the exchange of the syringe.
Setup Module	Sets up the configuration parameters for the Dilutor module and the Dilutor Tool.
Prime Dilutor	A selectable Solvent Port of the Dilutor is primed. Specifies the Solvent Port as well as the total liquid volume for priming. The number of cycles is calculated by the total volume divided by the volume of the Transfer Tubing.

Table 47. Dilutor Module Pull-up Menu Options (Sheet 2 of 2)

Item	Description
Home Plunger	The Plunger is moved to the home position and the Z-Axis is referenced.
Home Drive	Moves the Dil. Plunger Motor to Home position.
Enable Drive	Enables the selected motor after it has been disabled.
Disable Drive	Disables the selected motor to permit moving it manually.

Figure 80. Dilutor Module Options Menu (1)
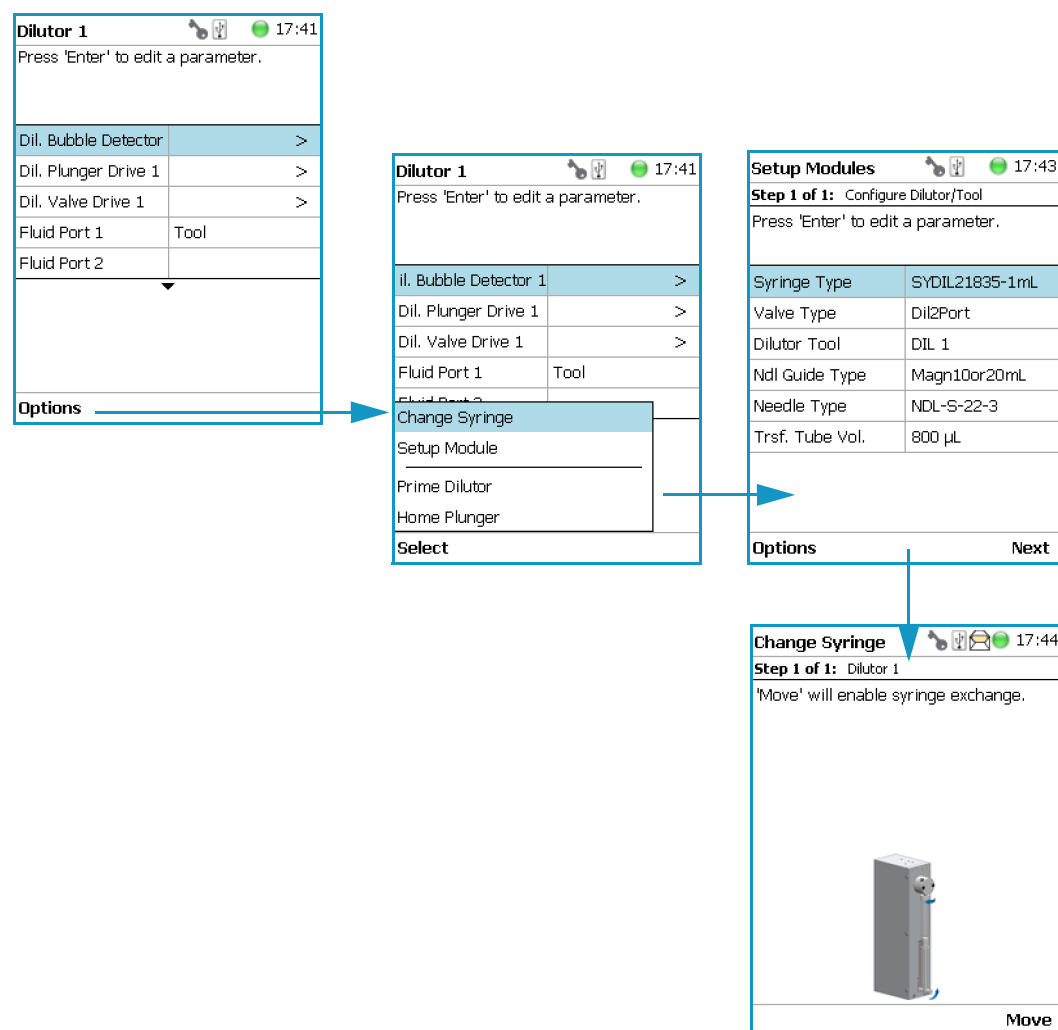
Selecting the item **Setup Module** from the **Options** Pull-up Menu allows you to setup the Dilutor Module and the corresponding Tool in one menu.

All parameters can also be adapted separately within the corresponding sub-menus of the Dilutor Tool and the Dilutor Module.

Using the **Options** Pull-up menu in the sub-menus **Dil. Plunger Drive** and **Dil. Valve Drive**, the corresponding motor (drive) can be disabled or enabled.

This functionality is useful if the plunger or the valve motor must be moved manually. See Figure 81.

Figure 81. Menu Options (2)
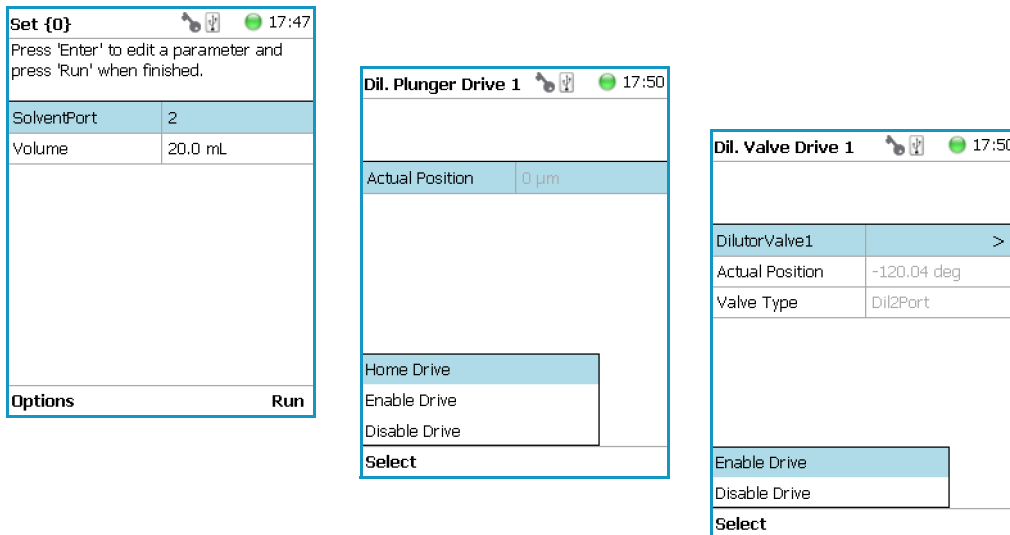
Setting Up the Dilutor Tool

Note There are two different ways to access the steps for setting up the Dilutor Syringe Module.

- One path uses the **Options** menu from the Start Screen. See "First Path" on page 102.

- The second path is by selecting the menu item **DIL x** from the Start Screen. See "Second Path" on page 104.

First Path

The **Options** Pull-up menu under the Start Screen is used.

Select the access level **Extended User** then navigate to the Start Screen. See Figure 82.

Figure 82. Dilutor Tool Start Screen and List Items (1)
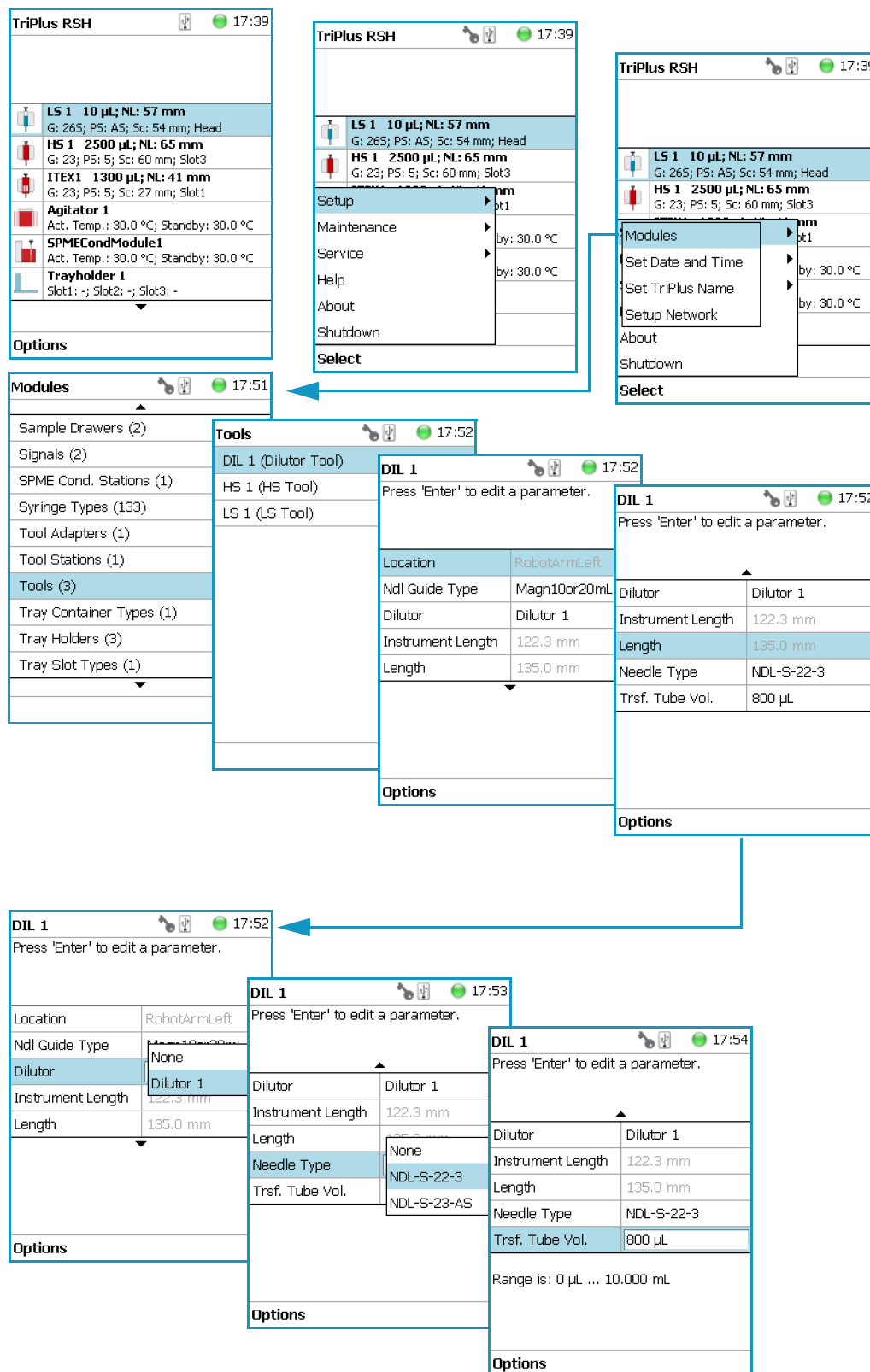
Second Path

The Dilutor Tool List Items can be accessed directly from the Start Screen. See Figure 83.

Figure 83. Dilutor Tool Start Screen and List Items (2)
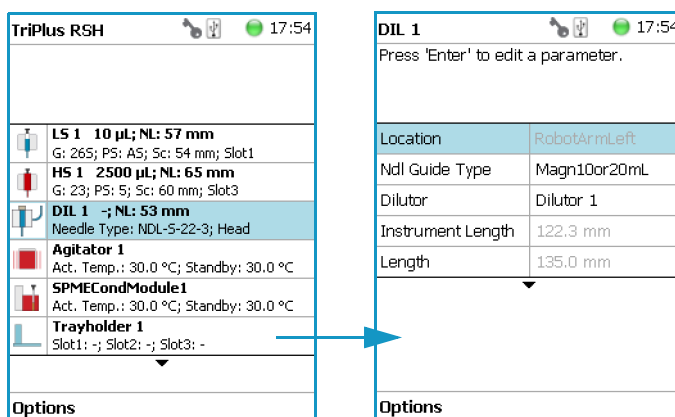
Dilutor Tool Parameters

Table 48 lists the Dilutor Tool parameters.

Table 48. Dilutor Tool Parameters

Item	Description
Location	The location of the Tool. Read-only parameter.
Dilutor	Selects the corresponding Dilutor Module to which the Tool will be connected.
Instrument Length	The total length of the instrument without the height of the instrument base plate. Read-only parameter.
Length	The total length of the instrument including the height of the instrument base plate. Read-only parameter.
Ndl Guide Type	Selects the Type of the Needle Guide.
Needle Type	Selects the needle type to use.
Trsf. Tube Vol.	Specifies the volume of the Transfer Tubing. The Volume is calculated using the following formula: $$V = \pi \times r^2 \times l$$ where: V = volume of the tubing. r = half of the inner diameter of the tubing l = length of the tubing Typical values for the volume of the transfer tubing are in the range of 800 µL.

Options Menu Items for DIL (x)

Selecting **Options** pull-up menu, the following tasks are opened. See Table 49.

Table 49. Dilutor Tool Pull-up Menu Options

Item	Description
Calibrate Tool	Calibrates the Tool installed in the head.
Check Tool Calibration	Checks the calibration point of the Tool installed in the head.
Select Tool	Selects another Tool. The currently attached Tool is first parked and the newly-required Tool is picked up.
Park Tool	Parks a Tool without picking up another Tool from the ATC Station.

Calibrating the Dilutor Tool

Note Refer also to the section **Calibrate Tools** in the *TriPlus RSH User Guide*.

The calibration of the motors is basically a check to determine whether the mechanical stop points of the various axes can be detected reliably. A clearance distance (offset) from the mechanical stop point is assigned and stored as the electronic stop point. This calibration of the axes is mandatory and ensures reliable performance.
This step must be repeated if a motor has failed, has been replaced, or when any other major error has occurred. This calibration task brings the robot back to reliable operation.

❖ **To calibrate the dilutor tool**

1. Select the access level E**xtended User**, then from the Start Screen select the item **Dilutor Tool DIL1**. See Figure 84.

Figure 84. Dilutor Tool Calibration (1)
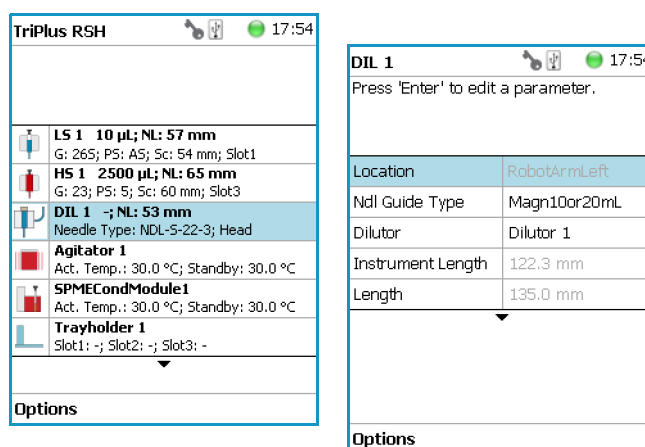
2. Press **Options**, select **Calibrate Tool** and follow the wizard. See Figure 85.

Figure 85. Dilutor Tool Calibration (2)

Alternatively, the Dilutor Tool can also be calibrated from the Start Screen using the path **Options | Service | Installation | Calibrate Tools**. The wizard will guide you through the calibration process.

Note It is recommended to create a backup file when a module has been added or moved within the TriPlus RSH system.

Input/Output Interface

This section provides the signal settings and synchronization to the external device, such as a GC System. It is the second step in the setting up and synchronization of Input/Output Signals between the system and the external device. See Figure 86.

See also the sections "Chromatograph System" on page 96 and "Signals" on page 126.

Figure 86. Menu Item for Input/Output Interface
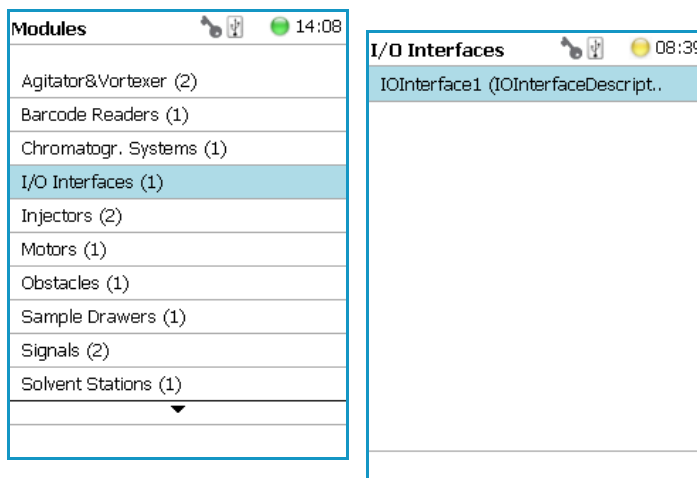
Press **Enter** to edit a parameter.

Selecting the list item **I/O Interface**, the following parameters are available for modification. See Table 50.

Table 50. List of Items for Input and Output Signals (Sheet 1 of 3)

Item	Description
Immediate *Ignores any Input or Output Signal*	Signal On Debounce Time
Opto In1 *Opto-isolator or Opto-coupler*	Signal On Debounce Time Negative Logic
PWM Out *Pulse-Width Modulation*	Signal On Output Voltage
Reset Button *Reset Button on Control Board*	Signal On Debounce Time Low Active
Simulated *This signal can be used for testing, simulation of sending a signal (Output Signal)*	Signal On Trigger Event Waiting Time

Table 50. List of Items for Input and Output Signals (Sheet 2 of 3)

Item	Description
Software In *Signal for Handshake with CDS Software*	Signal On
Software Out *Signal for Handshake with CDS Software*	Signal On
SW Out1 *Switch-out Signal, Relay contact*	Signal On Low Active
SW Out2 *Switch-out Signal, Relay contact*	Signal On Low Active
TTL In1 *Transistor-Transistor Logic*	Debounce Time Low Active
TTL In2 *Transistor-Transistor Logic*	Signal On Debounce Time Low Active
TTL In3 *Transistor-Transistor Logic*	Signal On Debounce Time Low Active
TTL Out1 *Transistor-Transistor Logic*	Signal On Low Active
TTL Out2 *Transistor-Transistor Logic*	Signal On Low Active
TTL Out3 *Transistor-Transistor Logic*	Signal On Low Active
Beep Volume	Selectable scale from 1 to 5
Debounce Time	Specifies how long the signal is applied.
Low Active	The standby status of a signal from the chromatographic system can be **High Active** or **Low Active**. Depending on what has to be applied for the specific system, one has to match the signal logic to that of the TriPlus RSH. By setting a mark to **Low Active** means that **Low Active** is selected. Low Active disabled means that **High Active** is selected. Information for the required signal logic is provided with the schematic of the sync cable which is part of the GC mounting kit.
Signal On	**Signal On** means that the signal has been sent or received.

Table 50. List of Items for Input and Output Signals (Sheet 3 of 3)

Item	Description
Output/Voltage	An output voltage in the range from 0 V to 35 V can be selected.
Trigger Event	Select the desired type of output signal for testing.
Waiting Time	Select the time to be waited until the signal is activated, delay time in seconds.
Beep Volume	The sound volume for the Beep tone can be selected.

Input/Output Interface Pull-up Menu

Selecting **Beep** from the **Options** pull-up menu, the following tasks are opened. See Table 51.

Table 51. Option Pull-up Menu for Input/Output Interface

Item	Description
Reset to Default	Resets the selected module parameter to default value.
Beep	Actives a Beep sound local on the TriPlus RSH. If activated, you can select the **Duration**, **Frequency** and the **Volume** of the tonal sound.
Duration	The time for the tonal sound is selectable from 100 ms to 60 seconds.
Frequency	The frequency of the tonal sound is selectable from 100 Hz to 10000 Hz.
Run	Activates the tonal sound with the selected parameters for testing.
Beep Utility	Sets the frequency and the time length of the beep tone.

From all other list parameters the pull-up menu **Beep** is directly available.

Injectors

Selecting the list item **Injectors**, the following parameters are available for modification. See Figure 87.

Figure 87. Injectors - Selection and Parameters
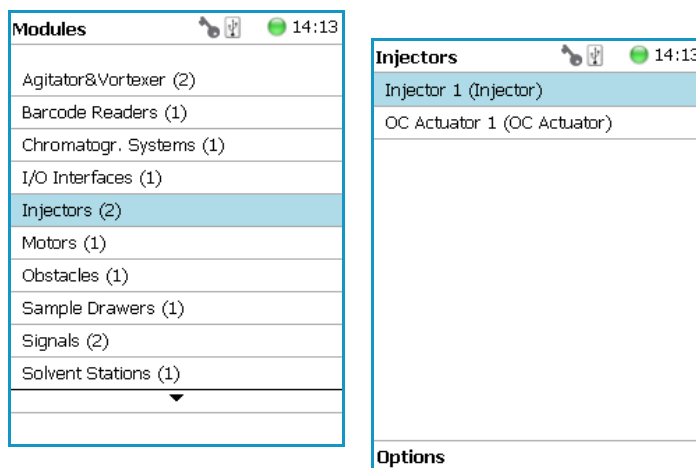
Press **Enter** to edit a parameter. See Table 52.

Table 52. Injector Parameters (Sheet 1 of 2)

Item	Description
Default Needle Penetration Depth	Defines the **Needle Penetration Depth** in the GC injector.
Max Needle Penetration Depth	Sets the upper limit of **Needle Penetration Depth** into the GC injector.
Min Needle Penetration Depth	Sets the minimum limit of **Needle Penetration Depth** into the GC injector. **WARNING** This parameter is used for **SPME** and SPME **Arrow** Tools only. This parameter is not used for **LS**, **HS**, or **ITEX DHS** Tools. The default value is 18 mm. The adjustable range is from 10 mm to 50 mm.
Position Tolerance	Checks the difference between the taught X-Y-Axes positions against the actual position each time the head moves to the GC Injector. If the difference is greater than the **Position Tolerance** of 3.0 mm (default value) the TriPlus RSH immediately stops. This is a safety feature to avoid needle bending. **WARNING** It is highly recommended to check the teaching positions of the injectors again when the GC is ready (heated up to the level as used for routine runs).

Table 52. Injector Parameters (Sheet 2 of 2)

Item	Description
Z Tolerance	A tolerance window to give a plus/minus range (expressed in mm) in which the Head must expect an object.
	• If the value of this item is **> 0**, indicates a relative detection mode is triggered, and the sensor from the Head needle guide is active.
	• If the value of this item is set to **0**, the sensor of the needle guide is turned off and the syringe slider moves to an absolute value: the Z-axis position as specified for the object.

Injectors Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 53.

Table 53. Option Menu for Injectors

Item	Description
Reset to Default	Resets the selected module parameter to default value.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, (teaching).
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is incorrect, return to the **Setup** Menu for readjustment of the teaching position. This action can be done only under the **Extended User Level**.

OC Actuator

The OC Actuator allows the opening and closing of the On-column Injector rotary valve when the syringe needle is inserted or removed.

The OC Actuator is an active module, which means that the **OC Electronic Box** is connected to the Bus and the cable from the GC Injector is connected to the Box.

> **Note** The OC Adapter is part of the GC On-Column Injector and it is not provided with the TriPlus RSH.

Selecting the list item **OC Actuator**, the following parameters are available for modification. See Figure 88.

Figure 88. OC Actuator - Selection and Parameters
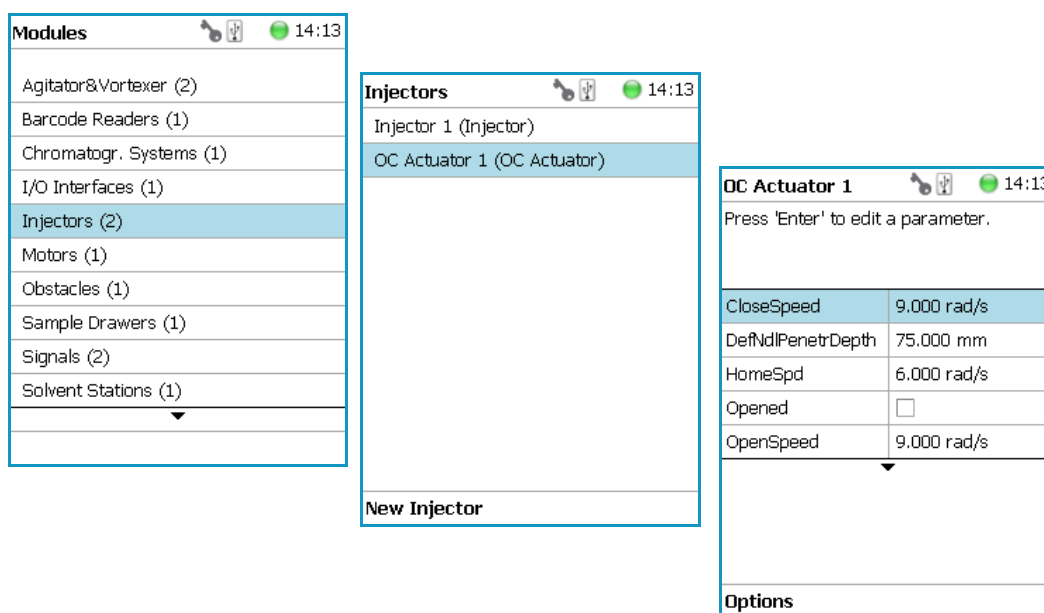
Press **Enter** to edit a parameter. See Table 54.

Table 54. OC Actuator Parameters (Sheet 1 of 2)

Item	Description
Def Ndl Penetr Depth	Defines the **Needle Penetration Depth** in the OC injector.
Opened	Changes the status **Opened** or **Closed**. This parameter is a check if the **gas lock** is opened or closed. If marked as true (check box marked) the injector is defined as **open**. This can be verified by inserting a syringe manually and if a resistance is noted, the gas lock is closed. If a mismatch is observed, check the settings of the parameters **Homing Direction** and **Homing Position**.

Table 54. OC Actuator Parameters (Sheet 2 of 2)

Item	Description
Actual Position	Reads out the position of the OC Actuator. This information can be used for troubleshooting purposes.
Homing Direction	Changes the direction of homing.
Homing Position	Changes the position of homing.
Max Ndle Penetr Depth	Defines the maximum allowed syringe needle penetration in millimeters.
Position Tolerance	Checks the difference between the taught X-Y-axes positions against the actual position each time the head moves to the OCI. If the difference is greater than the **Position Tolerance** of 1.5 mm (default value) then the TriPlus RSH immediately stops. This is a safety feature to avoid needle bending.

OC Actuator Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 55.

Table 55. OC Actuator Options Pull-up Menu

Item	Description
Reset to Default	Resets the selected module parameter to default value.
Check Teaching	Checks the teaching position of the module.This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, Z-axes can be defined again, (teaching).
Check OC Alignment	Verifies the Needle Penetration in the OC Injector.
Check OC Actuator	Verifies the opening and closing of the OC Actuator.

Motors

Upon selecting the list item **Motors**, the following parameters are available for modification. See Figure 89.

Figure 89. Motors Menu
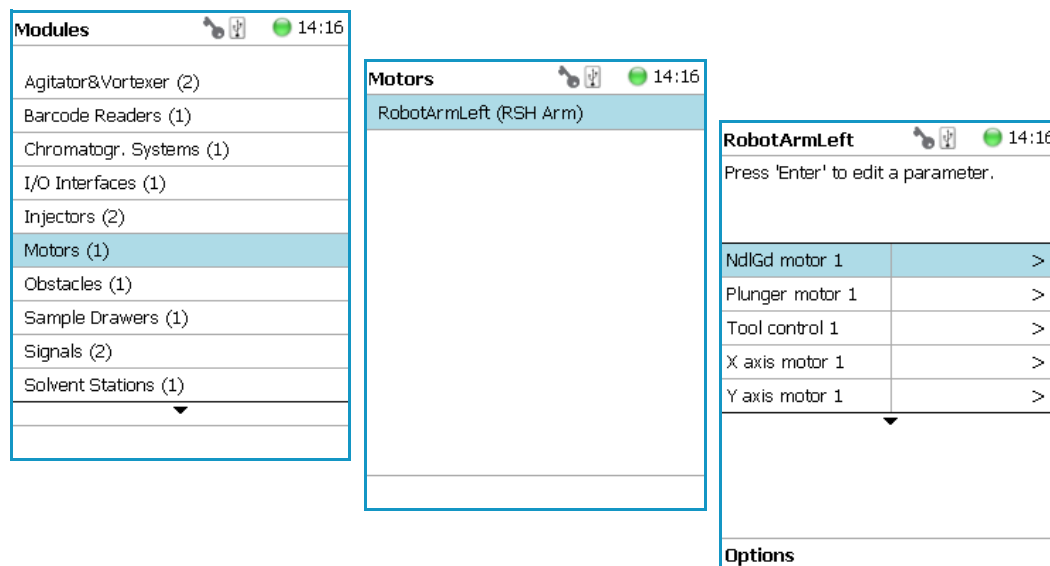
Press **Enter** to edit a parameter. See Table 56.

Table 56. List of Motors (Sheet 1 of 2)

Item	Description
Needle Gd Motor (#) (Motor V)	Actual position — Reads only for information.
Plunger Motor (#) (Motor W)	Actual position — Reads only for information.
	Check Plunger — Checks the presence of the plunger.
Tool Control	Shows which Tool is assigned and whether it is attached to the head. See the section "Tools" on page 141.
X Motor (#)	Actual position — Reads only for information.
	Total Axis Length— The length of the 850 mm or 1200 mm X-axis.
Y Motor (#)	Actual position — Reads only for information.
Z Motor (#)	Actual position — Reads only for information.
Acceleration Factor	Allows adjusting the acceleration of the motors.
	Note that a change of the Acceleration Factor does affect all the motors.

Table 56. List of Motors (Sheet 2 of 2)

Item	Description
Default Strategy	Defines of the global movement of the TriPlus RSH Head across the system platform. The following selections are possible:
	• **Parallel** — Allows simultaneously movement of all axes. This is the default mode. When the TriPlus RSH operates in this mode, the positions and heights of the known modules are respected. The TriPlus RSH changes the strategy automatically to accommodate the existing modules. *For example*: if one module is higher than another, the TriPlus RSH would lower the Z-axis to the zero position to allow the modules to cross over. If an external object is within the platform, for example a GC Detector, then the X-, Y-, and Z-positions of this potential obstacle are not known to the TriPlus RSH. In such a case, it is necessary to switch the strategy to **Safe** mode.
	• **Safe** — The Y-axis moves from any point first to zero Y (back to the X-axis) before the X-movement is started. This mode allows bypassing of an object (such as a large GC detector) that would be directly in the travel path if the **Parallel** mode is used.
Default Waste	Selects the corresponding Wash Module installed.
	None: **Important**: A Waste Module must be defined; default value is **None**.
	The selection defines a **Waste Positions** of the Fast Wash Module, Large Wash Module, or Standard Wash Module.

Motors Pull-up Menu Options

Selecting **Options** pull-up menu, the following tasks are opened. See Table 57.

Table 57. Option Pull-up Menu for Motors (Sheet 1 of 3)
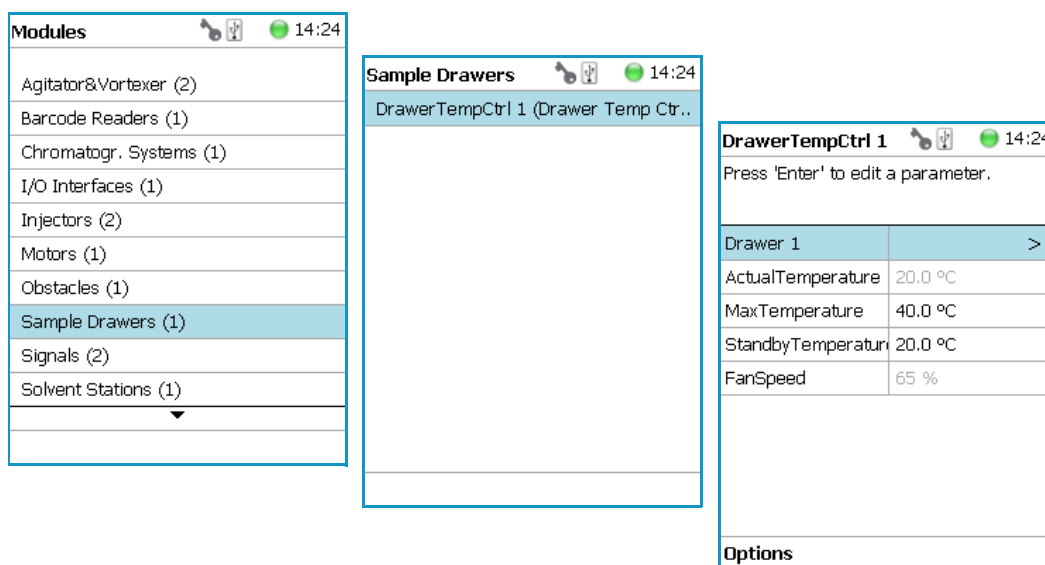
Item	Description
Calibrate Motors	Calibrates the motors. This task might be necessary after a motor has been disconnected. This is a recovery feature.
	For further details see "Service Menu Item" on page 193.

Table 57. Option Pull-up Menu for Motors (Sheet 2 of 3)

Item	Description
Teach Home Position	Allows a Home Position of the head to be defined, which can be at any X-, Y-, or Z-position.
Home RSH Head	Moves the TriPlus RSH Head to **Home** position and references all axes.
Disable RSH Head	All axes are electrically isolated, enabling the operator to move the axes manually.
Enable RSH Head	The axes (motors) are reconnected to mains again.
Move to Home	Moves the TriPlus RSH Head back to **Home** position, without referencing the axes.
Select Tool Utility *Visible only when TR Station is installed*	Picks the Tool from the TR Station.
Purge Syringe *Visible only when HS Tool or ITEX Tool is installed*	The gas purge valve, used for example for cleaning the headspace syringe, is manually activated. Can be used to check the functionality of the purge valve.
ATC Tool *Visible only if ATC Station is installed*	Provides the possibility to change a Tool on demand. If this task is activated, a window opens for the Tool; select the required Tool, and press **Run**. The RSH Head moves to an open Slot (starting with Slot1, if occupied it moves to Slot 2 or 3), ejects the Tool, and moves to the Slot where the required Tool is parked. The new Tool will be mounted, and the TriPlus RSH will be ready for the next application.
TR Tool *Visible only if TR Station is installed.*	The installed Tool will be parked in the TR Station.
Configure SPME Tool *Visible only if SPME Tool is installed.*	Configures the SPME Tool with Fiber adjustments.
Configure SPME Arrow Tool *Visible only if SPME Arrow Tool is installed.*	Configures the SPME Arrow Tool with Fiber adjustments.
Home Motor	Allows the Home position of the selected motor.
Enable Motor	Allows enabling the selected motor after it has been disabled.

Table 57. Option Pull-up Menu for Motors (Sheet 3 of 3)

Item	Description
Disable Motor	Allows disabling the selected motor to permit moving the corresponding axis manually.
Calibrate Tool	Allows calibrating the Tool installed in the head.
Check Tool Calibration	Allows checking the calibration point of the Tool installed in the head.
Select Tool	Allows selecting another Tool. The currently-attached Tool is first parked and the newly-required Tool is picked up.
Park Tool	Allows parking a Tool without picking up another Tool from the TR Station.
Reset to Default	Resets the selected module parameter to the default value.

Obstacle

The **Obstacle** is a module or detector that could get in the path way of the TriPlus RSH. The dimensions and the position of the Obstacle can be defined. The TriPlus RSH will exclude this area from the allowed path way and will bypass it.

A **Teach Position** can be defined. It is thought for third-party modules that are not necessarily mounted on the X-Axis of the TriPlus RSH. Using this functionality, you can teach the position for the placement of a single vial.

Upon selecting the list item **Tools Station**, the following parameters are available for modification. See Figure 90.

Figure 90. Obstacle - Selection and Parameters
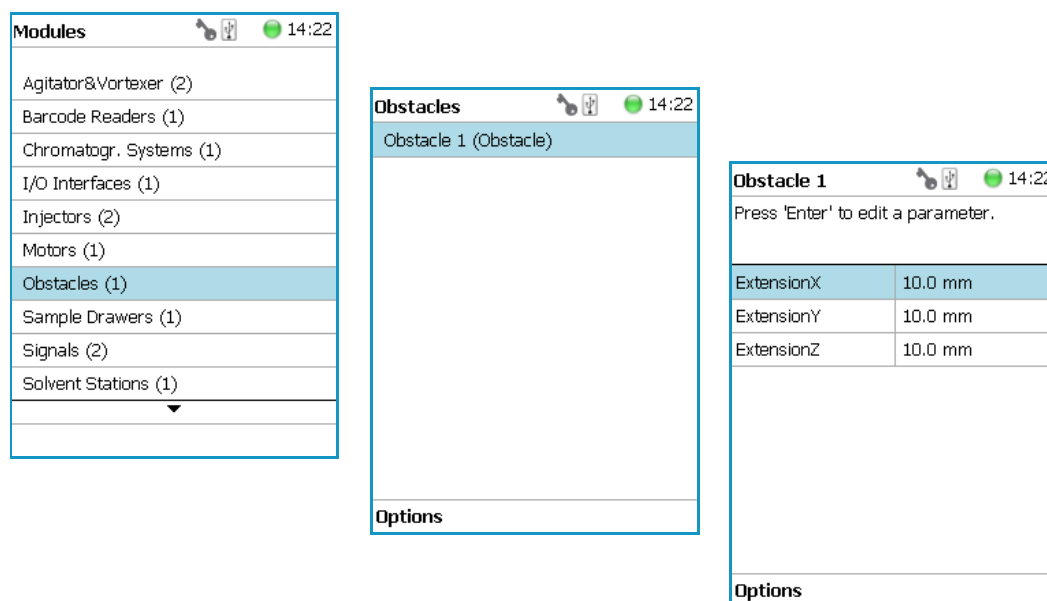
Press **Enter** to edit a parameter. See Table 58.

Table 58. Obstacle Parameters

Item	Description
Extension X	Extension from the center point of the **Obstacle** in X-axis direction.
Extension Y	Extension from the center point of the **Obstacle** in Y-axis direction.
Extension Z	Extension from the center point of the **Obstacle** in Z-axis direction.

Obstacle Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 59.

Table 59. Obstacle Option Parameters

Item	Description
New Obstacle	Creates a new obstacle.
Copy Obstacle	Copies the present obstacle.
Delete Obstacle	Deletes the present obstacle.
Reset to Default	Resets the selected module parameter to default value.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined for teaching.

Sample Drawers (Temperature Controlled Drawer)

> **Note** The Temperature Controlled Drawer can be adjusted through the BUS protocol. For the power supply it is mandatory to use a second Power Module. Do not use the same power supply as used for the TriPlus RSH.

Selecting the list item **Sample Drawers**, the following parameters are available for modification. See Figure 91.

Figure 91. Menu Item Temperature Controlled Drawer and Menu List Item

Press **Enter** to edit a parameter. See Table 60.

Table 60. Temperature Controlled Drawer Module Parameters (Sheet 1 of 3)

Item	Description
Drawer #	This parameter is for information only. The status of the drawer can be checked in **Drawer Status**.
Actual Temperature	This parameter is for information only.
Max Temperature	The maximum temperature which can be set is 40 °C, but this parameter is often defined by your specific needs.
Min Temperature	Sets the minimum temperature.
Standby Temperature	The Standby Temperature can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**. The Standby Temperature is activated when the TriPlus RSH is powered up.

Table 60. Temperature Controlled Drawer Module Parameters (Sheet 2 of 3)

Item	Description
Standby Temperature (*Continued*)	In routine use, the Standby Temperature is usually activated after a job has been terminated. The Standby Temperature is typically around ambient temperature; this helps to dry out the internal parts of a Temperature Controlled Drawer eliminating condensation.
Temp Setpoint	Shows the actual target temperature. Read-only.
CloseSpeed	The speed for closing the drawer can be adapted to a value between 15 and 100%. The default value is 80%.
OpenSpeed	The speed for opening the drawer can be adapted to a value between 15 and 100%. The default value is 80%.
Fan Speed	Shows read-only information, and can be used for diagnostic purposes.
Stdby Temp Control	If switched off, the module will not go to standby temperature if idle.
Temp. Gain	The coefficient used, if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only.
Temp. Offset	The Offset temperature used, if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.

In the field **Drawer#**	• **Slot1 to Slot2** — Defines the position of the Tray.
	
	• **Drawer Status** — Displays the status of the Drawer position. The following positions are possible:
	
	  – Closed
	
	  – Opened
	
	  Status **Opening** indicates an error. Readout functions only.
	• **Slot Count** — Indicates the total number of Slots available in the Temperature Controlled Drawer Module.
	• **Magnet Location** — It is possible to use either the magnet plate on the right-hand side or the magnet plate on the left-hand side of the drawer for opening and closing. The actual setting is displayed.

Table 60. Temperature Controlled Drawer Module Parameters (Sheet 3 of 3)

Item	Description
In the field **Tray** (Tray or Well Plate)	• **Cap Type** — This is a read-only parameter. The parameter can been in the class **Vial Type**. • **Tray Type** — Defines the pattern and sampling sequences of sample locations within a Tray. • **Well Plate Type** — Defines the pattern and sampling sequences of sample locations within a Well Plate. • **Vial Type** — Defines the Vial specifications.

Temperature Controlled Drawer Option Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 61.

Table 61. Option Pull-up Menu for Temperature Controlled Drawer

Item	Description
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach module	The positions of the X-, Y-, and Z-axes can be defined again, teaching.
Use magnet plates on left-hand / right-hand side	Determines which magnet plate on the left-hand side or on the right-hand side shall be used for opening and closing the drawer.
Activate Standby Temperature	This task activates the newly-set Standby Temperature.
New Tray Adapter	Allows creating a new Tray Adapter
New Rack	Allows creating a new Tray
New Well Plate	Allows creating a new Well Plate
Delete Tray Type	Allows deleting the present Tray Type.
Adjust Needle Penetration	Allows adjusting the **Needle Penetration Depths** in the vial. Manually turn the needle as far down in the vial as required. The cut-out in the Tray Holder frame as well as in the Rack allows visual control of the needle tip. **Note** The value found is not stored automatically. This task allows for a check only. If the needle penetration should be changed, select the Rack Type to enter the newly-established Needle Penetration value.

Tool Stations

The following stations are actively supported:

- **TR Station** — Passive module with single slot for a single Tool. See the section "TR Station" on page 123.

  > **Note** TR Station is not supported in combination with the RSH Firmware version 1.5.0 or higher.

- **ATC Station** — Active module with three slots for three Tools. See the section "ATC Station" on page 124.

Selecting the list item **Tool Station,** the following parameters are available for modification. Press **Enter** to edit a parameter. See Figure 92

Figure 92. Menu Item Tool Stations and Menu List Items for Tool Stations
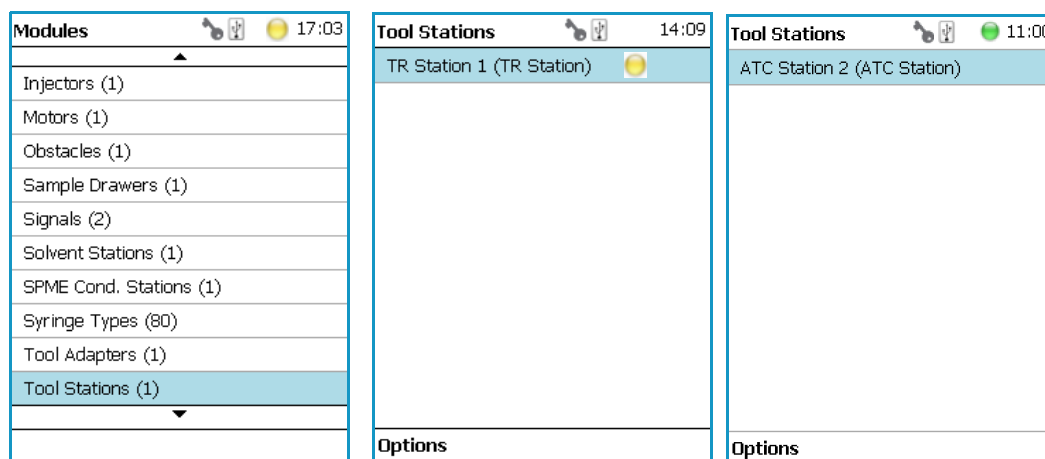
TR Station

Selecting the item **TR Station,** the following parameters are available for modification. See Table 62.

Table 62. List Item of TR Station

Item	Description
Slot1	Slot available for Tool.
TR Slot Index	For information only.

TR Station Pull-up Menu Options

Selecting **Options** pull-up menu, the following tasks are opened. See Table 63.

Table 63. Pull-up Menu Options for TR Station

Item	Description
New TR Station	Creates a new TR Station.
Copy TR Station1	Copies the present TR Station.
Delete TR Station	Deletes the present TR Station.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined, for teaching.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu 'Setup' for readjustment of the teaching position. Please note that this action can be done under only the **Extended User Level**.
Pick Tool	Picks the Tool up from the TR Station.
Park Tool	Parks the Tool in the TR Station.

ATC Station

Selecting the list item **ATC Station,** the following parameters are available for modification. See Table 64.

Table 64. ATC Station Parameters (Sheet 1 of 2)

Item	Description
Slot1 to Slot3	A slot can be selected to see which Tool has been assigned to this particular slot.
Tool EEPROM Access	Disabling the EEPROM Access, the Tool from the ATC Station will be electrically isolate. This is a protective measure when the TriPlus RSH Head positions the Tool in the ATC Station. For automation, Tool change or Tool calibration, the automatic disabling and enabling of EEPROM Access is built into the wizards. However, when working with the Virtual Handheld Controller, the closure of its window before a task is finished might cause the ATC Station to remain disabled. This feature gives the operator the possibility to manually control the ATC Station.
ATC Slot Index	For information only.

Table 64. ATC Station Parameters (Sheet 2 of 2)

Item	Description
Tool Present	Indicates if the Tool is parked in the Slot or not. If not present, the Tool is either mounted in the TriPlus RSH Head or not recognized by the system.
Fiber Protection	This parameter allows defining the Slot Position for the SPME Tool.

Options Pull-up Menu for ATC Station

Selecting **Options** pull-up menu, the following tasks are opened. See Table 65.

Table 65. Option Pull Menu for ATC Station

Item	Description
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the **Menu Setup** for the re-adjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined for teaching.
ResetEeprom	In the case of a broken communication to the ATC Station, this parameter re-establishes the communication on the running system, without shutting down the entire TriPlus RSH system.
Park Tool	Allows parking a Tool in a slot without picking up another Tool.

Signals

> **Note** Synchronization signals are inputs that tell the TriPlus RSH when to wait or to proceed with a sample-processing step. Output signals are sent from the system to external devices to indicate the status or completion of particular processing steps.

❖ **How to set-up the synchronization signals from the TriPlus RSH to an external device**

The synchronization signals must be set step-by step.

1. The first step is assigning an **Input Signal** and an **Output Signal**. The next step is to establish what type of contact is required to receive or send a TTL signal.
   It could be **Transistor-Transistor Logic** (TTL), a **relays contact**, an **Opto-coupler**, or another type. Add the required parameters such as **Pulse Duration** and **Blocking Time**. This section provides informations for copying the default signals, and adding for example a second output signal if required.

   An output signal is required to send a start signal to an external device. Typically the Switch Out Signal1 (**SWOut1**) is used.

   A second output signal, named **Destination Aux,** can be used for cases where one command is sent to two different GC which must be started at the same time. A Y-shape synchronization cable is required for connecting the TriPlus RSH to the two GC units. One signal used could be **SWOut1** and the second signal would be **SWOut2**. The assigned signals have to be matched with the pin allocation of the synchronization cable.

2. The second step is to synchronize the signal parameters with the GC. This step is made in the section "Input/Output Interface" on page 107.

   The **Ready** signal from the GC is usually sent to the system, and a **TTL-In** signal is used to receive the **Ready** signal. Depending on the GC manufacturer settings, the signal is set to **active high** or **active low**.

3. The third step is to bundle the required Input and Output Signals for a specific chromatographic system. This bundle can be configured once and tested in the combination of the TriPlus RSH and the other device. This bundling is described in the section "Chromatograph System" on page 96 as the last step in setting up signals.

Selecting the list item **Signals,** he following parameters are available for modification. See Figure 93.

Figure 93. Menu List Item Signals and List Items Input and Output Signals
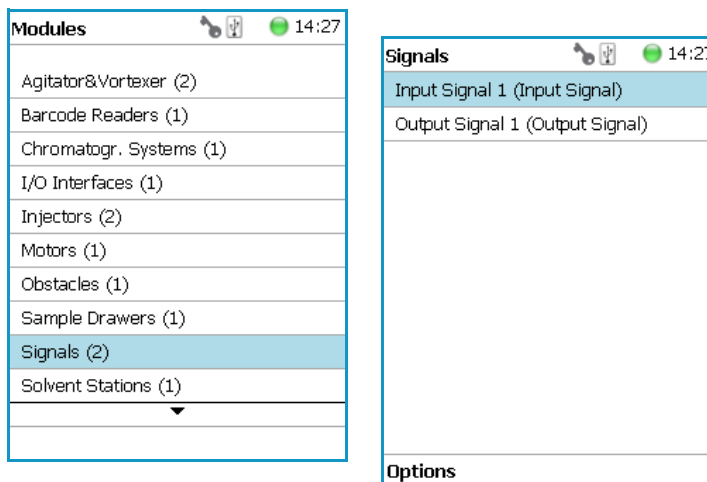
Press **Enter** to edit a parameter. See Table 66 and Table 67.

Table 66. Input Signal Parameters

Items	Description
Input Signal	Selects the required Input Signal. A **TTL-In** contact is typically used for the Ready Signal.
Signal On	Indicates the signal has been received. A crossed-out box means that a signal has been received.
Blocking Time	Used to program a time delay after receiving the signal (usually the **Ready Signal** from an external device).
Source	Selects the required Input Signal for synchronization with an external device. Usually a **TTL-In** contact is used to receive the **Ready Signal** from an external device.

Table 67. Output Signal Parameters (Sheet 1 of 2)

Item	Description
Output Signal	Selects the required Output Signal
Signal On	Indicates if the signal has been received. A crossed-out box means that a signal has been received.
Destination	Selects the required Output signal for the synchronization with an external device. Usually a switch out signal (**SW Out**) contact is used to send the **Start Signal** to an external device.

Table 67. Output Signal Parameters (Sheet 2 of 2)

Item	Description
Destination Aux	Used for cases where one command is sent to two different GC which must be started at the same time.
Pulse Duration	Selects the time how long the signal is sent.

Signals Option Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 68.

Table 68. Option Pull-up Menu for Signals

Item	Description
New Signal	Creates a new Input or Output Signal. A dialog window opens allowing you to assign a unique name to the new signal. When finished, press **New** and the entire class with the corresponding parameters is copied over.
	Select the required contact, such as a **TTL-In** or a **SW Out** using the parameter **Source**.
	The signal name does not require to be in a consecutive order for example, **Input Signal 2**, it can also be a specifically-named signal such as **Inject** or **Start**. Some cycles require a specifically-named signal. Check the cycle description for specific names.
Copy Input Signal	An Input Signal can be copied with this task. The task functions in a similar manner as described above with **New Signal**.
Copy Output Signal	Copies an Output Signal. The task functions in a similar manner as described above with **New Signal**.
Delete Input Signal	Deletes an Input Signal which is no longer required for the system configuration in combination with an external device.
Delete Output Signal	Deletes an Output Signal which is no longer required for the system configuration in combination with an external device.
Set Signal	Activates the selected signal for the time set with the parameter **Duration**. Since the **Duration** time is usually short, a status change in the parameter **Signal ON** is not visible.
Reset to Default	Resets the selected module parameters to default value.

Solvent Stations

Selecting the list item **Solvent Stations** opens up the following parameters. See Figure 94.

Figure 94. Menu Items for Solvent Stations and Menu Item Large Solvent Station

Pos1 = Large solvent reservoir bottle (100 mL volume in back position)
Pos2 = Large solvent reservoir bottle (100 mL volume in middle position)
Pos3 = Large solvent reservoir bottle (100 mL volume in front position)
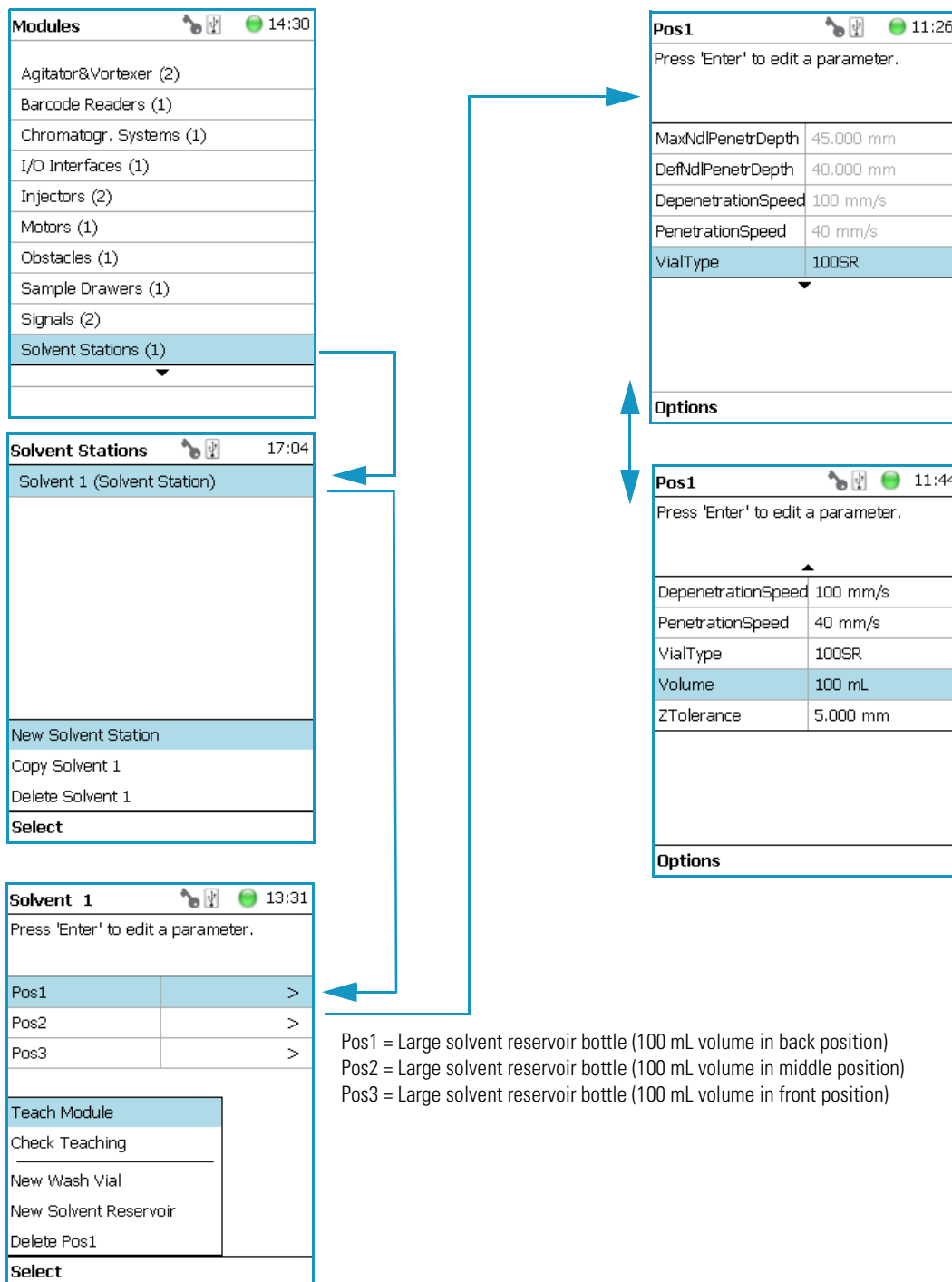
Selecting one of the positions allows to access following parameters. See Table 69.

Table 69. Solvent Station Parameters

Item	Description
Max Needle Penetration Depth	The maximum allowed **Needle Penetration** can be defined as a safety measure so that you cannot destroy the needle tip by going too far down. The maximum needle penetration must not exceed the length of the syringe needle, considering the loss of approximately 12 mm due to the needle guide, and so on. For a typical needle length of 57 mm or 85 mm for the long needle, the maximum penetration depth must not exceed 45 mm or 73 mm.
Default Needle Penetration Depth	The default value of the syringe needle penetration depth in the reservoir vial is set by this parameter.
Depenetration Speed	Selects the required speed for pulling the syringe needle out of the reservoir vial.
Diameter	Defines the diameter of the solvent reservoir.
Height	Defines the height of the solvent reservoir.
Penetration Speed	Sets the syringe needle penetration speed. It is recommended to use the default value first. Changing this parameter in one or the other direction might lead to needle bending.
Vial Type	Selects a predefined Vial Type.
Volume	Defines the volume of the reservoir container.
Z-Tolerance	A tolerance window to give a plus/minus range (expressed in mm) where the Head must expect an object. • If the value is set **> 0**, indicates a relative detection mode, and the sensor from the Head needle guide is active. • If the value is set to **0**, the Needle Guide Motor detection current is turned off and the syringe slider moves to an absolute value, the Z-axis position as specified by the object.

Solvent Station Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 70.

Table 70.   Solvent Station Options Parameters

Item	Description
New Solvent Station Description	Creates a new Solvent Station.
Copy Solvent Station 1	Copies the present Solvent Station.
Delete Solvent Station 1	Delete the present Solvent Station.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	Resets the selected module parameter to default value.

SPME Conditioning Station

Upon selecting the list item **SPME Conditioning Station**, the following parameters are available for modification. See Figure 95.

Figure 95. Menu Item and List Items for SPME Conditioning Station
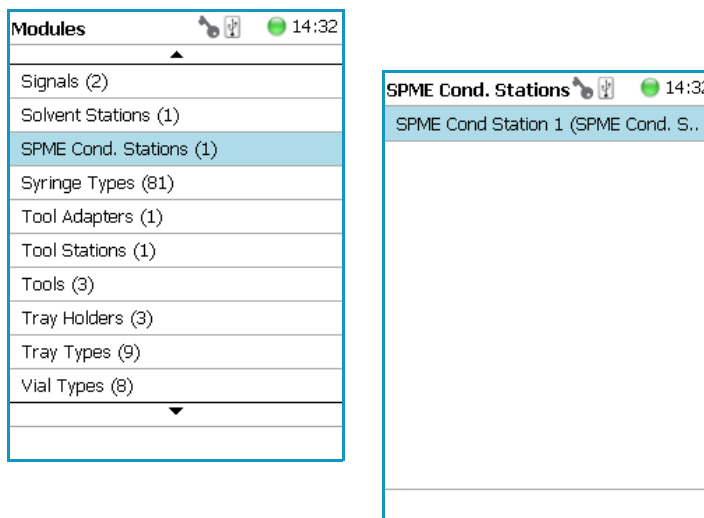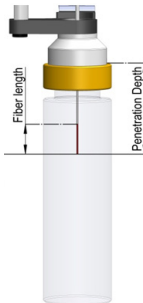
Select **SPME Cond Station** then press **Enter** to edit a parameter. See Table 71.

Table 71. SPME Conditioning Station Parameters (Sheet 1 of 2)

Item	Description
Actual Temperature	Reads out the actual temperature of the module; read-only function.
Max Temperature	Sets the upper temperature limit. The Maximum Temperature which can be set is 350 °C, but this parameter is often defined by the specific needs for the application.
Min Temperature	Sets the lower temperature limit.
Standby Temperature	The Standby Temperature can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**. The Standby Temperature is activated when the TriPlus RSH is powered up. In routine use, the Standby Temperature is activated after a job has been terminated. The Standby Temperature is typically lower than the application temperature.
Temp Setpoint	Shows the actual target temperature. Read-only.

Table 71. SPME Conditioning Station Parameters (Sheet 2 of 2)

Item	Description
Default Needle Penetration Depth	Defines the penetration depth of the SPME Needle in the module. The value reflects the total length including the length of the fiber.
Max Needle Penetration Depth	Upper limit of penetration depth of the SPME needle in the module. The value reflects the total length including the length of the fiber.
Stdby Temp Control	If switched off, the station will not go to standby temperature if idle.
Temp. Gain	The coefficient used, if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only.
Temp.Offset	The Offset temperature used, if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.

SPME Conditioning Station Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 72.

Table 72. Option Pull-up Menu for SPME Conditioning Station

Item	Description
Reset to Default	Sets the value for the selected item back to the default value.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, teaching.
Activate Standby Temperature	Activates the newly-set Standby Temperature.

SPME Arrow Conditioning Station

Upon selecting the list item **SPME Arrow Conditioning Station**, the following parameters are available for modification. See Figure 96.

Figure 96. Menu Item and List Items for SPME Arrow Conditioning Station
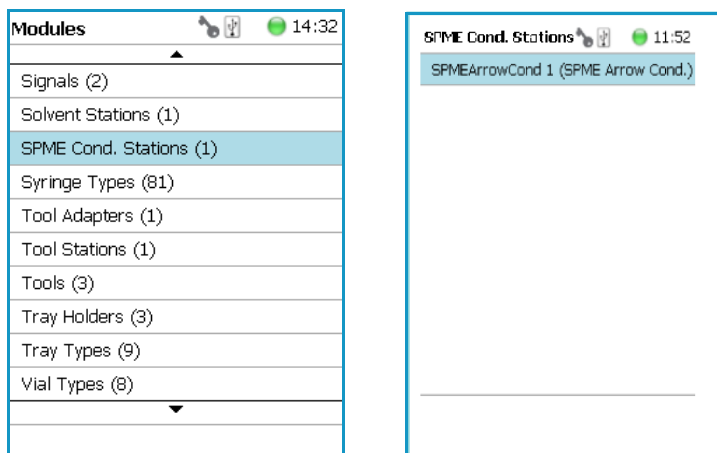
Select **SPME Arrow Cond** then press **Enter** to edit a parameter. See Table 70.

Table 73. SPME Arrow Conditioning Station Parameters (Sheet 1 of 2)

Item	Description
Actual Temp	Reads out the actual temperature of the module; read-only function.
Gas Valve	Shows if the gas valve is actually open, or closed.
Max Temperature	Sets the upper temperature limit. The Maximum Temperature which can be set is 350 °C, but this parameter is often defined by the specific needs for the application.
Min Temperature	Sets the lower temperature limit.
Stdby Temp Control	If switched off, the module will not go to standby temperature if idle.
Standby Temperature	The Standby Temperature can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**. The Standby Temperature is activated when the TriPlus RSH is powered up. In routine use, the Standby Temperature is activated after a job has been terminated. The Standby Temperature is typically lower than the application temperature.

Table 73. SPME Arrow Conditioning Station Parameters (Sheet 2 of 2)

Item	Description
Temp Setpoint	Shows the actual target temperature. Read-only.
Def Ndl Penetr Depth	Defines the penetration depth of the SPME Arrow fiber in the module.
Max Ndl Penetr Depth	Upper limit of penetration depth of the SPME Arrow fiber in the module.
Temp. Gain	The coefficient used if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only.
Temp.Offset	The Offset temperature used if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.

SPME Arrow Conditioning Station Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 74.

Table 74. Option Pull-up Menu for SPME Arrow Conditioning Station

Item	Description
Reset to Default	Sets the value for the selected item back to the default value.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done under the **Extended User Level** but not under **User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, teaching.
Activate Standby Temperature	Activates the newly-set Standby Temperature.
Open gas valve for 5 minutes	Opens the gas valve for flushing the back conditioning chamber.
Close gas valve	Closes the gas valve.

Syringe Types

Syringe Type defines the syringe. Selecting the list item **Syringe Type**, the following parameters are available for modification. See Figure 97.

Figure 97. Menu List Item Syringe Types and List Items Syringe Types
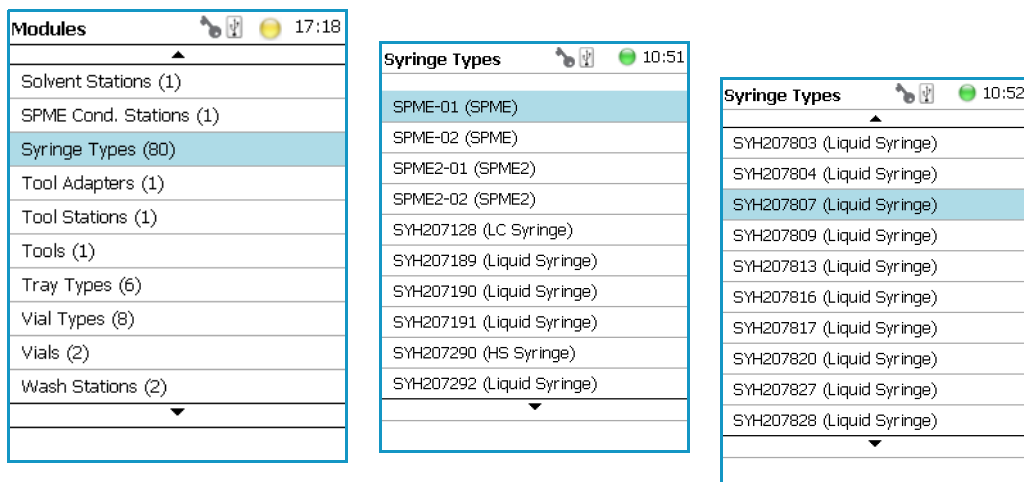
Press **Enter** to edit a parameter.

Selecting a syringe, for example a 10 µL Liquid Syringe, opens all the necessary parameters to define the syringe in geometry, and to define default values for an optimized use. See Table 75.

Note that the same parameters are used for both a liquid syringe and a headspace syringe. The SPME technique requires additional parameters.

Table 75. List of Syringe Types Parameters (Sheet 1 of 2)

Item	Description
Bottom Sense	When this function is enabled, the needle goes down to the bottom of the internal standard vial. See the section "Bottom Sense Parameter — Criteria for Syringe Needle" on page 137.
Def Aspirate	Specifies the default aspirate flow rate in µL/s.
Def Aspirate Acc	Specifies the default aspirate acceleration in µL/s*s.
Def Aspirate Delay	Specifies the default aspirate delay time after the end of the aspiration.
Def Dispense	Specifies the default dispense flow rate in µL/s.
Def Dispense Acc	Specifies the default dispense acceleration in µL/s*s.
Def Dispense Delay	Specifies the default dispense delay after the end of the dispense.

Table 75. List of Syringe Types Parameters (Sheet 2 of 2)

Item	Description
Def Fill Strokes Asp	Specifies the default fill strokes aspiration flow rate in μL/s.
Def Fill Strokes Disp	Specifies the default fill strokes dispense flow rate in μL/s.
Def Fill Strokes Count	Specifies the default number of syringe plunger strokes from the same vial, to have a homogeneous phase between the headspace gas in the vial and the sample in the syringe.
Def Fill Strokes Vol	Specifies the default fill strokes volume in μL.
Def Pen Vel	Specifies the default penetration velocity in mm/s.
Max Aspirate	Maximum Aspirate Flow Rat in μL/s.
Max Dispense	Specifies the maximum dispense flow rate in μL/s.
Max Fill Strokes Asp	Specifies the maximum fill strokes aspirate flow rate in μL/s.
Max Fill Strokes Disp	Specifies the maximum fill strokes dispense flow rate in μL/s.
Max Pen Depth	Specifies the maximum penetration depth in mm.
Max Pen Force	Specifies the maximum penetration force in N.
Max Pen Vel	Specifies the maximum penetration speed in mm/s.
Needle Gauge	Specifies the syringe suppliers specific.
Needle Inner Dia	Specifies the internal diameter of the syringe needle in mm.
Needle Length	Specifies the length of the syringe needle in mm.
Needle Out Dia	Specifies the external diameter of the syringe needle in mm.
Plunger Type	Specifies the syringe suppliers specific.
Point Style	Specifies the syringe suppliers specific.
Scale Length	Specifies the length of the scale in mm
Syringe Volume	Specifies the volume of the syringe in μL.
Gas Inlet Pos	Specifies the position in mm of the gas inlet. HS Tool only.
Fiber Length	Specifies the length in mm of the SPME fiber.
Fiber Type	Specifies the type of the SPME fiber. SPME Tool only.

Bottom Sense Parameter — Criteria for Syringe Needle

In order to use the parameter **Bottom Sense** successfully, consider the following points:

- For successful bottom detection, the syringe needle must be intact (not bent from previous use).

- The needle length does not exceed 65 mm. If longer needles are used, for example 80 mm in length, then the needle gauge 26 and 26S (outer needle diameter 0.47 mm) is too thin to withstand the touchdown pressure.
The needle gauge has to be changed to 23 or 23S (outer needle diameter 0.63 mm).

Syringe Types Options Pull-up Menu

The Pull-up Menu allows to:

- create a new Syringe Type definition based on a template (**New Syringe Type**)

- make a copy of an existing Syringe Type definition

- export a Syringe Type definition to the USB stick

> **Note** All predefined Syringe Type definitions are write-protected and cannot be deleted. The corresponding parameters can only be viewed, but not adapted. Copied or new created Syringe Types can be adapted and also deleted.

Selecting **Options** pull-up menu, the following tasks are opened. See Table 76.

Table 76. Option Pull-up Menu for Syringe Types

Item	Description
New Syringe Type	Creates a new Syringe Type template.
Copy Syringe Type	Copies the present Syringe Type template.
Export Syringe Type	Exports the present Syringe Type template to a USB stick.
Export All	Exports all Syringe Type templates at once to a USB stick.
Delete Syringe Type	Deletes the present Syringe Type template.

Tool Adapters

Selecting the list item **Tool Adapters**, the following parameters are available for modification. See Figure 98.

Figure 98. Menu Item Tool Adapter and List Item MHE Station
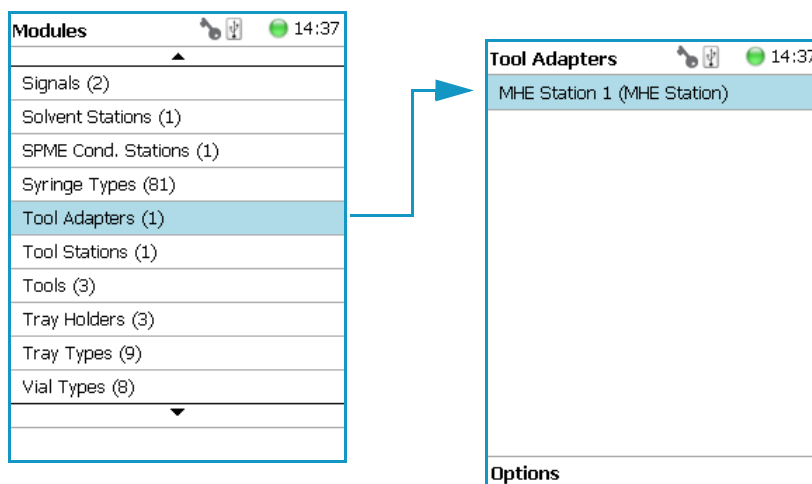
Selecting the list item **Tool Adapters** opens the dialog window for **MHE Station**.

Press **Enter** to edit a parameter. See Table 77.

Table 77. MHE Station Adapter Parameters

Item	Description
Z-Tolerance	A tolerance window to give a plus/minus range (expressed in mm) where the Head must expect an object.
	If the value of this item is **> 0**, this indicates a relative detection mode, and the sensor from the Head needle guide is active.
	If the value of this item is set to **0** the Needle Guide Motor detection current is turned off and the syringe slider moves to an absolute value, the Z-axis position as specified by the object.

Tool Adapter Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 78.

Table 78. Options Pull-up Menu for Tool Adapter Options (Sheet 1 of 2)

Item	Description
New MHE Station	Creates a new MHE Station.

Table 78. Options Pull-up Menu for Tool Adapter Options (Sheet 2 of 2)

Item	Description
Copy MHE Station	Copies the present MHE Station.
Delete MHE Station	Deletes of the present. MHE Station.
Check Teaching	Checks the teaching position of the station. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, (teaching).
Reset to Default	Resets the selected module parameter to default value.

Tools

In the class Tools, the various Tool Types are defined. Selecting the list item **Tools**, the following parameters are available for modification. See Figure 99.

Figure 99. Menu Item Tools and Menu List Items Tools
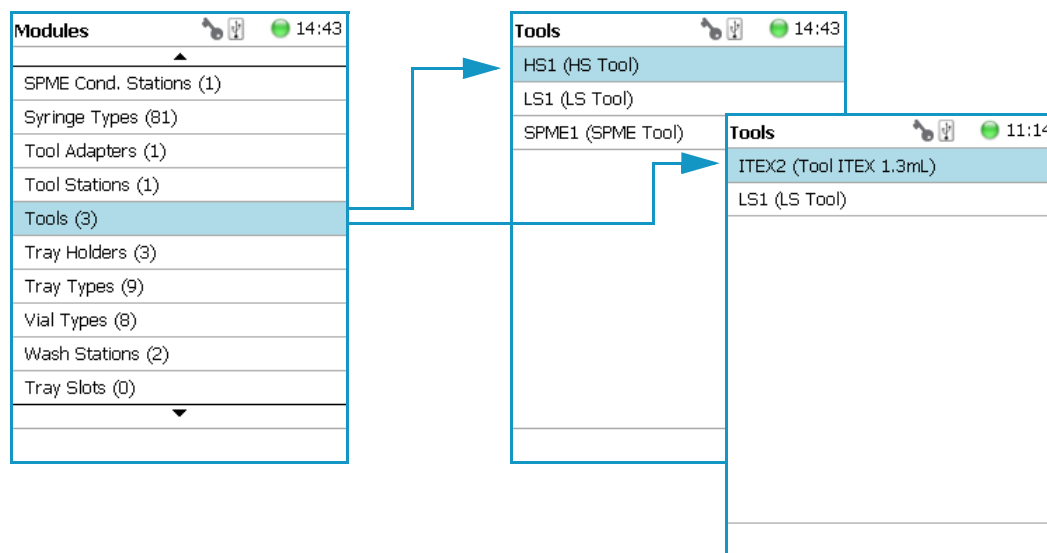
- Figure 100 shows the Syringe Type selection for HS, LS, and SPME Tools.

- Figure 101 shows the Syringe Type selection for ITEX DHS Tool.

Figure 100. Syringe Type Selection for HS, LS, and SPME Tools
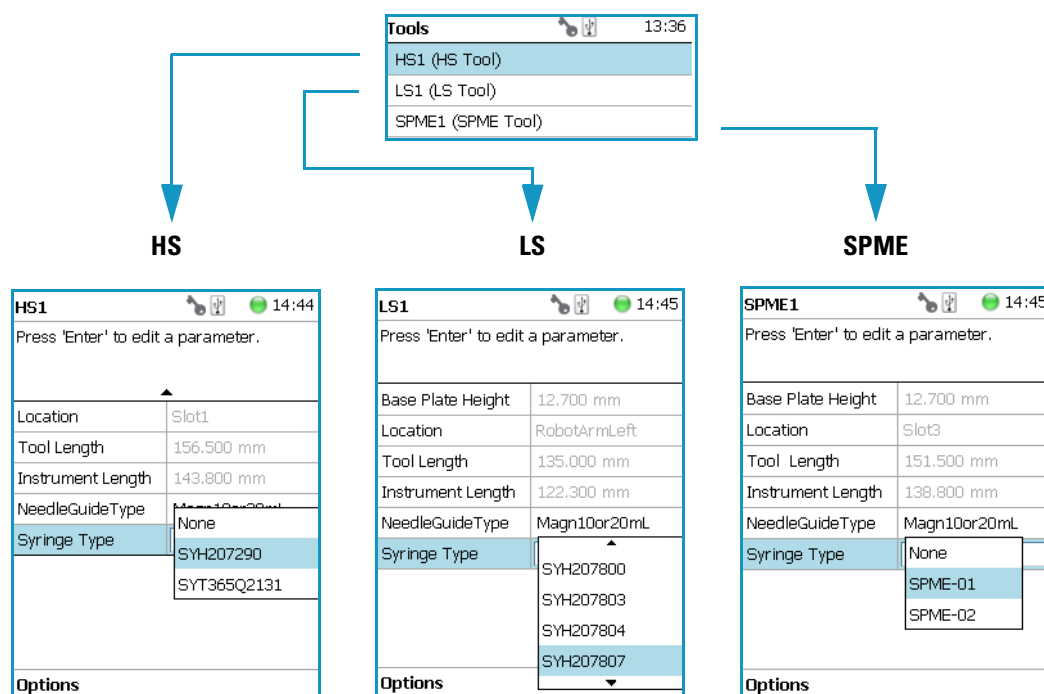
Figure 101. Syringe Type Selection for ITEX DHS Tool
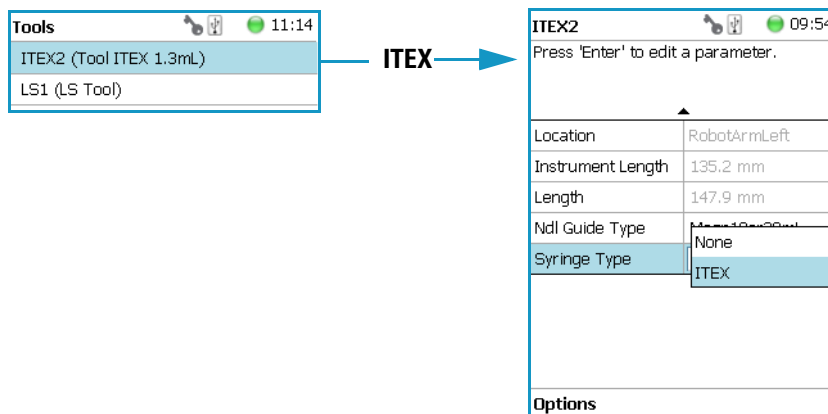
Press **Enter** to edit a parameter. See Table 79.

Table 79. List Item Parameters for HS, LS, SPME, and ITEX DHS Tools (Sheet 1 of 5)

Item	Description
Parameters for HS Tool	
Syringe Heater	This menu list item is specific for the HS Tool. Selecting the item opens the parameters for:

- **Actual Temperature** — Reads out the actual temperature of the syringe; read-only function.

- **Max Temperature** — Sets the upper temperature limit. The Maximum Temperature which can be set is 200 °C, but this parameter is often defined by the specific needs for the application.

- **Min Temperature** — Sets the lower temperature limit. The Minimum Temperature which can be set is 40 °C.

- **Standby Temperature** — The Standby Temperature can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**.

The Standby Temperature is activated when the TriPlus RSH is powered up. In routine use, the Standby Temperature is activated after a job has been terminated. The Standby Temperature is typically lower than the application temperature.

Table 79. List Item Parameters for HS, LS, SPME, and ITEX DHS Tools (Sheet 2 of 5)

Item	Description
Syringe Heater (*Continued*)	• **Temp Setpoint** — Read out the setpoint of the temperature. • Stdby Temp Control — If switched off, the module will not go to standby temperature if idle. • Temp Gain — The coefficient used, if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only. • Temp. Offset — The Offset temperature used, if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.
Location	Location (Slot Position) where the specific Tool is parked.
Length	Defines total length of the Tool. Read-only function.
Instrument Length	Defines total length of the syringe (instrument). Read-only function.
Needle Guide Type	Defines if an adapter, such as the magnetic ring or the foil cutter, is connected to the Needle Guide. **Important:** The Needle Guide Type has to be defined, default value is **Not Specified**. See "Installation Item" on page 195.
Syringe Type	All syringes with the same geometry (barrel diameter, needle length) and corresponding syringe type to the Tool are filtered by the software and are selectable for use.
Parameters for ITEX DHS Tool	
Syringe Heater	This menu list item is specific for the ITEX DHS Tool. Selecting the item opens the parameters for: • **Actual Temperature** — Reads out the actual temperature of the syringe; read-only function. • **Max Temperature** — Sets the upper temperature limit. The Maximum Temperature which can be set is 150 °C. • **Min Temperature** — Sets the lower temperature limit. The Minimum Temperature which can be set is 40 °C.

Table 79. List Item Parameters for HS, LS, SPME, and ITEX DHS Tools (Sheet 3 of 5)

Item	Description
Syringe Heater (*Continued*)	• The **Standby Temperature** can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**. The Standby Temperature is activated when the TriPlus RSH is powered up. In routine use, the Standby Temperature is activated after a job has been terminated. The Standby Temperature is typically lower than the application temperature. • **Temp Setpoint** — Read out the setpoint of the temperature. • **Stdby Temp Control** — When off, the module will not go to standby temperature if idle. • **Temp Gain** — The coefficient used if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only. • **Temp. Offset** — The Offset temperature used if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.
Trap Heater	This menu list item is specific for the ITEX DHS Tool. Selecting the item opens the parameters for: • **Actual Temperature** — Reads out the actual temperature of the trap. Read-only function. • **Max Temperature** — Sets the upper temperature limit. The Maximum Temperature which can be set is 350 °C. • **Min Temperature** — Sets the lower temperature limit. The Minimum Temperature which can be set is 100 °C. • The **Standby Temperature** can be adjusted according to the application's requirements. Setting the Standby Temperature using this function, the newly-selected temperature is not immediately active. To activate it, go to the **Options** pull-up menu and select **Set Standby Temperature**.

Table 79. List Item Parameters for HS, LS, SPME, and ITEX DHS Tools (Sheet 4 of 5)

Item	Description
Trap Heater (*Continued*)	The Standby Temperature is activated when the TriPlus RSH is powered up. In routine use, the Standby Temperature is activated after a job has been terminated. The Standby Temperature is typically lower than the application temperature. • **Temp Setpoint** — Read out the setpoint of the temperature. • **Stdby Temp Control** — When off, the module will not go to standby temperature if idle. • **Temp Gain** — The coefficient used if a temperature calibration has been performed. Possible values are between 0 and 2. Read-only. • **Temp. Offset** — The Offset temperature used if a temperature calibration has been performed. Possible values are between -10 °C and +10 °C. Read-only.
Location	Slot Position where the specific Tool is parked.
Length	Defines the total length of the Tool. Read-only function.
Instrument Length	Defines the total length of the syringe (instrument). Read-only function.
Needle Guide Type	Defines if an adapter, such as the magnetic ring or the foil cutter, is attached to the Needle Guide. **Important:** The Needle Guide Type must be defined. The default value is **Not Specified**. See "Installation Item" on page 195.
Syringe Type	Use the ITEX syringe only.
Parameters for LS and SPME Tools	
Location	Slot Position where the specific Tool is parked.
Instrument Length	Defines the total length of the syringe (instrument). Read-only function.
Length	Defines the total length of the Tool. Read-only function.
Needle Guide Type	Defines if an adapter, such as the magnetic ring or the foil cutter, is attached to the Needle Guide. **Important:** The Needle Guide Type must be defined. The default value is **Not Specified**. See "Installation Item" on page 195.

Table 79. List Item Parameters for HS, LS, SPME, and ITEX DHS Tools (Sheet 5 of 5)

Item	Description
Needle Penetration Depth	Defines the penetration depth of the fiber in the vial.
Syringe Type	All syringes with the same geometry (barrel diameter, needle length) and corresponding syringe type to the Tool are pre-selected by the software and are selectable for use.

Tools Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 80.

Table 80. Options Parameters for HS, LS, SPME, and ITEX DHS Tools

Item	Description
Calibrate Tool	Calibrates the specified Tool. **Note** This might be necessary after a Tool has been accidentally dropped, and assuming that the Needle Guide was bent. A **re-calibration** corrects for the difference.
Check Tool Calibration	A calibration check is activated.
Select Tool	Selects another Tool. The current Tool is parked first and the new required one is picked up.
Purge Syringe	Available only with HS and ITEX DHS Tools. Allows to purge manually a headspace syringe.
Park Tool	Parks a Tool without picking up another Tool from the ATC Station.
Configure SPME Tool	This line is visualized when a SPME Tool is selected. This task allows to configure a SPME Tool. Fiber adjustment.

Naming Convention and Relationship between Software Classes, Tray Holder, Trays, Tray Types, and Cap Type

The RSH Firmware filters the selection of the subsequent classes based on the selection of the initial item. The following points are very important:

- First, the **Needle Guide Type** must be defined. If **Not Specified** is selected under **Needle Guide Type**, the execution of the run will be prohibited.

- In addition, the **Cap Type** and **Needle Guide Type** must be compatible in order to transport a vial. If a mismatch is observed, the software will prohibit the execution of the run; for example when a 2 mL vial with a magnetic cap is in use, but the **Needle Guide Type** is selected for a 20 mL vial.

Figure 102 illustrates the interdependency between the various software classes and subclasses. The different colors depict the main classes and the parameters assigned to each of them. See Color Coding and "Software Classes" on page 148.

Figure 102. Relationship between Software Classes: Tray Holder, Tray, Tray Type, Cap Type, and Needle Guide Type.
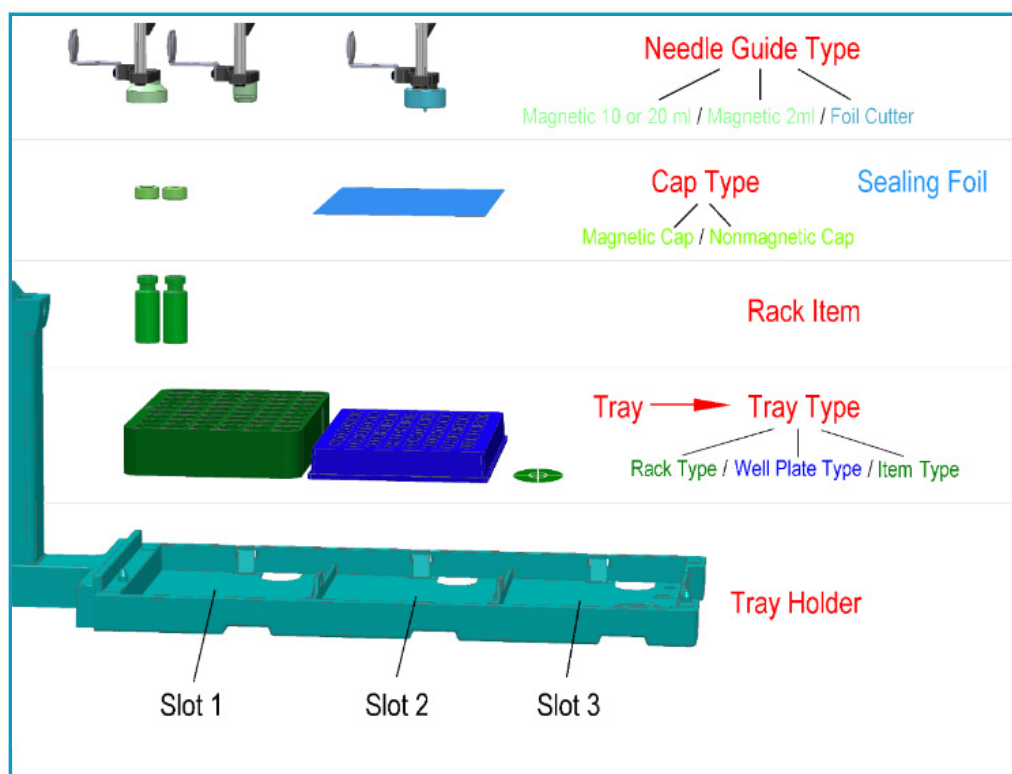
Color Coding

The software classes are labeled in **red**. All related software classes where a **Vial** is used are displayed using a **green** shade. The classes related to **Well Plates** are displayed using a **blue** shade.

Software Classes

- The **Tray Holder** is the basic item encompassed by this software class; all the other subsequent software categories, such as Tray, Vial Type, and Cap Type are pre-defined by the Tray Holder.

- A **Tray** is a generic term and can be a Rack for holding vials or a Well Plate (Deep Well or Micro Titer Plate).

- A **Tray Type** is linked to each Tray. Depending on the actual Tray used, the Tray Type can be either a **Rack Type** or a **Well Plate Type**.

- The **Vial Type** depends on the Rack Type, but the Well Plate Type does not have any type of vial associated with it (i.e. the class of software that defines the vial type does not exist for a Well Plate).

- The **Cap Type** is linked to the **Vial Type**. This class defines the cap material, and whether or not the vial is transportable by magnetic force.

- The **Sealing Foil** is actually not a software subclass but the presence of the Sealing Foil with a Well Plate is automatically linked to the Needle Guide Type, which in turn will determine whether the Foil Cutter will be used.

- The **Needle Guide Type** is not a software class directly linked to the class Tray Holder and its subclasses; rather, it is linked to the class **Tools**.
  The Needle Guide Type will determine which adapter has to be used to handle the selected vial or well plate.
  Is it necessary to transport a vial, and is a Foil Cutter required to pierce the Sealing Foil?

Tray Holders

Tray Holders are passive modules. These modules are described by their geometric design parameters, but there is no control whatsoever through the TriPlus RSH.

A Tray Holder can be a Liquid Cooled Tray (using a circulation bath for heating/cooling), or a Tray Holder without any temperature control.

Selecting the list item **Tray Holder,** the following parameters are available for modification. See Figure 103.

Figure 103. Menu Item 'Tray Holder and List Items for Tray Holders
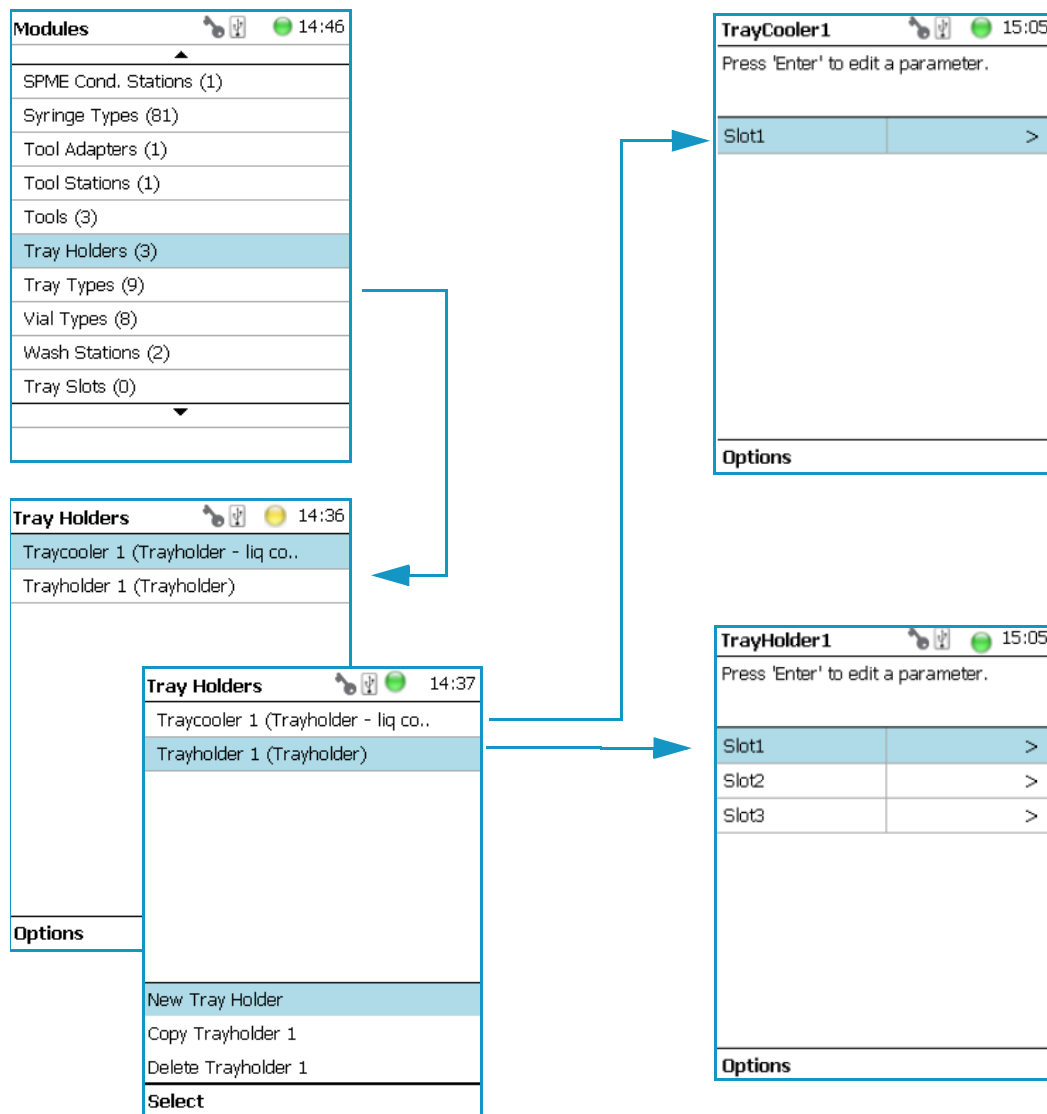
Press **Enter** to edit a parameter.

Select the Tray Holder, If the required **Tray Holder** is not assigned yet, use the button **New Tray Holder**. Select the type and assign the name.

Selecting the list item **Slot** opens the dialog window for **Tray** (Rack), containing the parameters **Tray Type** and **Vial Type**.

If no Tray is assigned yet, use the button **New** to assign a Tray to a particular Slot.
The dialog for naming a Tray can be started by pressing the **Enter** button. See the examples. See Figure 104.

Figure 104. Tray Type and Vial Type Selections to Assign to Tray
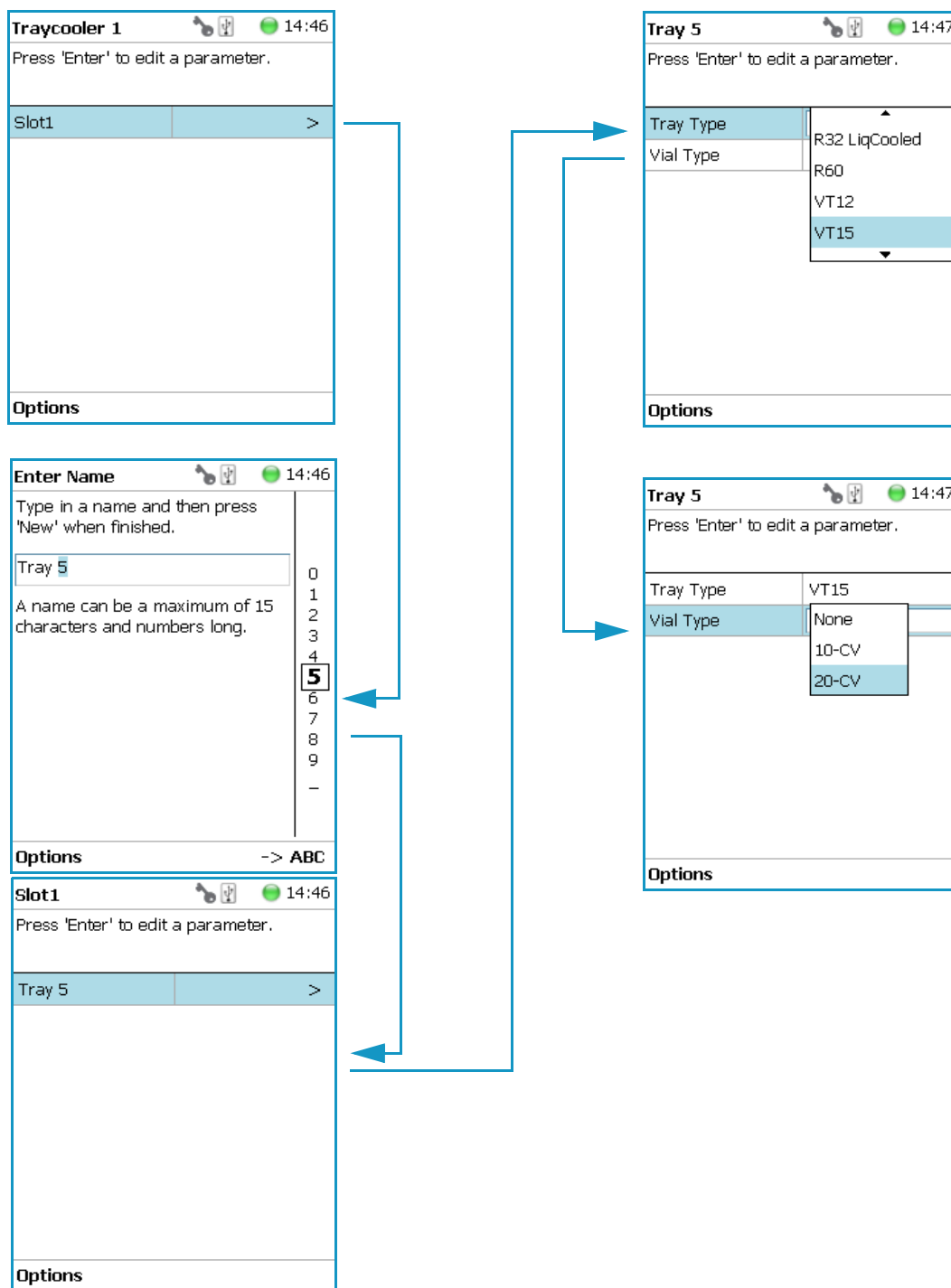
The parameters are the follows:

- **Slot(#)** — Selects the required Slot number to assign a Tray Type and Vial Type.

- **Tray(#)** — Selects the required Tray number to assign the Tray Type and Vial Type.

- **Cap Type** — Describes the Cap Type. Read-only. The definition is made in the class Vial Type.

- **Tray Type** — A list with all predefined Tray Types opens up for selection.

- **Tray Item** — A list with all predefined Tray Item opens up for selection.

- **Vial Type** — A list with all predefined Vial Types opens up for selection.

- **Well Plate(#)** — Select the required Well Plate number to assign the Well Plate Type.

- **Well Plate Type** — A list with all predefined Well Plate Types opens up for selection.

Note A passive Tray Holder module can adapt Trays made for different vial sizes. When the different Trays are used, consider the various vial heights, and ensure that the Drawer Magnet, connected to the lower needle guide, does not catch at front row of vials from behind the Tray.

Tray Holder Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 81.

Table 81. Tray Holder Options Pull-up Menu
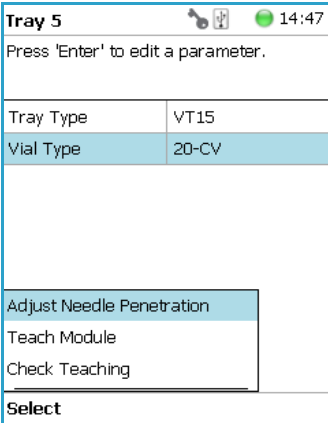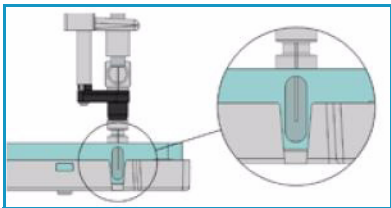
Item	Description
Create New Tray System	Guides through a wizard for creating a new Tray System. This includes the Tray Holder, Slots, Tray, Tray Type, and Vial Type.
New Tray Holder	Creates of a new Tray Holder.
Delete Tray Holder	Deletes the present Tray Holder.

Another Option pull-up Menu is available when the list item **Tray(#)** is selected. See Table 82.

Table 82. Tray Holder Options Pull-up Menu Parameters When Tray(#) is Selected (Sheet 1 of 2)

Item	Description
New Tray	Allows creating a new Tray (Rack).
New Well Plate	Allows creating a new well plate.
Delete Tray Type	Allows deleting the present Try Type.

Table 82. Tray Holder Options Pull-up Menu Parameters When Tray(#) is Selected (Sheet 2 of 2)

Item	Description
Adjust Needle Penetration	Adjusts the Needle Penetration Depths in the vial. Manually turn the needle as far down in the vial as required. The cut-out in the Tray Holder frame as well as in the Tray allows visual control of the needle tip. **Note**: The value found is not stored automatically. This task allows a check only. If the needle penetration must be changed, select the Tray Type to enter the new established Needle Penetration value.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, teaching.

Tray Types

A Tray Type contains all the information about the geometry of the Tray.
Parameters such as how many sample vials are in a column and in a row, and the distance from vial to vial are all summarized in this class for each Tray Type.

Selecting the list item **Tray Types,** the following parameters are available for modification. See Figure 105.

Figure 105. Menu Item 'Tray Types and Menu List Items Tray Types
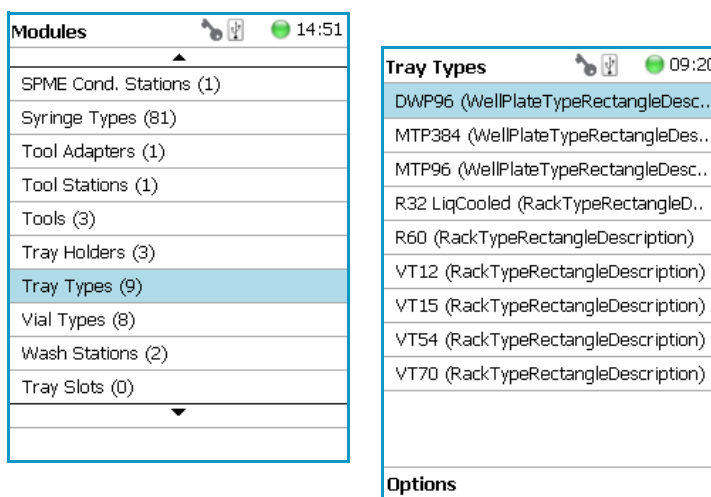
The individual parameters are identical for each Tray Type. The main difference depends on the primary differentiation of a **Tray Type** or **Plate Type**. In a Tray Type vials are inserted, the combined height of a Tray and the height of the vial above the upper surface of the Tray yields to the total height of the Tray Module.

A Plate has no vial inserted and the total height of the Tray corresponds with the height of the Well Plate.

The second main difference is the order of sample treatment. A Tray Type R60 has the vial numbering in the order of the Y-axis; in a Well Plate the numbering order is by the X-axis.
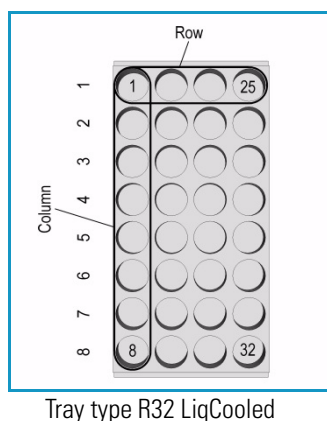
Tray type R32 LiqCooled
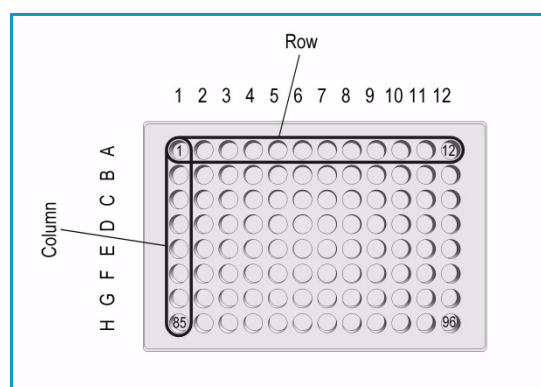
Well Plate type MTP96

Press **Enter** to edit a parameter. See Table 83.

Table 83. Tray Type Parameters (Sheet 1 of 4)

Item	Description
1st Sample Offset X	Offset distance from **Tray Zero Point** to first position in X-axis direction. Unit: mm.
1st Sample Offset Y	Offset distance from **Tray Zero Point** to first position in Y-axis direction. Unit: mm.
1st Sample Offset Z	Offset distance from **Tray Zero Point** to first position in Z-axis direction. Unit: mm. (This parameter is currently not used with released Tray Types. Value = 0)
Alt Sample Offset X	Offset from **Tray Zero Point** to first sample position of staggered row/column in direction X-axis. Unit: μm.
Alt Sample Offset Y	Offset from **Tray Zero Point** to first sample position of staggered row/column in direction Y-axis. Unit: μm.
Alt Sample Offset Z	Offset from **Tray Zero Point** to first sample position of staggered row/column in direction Z-axis. Unit: μm. (This parameter is currently not used with released Tray Types. Value = 0)
Cavity Depth	Defines the total depth of the cavity. Unit: mm.
Cavity Diameter	Defines the diameter of the cavity. Unit: mm.
Columns	Number of columns.
Indexing Orientation	Defines the order of sampling either in **Column Direction** (DirectionX) or in **Row direction** (DirectionY). *Examples:* Tray R60: Column Direction. Tray VT54: Row Direction.

Table 83. Tray Type Parameters (Sheet 2 of 4)

Item	Description
Length X	Total length of the Tray in X-axis direction, outer frame of Tray is considered. Unit: mm.
Length Y	Total length of the Tray in Y-axis direction, outer frame of Tray is considered. Unit: mm.
Length Z	Total length of the Tray in Z-axis direction, outer frame of Tray is considered. Unit: mm.
Penetr. Vial Index	Specifies the position in the Tray where the cut-out for needle penetration adjustment is located.
Rows	Number of rows.
Slot Offset X	Distance from Tray Holder Zero Point to Slot in X-axis direction. Used for Trays which are larger than the footprint of the Slot, (Oversize). This parameter is for example used for the Tray Type R60. Value = -13.5 mm.
Slot Offset Y	Distance from Tray Holder Zero Point to Slot in Y-axis direction. Used for Trays which are larger than the footprint of the Slot, (Oversize). This parameter is for example used for the Tray Type R60. Value = -13.5 mm.
Slot Offset Z	Distance from Tray Holder Zero Point to Slot in Z-axis direction. Used for Trays which are larger than the footprint of the Slot, (Oversize). This parameter is for example used for the Tray Type R60. Value = -3.8 mm.
Slot Span	Number of the Tray installed on the Tray Holder. *Examples*: Tray 60: Slot Span 1. Tray 54: Slot Span 3. **Note**: A Tray Type with a **Slot Span >1** has to be positioned in Slot 1. The Rack does **span** from Slot 1 to Slot 2 to Slot 3.
Total Column Length X	Defines the total length of the Column (X-axis). Distance from center to center of cavity is measured. Unit: mm.
Total Row Length Y	Defines the total length of the Row (Y-axis). Distance from center to center of cavity is measured. Unit: mm.

Table 83. Tray Type Parameters (Sheet 3 of 4)

Item	Description
Uses Adapter	Select this parameter when an Adapter is used to compensate for vial height. The adapter installed plus the vial height must not exceed the total height of a 20 mL vial. ***Example***: 10 mL vial plus corresponding adapter must be equal to the height of a 20 mL vial.
Z Tolerance	A tolerance window to give a plus/minus range (expressed in mm) where the Head must expect an object. If the value of this item is **> 0**, indicates a relative detection mode, and the sensor from the Head needle guide is active. If the value of this item is set to **0**, the Needle Guide Motor detection current is turned off, and the syringe slider moves to an absolute value. The Z-axis position as specified by the object. The Z Tolerance is calculated in combination with a Rack from the Vial top. The Rack plate top surface is not used as reference. The Z Tolerance is calculated in combination with a Well Plate (MTP) from the plate top surface. Unit: mm.
DefNdlPenetrDepth *(Parameter used for MTP only)*	Defines the default value for the syringe needle penetration depth in the well of the Micro Titer Plate (MTP). Unit: mm.
Depenetration Speed *(Parameter used for MTP only)*	Defines the speed of the syringe needle de-penetration from the well of the Micro Titer Plate (MTP). Unit: mm/s.
Sealing Foil *(Parameter used for MTP only)*	Setting the mark to **Has Foil** indicates that the plate is sealed with a foil. The **Foil Piercing Tool** will be applied.
MaxVolume *(Parameter used for MTP only)*	Defines the maximum volume of the well of a Micro Titer Plate (MTP). Unit: mL.

Table 83. Tray Type Parameters (Sheet 4 of 4)

Item	Description
Penetration Speed *(Parameter used for MTP only)*	Defines the speed of the syringe needle penetration from the well of the Micro Titer Plate (MTP). Unit: mm/s.
Bottom Sense supported *(Parameter used for MTP only)*	Setting the mark to **Bottom Sense supported** enables the functionality of needle bottom sensing.

The tray type parameters are described in the following Table 84.

Table 84. Tray Type Parameters (Sheet 1 of 7)
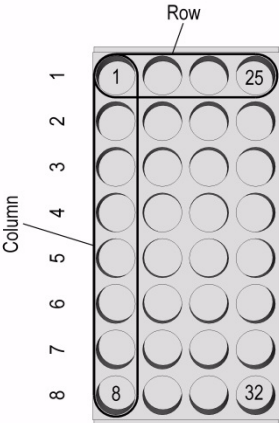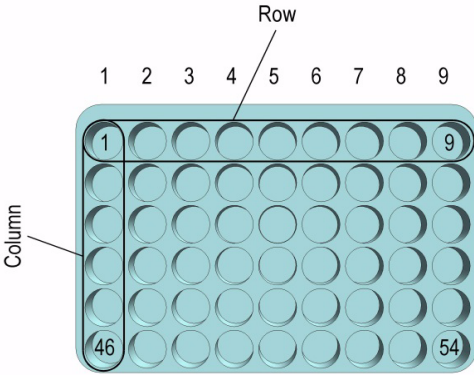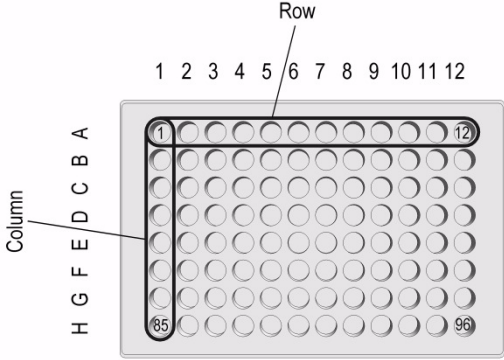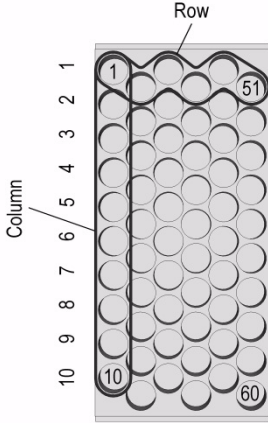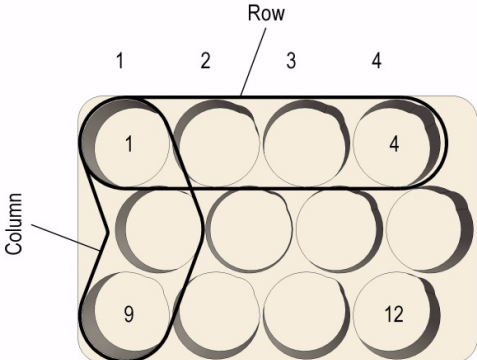
Tray Type Parameter	Illustration
Rows — Number of Rows **Columns** — Number of Columns Definition of Row and Column *Example:* Regular order of vials.	**Figure 106.** Tray type R32 Liquid Cooled
Rows — Number of Rows **Columns** — Number of Columns Definition of Row and Column *Example:* Regular order of vials.	**Figure 107.** Tray type VT54
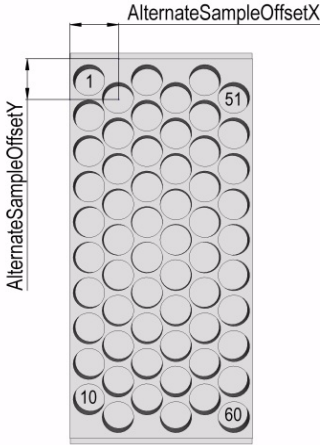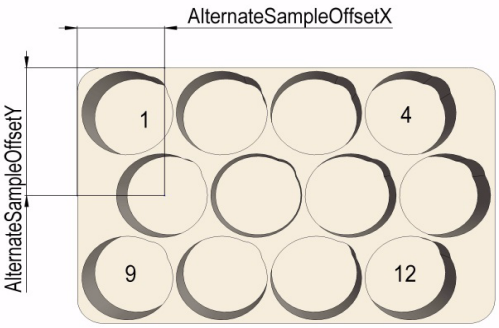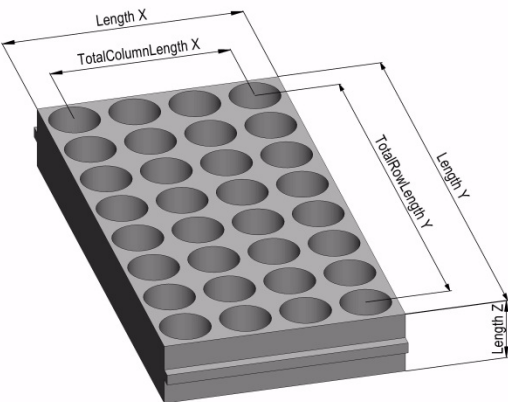
Table 84. Tray Type Parameters (Sheet 2 of 7)

Tray Type Parameter	Illustration
Rows — Number of Rows **Columns** — Number of Columns Definition of Row and Column *Example*: Regular order of wells.	**Figure 108.** Tray type MTP 96
Rows — Number of Rows **Columns** — Number of Columns Definition of Row and Column *Example*: Staggered order of vials.	**Figure 109.** Tray type R60
Rows — Number of Rows **Columns** — Number of Columns Definition of Row and Column *Example*: Staggered order of vials.	**Figure 110.** Tray type R12
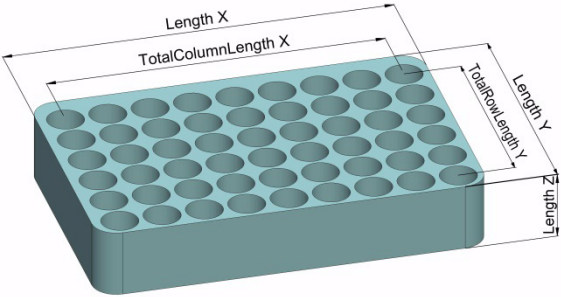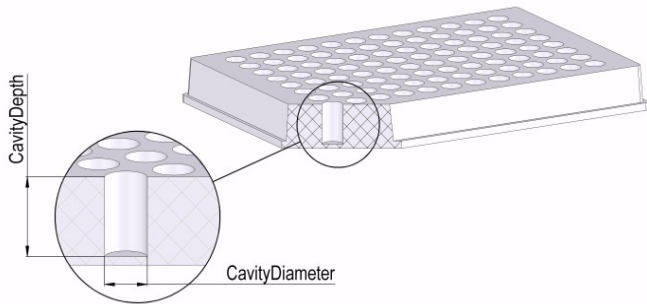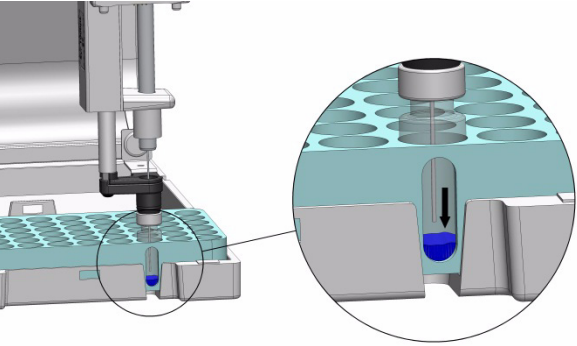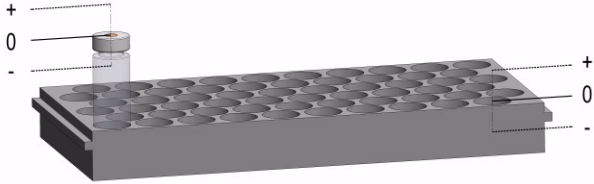
Table 84. Tray Type Parameters (Sheet 3 of 7)

Tray Type Parameter	Illustration
Indexing Orientation **Direction X** (or **Row Direction** with RSH Firmware 1.4.0 or lower) **Direction Y** (or **Column Direction** with RSH Firmware 1.4.0 or lower)	**Figure 111.** Indexing orientation
1st Sample Offset X 1st Sample Offset Y (1st Sample Offset Z)	**Figure 112.** Tray type R32 LiqCooled
1st Sample Offset X 1st Sample Offset Y (1st Sample Offset Z)	**Figure 113.** Tray type VT54
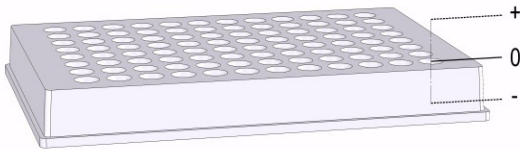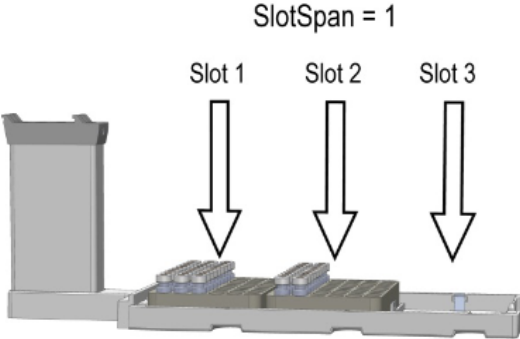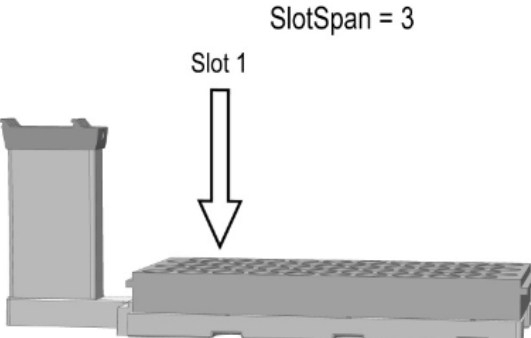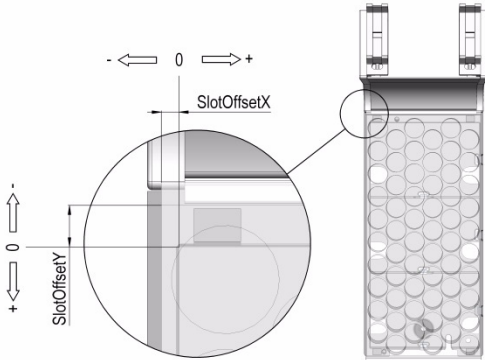
Table 84. Tray Type Parameters (Sheet 4 of 7)

Tray Type Parameter	Illustration
Alt Sample Offset X Alt Sample Offset Y (Alt Sample Offset Z)	**Figure 114.** Tray type R60
Alt Sample Offset X Alt Sample Offset Y (Alt Sample Offset Z)	**Figure 115.** Tray type R12
Length X Length Y Length Z Total Column Length X Total Row Length Y	**Figure 116.** Tray type R32 Liquid Cooled

Table 84. Tray Type Parameters (Sheet 5 of 7)
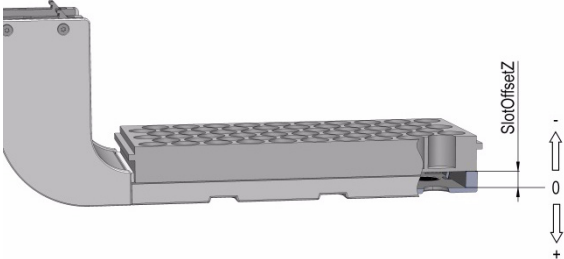
Tray Type Parameter	Illustration
Length X Length Y Length Z Total Column Length X Total Row Length Y	**Figure 117.** Tray type VT54
Cavity Depth Cavity Diameter	**Figure 118.** Tray type MTP96
Penetration Vial Index	**Figure 119.** Tray type VT54
Z Tolerance	**Figure 120.** Tray type R60

Table 84. Tray Type Parameters (Sheet 6 of 7)

Tray Type Parameter	Illustration
Z Tolerance	**Figure 121.** Tray type MTP96
Slot Span *Example*: Slot Span = 1	**Figure 122.** Tray Holder with Tray Type VT54 inserted
Slot Span *Example*: Slot Span = 3	**Figure 123.** Tray Holder with Tray Type R60 inserted
Slot Offset X Slot Offset Y Note that the value has a negative sign if the Tray is oversize, which means larger than the Tray Holder.	**Figure 124.** Tray Holder with Tray Type R60 inserted

Table 84. Tray Type Parameters (Sheet 7 of 7)

Tray Type Parameter	Illustration
Slot Offset Z Note that the value has a negative sign if the Tray is not inserted in the slot, support for Tray is higher up.	**Figure 125.** Tray Holder with Tray Type R60 inserted
Uses Adapter	**Figure 126.** Agitator
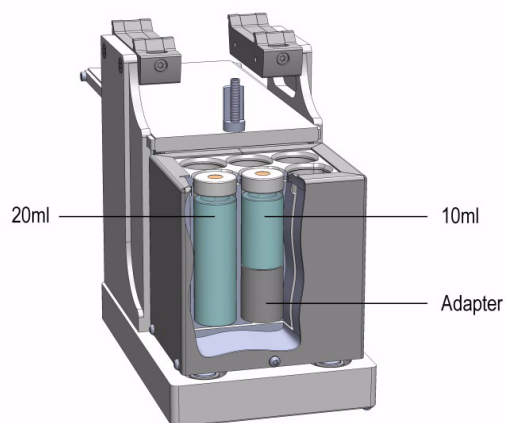
Tray Types Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 85.

Table 85. Tray Types Options Pull-up Menu

Item	Description
New Tray Type	Creates a new Tray Type.
Copy Tray Type	Copies the present Tray Type (for example VT54).
Delete Tray Type	Deletes the present Tray Type (for example VT54).
Reset to Default	Resets the selected Tray parameter to default value.

Trays

The term Trays is a generic term. A Tray can be a Tray or a Well-plate.

A Tray is prepared to accept vials, a well-plate can be typically a Deep well-plate or a Micro Titer-plate. The software has a structure which interlinks the classes **Vial Type**, **Tray Type** (or **Well Type**) with the Tray. To create a new Tray these classes have to be prepared in the order **Vial Type** and **Tray Type**. The allocated types are then ready for selection in the class Trays.

Selecting the list item **Tray Types,** the following parameters are available for modification. See Figure 127.

Figure 127. Menu Item Trays Menu List Item Trays
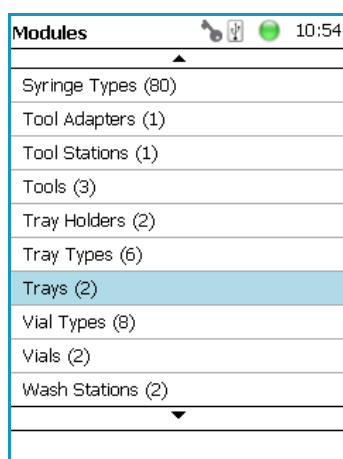
Press **Enter** to edit a parameter. See Table 86.

Table 86. Tray Type and Vial Type Parameters

Item	Description
Cap Type	Read-only parameter. Definition is made in the class Vial Type.
Tray Type	A Tray Type is assigned the specified Tray.
Vial Type	A Vial Type is assigned to the specified Tray and selected Tray Type.

Trays Options Pull-up Menu for Vial Tray

Selecting **Options** pull-up menu, the following tasks are opened. See Table 87.

Table 87. Trays Options Pull-up Menu for Vial Tray (1)

Item	Description
New Tray	Creates a new Tray.
Delete Tray	Deletes a present Tray.

In the case no Tray (or Plate) is available, the command **New Tray** is available with the **Menu Button Option**. Follow the dialog with the known possibilities to assign a name as shown in Figure 128.

Figure 128. Menu Button New Tray and Defining Name for New Tray

Another pull-up menu is available from the menu list items **Tray Type** and **Vial Type**. Selecting the item **Adjust Needle Penetration** allows checking the needle penetration in the vial.
The position of cut-out in the Tray is specified in the Tray Type, therefore is the position known. Starting this task, moves the TriPlus RSH Head to the defined vial position where it waits for the manual adjustments. Figure 129, illustrates the cut-out in the Tray.

Figure 129. Adjust Needle Penetration Into the Vial
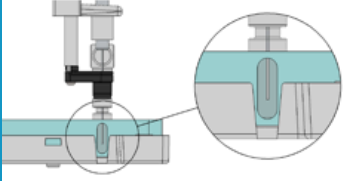
Trays Options Menu Parameters are detailed in Table 88.

Table 88. Trays Options Pull-up Menu Parameters for Vial Tray (2)

Item	Description
Adjust Needle Penetration	Adjusts the Needle Penetration Depths in the vial. Manually turn the needle as far down in the vial as required. The cut-out in the Tray Holder frame as well as in the Tray allows visual control of the needle tip. **Note**: The value found is not stored automatically. This task allows a check only. If the needle penetration must be changed, select the Tray Type to enter the newly established Needle Penetration value.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, for teaching.

Trays Options Pull-up Menu for Well Plate

Selecting **Options** pull-up menu, the following tasks are opened. See Table 89.

Table 89. Trays Options Pull-up Menu for Well Plate

Item	Description
New Tray	Creates a new Tray Type.
Copy Well Plate (#)	Copies the present Well Plate.
Delete Well Plate (#)	Deletes the present Well Plate.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, for teaching.

Vial Types

The Vial Type describes the geometry of the vials used and adds parameters such as syringe needle penetration, search distance, or Z-Tolerance. The Vial Type is a group of parameters which can be linked to a Tray.

All vial types to be used within Wash Stations are defined as **Vial Types**.

Selecting the list item **Vial Types,** the following parameters are available for modification. See Figure 130.

Figure 130. Menu Items Vial Types and List Items for Vial Type

Vial Types Parameters are detailed in Table 90.

Table 90. Vial Types Parameters (Sheet 1 of 2)

Item	Description
Default Needle Penetration Depth	Sets the default value of the syringe needle penetration depth in the reservoir vial.
Allow Needle Transport *Available for Vial Type only.*	Sets the transport to **Needle Transport**. In order to allow another transport as the common **Magnetic Transport**, the syringe needle is inserted in the vial septum. If the weight of the vial is not too high, the vial sticks to the needle. All parameter as used for the magnetic transport (such as stripping of) are not functional.
Cap Type *This parameter has to correspond with the Tool parameter "**Needle Guide Type**".*	The type of cap used for the vial can be defined. The following options are available: • **No Cap —** Mainly used for Well-plates • **Magnet Cap** — A magnetic cap is used to transport a vial, typically from a Tray to the Agitator. • **Non Magnetic Cap —** For applications which do not require the sample vials to be transported.
Depenetration Speed	Defines the speed to retrieve the syringe needle from the vial.
Diameter	Defines the diameter of the reservoir container.
Dispose In Waste Container *Available for Vial Type only.*	Used if e.g. a pipetting tip or a SPE cartridge has to be expelled into a dedicated Waste Container. All parameters as used for liquid disposal, such as rinsing syringe, and so on are not functional.
Height	Defines the height of the reservoir container.
Max Ndl Penetr Depth	The maximum allowed Needle Penetration can be defined as a safety measure so that you cannot destroy the needle tip by going too far down. The maximum needle penetration must not exceed the length of the syringe needle, considering the loss of approximately 12 mm due to the needle guide. For a typical needle length of 57 mm or 85 mm for the long needle, the maximum penetration depth must not exceed 45 mm or 73 mm.

Table 90. Vial Types Parameters (Sheet 2 of 2)

Item	Description
Penetration Speed	The syringe needle penetration speed is set by this parameter. It is recommended to use the default value first. Changing this parameter in either direction might lead to needle bending.
Strip Distance	When a magnetic cap is used, the distance to move the TriPlus RSH Head to the side (in the Y-direction) to wipe off the vial can be defined. Measured in mm.
Volume	This parameter defines the volume of the vial.
Z-Tolerance	A tolerance window to give a plus/minus range (expressed in mm) where the Head must expect an object. If the value of this item is **> 0**, this indicates a relative detection mode, and the sensor from the Head needle guide is active. If the value of this item is set to **0**, the sensor of the needle guide is turned off, and the syringe slider moves to an absolute value, Z-axis position as specified in the object.

IMPORTANT Using the SPME technique pay special attention to the parameters **DefNdlPenetrDepth** and **MaxNdlPenetrDepth**.

The penetration depth is always the penetration of the needle itself. Consider the length of the SPME fiber, 10 mm or 20 mm length. When the fiber is lowered, it must not touch the bottom of the vial.

Vial Type Options Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened. See Table 91.

Table 91. Vial Type Options Pull-up Menu

Item	Description
New Vial Type	Creates a new Vial Type.
Copy Vial Type	Copies the present Vial Type.
Delete Vial Type	Deletes a present Vial Type.
Export Rack Item	Exports the Vial Type template to a USB stick.
Export All	Exports all Vial Type templates to a USB stick.
Reset to Default	Resets the selected module parameter to the default value.

Vials

In this class of **Vials**, dedicated vials can be added to the system configuration.

The use of the **Vial** can be specified according to the following categories:

- Wash Vial
- Waste Vial
- Reservoir
- Attachable

The use of these **Vials** is in assigning an extra, custom specific vial, for any use, such as providing a dedicated vial for a reagent, internal standard or a dilution vial.

When the application requires a second Waste Vial or an extra Wash Vial, then this class of **Vial** could be used to define the non-standard vial.

The three categories **Wash Vial**, **Waste Vial**, and **Solvent Reservoir** contain the same available parameters under the **User Access Level**.

The category **Attachable** defines the dimensions and the **Strip-Distance** for any movable object that can be picked up and transported by a Tool with a Magnetic Needle Guide.

Selecting the list item **Vial,** the following parameters are available for modification. See Figure 131.

Figure 131. Menu List Vials and Menu List Items for Vials
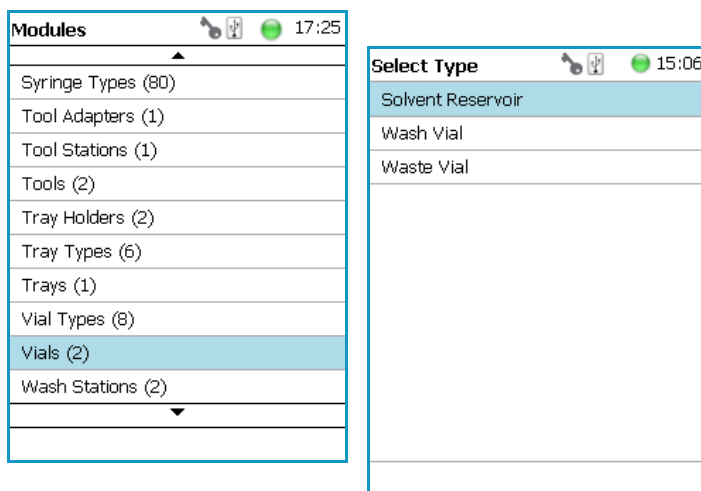
If there is not **Vial** available (Solvent Reservoir, Wash Vial or Waste Vial), the command **New Vial** is available in the **Options** pull-down menu. Follow the dialog with the selectble possibilities to assign a name as shown in Figure 132.

Figure 132. Menu Button New Vial, Selection of Vial Types, and Defining Name for New Vial
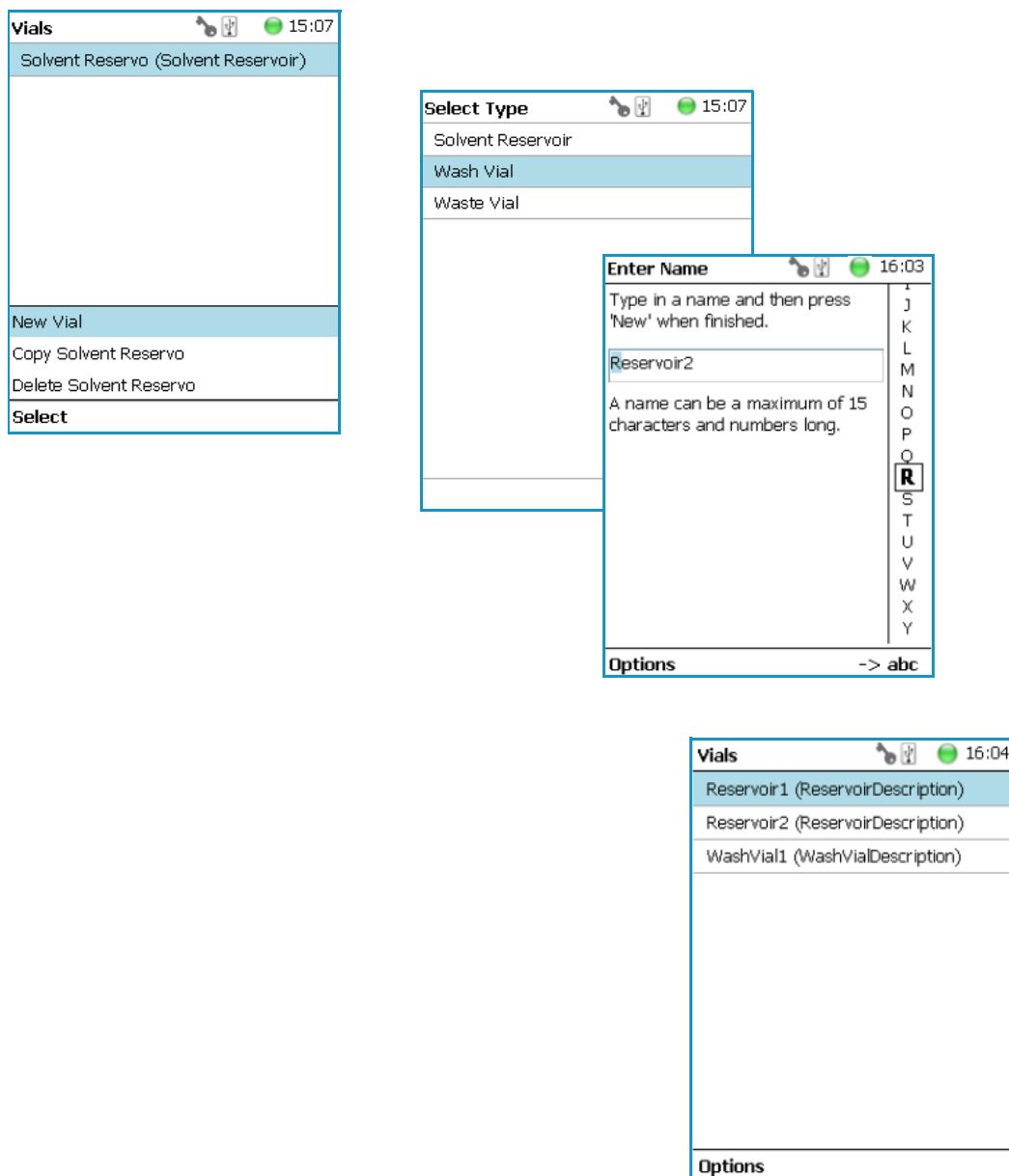
The parameters available for the Vial Type **Reservoir** are slightly different from the parameters for the Wash Vial and Waste Vial.

See the examples in Figure 133 and Figure 134, and the description in Table 92.

Figure 133. Menu List Item Reservoir Parameters for Vial Type Reservoir

Figure 134. Parameters for Vial Types Wash or Waste Parameters for Vial Types Wash or Waste

Table 92. Vials Parameters (Sheet 1 of 3)

Item	Description
Max Ndl Penetr Depths	The maximum allowed Needle Penetration can be defined as a safety measure so that you cannot destroy the needle tip by going too far down.
	The maximum needle penetration must not exceed the length of the syringe needle, considering the loss of approximately 12 mm due to the needle guide, and other factors. For a typical needle length of 57 mm or 85 mm for the long needle, the maximum penetration depth must not exceed 45 mm or 73 mm.
Def Ndl Penetr Depth	The default value of the syringe needle penetration depth in the reservoir vial is determined by this parameter.

Table 92. Vials Parameters (Sheet 2 of 3)

Item	Description
Depenetration Speed	This parameter allows you to select the required speed for pulling the syringe needle out of the reservoir vial.
Diameter	Specific for Waste Vial. Defines the diameter of the reservoir container.
Height	Specific for Waste Vial. Defines the height of the reservoir container.
Penetration Speed	The syringe needle penetration speed is set by this value. It is recommended to use the default value first. Changing this parameter in one or the other direction might lead to needle bending.
Vial Type	A list with all predefined Vial Types opens up for selection. Special cases for **Waste Vial**: • **None** — It is selectable, however if selected in combination with a Wash Module is an error message (Pending Message) propagated. Incompatible Type. • **Waste Port** — Used for the Fast Wash and Large Wash Module. • **Waste Vial** — Used for Standard Wash Module. • **Waste Inset** — This type is used for Standard Wash Module with inserted Waste Line Adapter.
Volume	Specific for **Wash** and **Waste Vial**. Defines the volume of the reservoir container.
Z-Tolerance	A tolerance window to give a plus/minus range (expressed in mm) where the Head must expect an object. • If the value of this item is **> 0**, indicates a relative detection mode, and the sensor from the Head needle guide is active. • If the value of this item is set to **0** the sensor of the needle guide is turned off and the syringe slider moves to an absolute value, the Z-axis position as specified by the object.
Strip Distance	When a magnetic cap is used, defines the distance in millimeters to move the head in the Y-direction in order to wipe off the vial.

Table 92. Vials Parameters (Sheet 3 of 3)

Item	Description
Diameter	Diameter of the attachable object, measured in mm.
Height	Height of the attachable object, measured in mm.

Vials Option Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened See Table 93.

Table 93. Vials Options Pull-up Menu

Item	Description
New Vial	Creates of a new Vial.
Copy Vial	Copies the present Vial.
Delete Vial	Deletes the present Vial.
Reset to Default	Resets the selected Vial parameter to default value.
Check Teaching	Checks the teaching position of the module. This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly. If a teaching point is off, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again, (teaching).

Wash Stations

Four different wash stations are available with the TriPlus RSH: **Standard Wash Station**, **Large Volume Wash** Station, **Large Solvent Station** and **Fast Wash Station** (active module).

Selecting the list item **Wash Stations** opens up the following parameters. See Figure 135.

Figure 135. Menu Item Wash Stations Menu and List Items Wash Modules
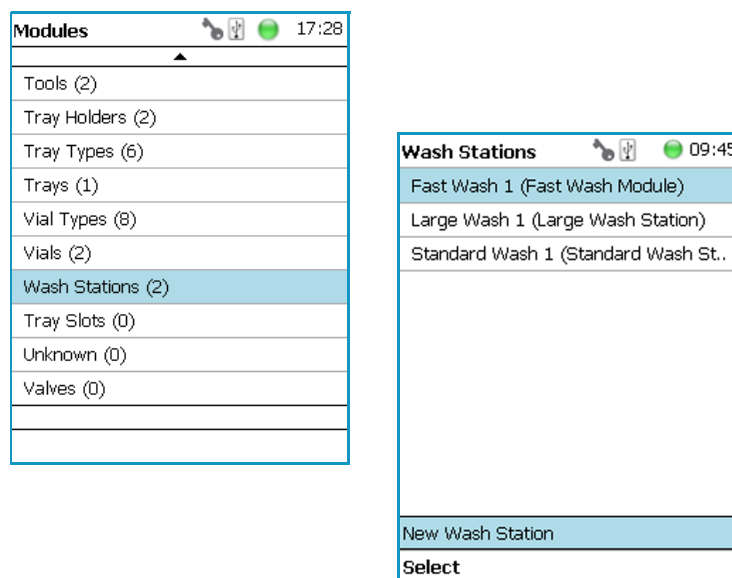
Press **Enter** to edit a parameter.

Select the required menu list item to access the parameters. The wash stations differ in number of positions, Wash Vial size.

- The **Standard Wash Station** accepts 10 mL vials.

- The **Large Volume Wash Station** contains two 100 mL vials, and a Waste position with a drainage tubing.

- The **Large Solvent Station** contains three 100 mL vials, and a Waste position with a drainage tubing.

- The **Fast Wash Station** contains active pumps to deliver two different wash solvents

The available menu list parameters are identically for the **Standard**, **Large Solvent Wash** and **Large Volume Wash Stations**, aside from the number of positions. See Table 94 for details.

The menu list parameters for the **Fast Wash Station** are detailed in Table 95.

Table 94. Parameters for Standard Large Solvent, Large Volume Wash Stations (Sheet 1 of 2)

Item	Description
Pos 1 to Pos 4	Positions **1** and **2** are available for the **Large Solvent Wash Station**. Positions **1** to **4** are available for the **Standard Wash Station**. Each Position can be defined by using the next parameters.
Waste	Defines the Waste position.
Max Ndl Penetr Depth	The maximum allowed Needle Penetration can be defined as a safety measure so that the you cannot destroy the needle tip by going too far down. The maximum needle penetration must not exceed the length of the syringe needle, considering the loss of approximately 12 mm due to needle guide, and so on. For a typical needle length of 57 mm or 85 mm for the long needle, the maximum penetration depth must not exceed 45 mm or 73 mm.
Def Ndl Penetr Depth	This parameters sets the default value of the syringe needle penetration depth in the reservoir vial.
Depenetration Speed	This parameter allows you to select the required speed for pulling the syringe needle out of the reservoir vial.
Penetration Speed	The syringe needle penetration speed is set by this parameter. It is recommended to use the default value first. Changing this parameter in one or the other direction might lead to needle bending.
Vial Type	Defines the Vial Type of the reservoir container in Positions or the corresponding Waste Type in Waste Position. Selection for Wash Positions are: Vial Types None, 2SR, 10SR, or 100SR. Selection for Waste Position are: • **None** — If None is selected, an error (Pending Message) will be propagated. • **Waste Port** — Large Wash and Fast Wash Module • **Waste Vial** — Standard Wash. • **Waste Inset** — Standard Wash with inserted Drainage Adapter.
Volume	Defines the volume of the reservoir vial.

Table 94. Parameters for Standard Large Solvent, Large Volume Wash Stations (Sheet 2 of 2)

Item	Description
Z-Tolerance	A tolerance window to give a plus/minus range (expressed in mm) where the Head must expect an object.
	If the value of this item is **> 0**, this indicates a relative detection mode, and the sensor from the Head needle guide is active.
	If the value of this item is set to **0** the Needle Guide Motor detection current is turned off, and the syringe slider moves to an absolute value, Z-axis position as specified in the object.
Diameter	Specific for Waste Vial.
	Defines the diameter of the reservoir container.
Height	Specific for Waste Vial.
	Defines the height of the reservoir container.
Is Detectable	Specific for Waste Vial.
Visible for Waste Position only.	Differentiates if the Waste position is a Vial, which is detectable, or if it is a nipple with a connected waste tubing.

Table 95. Parameters for Fast Wash Stations (Sheet 1 of 3)

Item	Description
Wash 1 to Wash 2	Wash positions **1** and **2** can be assigned to Fast Wash Station.
Waste	Defines the Waste position.
Max Flow Rate	Sets the upper limit of flow rate for the selected **Wash** Position.
Post Rinse Liner	Activates the solvent pump to rinse the wash liner of the selected **Wash** Position. Number of rinse cycles is selectable after the syringe needle has been removed from the Wash Station.
	Note Without the syringe needle inserted in the liner, the solvent flow is unrestricted. Expect a higher solvent consumption.

Table 95. Parameters for Fast Wash Stations (Sheet 2 of 3)

Item	Description
Pre Rinse Liner	Activates the solvent pump to rinse the wash liner of the selected **Wash** Position. Number of rinse cycles is selectable before the syringe needle has been inserted into the Wash Station. **Note** Without the syringe needle inserted in the liner, the solvent flow is unrestricted. Expect a higher solvent consumption.
Def Ndl Penetr Depth	Sets the default value of the syringe needle penetration depth in the reservoir vial. The default values are:
Depenetration Speed	Selects the required speed for pulling the syringe needle out of the reservoir vial.
Max Ndl Penetr Depth	The maximum allowed Needle Penetration can be defined as a safety measure so that the you cannot destroy the needle tip by going too far down. The maximum needle penetration must not exceed the length of the syringe needle, considering the loss of approximately 12 mm due to needle guide, and so on. For a typical needle length of 57 mm or 85 mm for the long needle, the maximum penetration depth must not exceed 45 mm or 73 mm.
Penetration Speed	The syringe needle penetration speed is set by this parameter. It is recommended to use the default value first. Changing this parameter in one or the other direction might lead to needle bending.
Z-Tolerance	A tolerance window to give a plus/minus range (expressed in mm) where the Head must expect an object. If the value of this item is **> 0**, this indicates a relative detection mode, and the sensor from the Head needle guide is active. If the value of this item is set to **0** the Needle Guide Motor detection current is turned off, and the syringe slider moves to an absolute value, Z-axis position as specified in the object.
Diameter	Specific for Waste Vial. Defines the diameter of the reservoir container. The default value is 20 mm

Table 95. Parameters for Fast Wash Stations (Sheet 3 of 3)

Item	Description
Height	Specific for Waste Vial. Defines the height of the reservoir container. The default value is 80 mm
Vial Type	Defines the Vial Type of the reservoir container in Positions or the corresponding Waste Type in Waste Position.
	Selection for Wash Positions are: Vial Types None, 2SR, 10SR, or 100SR.
	Selection for Waste Position are:
	• **None** — If None is selected, an error (Pending Message) will be propagated.
	• **Waste Port** — Large Wash and Fast Wash Module
	• **Waste Vial** — Standard Wash.
	• **Waste Inset** — Standard Wash with inserted Drainage Adapter.
Volume	Defines the volume of the reservoir vial.

Wash Stations Option Pull-up Menu

Selecting **Options** pull-up menu, the following tasks are opened.
See Table 96 for **Standard** and **Large Volume Wash Stations**, and Table 97 for **Fast Wash Station**.

Table 96. Standard and Large Volume Wash Option Parameters (Sheet 1 of 2)

Item	Description
Check Teaching	Checks the teaching position of the module.
	This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly.
	If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done only under the **Extended User Level**.
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again (teaching).
New Wash Station	Creates of a new Wash Station.
Copy Wash Station	Copies of the present Wash Station.

Table 96. Standard and Large Volume Wash Option Parameters (Sheet 2 of 2)

Item	Description
Delete Wash Station	Deletes of the present. Wash Station.

Table 97. Fast Wash Option Parameters

Item	Description
Teach Module	The positions of the X-, Y-, and Z-axes can be defined again (teaching).
Reset to Default	Resets the selected station parameter to default value.
Check Teaching	Checks the teaching position of the module.
	This task serves as a quick check to determine if the X-, Y-, and Z-positions are defined correctly.
	If a teaching point is incorrect, return to the Menu **Setup** for readjustment of the teaching position. Please note that this action can be done under the **Extended User Level** but not under **User Level**.
New Wash Station	Creates of a new Wash Station.
Prime Wash Liner	Primes the tubing of the selected Wash Position.
Duration	Sets the time required for priming.

Tray Slots

This menu List Item will be implemented in future. See Figure 136.

Figure 136. Menu Item Tray Slots

Setup Menu Item - Set Date and Time

Visible in **Extended User** access level only.

1. In the **Options | Setup** pull-up menu select the list item **Set Date** and **Time**. See Figure 137 and Table 98.

Figure 137. Set Date and Time
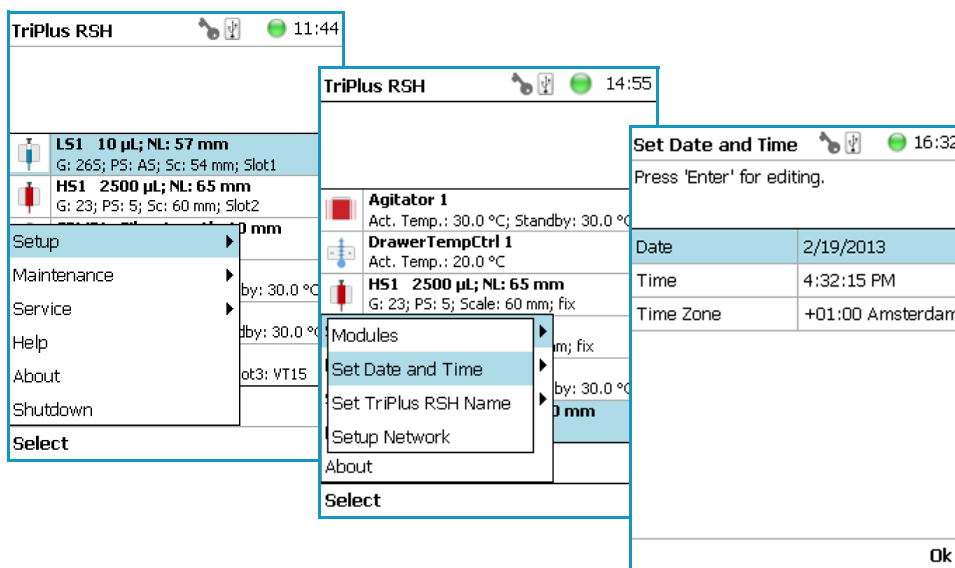
Table 98. Date and Time Format

Item	Description
Set Date and Time	**Date**: format **yyyy-mm-dd**
	Time: format **hh:mm:ss**
	Time Zone: Greenwich Mean Time (GMT) plus or minus the hour deviation from Greenwich standard time. Set your local time.
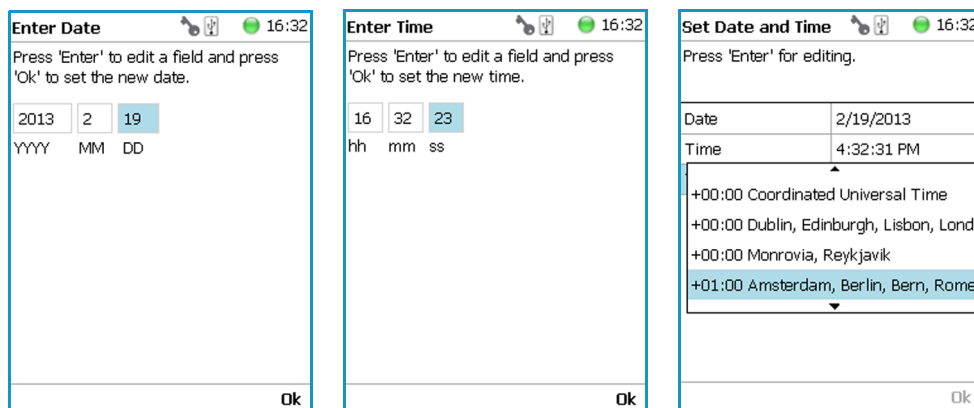
Setup Menu Item - Set TriPlus RSH Name

Visible in **Extended User** access level only.

1. In the **Option | Setup** pull-up menu select the list item **Set TriPlus RSH Name**. See Figure 138.

Figure 138. Set TriPlus RSH Name
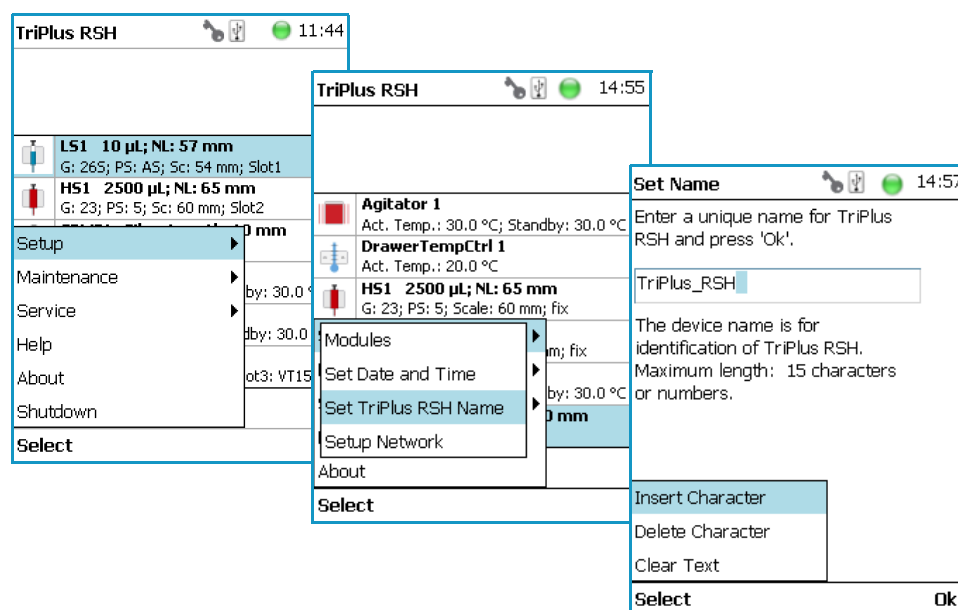
2. Press **Enter** to receive the alphabetical selection of characters or press the **Default Action** button to change from capital to lower case characters or to numbers. The name has to start with an alphabetical character.

3. Set a unique name for the TriPlus RSH. This name will be stored and can be used for identification of the system.

4. Press **Option** to receive the list item **Insert** or **Delete Character** or **Clear Text**.

5. Press **Ok** when finished.

Setup Menu Item - Setup Network

Visible in **Extended User** access level only.

In order to select the required network setup according to your laboratory setting, the following possibilities are available:

- **Direct connection** (Peer-to-Peer) — The TriPlus RSH is directly connected to the computer via the LAN cable. There is no corporate network or router connection.

  – IP Address TriPlus RSH: 192.168.99.230

  – IP Address computer: 192.168.99.210

  – Subnet Mask: 255.255.255.0

  – Default Gateway: not required, leave the field empty (if an address is entered, it will not be used).

- **Corporate Network with DHCP Protocol** — Ask the network administrator to verify and integrate the setup within the corporate network. Select the DHCP Protocol, the network will assign an IP Address and a Subnet Mask to the TriPlus RSH.

- **Corporate Network with Fixed IP Address** — Ask the network administrator to provide the **IP Address**, **Subnet Mask** and **Default Gateway** to configure the TriPlus RSH within the corporate network.

1. In the **Options | Setup** pull-up menu select the list item **Setup Network**. See Figure 139 and Table 99.

Figure 139. Setup Network
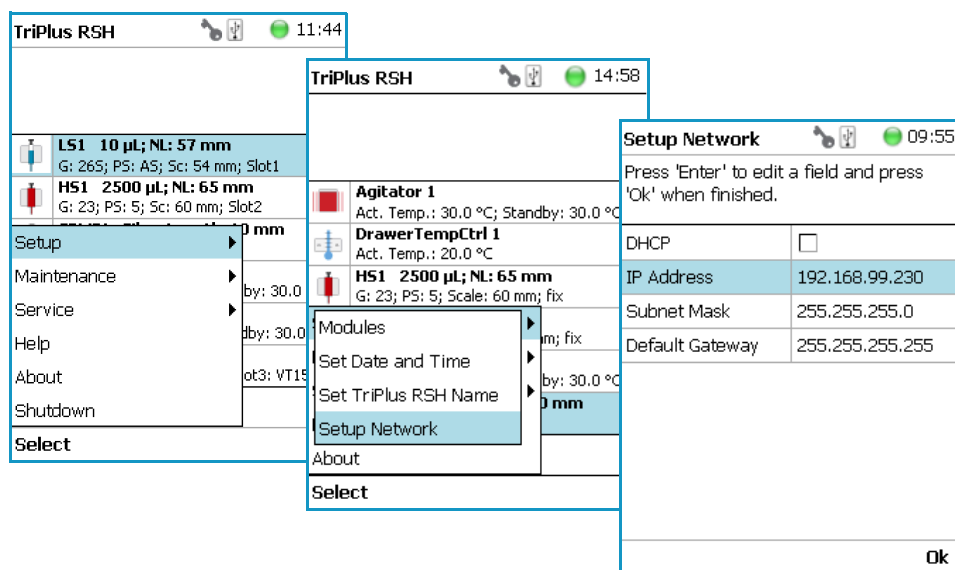
2. Select either the mode **DHCP** or enter a unique fixed IP Address.

3. Press **Ok** when finished.

**Table 99.** Setup Network Parameters

Items	Description
Setup Network	Defines the Network communication parameters.
DHCP	Dynamic Host Configuration Protocol. If activated, an IP Address is dynamically sought throughout the provided network. It is advisable not to use the DHCP mode but to use a fixed IP Address.
IP Address	The IP Address is a fixed system address. The IP Address is often provided by the network administrator. Default Address TriPlus RSH: **192.168.99.230**
Subnet Mask	The Subnet Mask is used for network configuration; it must be provided by the network administrator. Default Subnet mask: **255.255.255.0**
Default Gateway	The Gateway is used if independent networks must communicate interactively. Communication within the network is provided by a hub or switch, defined as **Gateway**. Default Gateway is **192.168.99.1**
MAC Address	Unique hardware identification number of the system. Read only.

Note For more information see Setting up the Network Interface in the *TriPlus RSH Hardware Manual*.

Maintenance Menu Items

This chapter describes the options of the **Maintenance Menu** operated either with the Virtual Handheld Controller, or directly using the installed Handheld Controller.

Contents

- Maintenance Menu
- Check Tool Calibration
- Check Teaching Module
- Check Configuration
- Reset Configuration
- Create Diagnostic Backup
- Create Configuration Backup
- Copy Backup
- Restore Backup

Maintenance Menu

The Maintenance function is available from the **Options** pull-up menu. See Figure 140.

Figure 140. Maintenance
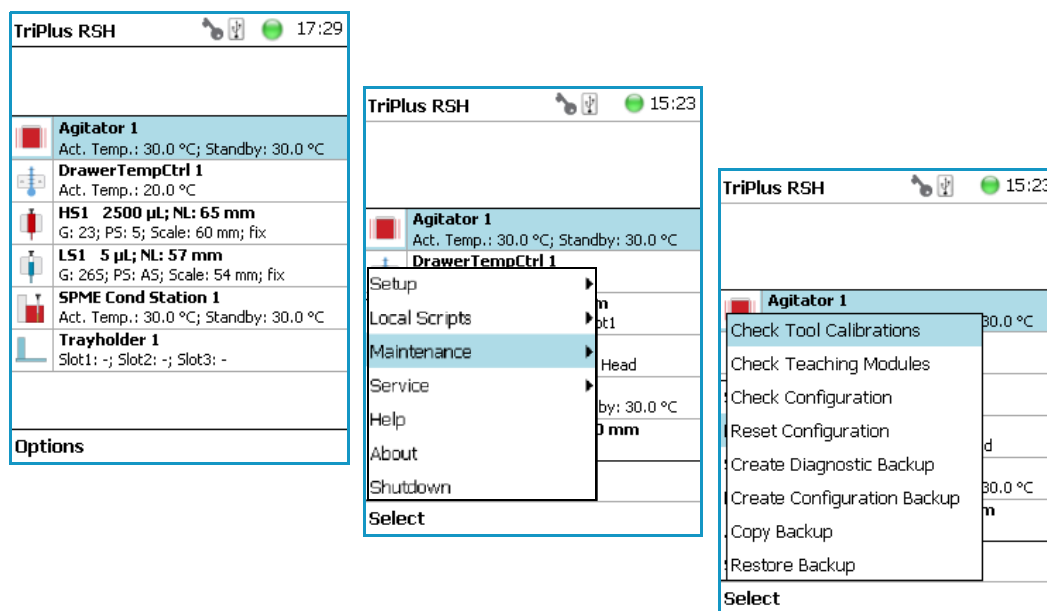
1. Select **Options** to open the pull-up menu, then select **Maintenance** for accessing the list items **Check Tool Calibrations**, **Check Teaching modules**, **Backup**, and **Restore**.

Refer to the following sections:

- "Check Tool Calibration" on page 187
- "Check Teaching Module" on page 187
- "Check Configuration" on page 188
- "Reset Configuration" on page 188
- "Create Diagnostic Backup" on page 190
- "Create Configuration Backup" on page 190
- "Copy Backup" on page 191
- "Restore Backup" on page 192
- "Import Templates" on page 192

Check Tool Calibration

Check Tool Calibration accesses the **Calibration Wizard** without leaving the **Maintenance** menu.
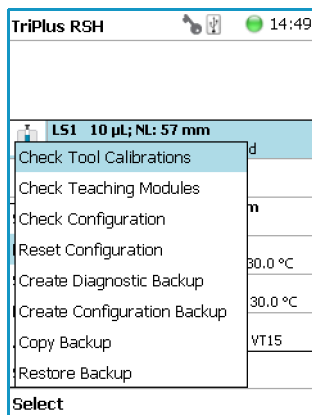
Follow the dialog shown on the display of the Handheld Controller, or on the screen of the Virtual Handheld Controller.

Details are described in **TriPlus RSH Check Tool Calibration** in the *TriPlus RSH Hardware Manual.*

Check Teaching Module

Selecting **Check Teaching** modules the TriPlus RSH Head moves from one module to the next, in the order listed in the table **modules**.
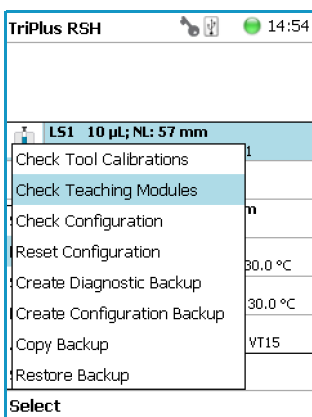
The unit waits at the programmed teaching point for visual inspection; press the button **Next** to continue.

If a teaching point is incorrect return to the Menu **Setup** for readjusting the teaching position of the module involved. The automated check of the teaching position of all the modules is stopped by pressing the **Back** button.

Check Configuration

Selecting **Check Configuration** provides the possibility to check the entire system configuration for any mismatches. **Pending Messages** or **Service Issues** which have been clicked away can be retrieved again.

The software checks the entire configuration for any hidden problems. The message symbol (envelope) in the Status Line indicates that one or more mismatches have been detected.
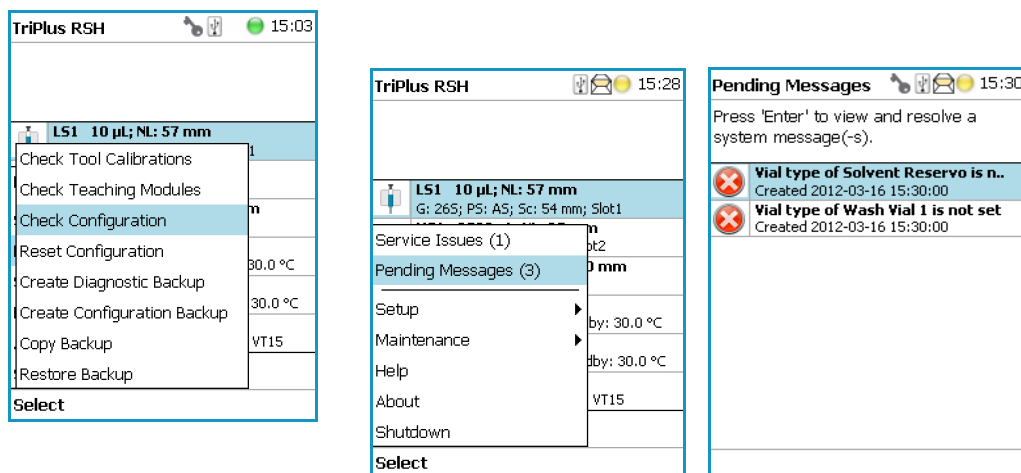
From the pull-up menu select the **Pending Messages** or **Service Issues**.
Note that the messages can be opened and viewed in the **Extended User** access level only.

Reset Configuration

By selecting **Reset Configuration** the RSH Firmware (Application) resets the configuration to a standard application package.
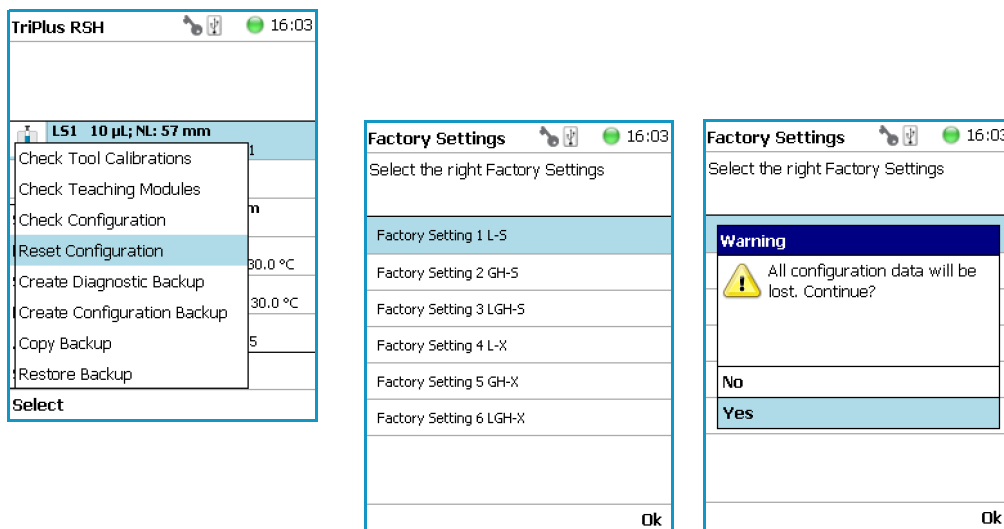
WARNING As pointed out in the **Warning Message** the configuration data will be lost. This means that in the software, Configuration data base will be deleted and the few parameters such as the X-Axis length and the Signal settings (see Table 100 and Table 101) will be reset to default and re-entered.

All other parameters from the TriPlus RSH system configuration (e.g. teaching points for modules, and so on) will be deleted. Consequently, must follow all the steps in the **Installation Wizard** again.

Path from Start Screen: **Options | Service | Installation**.
Access level **Extended User** is required.

Table 100. List Items for Reset Configuration

Item	Description
Factory Setting 1-S	This will set the length of the X-Axis to 850 mm.
Factory Setting 2-L	This will set the length of the X-Axis to 1205 mm
Factory Setting 3 ITSP-S	This will set the basic configuration for the dedicated application ITSP. The dedicated Tray Types and the Waste Container for deposing the used ITSP cartridge are configured besides the standard parameters as listed below.

Table 101. System Parameters affected by Reset Configuration

Item	Default Value Settings with Reset Configuration
I/O Interface	TTLIn1 and TTLIn2; negative logic; 20 ms Debounce Time SWOut1 and SWOut2: PWMOut 36V.
Signals	Input Signals: TTLIn1 and TTLIn2 Output Signals: SWOut1 and SWOut2
Chromatography System	GC1: Input1, Output1
Plunger Check	Activated (Used in Service Installation Wizard Calibrate Tool.)

Create Diagnostic Backup

By using the command **Create Diagnostic Backup**, essential information from the current status of the TriPlus RSH is extracted, and saved in an encrypted form on the SD Card.
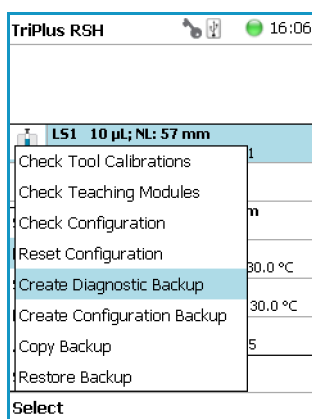
- The primary use of the Diagnostic Backup file is for supporting and troubleshooting a TriPlus RSH system.
  For this purpose it is necessary to send the file by e-mail to the Thermo Fisher Scientific technical support center: gc.gcms.customersupport@thermofisher.com, with the file description provide as well the RSH Firmware version used. Refer also to the chapter **RSH Firmware** in the *TriPlus RSH Hardware Manual*.

The following software components are saved:

- **Application Software**

- **Device Firmware** — The Firmware of all active modules which are part of the specific TriPlus RSH configuration

- **Configuration** (Data Base)

- **Presets** — Defines a model configuration such as liquid and headspace injection technique, and so on.

This tool is available in the **Extended User** and **Service** access levels. After successful creation of the **Diagnostic Backup**, copy the file directly onto the USB Stick. The creation of the Diagnostic Backup file, with extension **'*.pack**, does take approximately eight minutes. The size of the file is in the range of 12 MB, depending on the configuration of the TriPlus RSH.

The **Diagnostic Backup** file can also be used for a **Restore** procedure.

Create Configuration Backup

This command creates a configuration backup file of the TriPlus RSH in its current status. This configuration backup is stored on the SD Card installed on the Control Board. Refer also to the chapter **RSH Firmware** in the *TriPlus RSH Hardware Manual*.
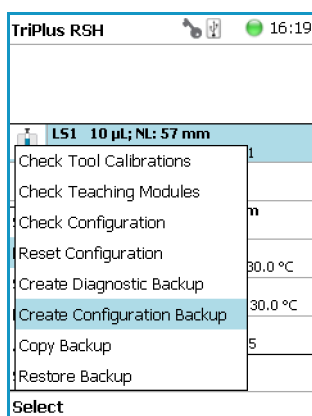
The command is available in all access levels. After successful creation of the Configuration Backup, copy the file directly onto the USB Stick. The creation of the Configuration Backup file does take approximately one to two minutes. The file size is in the range of 1.3 MB, depending on the TriPlus RSH configuration. The file extension is *.**pack**.

The **Configuration Backup** file can also be used for a **Restore** procedure.

Copy Backup

> **Note** Be aware that only one backup file can be stored on the SD Card.
> If for example a Diagnostic Backup file is created and directly followed by creating a Configuration Backup file, the first file (in this example the Diagnostic Backup file) will be overwritten. To save both files, it is necessary to copy each file immediately onto the USB Stick

It is good practice to store the configuration backup in a safe place, if possible on a network-server. You must keep an authorized configuration backup outside of your premises.
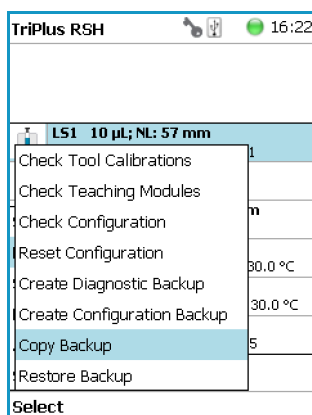
To copy a configuration backup from the SD Card, insert the USB stick into the connector USB Host on the back of the TriPlus RSH.
Refer also to the chapter **RSH Firmware** in the *TriPlus RSH Hardware Manual.*

Restore Backup

The function **Restore** allows loading a **Backup** file saved from the same TriPlus RSH system back to the system. Only a Backup file (*.**pack** file) can be used. The key, the encryption of the Application, and the device Firmware files must match.

Refer also to the chapter **RSH Firmware** in the *TriPlus RSH Hardware Manual*.
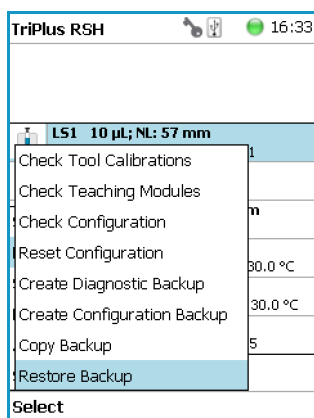
Import Templates

Selecting the menu item **Import Templates** allows the **Extended User** to import one or more customized templates for several items such as:

- Needle Types

- Tray Items

- Syringe Types

- Tray Slot Types

- Tray Types

- Valve Types

- Vial Types

- Tray Container Types
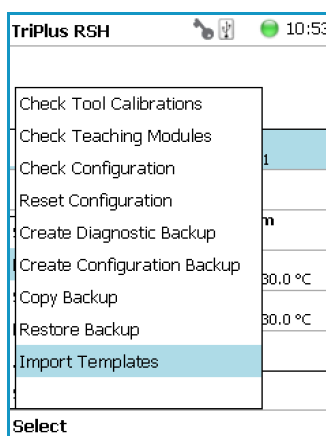
Service Menu Item

This chapter describes the options of the **Service Menu** operated either with the Virtual Handheld Controller, or directly using the installed Handheld Controller.

Contents

- Service Menu
- Installation Item
- Create New Tray System Item
- Teach Home Position

Note Items highlighted in **green** are only visible in the access level **Extended User**.

Service Menu

The Menu **Service** is only available under the **Extended User Level**. The menu contains the items **Installation** and **Create New Tray System**. The item **Installation** is a wizard that guides through the installation procedure covering all points, and controlling the status of the system. The **Create New Tray System** item will be used during routine operation.

- See

- See

- See

Prerequisites

When the TriPlus RSH is powered on, the **User Access Level** is always active by default. To enable access to the **Extended User Level** press the two **Menu Buttons** simultaneously, or press the two characters **A** and **B** simultaneously on the keyboard if you are working with a Virtual Handheld Controller. For more details, see the section .

Figure 141. Changing Access Level
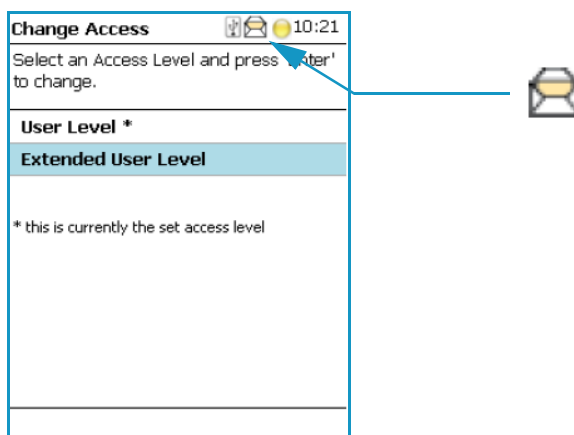
When the TriPlus RSH is powered up the first time, the **Message Envelope** is shown in the Menu Screen Status Bar. See the example in Figure 141.
The reason for this message is that a TriPlus RSH cannot be operated as long as the motors are not calibrated. The modules cannot operate if this step has not been completed.

When pending messages are indicating, verify the message. If the message can be explained with the concept as described above, click it away. For confirmation check all cables from the active modules are properly connected.

Installation Item

> **Note** During a new installation of the TriPlus RSH, it is advisable to first configure the
> Passive modules before activating the **Installation Wizard Service**. One wizard item is
> Teaching Module. If the Passive modules, such as the Injector, Wash Module, and so on,
> are not yet configured, it will be necessary to restart this wizard again.
>
> The **Quick Reference Guide** in the *TriPlus RSH Hardware Manual* shows the order of
> installation. Use this guide as reference.

Select **Options** to open the pull-up menu. Select the menu item **Service**; then the list item
Installation to start the wizard. See Figure 142.

Figure 142. Selecting the Menu List Item Installation
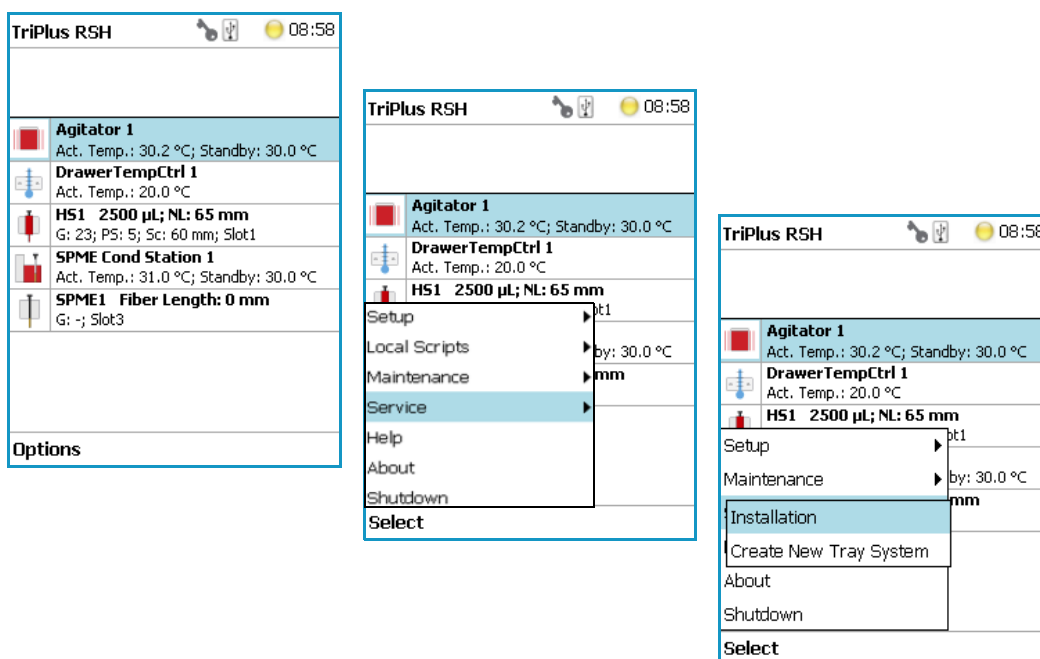
The **Installation** wizard begins with the basic setup items. Some of the list items can be
accessed under the menu item **Setup**.

The **Installation** wizard includes twelve points. See Figure 143. When the TriPlus RSH is
powered up the very first time, specific sections are grayed out until the section Calibration
Motors has been completed. Each point ticks off as it is completed.

When the TriPlus RSH is powered on for the very first time, these wizard items which have to
be accomplished are active (black). The grayed out wizard items will be active as soon as the
system is calibrated (Calibrate Motors), and if the hardware configuration of the TriPlus RSH
requires these points.

Figure 143. Installation Wizard.
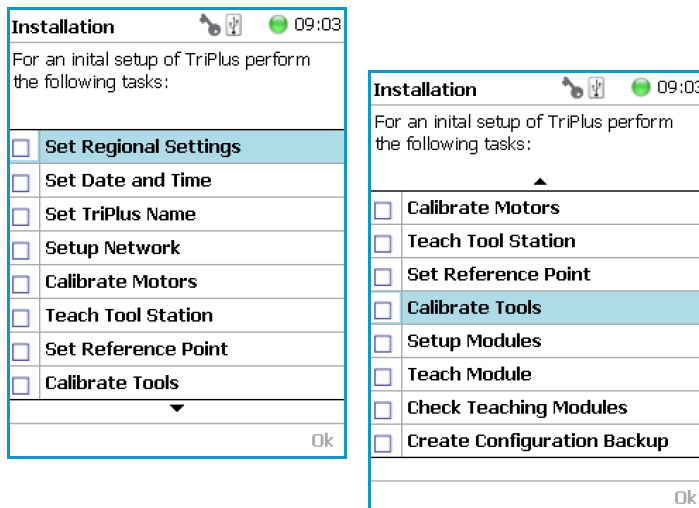
See the following sub-sections:

- "Set Regional Settings" on page 197

- "Set Date and Time" on page 198

- "Set TriPlus RSH Name" on page 199

- "Setup Network" on page 200

- "Calibrate Motors" on page 203

- "Teach Tool Station" on page 206

- "Configure SPME Tool" on page 211

- "Set Reference Point" on page 213

- "Calibrate Tools" on page 214

- "Setup Modules" on page 217

- "Teach Module" on page 218

- "Check Teaching Modules" on page 224

- "Create a Backup File" on page 225

Set Regional Settings

❖ **To set regional setting**

1. Select the wizard item **Set Regional Setting** to adjust the language and the region. See Figure 144.

Figure 144. Wizard Item Set Regional Settings
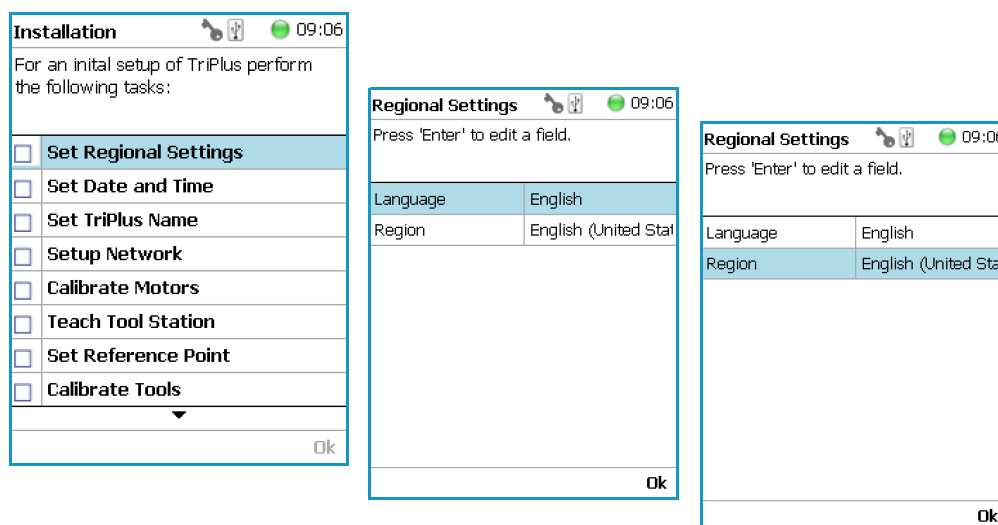
Table 102. Set Regional Settings

Item	Description
Language	English is the default language.
Regional Setting	Corresponds to the country settings of the computer operating system. The country setting mainly influences formatting such as for dates and numbers.

IMPORTANT When a Set Regional Setting parameter is changed, a reboot of the system is required. Please note that the Regional Settings are active for the Handheld Controller only, the Virtual Handheld Controller is dependent on the settings of the computer operating system.

Set Date and Time

❖ **To set date and time**

1. Select the wizard item **Set Date and Time** to adjust the date and time. See Figure 145 and Table 103.

Figure 145. Wizard Item Set Date and Time

Table 103. Set Date and Time Parameters

Item	Description
Date	The format is: **yyyy/mm/dd**
Time	The format is **hh:mm:ss**
Time Zone	Greenwich Mean Time (GMT) plus or minus the time deviation (in hours) from Greenwich standard time.

Set TriPlus RSH Name

❖ **To set TriPlus RSH name**

1. Select the wizard item **Set TriPlus RSH Name** to set a name for the TriPlus RSH for identification. See Figure 146 and Table 104.

Figure 146. Wizard Item Set TriPlus RSH Name
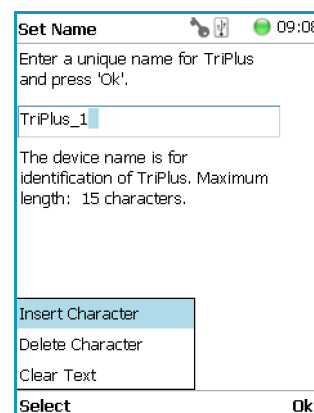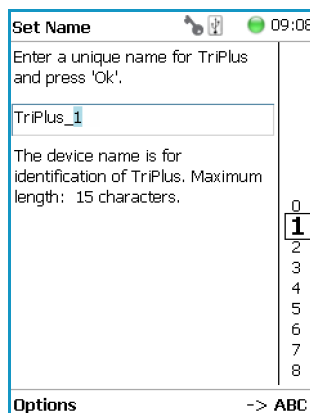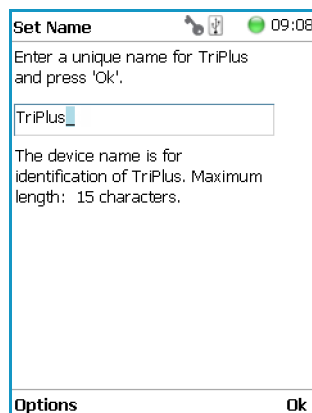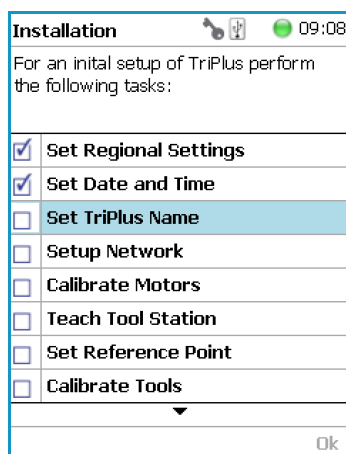
2. Press **Enter** to receive the alphabetical selection of 15 characters maximum or press the **Default Action** button to change from capital to lower case characters or to numbers.

> **Note** The name must start with an alphabetical character, and end with an alphanumerical character. Special characters or spaces cannot be used to start or end the name.

3. Press **Options** to access the list items **Insert**, or **Delete Character**, or **Clear Text**.

4. Press **Ok** when finished.

Table 104. Set TriPlus RSH Name Parameter

Item	Description
Set TriPlus RSH Name	Set a unique name for the TriPlus RSH. This name will be stored and is used for identification of the system.
Insert Character	Allows inserting a character. Press **Enter** to receive the selection of capital letters. Pressing the **Default Action** button will switch to lower case characters or to the alphanumeric selection.
Delete Character	Deletes the selected character.
Clear Text	Clears the full text.

Setup Network

❖ **To perform Setup Network**

1. Select the wizard item **Setup Network** to enable a network communication from the system to the computer, TCP/IP. See Figure 147 and Table 105.

2. Select either the mode **DHCP** or enter a unique fixed IP Address.

3. Press **Ok** when finished.

Figure 147. Wizard Item Setup Network

Table 105. Setup Network Parameters

Item	Description
Setup Network	Defines the Network communication parameters.
DHCP	Dynamic Host Configuration Protocol. If activated, an IP Address is dynamically sought throughout the available network. It is advisable not to use the DHCP mode but to use a fixed IP Address.
IP Address	The IP Address is a fixed system address. The IP Address is often provided by the network administrator. Default address TriPlus RSH is **192.168.99.230**
Subnet Mask	The Subnet Mask is used for network configuration, it must be provided by the network administrator. Default address TriPlus RSH is **255.255.255.0**
Default Gateway	Gateway is used if independent networks must communicate interactively. Communication within the network is provided by a hub or switch, defined as the **Gateway**. Do not assign a Default Gateway address.

When the network cable is not connected, and a LAN communication is not established, the following screens will appear.
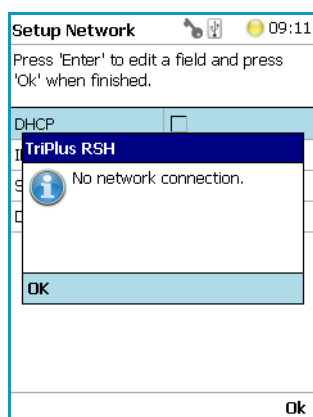
The system will recognize that no network communication is established or possible. A corresponding error message will appear.

1. Check the connections of the LAN cable. The default addresses is visible after reentering the **Setup Network** screen.

2. Check the LEDs on the Ethernet connector at the back of the TriPlus RSH.
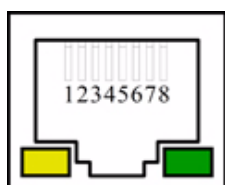
- **The LED on the left** — **Status** LED. Orange color indicates that the current is applied to the connector.

- **The LED on the right** — Indicates the Ethernet communication status. Green blinking status indicates that the Ethernet communication is established.

3. When the settings have to be changed, select one Network parameter after the other, and enter the required numbers. The next examples show the default values.

> **Note** When the LAN communication is not established, newly entered IP address numbers are not stored.

For more information refer to **Setting Up Network Interface** in the *TriPlus RSH Hardware Manual*.

In order to select the required network setup according to the laboratory setting, the following possibilities are available:

- **Direct connection** (Peer-to-Peer) — The TriPlus RSH is directly connected to the computer via the LAN cable. There is no corporate network or router connection.

  – IP Address TriPlus RSH: 192.168.99.230

  – IP Address computer: 192.168.99.210

  – Subnet Mask: 255.255.255.0

  – Default Gateway: not required, leave the field empty (if an address is entered, it will not be used)

- **Corporate Network with DHCP Protocol** — Ask the network administrator to verify and integrate the setup within the corporate network.
Select the DHCP Protocol; the network will assign an IP Address and a Subnet Mask to the TriPlus RSH.

- **Corporate Network with Fixed IP Address** — Ask the network administrator to provide the IP Address, Subnet Mask, and Default Gateway to configure the TriPlus RSH within the corporate network.

Calibrate Motors

The calibration of the motors is basically a check to determine whether the mechanical stop points of the various axes can be found reliably. A clearance distance (offset) from the mechanical stop point is assigned and stored as the electronic stop point. This calibration of the axes is mandatory and ensures reliable performance.

This step has been repeated when a motor has failed, has been replaced or when any other major error has occurred. This calibration task brings the TriPlus RSH back to reliable operation.

Note Please do not confuse the terms and tasks for **Calibration Motors** as explained in this section with those for **Calibration Tools** as described in the section "Calibrate Tools" on page 214. When starting the wizard **Calibrate Motors**, at least one Tool must be parked in a slot of the Tool Station.

❖ **To calibrate motors**

1. Select the wizard item **Calibrate Motors** and follow the dialog. In the following example, the **Calibration Wizard** guides you from the steps 1 to 6. See Figure 148.

Figure 148. Wizard Item Calibrate Motors and Starting Calibration Wizard Step 1 of 6
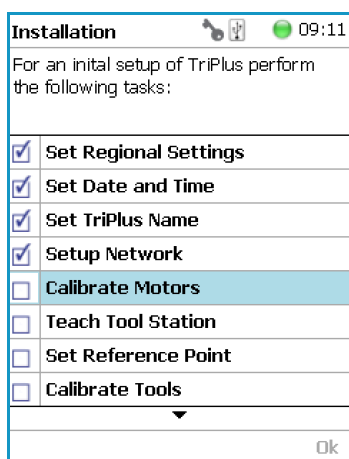
2. Press **Calibrate** to start the first step **Calibrate Axes**. All axes from the TriPlus RSH are calibrated. Wait until the yellow light stops flashing and **Next** becomes available (Step 1).

3. Press **Next** to continue with the **Calibrate Coupling** (Step 2).
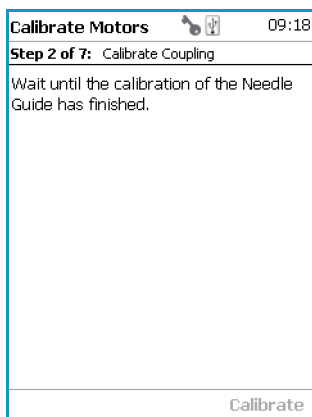
4. When finished, press **Next** again to **Calibrate Plunger Sensor** (Step 3).
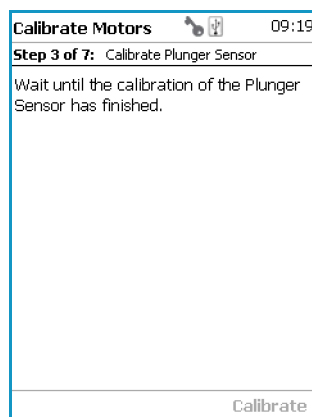
5. Step 4 calibrates the coupling of a Tool. The wizard text explains that the head must be moved above the **Coupling Pivots**.
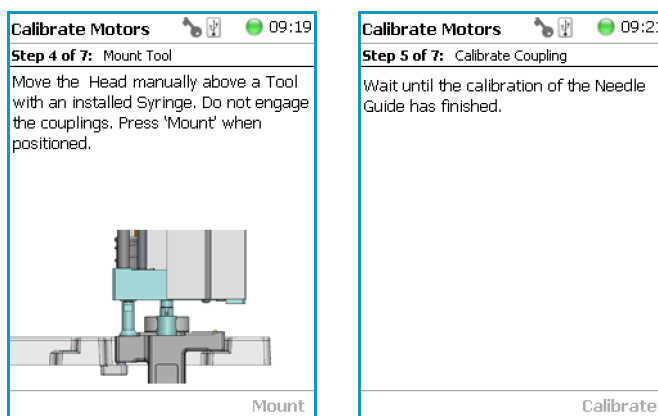
> **Note** Please note that the TriPlus RSH Head has to be positioned such that the receiving holes of the **Z-Slider** are above the **Coupling Pivots** of the Tool but they must not be engaged.

Upon starting the wizard, the TriPlus RSH automatically turns off the current to enable a manual movement of the TriPlus RSH Head.
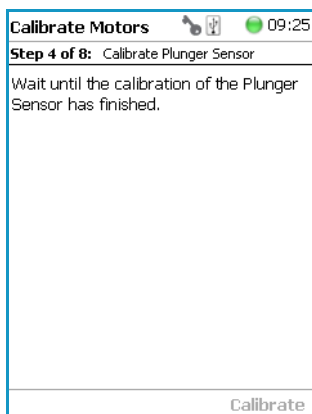
6. If the calibration step is activated with an installed Tool, the system dialog will ask you to move the Head first to an empty slot, and **Eject** the Tool first.

> **Note** When the Tool ejection has been completed, the Tool is not installed in the head of the TriPlus RSH. Continuing with **Calibrate Motors**, in the Installation Wizard will detect that the Tool is not mounted, and will adapt to this situation accordingly.

When Step 4 has been successfully completed, press **Next** to continue to Step 5 to calibrate the coupling.

7. In Step 6, the Sensor of the **Plunger motor** is calibrated. When finished, press **Next** to continue.
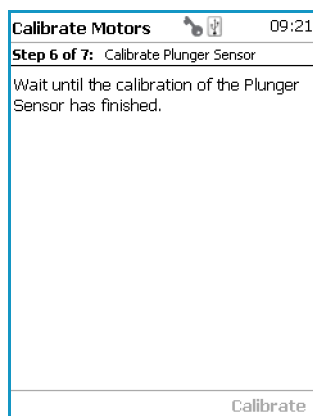
8. Step 7 completes the **Calibration Wizard**. The head of the TriPlus RSH moves back to the Home position.
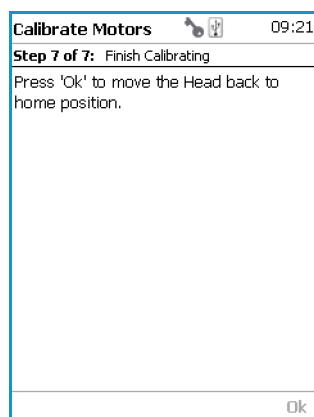
Teach Tool Station

This section describes the teaching of a ATC Station. The teaching of a TR Station uses the same steps.

> **CAUTION** When a ATC Station is used in the configuration of the system, remove any other Tool from the slots before the wizard is started.

❖ **To proceed with different types or configurations of the Tool station**

The TriPlus RSH system can be equipped with a TR Station or with one or two ATC Stations.

The following configurations are allowed:

- One TR Station

- One or two ATC Stations

The following configurations are prohibited:

- Two TR Stations

- The combination of a TR Station with a ATC Station

For the configuration with two ATC Stations see the following Caution **Exceptional Circumstances**.

> **CAUTION** **Exceptional Circumstances**
>
> To configure two ATC Stations see the following procedure:
>
> 1. Physically connect both ATC Stations at the desired position of the X-Axis.
>
> 2. Define which ATC Station shall be the **ATC Station #1**.
>
> 3. When the TriPlus RSH is powered off, connect the supplied control cable from the rear side of ATC Station #1 to the connector marked Bus on the TriPlus RSH control interface. If Bus connector is already occupied, connect the cable to another Active module with an open connector.
>
> 4. DO NOT connect the control cable from **ATC Station #2**.
>
> 5. Power-up the system. The software will assign the module address to **ATC station1**.
>
> 6. Turn off the system and connect the provided control cable to **ATC Station #2**.
>
> 7. Power-up the system again, the software will recognize the second ATC Station and will assign the address to **ATC Station2**.

After completing the steps to assign the addresses to the two ATC Stations, keep in mind the following points:

The slots in the two ATC Stations will be identically numbered from 1 - 3. The Address of the ATC Station will enable the system to distinguish between these slots.

For example: ATC Station1; Slot1 | ATC Station2; Slot1.

- Following the **Service Wizard**, the second point after Teach Tool Station is the item **Set Reference Point**. It is advisable, but not mandatory, to set the reference point at ATC Station #1. It is more likely that the second ATC Station will be removed in the future, and not the first one. Removing the ATC Station to which the Reference Point has been assigned would result in the elimination of the Reference Point for the system.

- When the wizard for **Teach Tool Station** is started, the software will check if the Tool (coupled in the TriPlus RSH head) is parked in the expected position.
  If the two ATC Stations are mixed up, an error message appears. Then, verify the identity of the ATC Station, the slot position, or both.

Wizard Teach Tool Station

The wizard procedure is identical for teaching a TR Station or an ATC Station. The difference is the number of slots to teach.

WARNING When an ATC Station is used in the configuration of the system, remove any other Tool from the slots before the wizard is started. If this is not observed, an error message will appear.
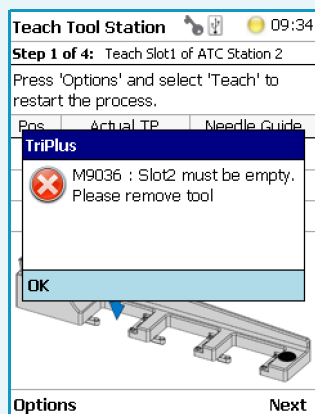
The wizard **Teach Tool Station** calibrates the position of the slot(-s). The height of the Tool, installed in the slot is calibrated against the TriPlus RSH Injection Unit base plate to define the coupling distance.

❖ **To calibrate the position of the slots**

1. Select the wizard item **Teach Tool Station**. See Figure 149.

Figure 149. Wizard Item Teach Tool Station
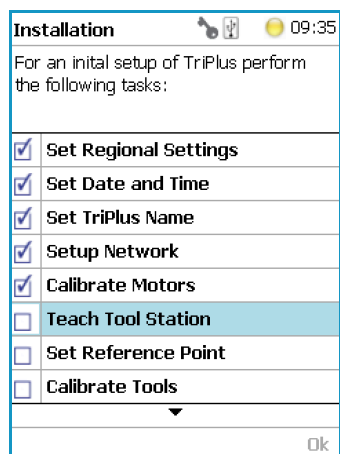
The wizard automatically turns off the current to the TriPlus RSH to enable a manual movement of the TriPlus RSH Injection Unit to the first Slot.

If you have performed the previous step "Calibrate Motors" on page 203, a Tool should still be installed. If for any reason there is no installed Tool, the TriPlus RSH will recognize the situation and will go through an intermediate step to mount a Tool.

2. Step 1 of 4 requests the installation of a Tool if one is not mounted to the Head. See Figure 150.

Figure 150. Mount a Tool
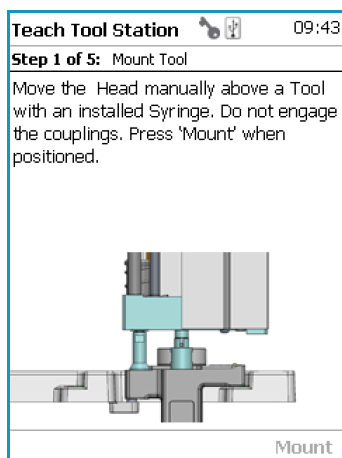
3. When a Tool has already been installed, the wizard starts with Step 1. See Figure 151.

Figure 151. Teach Slot 1
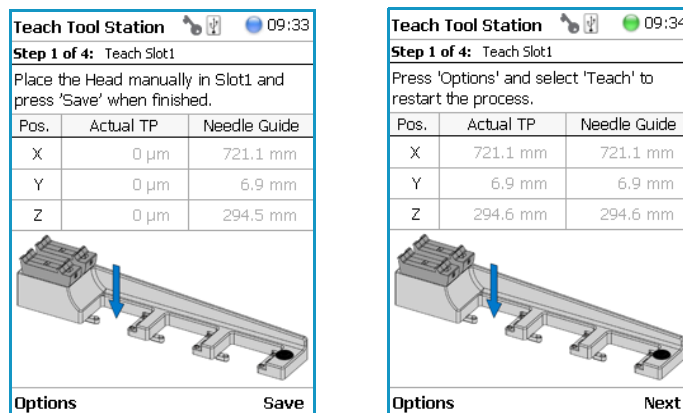
Step 1 asks you to place the TriPlus RSH Injection Unit manually into the first slot. Ensure that the guiding pins engage well into the guiding holes of the ATC Station. When positioned well, press **Save** to store the X-, Y-, and Z-Axes positions.

4. Repeat the previous steps to teach the positions for Slots 2 and 3. The last step moves the Head back to the **Home** Position. See Figure 152.
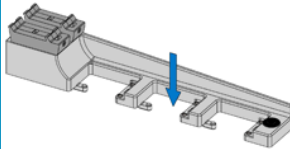
Figure 152. Teach Slot 2 and Slot 3

Note If the TriPlus RSH configuration contains two ATC Stations, the wizard will continue with teaching ATCStation2 in the same logical order as described above.

Configure SPME Tool

Working with the SPME Tool requires two adjustments of the SPME Fiber. Configure SPME Tool parameters are described in Table 106.

Table 106. Configure SPME Tool Parameters

Item	Description
Fiber Alignment	Fiber position is aligned with the needle tip.
Standby Position Offset	Fiber is inserted 2 mm into sheath metal needle. (2 mm retraction is a recommended value). When using very soft septa, adjust to 3.0 mm.

The last wizard point is Teach Tool Station. For this task, the Tool must be removed from the slots. After finishing the teaching task, the wizard will move to the next point, **Configure SPME Tool**. If the SPME Tool has not been positioned in a slot at the moment of activating this wizard point, the task will be grayed out.

❖ **To overcome the situation**

1. Insert the SPME Tool manually in a slot.

2. Select the previous wizard point **Teach Tool Station** again. Wait until the first movements of the Z-Axes are finished.

3. Press **Back** and leave this wizard point without going through all the steps. Check if the wizard point Configure **SPME Tool** is active.

❖ **To configure the SPME tool**

1. Select the wizard item **Configure SPME Tool**. See Figure 153.

Figure 153. Wizard Item Configure SPME Tool
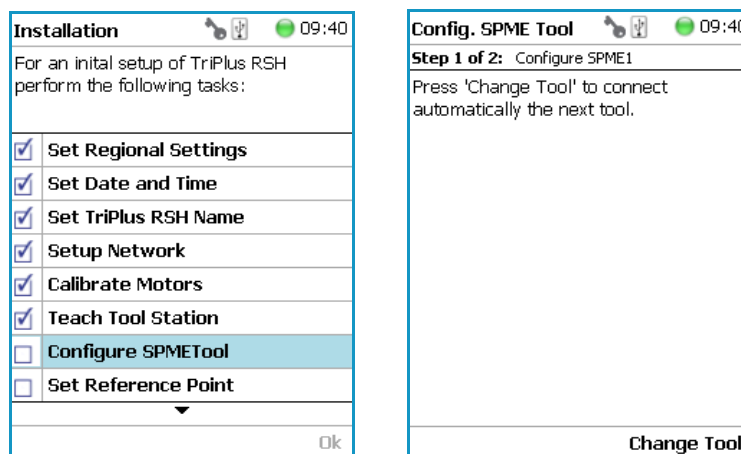
2. When a Tool other than the SPME Tool is installed in the TriPlus RSH Injection Unit, the wizard asks for a Tool change.

3. Adjust the **Fiber Alignment**. Align the fiber tip with the needle tip as indicated in the figure of the handheld controller, or the virtual handheld controller. Turn the fiber downwards until it is clearly visible. Turn it back at the same level as the needle tip, then save this value. See Figure 154.

Figure 154. SPME Fiber Alignment
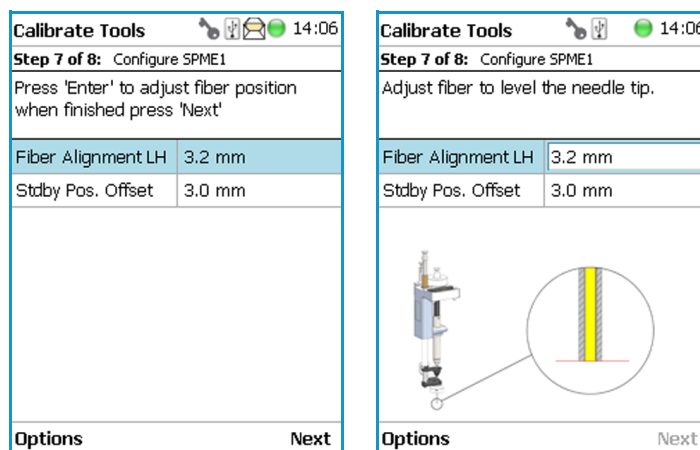
4. Adjust the **Standby Position**. Bring back the fiber by at least 2 mm into the needle (protection sheet), so the fiber does not touch the septum when penetrating through. The fiber could stick to the septum and be damaged or even lost. See Figure 155.

Figure 155. SPME Fiber Standby Position
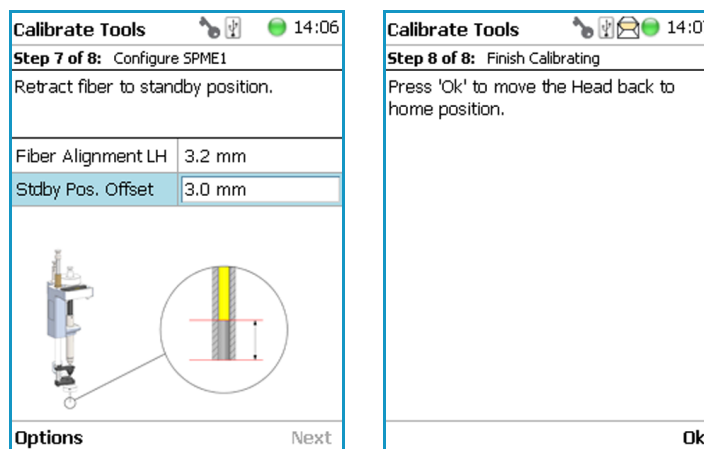
An approximate value for the parameter **Fiber Alignment** and the recommended value for the parameter **Fiber Standby Position** are given in Table 107.

Table 107. Fiber Alignment and Fiber Standby Position

SPME Type	Fiber Alignment	Fiber Standby Position
SPME	10.8 mm	2.0 mm

Set Reference Point

> **Note** The concept of **Referencing** and **Calibration** is explained in the chapter **TriPlus RSH Defining Object Positions** in the *TriPlus RSH Hardware Manual*.

Follow the **Installation Wizard** for the referencing of the **Ideal Tool**. Select a Tool which is most frequently used and define it as the **Ideal Tool**. This Tool is used for referencing and all other Tools used in the TriPlus RSH system configuration will be calibrated relative to this Tool.

❖ **To set the Reference Point**

1. Select the wizard item **Set Reference Point** and follow the dialog. See Figure 156.

   Figure 156. Wizard Item Set Reference Point
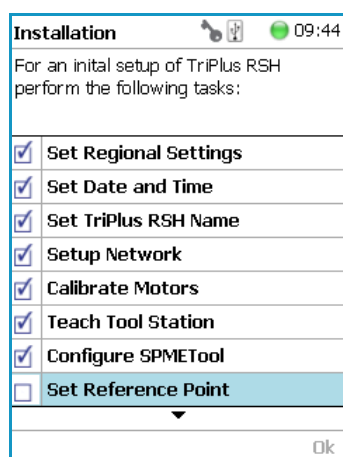
> ⚠️ **CAUTION** It is advisable to hold with one hand the Y-Axis and with the second hand move the Tool body in a controlled manner until the Head reaches the teaching position. Do NOT hold the Needle Guide to move the Head. This part is mechanically flexible and could lead to misalignment.
>
> The TR Station or ATC Station should not change in their position and only calibrated Tools should be used. If the Station has moved its position, it is necessary to redefine the Reference Point, and recalibrate all the other Tools.
>
> If for any reason, the referencing (Set Reference Point) has been repeated, it is mandatory to recalibrate all the Tools. Using the step **Set Reference Point** clears the calibration data for the individual Tools. A message will appear to inform the operator of the necessary steps. It is not important whether a TR or a ATC Station is used. The behavior during re-calibration will be identical.

2. Manually position the Head exactly within the guiding rings of the lunette. Store this value pressing **Save**. Now you the choice to fine tune the teaching by pressing Enter. This allows manually adjusting the three axes Y-, X-, and Z.

3. At the end pressing **OK** the Head move automatically back to the **Home Position**. See Figure 157.

Figure 157. Set Reference Point and Finish Wizard

Lunette
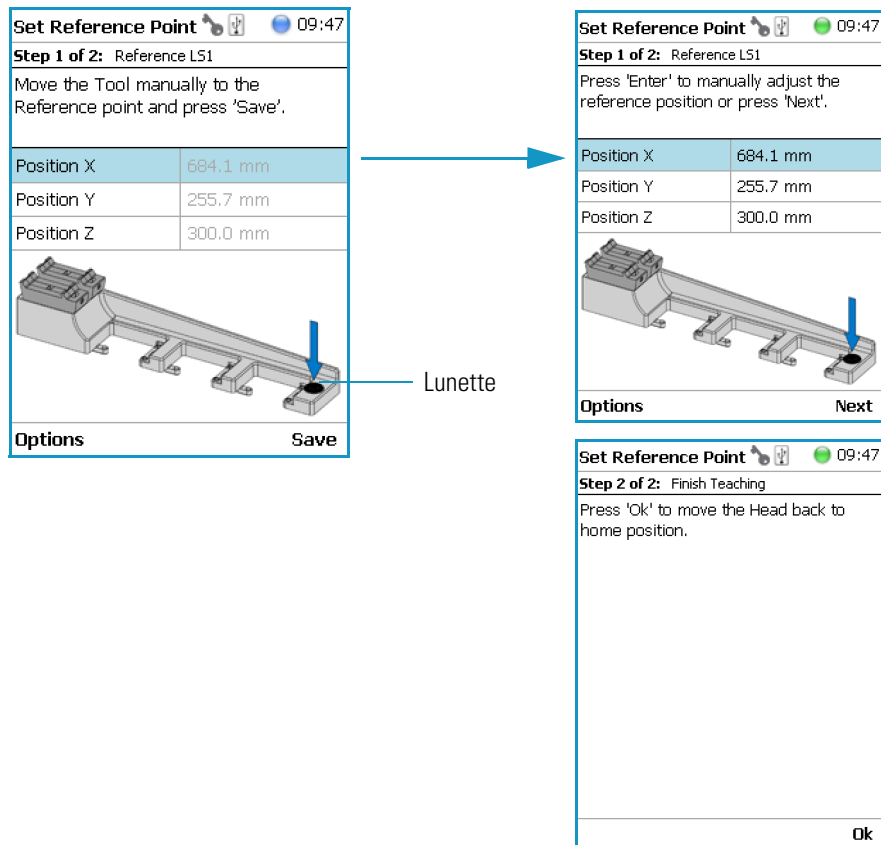
Calibrate Tools

> **Note** The concept of **Referencing** and **Calibration** is explained in the chapter **TriPlus RSH Defining Object Positions** in the *TriPlus RSH Hardware Manual*.
>
> The Tool which is most frequently used should be used for Calibration.
> This Tool can be considered as the **Ideal Tool**. All other Tools will be referenced with respect to the **Ideal Tool**. This step is not necessary when a single Tool Station, the TR Station, is used or if only one Tool is in use within the entire system.

⚠️ **CAUTION** It is advisable to hold with one hand the Y-Axis and with the second hand move the Tool body in a controlled manner until the Head reaches the teaching position. Do NOT hold the Needle Guide to move the Head. This part is mechanically flexible and could lead to misalignment.

The following example describes calibration of a Tool positioned in Slot 1, a second Tool positioned in Slot 2, and a third Tool positioned in Slot 3.

❖ **To calibrate the tools**

1. Select the wizard item **Calibrate Tools** and follow the dialog. See Figure 158.

    Figure 158. Wizard Item Calibrate Tools and Calibration of Ideal Tool
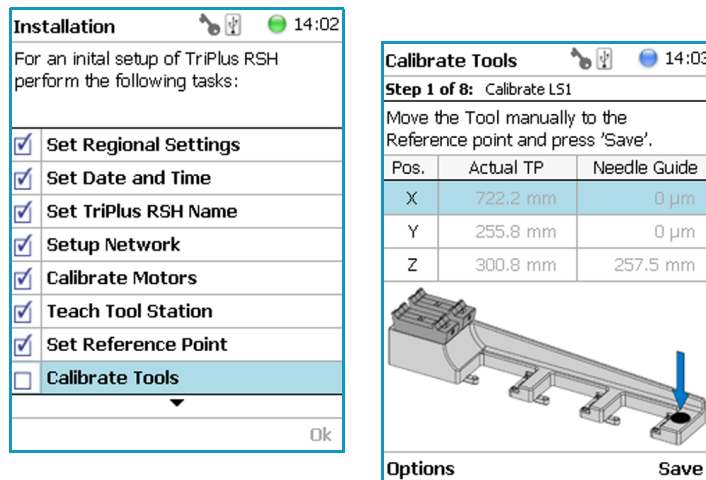
2. Press **Save** to continue in the wizard. The X-, Y-, and Z-positions will be stored. Select **Next** to open the window for assigning the Tool parameters.

    The default value of the Tool Parameter is **Not Specified**. This means that the parameter has to be specified for the application. The definition can be made at this stage of installation or later on during routine work. You are able to change this parameter to adapt it for another application; note that the **Extended User Level** is required.

    Table 108 details the **Calibrate Tool Parameters**.

    Table 108. Calibrate Tools Parameters

Item	Description
Not Specified	Prohibits the execution of a run.
Magn10or20mL	Magnetic Ring installed to enable the transport of 10 or 20 mL vials.
Magn2mL	Magnetic Ring not installed but Lower Needle Guide has Magnets installed to enable transport of a 2 mL vial.
Foil Cutter	Foil Cutter installed. The Foil Cutter pierces a sealing foil of a MTP or DW-Plate before the syringe needle penetrates the well.
NonMagn2mL	The lower Needle Guide has no magnets installed; a magnetic ring is not connected to it. Typically used for Microtiter Plates or for vials with a non-magnetic cap.

    The parameter **Cap Type** in the class **Vial Type** has to correspond with the Tool Needle Guide Type.

Examples:

- Magnetic10/20 | Magnet Cap

- Magnetic 2mL | Magnetic Cap

- Foil Cutter | MTP Plates

> **Note** If **Needle Guide Type** is defined as **Not Specified**, the execution of a sample run is prohibited even if the **Cap Type** is set to **No Cap** or **Non Magnetic Cap**.

3. After the first step of **Tool Calibration**, the wizard will park the **Ideal** Tool and pick up the next Tool, starting with the Tool in **Slot 1** and consecutively to **Slot 2** and **Slot 3**. See Figure 159 and Figure 160.

Figure 159. Preparing Tool Change for Step 2, Check Tool and Pick Tool
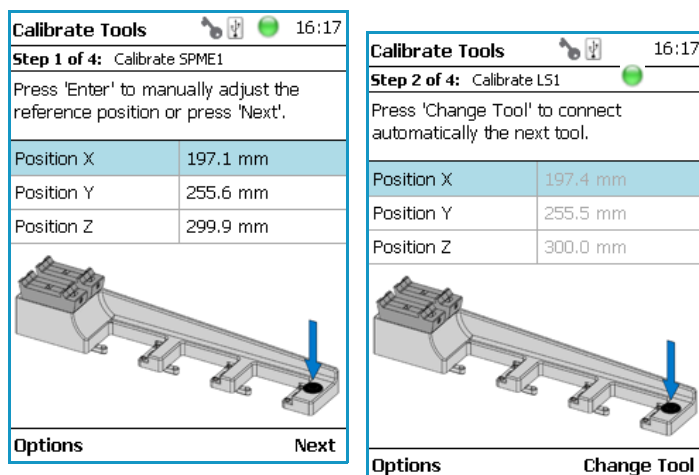
Figure 160. Tool Change to Prepare for Step 3 and Calibrating Tool
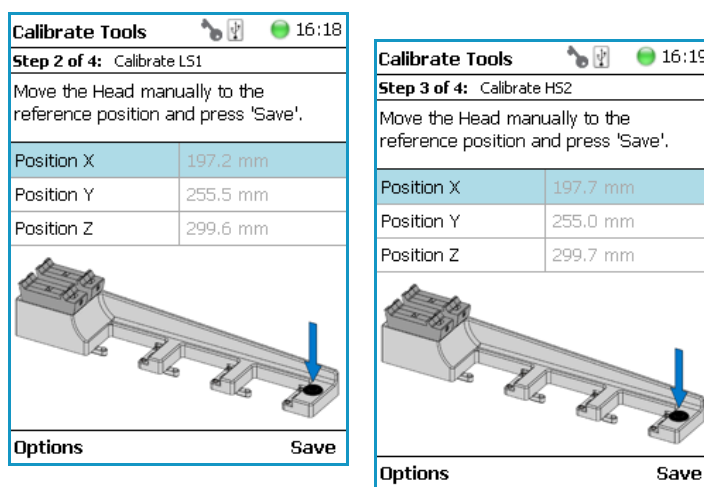
4. When finished, pressing **OK** the Head moves back to the **Home** position.

CAUTION TR Station or ATC Station should not change in the position. If the Station has moved its position, it is necessary to redefine the Reference Point, and recalibrate all the other Tools.

If for any reason, the referencing (Set Reference Point) has been repeated, it is mandatory to recalibrate all the Tools. Using the step **Set Reference Point** clears the calibration data for the individual Tools.

Setup Modules

This wizard item allows you to predefine the parameters from a module. Typically, this process is done once at first installation of the TriPlus RSH. See Figure 161.

Figure 161. Wizard Item Setup Module

❖ **To setup a module**

The example below shows the steps for defining the parameters for the **Agitator**:

1. Select the **Cover Plate Type** and the **Vial type** used for the Agitator.

   • **Not Specified** — Prohibits the execution of a run.

   • **Standard** — Cover without holes.

   • **Perforated** — Cover with 6 holes to enable Syringe Needle penetration through the cover into the vial inserted in the Agitator.

   • **Vial Type** — Select the type of vials used for the Agitator.

   If the Vial Type has to be changed during routine application, this can be done at any time by going to the Start Screen, selecting the menu item **Agitator**, scrolling down to the list item **Vial Type** and selecting another Vial Type.

Teach Module

The term Teaching is used for the definition of the X-, Y-, and Z-Axis positions for each module. Refer also to **TriPlus RSH Defining Object Positions** in the *TriPlus RSH Hardware Manual*.

> **Note** The difference between **Active** and **Passive** modules are:
>
> • The **Active** modules are recognized automatically by the system when connected to the Bus and at the next restart of the system.
>
> • The **Passive** modules are not automatically recognized; they have to be added to the configuration. The passive modules, such as Tray Holder, Wash Station, etc. have to be added first.

❖ **To teach the module**

1. Select the wizard item **Teach Module**. A dialog will guide the operator through this teaching wizard. Upon starting the wizard, the TriPlus RSH automatically turns off the current to enable a manual movement of the Head to the various modules configured within the system. See Figure 162.

Figure 162. Wizard Item Teach Module

2. If the wizard is started without an attached Tool, it first moves the TriPlus RSH Injection Unit to the first slot of the ATC Station or TR Station, picks up the provided Tool, and waits for the next command.

3. The teaching order follows the order of the objects listed as shown in **Setup Modules** (pull-up menu Options). During the teaching process, it is always possible to demand a fine tuning or to go back to a previous position or module. See the various possibilities under the **Options** pull-up menu.

> **CAUTION** It is advisable to hold the Y-Axis with one hand and with the other hand hold the Tool body to move the TriPlus RSH Injection Unit in a controlled way to the teaching position.
> **CAUTION** Do NOT hold the Needle Guide to move the TriPlus RSH Injection Unit. This part is mechanically flexible and could lead to misalignment.

4. When the wizard is started, the first module is displayed, an arrow indicates the teaching position. Follow the instructions given.
   As a general description, move the TriPlus RSH Injection Unit manually to the indicated teaching position, adjust the lower needle guide perfectly within the center of the lunette ring. Without the magnetic ring attached, use the inner ring for teaching.

5. The **Lower Needle Guide** should be centered on the lunette with the bottom of the Lower Needle Guide lightly touching its surface.

   For modules without a lunette, such as the Agitator, it is necessary to insert a vial (with the corresponding adapter if required), and use the vial cap surface as the reference for the Z-Axis value.

   The teaching process for the active modules are described in chapter **TriPlus RSH Defining Object Positions** in the *TriPlus RSH Hardware Manual*.

6. When you are satisfied with the teaching, press **Save** and continue by pressing **Next** to get to the following module. If in doubt, proceed with the fine tuning.

The Teach position of each module is reported in Table 109.

Table 109. Teach Modules Steps (Sheet 1 of 4)
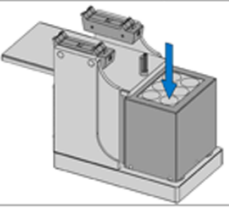
Steps
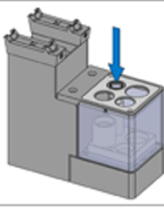
Agitator Teaching Position
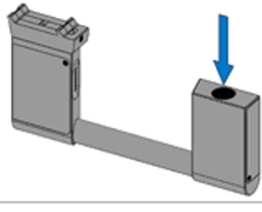
Vortexer Teaching Position
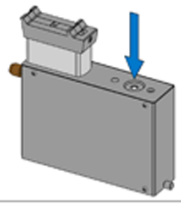
Barcode Reader Teaching Position
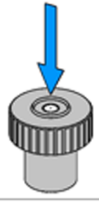
SPME Conditioning Station Teaching Position
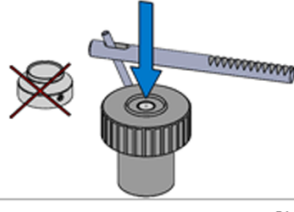
GC Injector Teaching Position

OC Actuator Teaching Position

Table 109. Teach Modules Steps (Sheet 2 of 4)

Steps

Obstacle Teaching Position

Large Solvent Station Teaching Position

Temperature Controlled Drawer St Teaching Position

Note Obstacle is a module from another device, for example the Thermo Conductivity Detector (TCD) from a GC system. If a module exceed a certain height, it could be get in the path way of the TriPlus RSH. The dimension and the position of the obstacle can be defined. The TriPlus RSH excludes this area from the allowed path way and bypasses it.

MHE Station Teaching Position

Tray Holder 1 Teaching Position

Tray Holder 2 Teaching Position

Table 109. Teach Modules Steps (Sheet 3 of 4)

Steps

Solvent Reservoir Teaching Position

Wash Vial Teaching Position

Fast Wash Station Teaching Position

Large Wash Station Teaching Position

Standard Wash Station Teaching Position

Teaching Position

Table 109. Teach Modules Steps (Sheet 4 of 4)

Steps
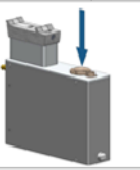
Heatex Stirrer Teaching Position

SPME Arrow Conditioning Station Teaching Position

The list items specific to each module is provided opening **Options** pull-up menu.

The **Previous** pull-up menu moves one step back to the previous module and verifies the teaching position again.

Check Teaching Modules

This section allows to check and verify the teaching positions of all the modules included into the system.

> **Note** In this section a fine tuning is not foreseen. If a fine tuning is necessary, go either back in the section "Teach Module" on page 218, or from the Start Screen activate the **Options** pull-up menu, then select **Setup | Modules**.

❖ **To check the teaching modules**

1. Select the wizard item **Check Teaching Modules**. See Figure 163.

   Figure 163. Wizard Item Check Teaching Modules
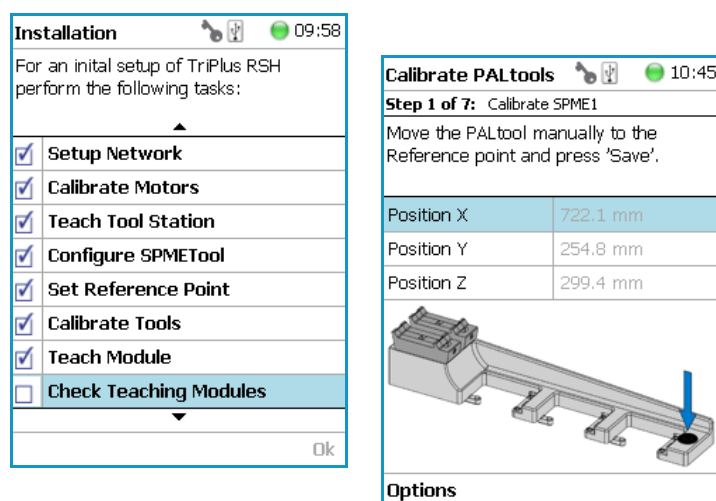
2. Press **Check** to activate the wizard. The Head moves to the first module in the list, positions itself at the Teaching Point, and waits for the next command. This gives the operator the chance to verify the position, and if necessary make some fine tuning and save the new settings.

3. Modules which have no direct access to the teaching point (lunette) such as the Agitator or the Vortexer are treated the same way as it would for a routine run.
   In other words, the cover of the Agitator is opened automatically or in combination with the MHE Adapter it moves the Head to the side to stripe off the magnetic adapter.

> **Note** It is mandatory to insert a vial into the Agitator or the Vortexer to teach the X-,Y-, and Z-Axes positions. If the vial is not inserted, the Z-Axis value could be out of range, resulting in an error.

4. Press **Next** to continue within the wizard; the TriPlus RSH Head moves to the next module.

5. The **Previous** pull-up menu moves one step back to the previous module and verifies the teaching position again.

Create a Backup File

It is highly recommended to backup the configuration of system after completing the **Installation** wizard.

The functions Backup, **Restore**, and **Updates** are explained in chapter **Interfacing the TriPlus RSH to Other Devices** in the *TriPlus RSH Hardware Manual*.

❖ **To create a configuration backup file**

1. Select the wizard item **Create Configuration Backup** and follow the dialog. See Figure 164.

   Figure 164. Wizard Item Create a Backup File
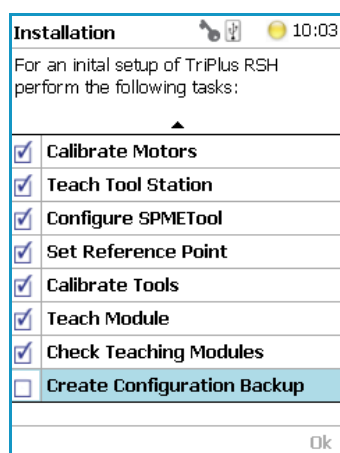
2. The proposed name for the backup file is **After Installation**. The file is tagged with the current date and time. The file name can be changed by the operator. Press the **Enter** button to open the alphanumeric characters or use the **Options** pull-up menu to insert or delete a character, see the examples in Figure 165.

   Figure 165. Creating a Backup File
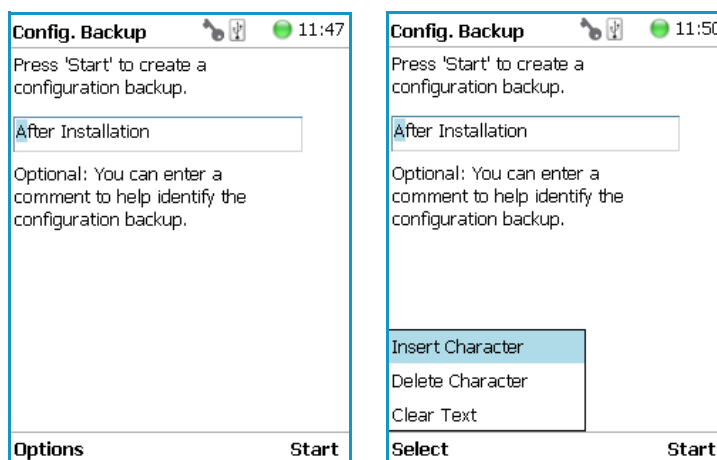
3. After the file name definition, press **Start** to start the process. The blinking light indicates that the process has been executed. The progress of the backup is updated to inform the operator how many percent are completed.

4. This process only takes a few minutes. After completion, press **Exit** to finish the installation wizard.
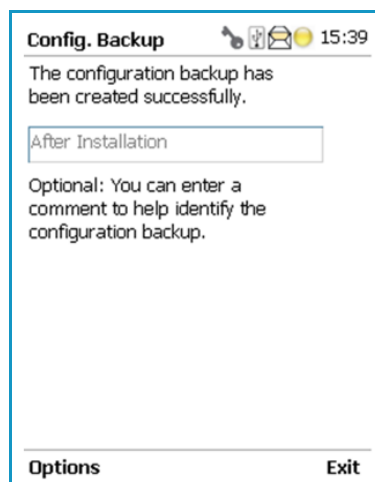
Note The Backup file is stored in the SD card, which is installed on the Control Board.

This file can be saved on the USB Stick, see the chapter "Setup Menu Item" on page 83.

The file can also be used to make a **Restore** of the Control Software. This option is only available with access level rights for the **Extended User.**

Create New Tray System Item

Selecting the menu item **Create New Tray System** enables you to define a combined system of a Tray Holder, Tray Type, and Vial Type. This task is mainly used when a custom specific Tray Holder will be used.

❖ **To create a new tray system**

1. Select the menu item **Create New Tray System**. See Figure 166.

Figure 166. Selecting Menu Item Create New Tray System
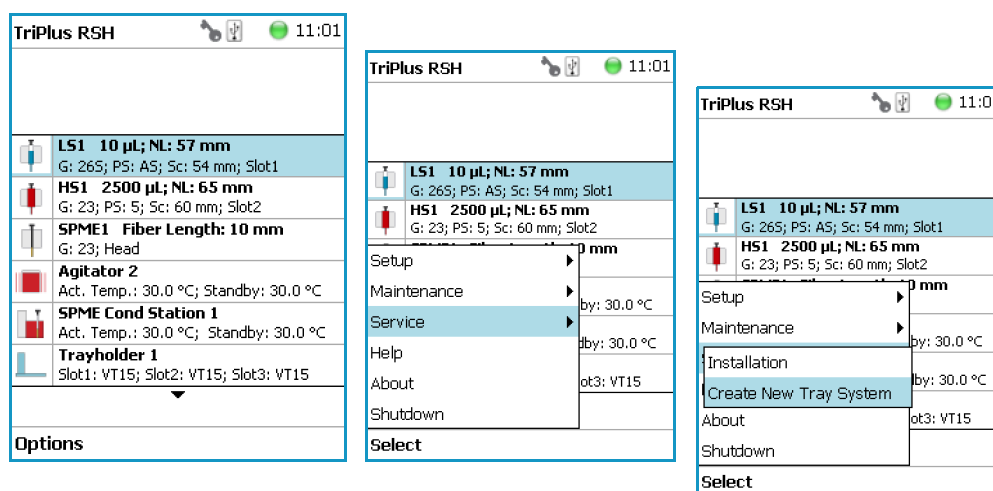
2. By opening the individual list items, the pre-selected parameters are available for use. See Figure 167.

Figure 167. Tray Holder Choices
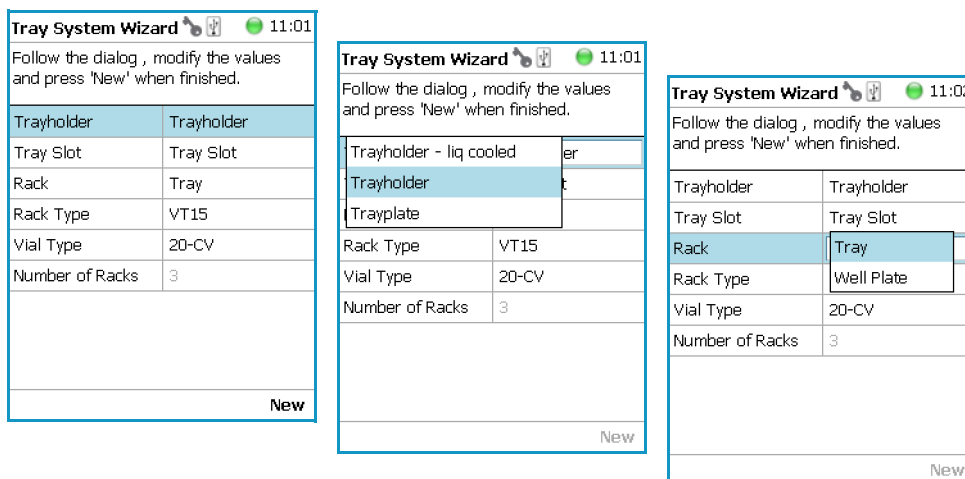
Note The Tray can be either a Tray or a Well Plate. Accordingly, the choices are pre-selected for Tray Type or a Well Plate Type.

3. Press **New** for creating the newly-defined Tray System, which is a complete setup of Tray Holder, Tray, Tray Type, and Vial Type.

4. The wizard closes, and the software returns to the Start Screen.

Table 110 lists the create New Tray Type parameters.

Table 110. Create New Tray Type Parameters

Item	Description
Tray Holder	Tray Holder Liquid Holder (passive module).
Tray Slot	Tray Slot, currently the only supported type.
Tray	Tray, currently the only supported type.
Tray Type	Tray 15, Tray 32, Tray 54, Tray 60, Tray 70.
	See the section "Definition of Terms, Naming Conventions, and Start Screen Icons" on page 3 for details.
Vial Type	1-CV, 2-CV, 10-CV, 20-CV Regular Vials.
	2-SR, 10-SR. Vials combined with corresponding adapter, reservoir.
Number of Racks	Defines the numbers of sample trays that can be placed in the Tray Holder.

Teach Home Position

This task is not part of the **Service | Installation** wizard but it must be discussed with the user during the installation process.

Access to this task by entering the module **RobotArmLeft**.

The Home Position is the position the head is moved to at the end of a task, for example when it returns to standby. By default, this position is at the far left side of the X-Axis. It is highly recommended to optimize this position according to the final configuration of each system.

The Home Position optimization is performed for several reasons as:

- For convenience, in order to have the head in a preferred standby position.

- To save time minimizing the movement of the head to a module.

- For avoiding the collision of the head and a module.

Changing Home Position

❖ **To change a home position**

There are two ways to get to the **Menu item | Teach Home Position**.

1. Use the short cut from the Start Screen with the menu item **RobotArmLeft**.
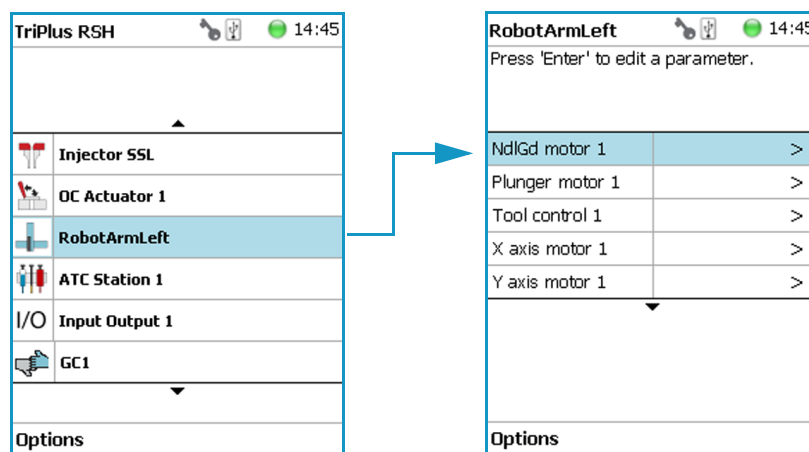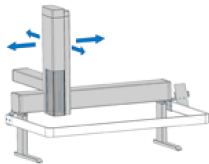
2. From the Start Screen select **Options | Setup** and continue with the modules. Several additional clicks are required to access the menu item **RobotArmLeft**. See the following example.
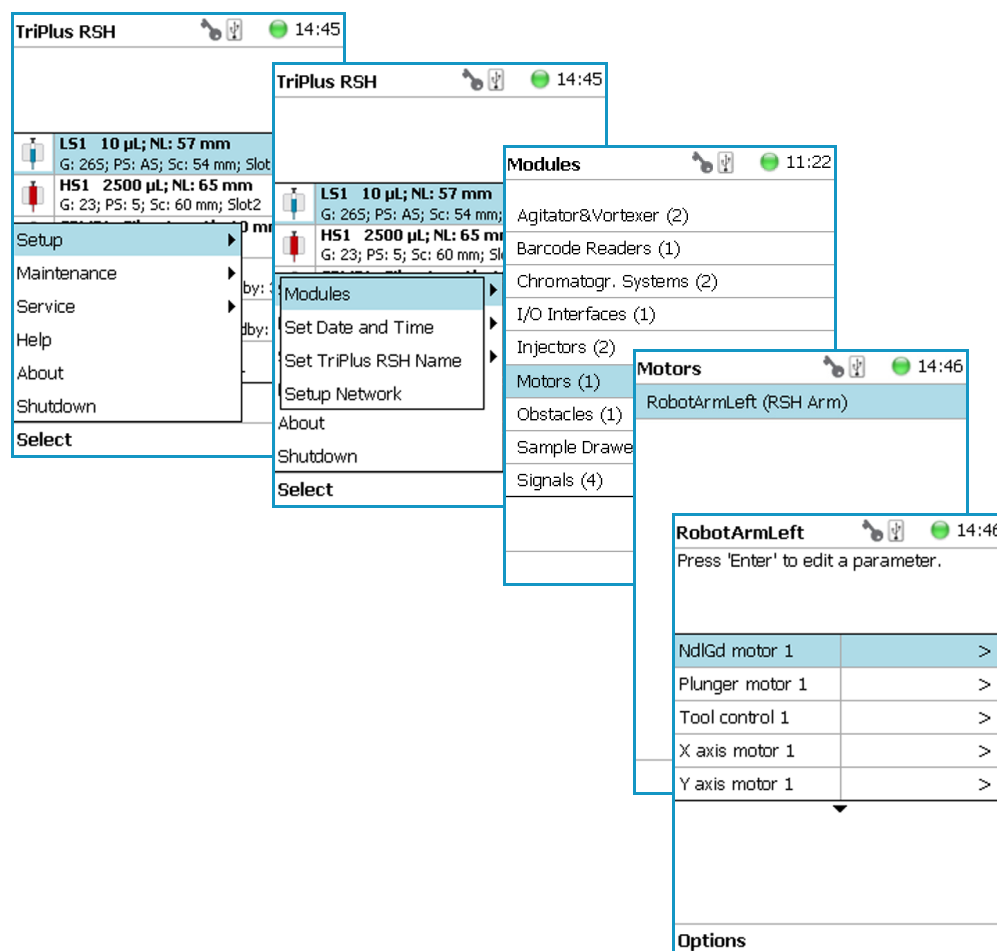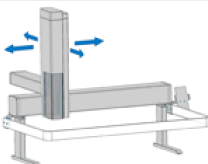
3. Under the screen **RobotArmLeft** select **Options | Teach Home Position | Select**.
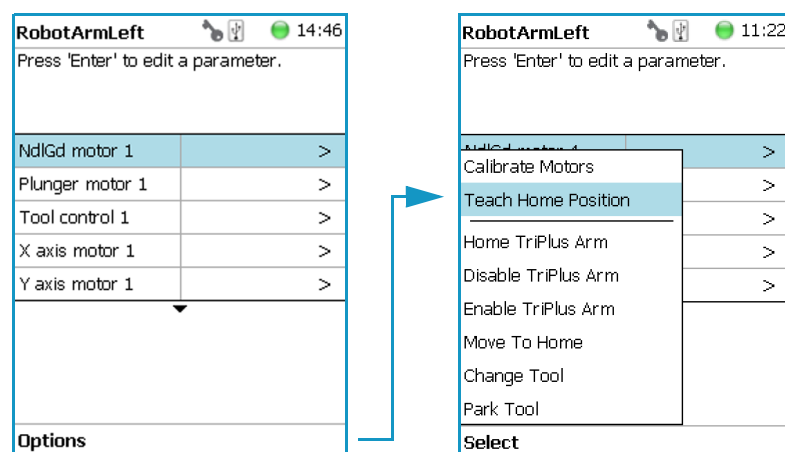
4. Move the head to the required position and save the X-, Y-, Z- Axes Positions as the new Home Position. Press **Ok** to leave this wizard.

Analytical Troubleshooting

This chapter gives a quick overview of possible causes and recommended actions which can be taken to eliminate an erratic behavior.

Contents

- General Points Regarding Chromatographic Effects

- Headspace Technique Points Regarding Chromatographic Effects

This guide does not replace the troubleshooting guides for chromatographic techniques.

General Points Regarding Chromatographic Effects

This sections provides general troubleshooting guidelines regarding the chromatographic effects. See Table 111.

Table 111. General Points Regarding GC Effects - Troubleshooting Guideline (Sheet 1 of 3)

Symptom or Error Message	Possible Cause	Recommended Action
Very low or no detector signal is observed.	Clogged syringe.	Remove syringe and aspirate/dispense liquid manually.
		Clean syringe.
	Bent syringe needle or bent plunger.	Inspect the syringe. Replace it if necessary
		Note: Bottom Sensing using a long needle (85 mm) has a high risk of needle bending.
		How to remove a syringe with a bent needle or plunger is explained in the section **Manually Removing a TriPlus RSH Tool from the RSH Head** of the *TriPlus RSH Hardware Manual*.
	No sample liquid is injected.	Check, adjust, the needle penetration into sample vial.
	Sample volume too low.	Increase sample volume.
	Wrong setting of syringe needle penetration in GC injector.	Check **Needle Penetration Depth** settings and compare with GC manufacturer recommended parameters.
Syringe does not fill properly.	Air bubbles below syringe plunger. It is possible that air bubbles remain below the plunger after the first pull-up. If the plunger is moved up and down several times, these air bubbles are worked out.	Increase method parameter **Def Fill Strokes Count** (Fill Strokes).
		Check the method parameters **Def Aspirate** (Fill Speed) and **Def Aspirate Delay** (Pull-up Delay).
	Wrong type of syringe assigned to the Tool Holder.	Check the syringe parameters to ensure that the correct syringe type is assigned to the Tool Holder. Verify the **Scale Length** parameter.
	Syringe needle penetration depth in vial incorrect.	Check the syringe needle penetration depth in the sample vial.
	Syringe plunger polymer tip worn out.	Manually check the tightness of the polymer plunger tip. When in doubt, replace the plunger.
	Glass barrel cracked.	Check the integrity of the syringe. When in doubt, replace the syringe.

Table 111. General Points Regarding GC Effects - Troubleshooting Guideline (Sheet 2 of 3)

Symptom or Error Message	Possible Cause	Recommended Action
Sample peaks/responses are not reproducible.	Dirty syringe.	Increase **PstClnSlv1/Slv2** values in method. Use **PreClnSlv1/Slv2** and **Pre Cln Spl**.
	Syringe pressure difference.	Increase **Def Aspirate Delay (**Pull-up Delay) value.
	Vacuum created in sample vial.	Reduce Sample volume in sample vial. Use Pre Pressure Vial mode.
	Highly volatile solvent.	Use gas-tight syringe and sample tray cooling.
	Improperly crimped vials.	Check vial cap by attempting to rotate by hand. Loose caps might cause selective loss of volatile compounds from the sample. Adjust crimping tool correctly.
	Method Parameters.	Check recommended Method Parameters. The following parameters are crucial and must be verified first: • **Def Aspirate Flow Rate** (Fill Speed) • **Def Aspirate Delay** (Pull-up Delay) • **Def Dispense Flow Rate** (Injection speed) • **Def Dispense Delay** (Post Inj Delay) Note that for dedicated cycles, certain parameters are locked.
Excessive carryover between samples.	Dirty syringe.	Increase **Pst InjSlv1/2** values in method. Use **PreClnSlv1/Slv2** and **PrClnSpl**. Check and, if necessary, replace vial septa from **Wash/Waste** vials.
	Inappropriate wash solvent.	Use appropriate wash solvent.
	Wash Solvent and Waste vial septa too tight.	Check if the syringe fills completely when washing. If several cleaning cycles are programmed and many samples are processed, then vacuum in the Wash Solvent vials and overpressure in the Waste vials might build up. Cut away a segment of the solvent and Waste septa to ensure equalization of pressure.
	Wash solvent level too low.	Check the solvent volume in the **Wash Vial** and the syringe needle penetration in the vial.
	Solvent level in Waste vial to high.	Check the volume of the solvent in the **Waste Vial**. Check also the needle penetration into the waste vial. The needle must not touch the liquid at all.

Table 111. General Points Regarding GC Effects - Troubleshooting Guideline (Sheet 3 of 3)

Symptom or Error Message	Possible Cause	Recommended Action
Unexplained collisions of Head.	Object not defined correctly.	Define Object correctly. See **Chapter 5 TriPlus RSH Defining Object Positions** in the TriPlus RSH Hardware Manual. Verify the position for all objects, including passive and active modules.
Object missed by Syringe Needle.	When several Tools are used from a ATC Station, have the Tools calibrated to compensate for any deviations.	Check the Tool calibration as described in **Chapter 5 TriPlus RSH Defining Object Positions** in the *TriPlus RSH Hardware Manual*.
Unexpected collision on Tray Holder.	Wrong Vial Type settings in Tray Type.	Check the settings in **Tray Type** (Rack Type).

Headspace Technique Points Regarding Chromatographic Effects

This sections provides general troubleshooting guidelines regarding the Headspace technique. See Table 112.

Table 112. Headspace Technique Points Regarding GC Effects - Troubleshooting Guideline (Sheet 1 of 2)

Symptom or Error Message	Possible Cause	Recommended Action
Sample peaks or responses are not reproducible.	Dirty syringe.	Increase method value **Syr Purge**.
	Syringe pressure differences.	Increase **Def Aspirate Delay (**Pull-up Delay) value.
	Vacuum created in sample vials.	Reduce sample volume.
	Improperly crimped vials.	Check vial cap by attempting to rotate manually. Loose caps might cause selective loss of more volatile components from sample. Adjust crimping tool correctly.
	None or too low syringe purge gas pressure.	Check pressure at purge gas regulator (0.5 bar; 7.25 psig; 50 kPa) during the syringe purging period. Check gas flow at syringe needle tip.
	Method parameters.	Check recommended Method Parameters. The following parameters are crucial and must be verified first: • **Def Aspirate Flow Rate** (Fill Speed) • **Def Aspirate Delay** (Pull-up Delay) • **Def Dispense Flow Rate** (Injection speed) • **Def Dispense Delay** (Post Inj Delay)

Table 112. Headspace Technique Points Regarding GC Effects - Troubleshooting Guideline (Sheet 2 of 2)

Symptom or Error Message	Possible Cause	Recommended Action
Sample peaks or responses are not reproducible (*continued*)	Back pressure of GC column too high.	Check the back pressure of the GC column. If the pressure is too high the electronic flow control device (EPC or EFC) of the GC could get in overload at the moment of sample injection. This will lead to uncontrolled opening of the split valve until the pressure falls back into a controllable range.
Peak distortion or tailing.	Method Parameters.	See recommended previous actions.
	Needle penetration speed in GC Injector.	Check the parameter for injection technique. If all changes give no positive result, check the **Injector Depenetration Speed**.
	Solvent not suitable for application.	Check the boiling point of the solvent and try to change the solvent (when e.g. a high boiling point organic solvent is used as matrix).
	GC Injector liner not suitable.	Check the liner geometry.
	GC related parameters.	Any parameter such as the injector, oven or detector temperature can contribute to bad peak shape. Check the column type and connections (square cut connections).
Excessive carry-over between samples.	Dirty syringe.	Increase method value **Syr Purge**. Set the value of the method parameter Syringe Temp 10 °C above the Agitator temperature, **Incubation Temp**.
	None or too low Syringe Purge gas pressure.	Check pressure at purge gas regulator (0.5 bar; 7.25 psig; 50 kPa) during **Syringe Purge** period. Check gas purge flow at syringe needle tip.
Unexplained chromatographic peaks.	Dirty purge gas.	Check the purge gas supply for impurities.
Faulty temperature read-out. e.g. value: -99 °C.	HS-syringe cartridge (holder) temperature heater, over temperature fuse or sensor broken.	Contact your Thermo Fisher Scientific representative.
	Agitator temperature heater, over temperature fuse or sensor broken.	
	SPME/SPME Arrow Conditioning Module temperature heater or sensor broken.	
	ITEX syringe cartridge (holder) temperature heater, over temperature fuse or sensor broken.	
	ITEX Trap temperature heater or sensor broken.	

Multi Headspace Extraction (MHE)

This appendix describes the principles and the use of the Multi Headspace Extraction (MHE).

Contents

- Introduction

- Principles of Multiple Headspace Extraction (MHE)

- MHE Cycle Step-by-Step

- Quantification from MHE Measurements

Introduction

In a classical headspace technique, one sampling is performed per vial. Sample quantification can be inaccurate in the presence of interfering matrices or when a calibration standard cannot be made using a matrix composition identical to that of the sample.

See the section "Principles of Multiple Headspace Extraction (MHE)" on page 240 for details.

he MHE station consists of a venting tool (MHE Adapter) combined with a MHE Adapter Holder. The MHE technique requires a series of sampling cycles using the same vial. First, the vial is pressurized to reach a specific pressure. The vial is then sampled and vented. The vial is re-pressurized and sampled again. This process is repeated multiple times to obtain the final results.

See the section "MHE Cycle Step-by-Step" on page 245.

Principles of Multiple Headspace Extraction (MHE)

Introduction

The multiple headspace technique is used in instances where interfering matrices interact with the analyte, such as by partial adsorption, or if a solid analyte contains low concentrations of moisture. Whenever it is impossible to prepare the calibration standard using an identical matrix to that of the actual sample, single point calibration using the static headspace technique will fail.

The term multiple headspace extraction (MHE) is partially self-descriptive. To determine the quantity of an analyte, sampling is carried out by repeated extraction of gas from the same vial above a sample solution containing the analyte (known as the headspace).

The method thus approaches continuous gas extraction but is carried out in a stepwise fashion. In concept, the procedure is analogous to the multiple extraction of a sample from a simple elution column, where each passage of eluate through the column reduces the amount of analyte contained in a subsequent passage.

The peak area from any given extraction will be smaller than that of the previous extraction step. The sum of the peaks will be proportional to the total content of the analyte. A quantitative determination of the total amount of analyte present in a sample depends on the relationship between peak area and the amount of analyte. The sum of the amounts of analyte that are removed will eventually equal the total amount of analyte in the original sample if the extractions are continued to infinity.

Theoretically, summing up the peaks obtained from an infinite number of column extractions would allow the calculation of the absolute amount of analyte in a sample. In practice, it is sufficient to carry out a limited number of extractions, permitting a determination of the underlying exponential relationship between the measured area and the number of extractions, in turn allowing for the determination of the total amount of analyte in the sample. The effect of the sample matrix is eliminated by extracting the entire amount of the analyte. Contrary to the situation that exists in single-headspace extraction, it is therefore possible to use calibration standards that are *not* prepared with the same matrix as the actual samples. For MHE to provide meaningful results, the only prerequisite is that equilibrium must exist with respect to the analytes in terms of the distribution between the phases in the headspace vial.

Instrumentation in MHE

In normal extraction using headspace gas chromatographic technique with a gas-tight syringe, the following steps are employed in order to sample an aliquot of the headspace gas:

The vial is thermostatted in order for equilibrium to be established between the phases in the headspace vial.

The gas-tight syringe is used to introduce an aliquot of headspace gas to the GC.

Loop-injection headspace samplers use a pressurization step to start the headspace cycle. The vial is pressurized to a preselected value, usually using Helium gas, which is also often the carrier gas. The pressure is selected so that it is always greater than the pressure increase due to sample heating and vapor pressure of the sample.

The sample is introduced onto the GC column for analysis and the system is ready for the next sampling after cleaning.

In MHE, equilibrium must be reestablished in the headspace following each extraction. With a syringe-based system the following steps would normally be employed:

- The vial is thermostatted in order for the equilibrium to be established between the phases in the headspace vial.

- The vial is pressurized.

- The gas-tight syringe is used to introduce an aliquot of headspace gas to the GC.

- The vial is vented. This is accomplished by a specially designed venting tool that punctures the septum.
  The pressurized headspace gas vents through the MHE Adapter needle (venting tool) to atmospheric pressure;

- Equilibrium is established again before the next analysis (Step 1).

- This procedure is repeated a number of times; typically three to five samplings are performed from a single vial (analytical sample and standard).

- The main steps are described in the section "MHE Cycle Step-by-Step" on page 245.

Examples

In the following examples, we will briefly go through the basics of multiple headspace extraction (MHE).

We will look at four examples **situations** of equilibrium between the condensed (solid or liquid) phase and the gas phase (the headspace). The examples will be shown in increasing complexity with respect to the equilibrium distribution and removal of the headspace between subsequent extractions.

In each of the four cases described below, the complexity of the equilibrium distribution and of the removal of the headspace between subsequent extractions will be increased. The final conclusion is that the MHE method will work in most cases, with the only prerequisite that the distribution of the analyte between the gas and the condensed phases is actually governed by an equilibrium.

Situation 1

The equilibrium between the solid phase and the gas phase is assumed to be a 50/50-distribution. In the course of each extraction, **all** of the headspace is removed/exchanged.

The measured area of the analyte peak is **A**.

A(ref) — Area we would measure if all of the analyte were in the headspace (corresponding to the measured signal from a similar gas standard).

A(0) — Measured area of the analyte peak from the first extraction.

With 50% of the analyte present in the headspace, this amounts to:

A(0) = ½ * A(ref)

The total area that is determined over a number of subsequent extractions is:

A(tot) = A(0) + ½ * A(0) + ¼ * A(0) + 1/8 * A(0) + ……, or

A(tot) = A0 / (1-½) = 2 * A0

However, A(0) = ½ * A(ref) and therefore:

A(tot) = A(ref)

Thus, it would be correct to determine the total amount of analyte by comparing the measured sum of analyte areas to a calibration measurement with data from a single determination of a gas standard.

Situation 2

The equilibrium between the condensed phase and the headspace is assumed to be 25/75 (with 75% in the gas phase). Furthermore, we assume that the entire headspace is exchanged during the course of each extraction step.

The measured area of the analyte peak is **A**.

A(ref) — Area that would be measured if all of the analyte were present in the headspace (again corresponding to the measured signal from a similar gas standard).

A(0) — Actual area measured from the first extraction with 75% of the analyte in the gas phase:

A(0) = ¾ * A(ref)

The total area determined by the MHE procedure is:

A(tot) = A(0) + ¼ * A(0) + 1/16 * A(0) + ……, or

A(tot) = A(0) / (1-¼) = 4/3 * A(0)

However, A(0) = ¾ * A(ref) and therefore:

A(tot) = A(ref)

In this case, you also arrive at the correct value by determining the total amount of analyte by comparing the measured sum of analyte areas to a calibration measurement using data from a single determination of a gas standard.

The conclusion is: when in equilibrium, the relative ratio of the condensed phase versus the headspace plays no role in the amount of analyte content that is determined from an MHE-series. Furthermore, it can be concluded that quantification based on a single determination from a gas standard will, in this particular case, yield the correct result, assuming that the entire headspace is removed/exchanged during each extraction step.

Situation 3

The equilibrium between the condensed phase and the headspace is assumed to be 50/50.

Furthermore, we assume that only a part of the headspace is removed between each sampling. The relative amount of the headspace removed between each successive extraction constant and is denoted α.

The measured area of the analyte peak is **A**.

A(ref) — Area that would be measured if all of the analyte were present in the headspace (again corresponding to the measured signal from a similar gas standard).

A(0) — Actual area measured from the first extraction with 50% of the analyte in the gas phase:

$$A(0) = ½ * A(ref)$$

The total area determined by MHE is:

$$A(tot) = A(0) + (1\text{-?} * ½) * A(0) + (1\text{-?} * ½)2 * A(0) + \ldots\ldots, \text{ or}$$

$$A(tot) = A(0) / (1\text{-}(1\text{-?} * ½)) = A(0) * 2/\alpha$$

However, $A(0) = ½ * A(ref)$ and thus:

$$A(tot) = ½ * A(ref) * 2/a, \text{ or}$$

$$A(tot) = A(ref)/a$$

If $\alpha = 1$ (the entire headspace is exchanged between each extraction) then:

$$A(tot) = A(ref)$$

If $\alpha = ½$ (half of the headspace is exchanged between each extraction step) then:

$$A(tot) = 2 * A(ref)$$

In this case A(tot) will be over-determined by a factor of two relative to A(ref). In other words, the content of analyte will be over-determined by a factor of two.

Situation 4

Similar to Situations 1 to 3 as described above, the general description for an equilibrium distribution with β being the relative amount of the analyte in the gas phase (in the headspace) and ? being the relative amount of the headspace that is exchanged between each successive extraction, is given by:

$$A(tot) = \beta * A(ref) * (1 + (1-\alpha * \beta) + (1-\alpha * \beta)2 + \ldots)$$

Using the expression for the geometric sum yields:

$$A(tot) = \beta * A(ref)/(1-(1-\alpha * \beta)) = \beta * A(ref) * 1/(\alpha * \beta)$$

or:

$$A(tot) = A(ref)/\alpha$$

That is: the total area, A(tot), will be over-determined by a factor of $1/\alpha$ relative to A(ref). In other words, the content of analyte will be over-determined by the factor $1/\alpha$. Thus the total area will depend on the amount of headspace removed during each successive extraction, but it will not depend on the position of the equilibrium (β).

Conclusion

If the headspace is only partially removed/exchanged between each extraction, the total area that results from the MHE determination will be greater than A(ref), where A(ref) denotes the area from a pure gas standard measured only once). Therefore, if MHE quantification is performed based on a singly-determined gas standard, the amount of analyte in the sample will be overestimated by a factor of $1/\alpha$, with α being the amount of the headspace that is removed/exchanged between each successive extraction. If the MHE quantification is based on gas standards that are subjected to the same MHE extraction sequences as the actual samples, there will be no overestimation. The amount calculated will be correct.

References

For more details, please refer to the corresponding publication on the static headspace technique and, in particular, on the MHE technique.

Title: 'Static Headspace-Gas Chromatography – Theory and Practice'
Authors: Bruno Kolb and Leslie S. Ettre, Second Edition.
Published by: John Wiley & Sons, Inc.

MHE Cycle Step-by-Step

This section details the basics steps for a routine operation of the MHE station.

1. The sample vial is placed into the Agitator and the equilibrium is established.
   Time and temperature are controlled. See **A** in Figure 168.

2. The vial is pressurized by inserting the headspace syringe needle 22 mm into the vial.
   The purge gas is activated for a fixed time of 30 seconds. See **B** in Figure 168.

3. The Headspace Syringe Needle is withdrawn from the vial. The gas purge valve is shut off
   after withdrawal. See **C** in Figure 168.

4. A sample aliquot is taken up into the syringe according to the sample volume defined in
   the sample list. See **D** in Figure 168.

5. The sample aliquot is injected into the GC. See E in Figure 168.

6. The Injection Unit moves the MHE Adapter from the Adapter Holder to the sample vial
   in the Agitator. See **F** in Figure 168.

7. The MHE Adapter needle is inserted into the vial (14 mm).
   The pressurized gas is vented to the atmosphere. See **G** in Figure 168.

8. The MHE Adapter is removed from the sample vial and positioned back into the MHE
   Adapter Holder.

9. The sample vial will equilibrate to the same conditions as applied in Step 1.
   This cycle is repeated as often as defined by the MHE Counter method variable.
   See **H** in Figure 168.

10. After this cycle has been completed, the sample vial is transported back to its original
    position in the Rack. The next sample is placed in the Agitator and the cycle will be
    repeated.

Figure 168. MHE Cycle Steps
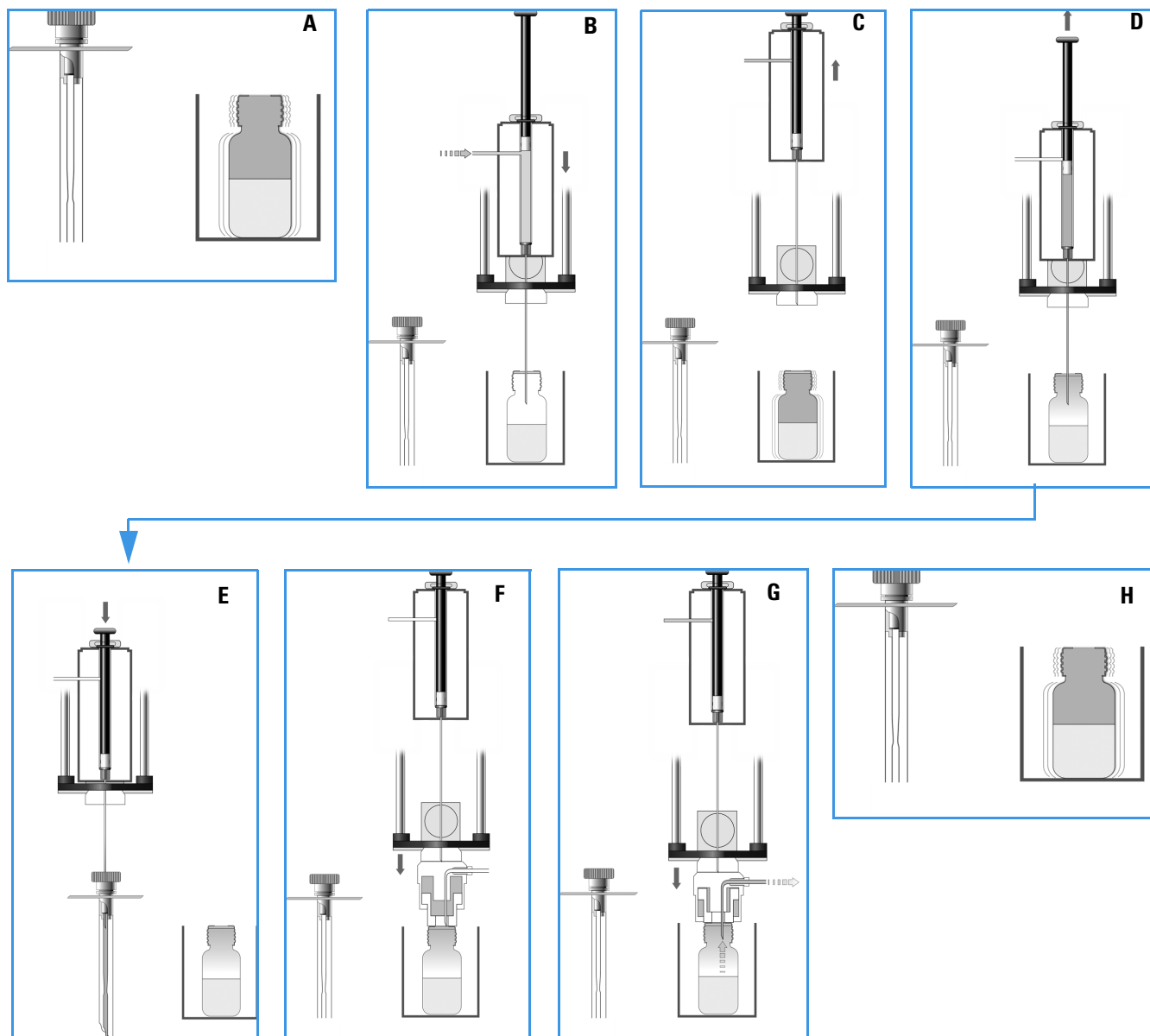
Quantification from MHE Measurements

The raw data from analytical samples deriving from MHE measurements must be treated differently from those deriving from a classic, static headspace experiment.
In general, software packages for chromatographic data handling are not designed to cope in an automated manner with MHE raw data. Raw data can be extracted from a chromatogram resulting from a single GC run into an Excel spreadsheet.

An example with explanations is given in the section "Example of Quantitative Determination: Acetone and 2-Propanol in Granulate Samples" on page 247.

Example of Quantitative Determination: Acetone and 2-Propanol in Granulate Samples

The determination of residual solvents, such as acetone and 2-propanol in granulates as used in the production of pharmaceutical products, is most often performed by headspace analysis.

Often the analysis is performed as a standard, single extraction determination with quantitation based on direct comparison to the response from gas standards.
The drawback of this procedure is that it neglects any sample with matrix interaction.
This can lead to the analyte not residing entirely in the gas phase (the headspace) in its distribution between the condensed phase and the headspace. In this case the analyte amount will be underestimated. In other words, the determined amount of analyte will be lower than the true value.In contrast, a true measure of the total content of the analyte can be obtained by applying multiple headspace extraction (MHE).

The following simple example briefly describes the practical steps involved in such an MHE-determination. The current example describes the procedure to determine the residual content of acetone and 2-propanol in samples of polyvinyl pyrrolidone-bound 5-amino salicylic acid (5-ASA) granulate. For simplicity, only the determination of the acetone content is discussed. The determination of the 2-propanol content is performed using a similar procedure. A three-level calibration curve (double determination at each level) is used for the quantitation – thus a total of six calibration samples are run. In this particular example, the calibration curve is used for determining the acetone content in one sample – in practice the number of samples will obviously be larger.

Procedure for Determining Acetone Content

The steps for determining the acetone content are outlined in the following example:

- **A** — Each of the six calibration standards is extracted five times for increasing the **quality** of the determination).
  See "A. Performing the Actual MHE Measurements" on page 248.

- **B** — For each of the six calibration samples, the five areas from the five extractions are taken into account in determining the **total area**.
  See "B. Determination of the Total Area" on page 248.

- **C** — An external standard calibration curve is established for acetone by plotting the calculated total area as a function of the amount of acetone in the standard. Remember that each of the **total areas** is a result of the MHE calculation for five extractions.
  See "C. Construction of the Calibration Curve" on page 251.

- **D** — The **total area** is determined for any one of the real samples. The total content of the analyte is calculated from this value and the calibration curve.
  See "D. Calculation of the Analyte Content in Real Samples" on page 251.

A. Performing the Actual MHE Measurements

The parameters of the actual MHE measurements, such as incubation time, incubation temperature, injection parameters, and so on, can be controlled using the MHE cycle that is part of the MHE kit.

B. Determination of the Total Area

As you are performing a multiple headspace extraction to determine the total area, you can expect a functional relationship of the type. $A = A(0) * exp(-k * n)$, where n is the extraction number

See Step 1 and Figure 169.

Therefore, by plotting the natural logarithm of the area as a function of the extraction number, you can expect a linear relationship, from which the constants $A(0)$ and **k** can be directly determined by means of the standard linear regression techniques.
Finally, the **total area** can be determined as: $A = A(0)/(1-exp(-k))$.

The linear regression determination of the constants can be easily performed using a simple Excel setup as well as the determination of the total area. The following Excel-sheet shows the MHE-data for one of the calibration samples. See Figure 169.

Figure 169. Sample Excel Setup for MHE Quantitation
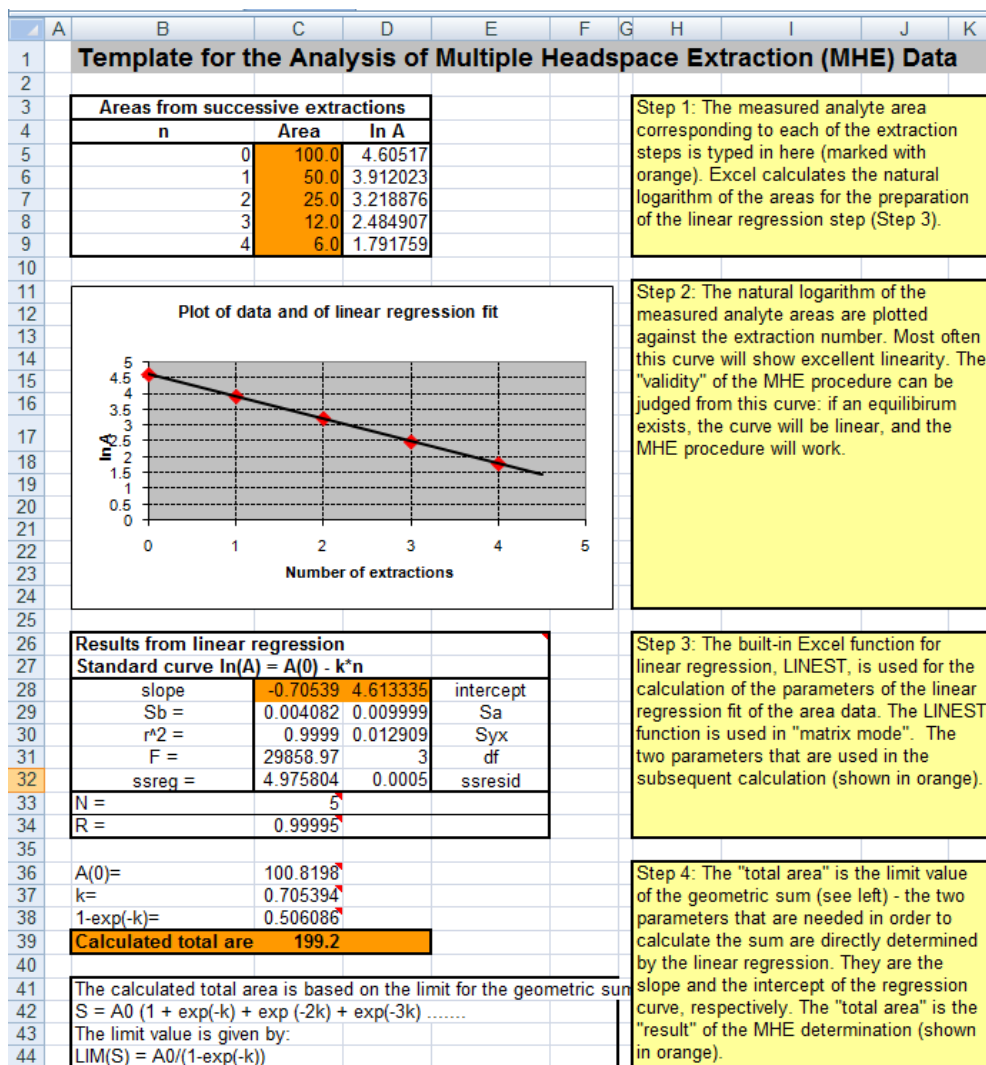
The following is an overview of each of the steps involved in completing and interpreting the data shown the Excel spreadsheet of Figure 169.

Step 1

The measured analyte area corresponding to each of the extraction steps is typed here. See the orange field **Area** in Figure 170.

Excel calculates the natural logarithm of the areas for the preparation of the linear regression step. See Step 3.

Figure 170. Entering Measured Areas of Calibration Standard Analyte

Areas from successive extractions		
n	Area	ln A
0	53,690	3,983227
1	25,480	3,237894
2	11,610	2,451867
3	5,400	1,686399
4	2,440	0,891998

Step 2

The natural logarithm of the measured analyte areas are plotted against the extraction number. Usually, this curve will show good linearity. The validity of the MHE procedure can be judged from this curve: if equilibrium exists, the curve will be linear, and the MHE procedure will work. See Figure 171.

Figure 171. Linear Regression for Calibration Standard Analyte
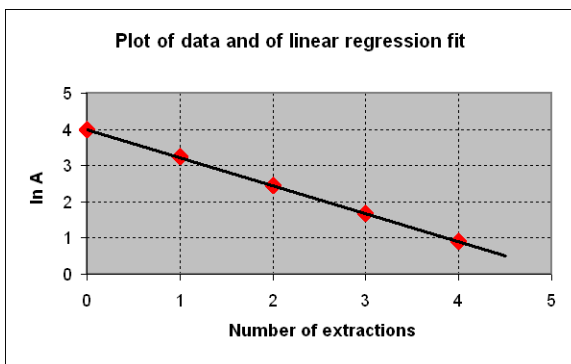
Step 3

The built-in Excel function for linear regression LINEST is used for the calculation of the parameters of the linear regression fit of the area data. The LINEST function is used in **matrix mode**.

> **Note** LINEST is the name of this function in the UK version of Excel. This name might be different in other language versions of Excel.

Figure 172 shows the example of the **slope** and **intercept** parameters used in the subsequent calculation.Calculation of Linear Regression for Calibration Standard Analyte

Figure 172. Calculation of Linear Regression for Calibration Standard Analyte

Results from linear regression			
Standard curve ln(A) = A(0) - k*n			
slope	-0,7734	3,997067	intercept
Sb =	0,004542	0,011126	Sa
r^2 =	0,999897	0,014363	Syx
F =	28993,3	3	df
ssreg =	5,981402	0,000619	ssresid
N =	5		
R =	0,999948		

Step 4

The **total area** is the limit value of the geometric sum. The two parameters needed for the calculation of the sum are directly determined by the linear regression. They are the slope and the intercept of the regression curve, respectively. The **calculated total area** is the result of the MHE determination. See Figure 173.

Figure 173. Calculation of Total Area of Calibration Standard Analyte

A(0)=	54,43827		
k=	0,773395		
1-exp(-k)=	0,538556		
Calculated total area	**101,1**		
The calculated total area is based on the limit for the geometric sum:			
S = A0 (1 + exp(-k) + exp (-2k) + exp(-3k)			
The limit value is given by:			
LIM(S) = A0/(1-exp(-k))			

C. Construction of the Calibration Curve

For each of the calibration samples the resulting total area, (determined according to the description above), is plotted against the amount of analyte.
In the following example we have three concentration levels of standards, each determined twice – thus the calibration curve comprises six points in total. See Figure 174.
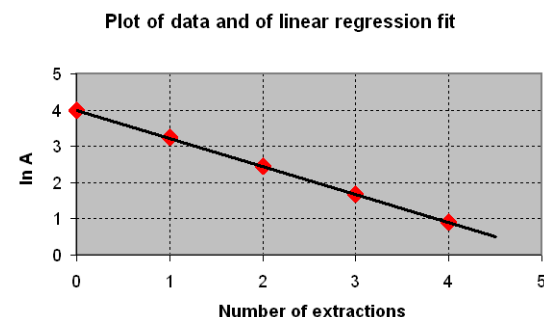
Figure 174. Calibration Curve: Total Area versus Amount of Acetone
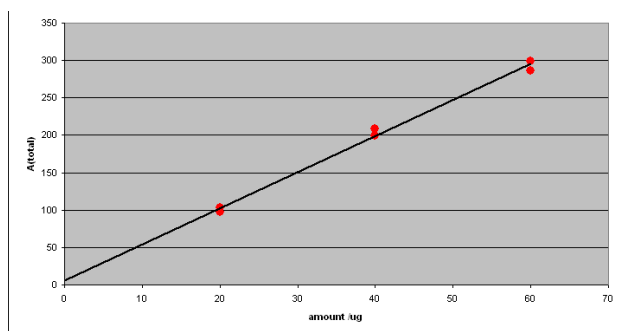
D. Calculation of the Analyte Content in Real Samples

From the MHE measurements of each of the actual samples, an MHE plot is generated.
A typical example yields an MHE curve as shown in Figure 175.

Figure 175. MHE Plot of Analyte form an Analytical Sample

The **total area** is determined from the MHE-plot of Figure 175.

Consequently, the acetone content can be determined as follows:

1. Calculate the total area using the Excel spreadsheet. In this example the total area is 101.1

2. Compare the total area against the calibration plot from which the amount can be determined as 19 µg. See Figure 175.