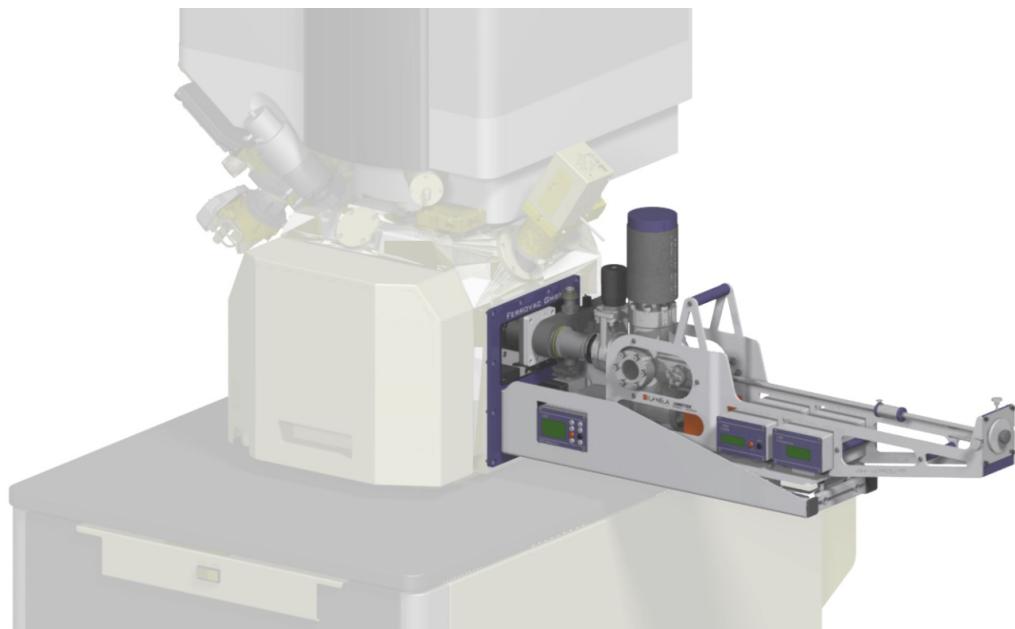


FERROVAC

ULTRA HIGH VACUUM TECHNOLOGY

IAKTHFIHELIOS Docking Solution



Operation Manual

Version: 25260_Rev_D [March, 2023]

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**Important!**

It is the sole responsibility of the service engineers and service technicians to carefully read the installation manual and keep them safe. Read and follow all safety instructions carefully before using the product described in this document. Ferrovac AG declines any and all responsibility and liability for any damage/injuries resulting from incorrect use/adjusting/controlling or programming of the product.

Warranty

Ferrovac AG warrants this product to be free of defects in material and workmanship for a period of 24 months from the date of shipment. In case of proof of any defective parts in the product, we will at our option, either repair the product or replace it.

Warranty limitations

The warranty for this product does not apply to defects resulting from the following:

- Non-observance of operational- and safety instructions
- Natural wear of components
- Consumables
- Modifications to our products without our written consent
- Misuse of any product or part of the product

This warranty stands in place of all other warranties, implied or expressed, including any implied warranty of implied merchantability or fitness for a particular use. The remedies provided herein are buyer's sole and exclusive remedies.

Neither the company Ferrovac AG nor any of its employees shall be liable for any direct, indirect, incidental, consequential or special damages arising out of the use of its products, even if the company Ferrovac AG has been advised in advance of the possibility of such damages. Such excluded damages shall include but are not limited to: Costs of removal and installation, losses sustained as the result of injury to any person, or damage to property.

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1 General Information

This installation manual covers all important information about the installation of the IAKTHFIHELIOS Docking Solution. The correct commissioning and operation of the Docking Solution is described in additional manuals, accordingly. It also provides important safety information, maintenance- and fault finding procedures.

The product described was manufactured in accordance with the applicable national standards and guidelines. The information in this document represents the state of the product at the date of print. Technical changes may be made without notice. Ferrovac AG makes no warranties or representations with respect to accuracy or completeness of the contents of this publication. Figures and photos are not binding. The product names used are for identification purposes and may be trademarks of their respective companies.

1.1 Designated Use

The product described in this document may only be used for its designated application. Designated use of the product is exclusively given if the following rules are obeyed:

- Product is used with original parts supplied by Ferrovac which are explicitly specified for the use with the product described in this publication
- In an indoor research laboratory environment or an industrial production or processing facility
- By personnel qualified for the installation of delicate scientific equipment
- In accordance with all related manuals.



Important!

Carefully read all safety instructions and all relevant manuals before installing the product and any related equipment!

Non-designated use is given if the following is true:

- Product is used with other equipment not explicitly acknowledged by Ferrovac in writing.
- Product is used outdoors or at ambient conditions exceeding the values given in the product specification
- Product is used by non-qualified persons
- Operation of the product in disregard of the safety instructions
- Operation of the product with disabled, modified, removed or damaged safety equipment and devices.

2 Terms and Symbols

Symbol	Term	Meaning
	Danger!	Risk of mortal danger when not observed
	Warning!	Risk of severe injury or danger to life when not observed
	Caution!	Slight risk of injury or damage to product when not observed
	High Voltage!	Potentially lethal voltages are present
	Cryogenic Substances!	Potential cold burn hazard if safety precautions are not followed
	Important!	Important information for proper operation of the product
	Info, Hint!	Useful hints, tips and clues

3 General Safety Information

Read the safety instructions very carefully. All safety precautions must be strictly observed at all times before using the product described in this manual and any associated instrumentation.

Study this document to learn how to operate your product properly. Keep this instruction manual in a save place close to the described product and inform all other users of the product. Always include this manual when handing the product over to third party persons.

Responsible body is the individual or group of persons that are responsible for the proper use and maintenance of the product, ensuring that the product is operated within its specifications and operating limits. The responsible body must ensure that users of the product are adequately trained.

Operators are using the product for its intended purpose. Users must be trained in electrical safety, handling of cryogenic liquids and adequate use of the instrument. They must be protected from electric shock and contact with potentially dangerous situations.

Maintenance Personnel perform routine tasks on the product to keep it in proper operating conditions i.e. setting up the line voltage or replacing consumables. Maintenance procedures are described in this manual and must be followed at all times.

Service Personnel are trained to work on live circuits and to work cryogenic liquids as well as perform fault finding measurements and repair work to the product. Only fully trained service personnel qualified to handle potentially lethal voltages may perform servicing and repair.

Shock hazard: The American National Standards Institute states that a shock hazard exists when voltage levels are greater than 30 V RMS, 42.2 V peak or 60 VDC. A good safety practice is to assume that hazardous voltages are present in any unknown circuitry.



Warning!

- Always observe and strictly follow the safety notes and regulations given in this document
- Never operate the device outside its dedicated environment.
- DO NOT OPEN the device unless you fulfill the requirements of a fully trained service personnel and you are familiar with ultra-high vacuum products



Important! Ambient conditions and environment:

This product is only to be used indoors, in locations meeting the following requirements:

- Room temperature lies between 5°C/41°F and 40°C/104°F
- Humidity up to maximum of 80%
- Altitudes up to 2000m
- Pollution Degree 2 environments

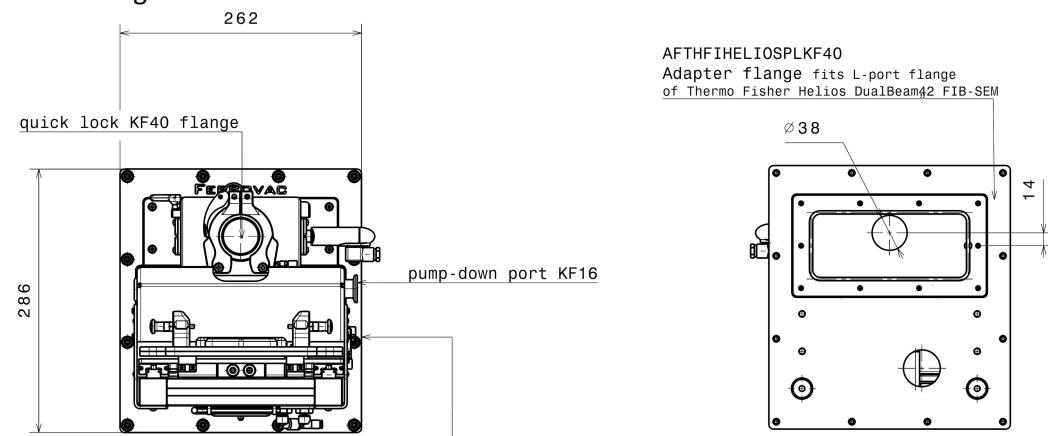
4 About

The IAKTHFIHELIOS is a docking package that can be directly mounted to the L-Port of the Thermo Fisher FIB Helios system. The docking package allows for connecting Ferrovac Ultra-High Vacuum Suitcases (VSN40 or identically constructed suitcases) for loading samples to and from various analysis modalities (e.g. FIB, TEM) under ultra-high vacuum conditions.

Currently, 3 different docking solutions for the Thermo Fisher Helios system are offered: A Direct Docking (DD), Fast Loader (FL) and Quick Loader (QL) solution.

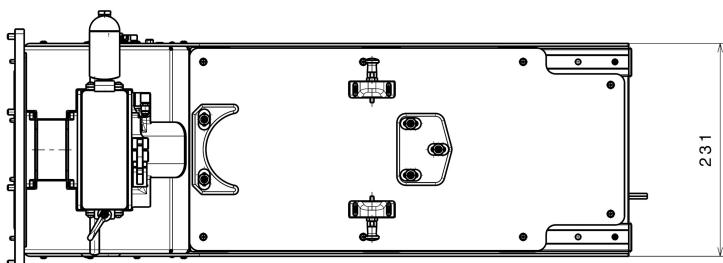
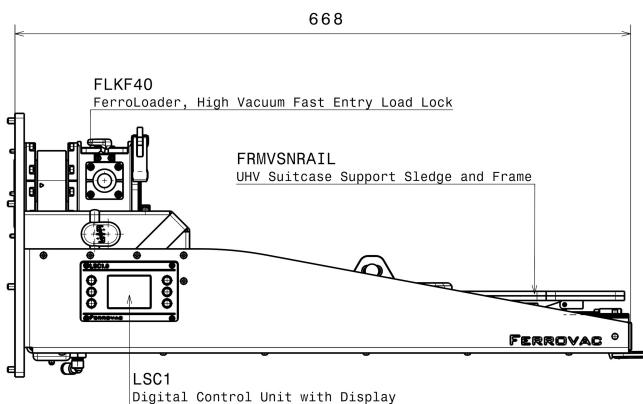
4.1 Dimensions

Technical drawing of IAKTHFIHELIOSFL dock. All measures are in mm.

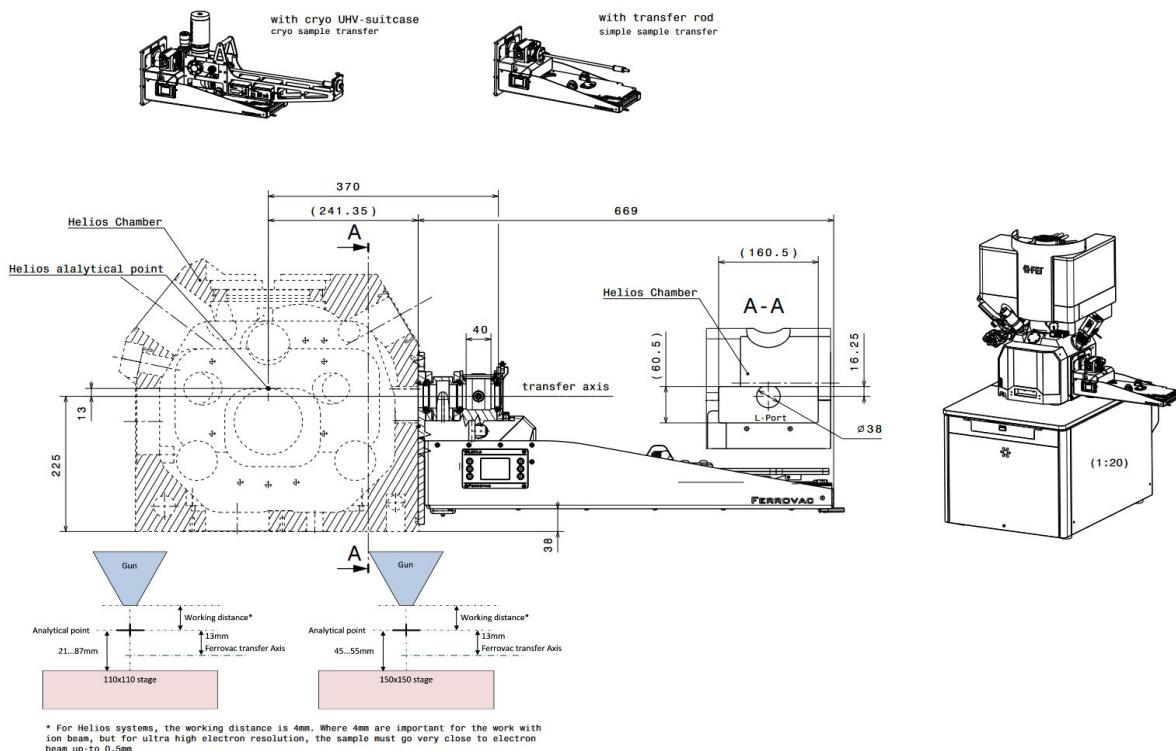


ELAHUBLSCTHFIHELIOS:

- FESTO push in fitting for Ø4mm tube
- 1x connector for FEI SEM and SDB systems
- D-Sub 15, male
- 1x connector for roughing pump controller
- D-Sub 15, female



4.2 Application Example



4.3 Specifications

- Pressure Range: 5E-7 to 1000 mbar
- Operating Temperature: Ambient temperature (room temperature)
- Material:
 - Body: EN AW-5754, AISI 304 (1.4301), AISI 316L (1.4435)
 - Linear Rails: Stainless Steel, Fluororubber
 - Anodized: EN AW-6060
 - Ball Bearings: Stainless Steel
- Tolerances:
 - Machined Parts: ISO 2768 -m -K
 - Welded Structures: ± 1 mm and $\pm 1^\circ$
- Power: LSC control unit needs +12VDC, 48W (80-264VAC power supply included)
- Compressed air: 5bar recommended (min 4.5 bar ... max. 7.0 bar)
- Ventilation: Nitrogen (N₂) or Argon (Ar) - (min 0.5 ... max. 1.0 bar)



Caution!

Specification can change if some upgrades or accessories are mounted to the main product.

5 Operation

5.1 Start-up of the Controller



Important!

The controller has no ON/OFF functionality. Ignore the  symbol on the front panel. The controller automatically starts when it is powered by a charging device.



Important!

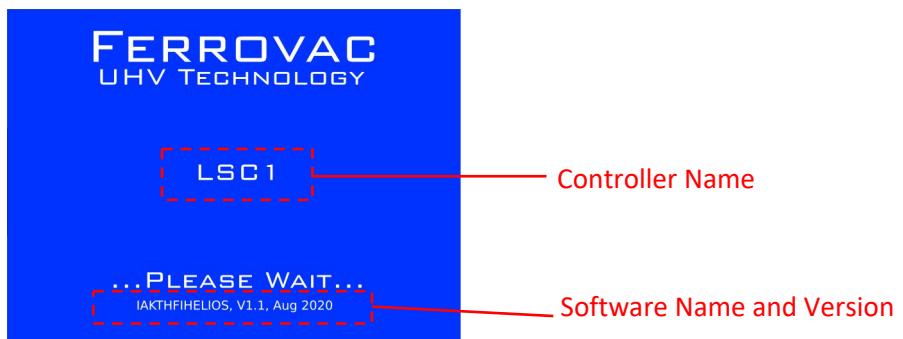
To transition the gate valve's status toward the FIB HELIOS, it must undergo deliberate opening and closing procedures. Upon initializing the controller, it begins by registering the gate valve's current position and retaining this state information. In the event of a power outage, if the gate valve happens to be in an open position, restarting the controller can be safely accomplished without the concern of unintentionally triggering the gate valve to close.



Important!

When the controller starts up, it automatically starts the Scroll Pump and starts to pump the dock. Thus, before powering the controller, make sure that the buffer volume is always fully closed and air-tight, even if the dock is not being used.

In order to start the start up the LSC1 controller, connect it to a power source using the 12V power supply that was provided by Ferrovac AG. Once the controller is connected to a power source, it will automatically start up and show a welcoming screen:



After the start-up screen, the main screen will appear.

5.2 Overview

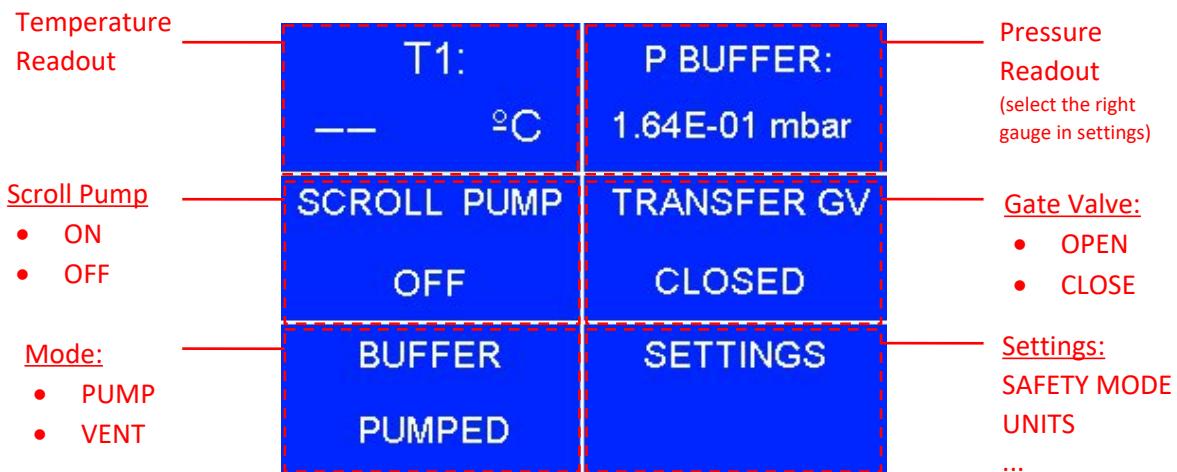


Important!

In the main menu, press the according buttons for **at least 3 seconds** in order to activate/change the status.

Read the manual carefully. It is the sole responsibility of the user to fully understand the controller, to understand what each function and setting does and what the consequences are when the controller is not properly used.

During normal operation of the dock, the user must strictly follow the [Step by step workflow to load a sample into the FIB Helios](#). Deviating from the mandated workflow may harm both the dock and the FIB Helios.



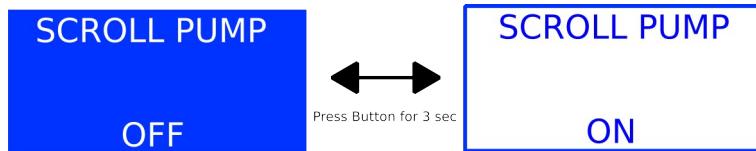
5.2.1 Temperature Readout

The temperature display can be used to read out the temperature of a PT100 sensors. In the settings menu, the units can set to Celsius, Fahrenheit and Kelvin. Please be advised that in the standard configuration of the package, no temperature sensors are included. The temperature readout is an additional feature, and thus in the standard configuration, it will always display “--”. The sensor is purposely not included, because the demand and purpose for temperature readout vary significantly from customer to customer. Please contact Ferrovac in case you want to know more about the temperature feature of the LSC controller.

5.2.2 Pressure Readout

The pressure display can be used to read out the pressure of different gauges. In the settings menu, the gauge-type, gas-type & units can set. Please be advised that in the standard configuration of the package, only one pirani gauge is included and the pressure is displayed in “P1”. Please contact Ferrovac in case you want to know more about the additional pressure readout feature of the LSC controller.

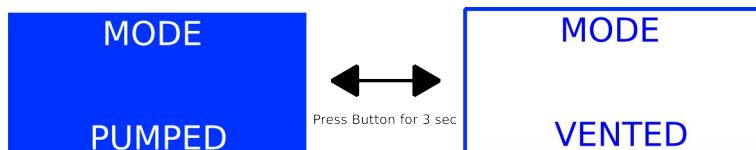
5.2.3 Scroll Pump Menu



In the scroll pump menu, the scroll pump can be manually turned on and off. Be aware that the interface is specifically designed for an Edwards NXDS scroll pump. In order to turn it on and off, the Edwards nXDS scroll pump must be connected with the electronics box of the IAKTHFIHELIOS.

- If an Edwards nXDS scroll pump is connected to the controller: Press the button for 3 seconds to turn the scroll pump on and off
- If another pump is used and no connection exists between controller and pump: When the pump is manually turned on and off, the user must still change the status to ON and OFF by pressing the button for at least 3 seconds.

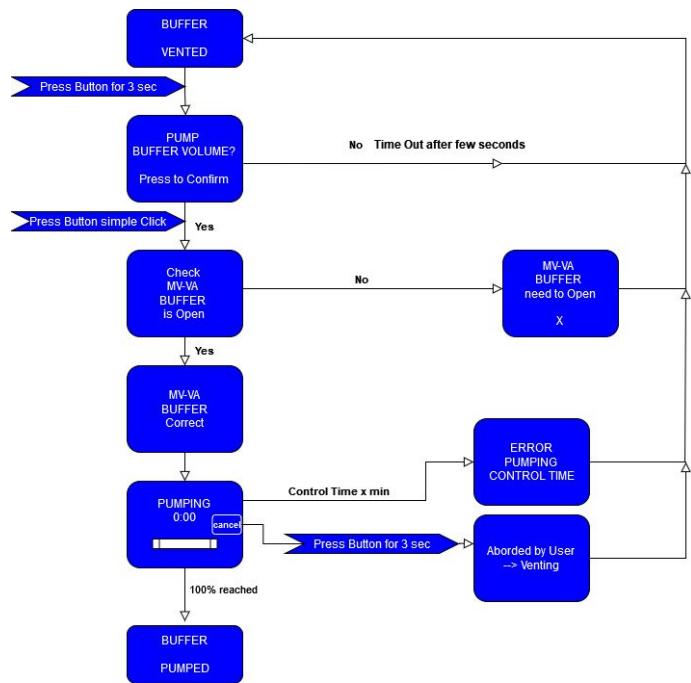
5.2.4 Mode Menu



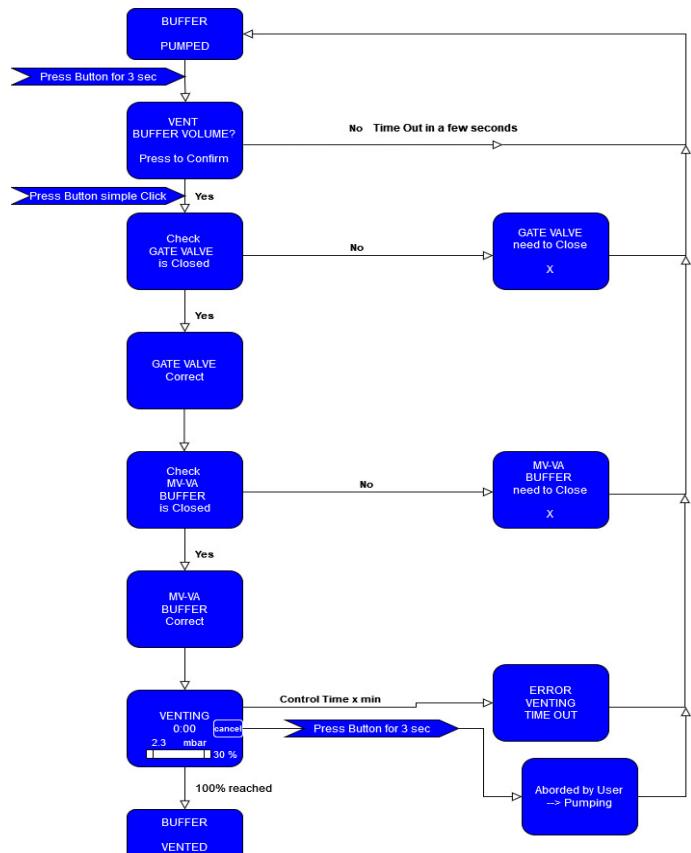
In the mode Menu, the user can either vent or pump the dock. To pump the dock, the scroll pump must be ON. If the user wants to change the status from "vented" to "pumped", but the scroll pump is not selected to be ON, the display will show the message "Turn Scroll Pump ON". Always indicate in the scroll pump menu that the scroll pump is on, even if another pump not provided by Ferrovac is used.

- Vented: when the status is switched to vented, the gate valve towards the FIB Helios must be closed. If the gate valve is open, the message "Close the Gate Valve" will be displayed and no venting is possible. This is a safety feature so that the user does not accidentally vent the FIB Helios. If the gate valve is closed, the dock can be vented. During the venting, the angle valve towards the scroll pump will close and the dock will be vented with dry nitrogen/air.
- Pumped: when the status is switched pumped, the scroll pump must be on. If the scroll pump is not indicated to be on, pumping of the dock is not possible and the message will show "Turn Scroll Pump ON". Once the scroll pump is indicated to be on, the angle valve towards the scroll pump will open and the dock will be pumped down. Always ensure that the dock is fully closed when the dock is being pumped.

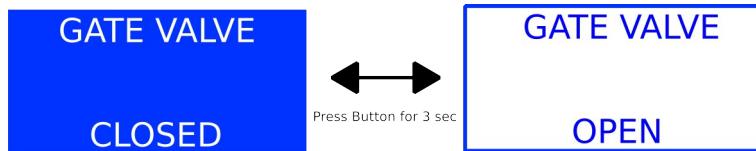
Pumping



Venting



5.2.5 Gate Valve

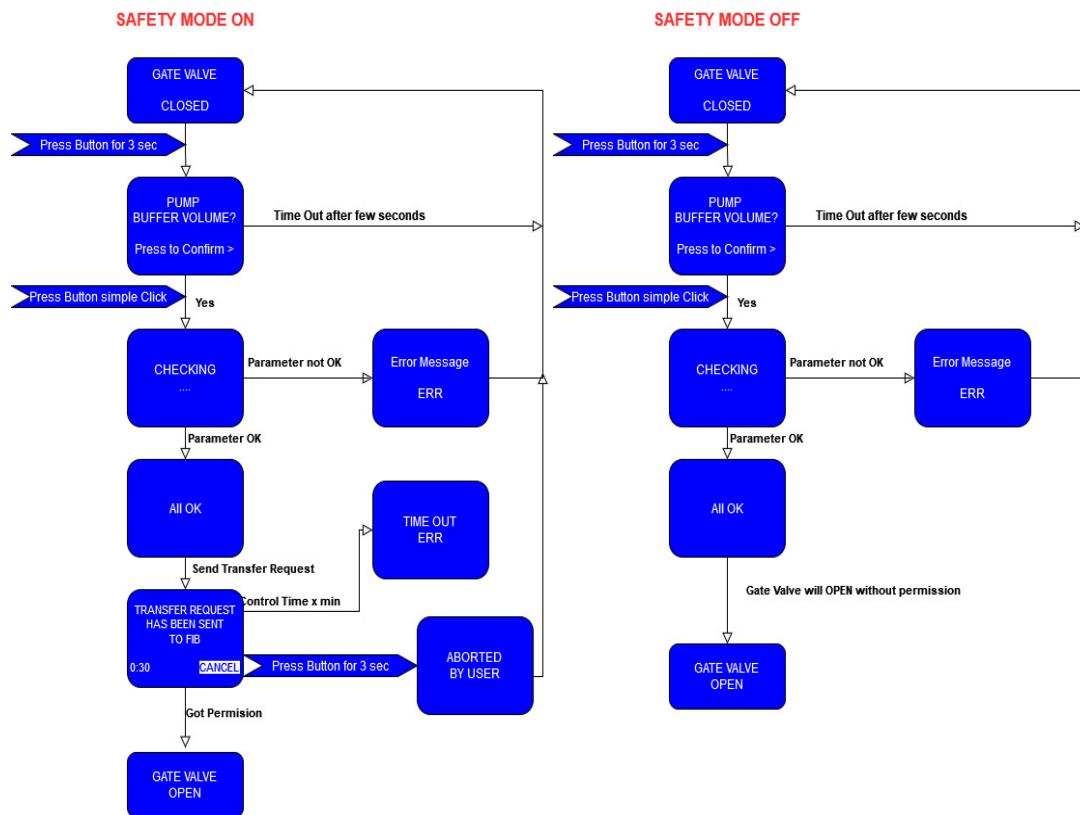


In the gate valve menu, the gate valve towards the FIB Helios can be opened and closed. The gate valve is a particularly important part of the dock and opening and closing the gate valve needs a lot of attention and precautions from the user. First, the controller has a safety mode that is directly linked with the opening of the gate valve. In the settings menu, the safety mode can be changed (see subsection “Safety Mode” in the chapter [Settings Menu](#) and read it carefully).

The standard recommended safety setting that the user must take is ON (SEM Interact is activated). In the “SAFETY MODE: ON” mode, the dock interacts with the FIB Helios via a serial interface connection. In this mode, if the user wants to open the gate valve, the controller first sends a request to open the gate valve to the FIB Helios. The FIB Helios then prepares the stage (automatically switches off the high voltage, retracts the detectors and gas injection systems). Once the FIB Helios is ready, the FIB Helios sends a signal to the dock allowing to open the gate valve. The other safety mode (SAFETY MODE: OFF) cancel out safety measurements and thus can be harmful to both the FIB Helios and the dock if they are not used properly. Contact Ferrovac immediately and prior to changing the safety settings. Please refer to the “Safety Mode” subsection in this manual to read more these modes.

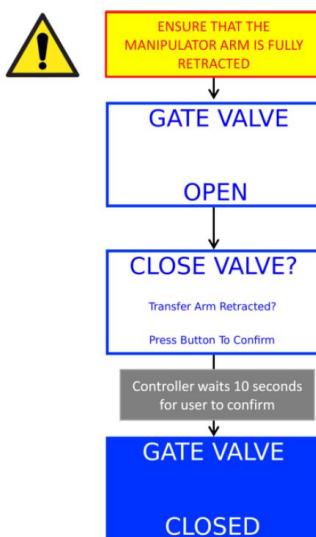
- **Opening the Gate Valve:** In order to open the gate valve, the status of the valve must be changed from “CLOSED” to “OPENED” by pressing the corresponding button for at least 3 seconds. Once the button is pressed, the controller goes through several safety checks depending on the safety mode that the user has chosen (refer to the flowchart below):
 - **Pressure in the dock below <5E-2mbar and Mode set to Pumped:** The controller checks if both conditions are given. If one or both statements are not given, the controller will beep for 1 second and display “Pressure not OK/Change Mode to Pump” to indicate the problem. The controller will not allow the opening and abort it.
 - **Request for Loading:** The controller checks if the FIB Helios gives permission to open the gate valve. If permission is directly granted, the gate valve will open. If the FIB Helios is not ready yet and permission is not granted yet, the controller sends a request to the FIB Helios.
 - **Request Sent:** When the FIB Helios receives the request, the FIB Helios automatically switches the high voltages off, retracts detectors and gas injection systems and sends the stage to the loading position when the loading was requested. **The controller will wait for 1 minute*** and await the response from the FIB Helios. If there is no response from the FIB Helios within 1 minute, the controller will abort the opening of the gate valve.

*Be aware that 1 minute waiting time might not be enough time for the FIB Helios to prepare itself. In this, case, change the time out in the settings menu.

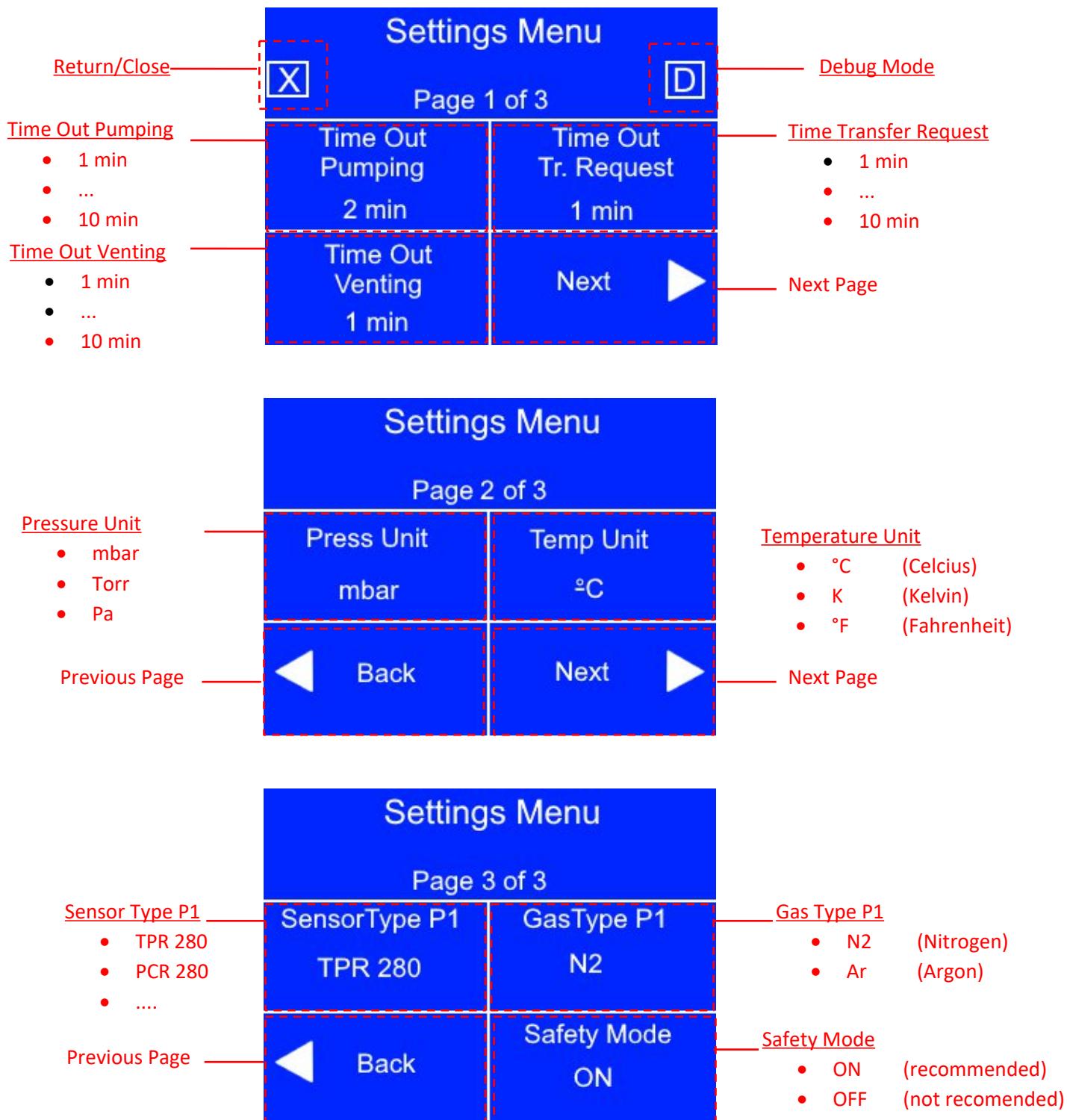


- **Closing the Gate Valve:** When closing the gate valve, the user must always visually ensure that the transfer arm is fully retracted. **Never close the gate valve when the transfer arm is extended, this will lead to unforeseeable damages on the FIB Helios, the dock and the UHV Suitcase. The user must strictly follow the [Step-by-step workflow to load a sample into the FIB Helios](#) to avoid any damages to the system.** The procedure in the controller will be the following (see flowchart below):

- **Retract Manipulator Arm:** Ensure that the manipulator arm is fully retracted
- **Close the Gate Valve:** Press the corresponding button for 3 seconds. As a safety measure, it will display “CLOSE VALVE? Transfer Arm Retracted? Press Button To Confirm”. In order to confirm, **press the button again for 2 seconds to confirm**. The controller will beep while the buttons is pressed. If the user does not confirm within 10 seconds that the gate valve can be securely closed, the controller will abort and keep the gate valve closed.



5.2.6 Settings Menu



In the settings menu, following configurations can be changed by pressing the according button:

- **Time Out Settings**
 - 1 min , 2 min ... 10 min before the controller throws a timeout error
- **Temperature Unit:** Change the temperature readout unit to degree Celsius, Kelvin or degree Fahrenheit
- **Pressure Unit:** Change the pressure readout unit to mbar, Torr or Pascal
- **Safety Mode:**



Caution!

During normal operation, the **Safety Mode** must always be set to **ON**. In this setting, an interface between the dock and FIB Helios allows reliable and safe way to integrate a loading device for SEM and SDB systems. The main features are that the SEM/SDB system automatically switches the high voltages off, retracts detectors and gas injection systems and send stage to loading position when the loading requested. When the loading is finished, the system automatically and safely recovers to basic SEM operation conditions. **In case the interface between the dock and FIB Helios is not working properly, contact Ferrovac immediately.**

Changing the Safety Mode to **OFF** or **Debug** can be harmful for the FIB Helios system and the dock. **During normal operation, never change the safety mode to OFF or Debug.** It is to the sole responsibility of the operator to understand the risk and consequences of changing the safety mode and to operate the dock properly when the safety mode is switched to **OFF** or **Debug**. Read the section about the Gate Valve carefully before you want to change the Safety Mode.

This configuration entirely concerns the opening of the gate valve towards the FIB Helios. The configuration can be changed between **ON** (SAFETY MODE: ON), **OFF** (SAFETY MODE: OFF). Please read the section [6.2.5 Gate Valve](#) carefully before you change the Safety Mode.

- **ON:** This is the standard recommended safety setting. In this mode, the dock interacts with the FIB Helios via a serial interface connection. In this mode, if the user wants to open the gate valve, the controller first sends a request to open the gate valve to the FIB Helios. The FIB Helios then prepares the stage (automatically switches off the high voltage, retracts the detectors and gas injection systems). Once the FIB Helios system is ready, it sends a signal to the dock and tells the controller that it is safe and allowed to open the gate valve. **In this configuration, the gate valve thus can only be opened if the pressure in the dock is below <5E-2mbar and if the FIB Helios allows gate valve opening.**
- **OFF:** Only use this setting if the serial connection between the FIB Helios and the dock is not working properly. Contact Ferrovac immediately and prior to changing the safety mode. The purpose of this safety setting is to still be able to open the gate valve, even in the rare occasion if there are issues with communicating to the FIB Helios properly. In this mode, the user must manually prepare the FIB Helios (turn off high voltage, retract the detectors and gas injection systems). **In this configuration, the gate valve can only be opened if the pressure in the dock is below <5E-2mbar. The dock does not ask the FIB Helios for permission if it is safe to open the gate valve. It thus can be harmful to the system if the user does not correctly prepare the system.**

- **Debug-Mode:** Change to the Debug-Mode (key sequence protected)

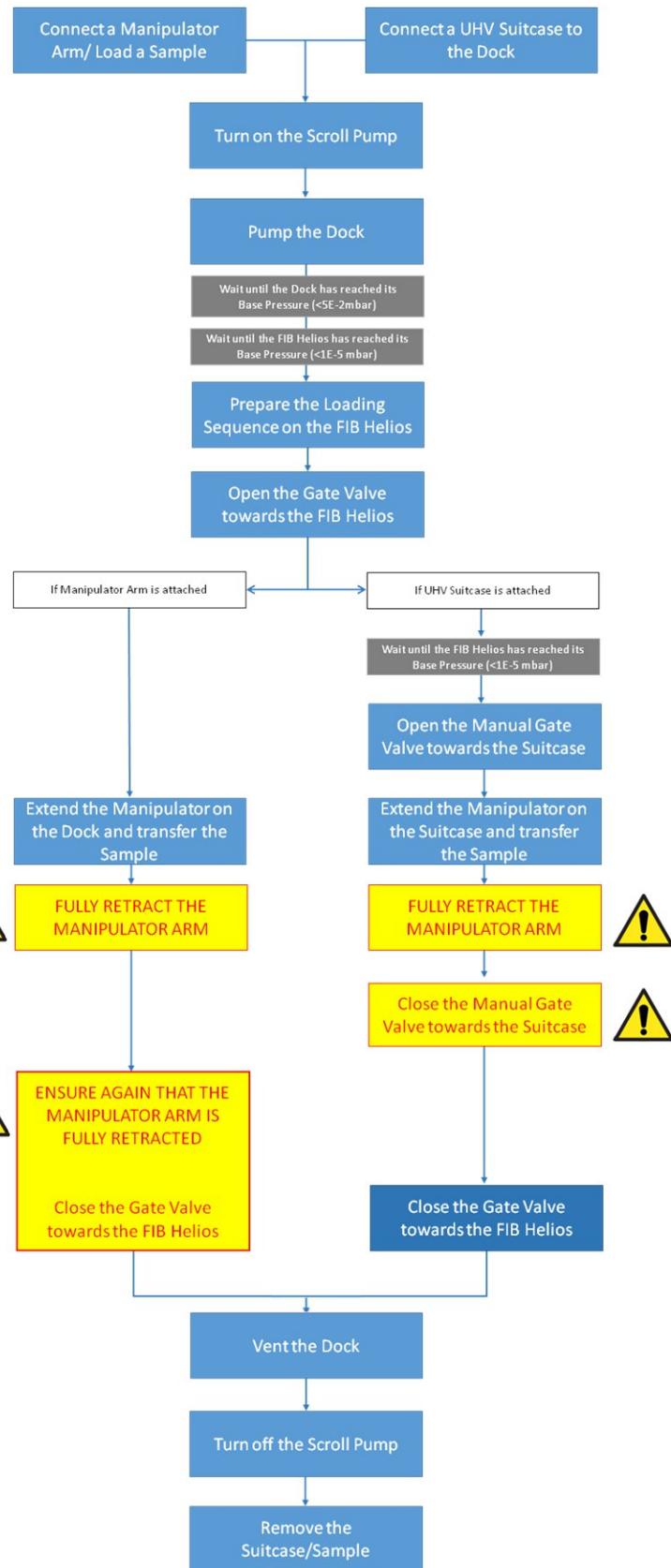


Caution!

The “Debug-Mode” allows the user to manipulate all valves, pumps and the filling of the dewar independently of the vacuum level and the state of the valves.

The use of the “Debug-Mode” is only permitted for trained persons. Ferrovac declines any and all responsibility and liability for any damage/injuries resulting from use of this mode.
(key sequence to enter *413*)

5.3 Step-by-step workflow to load a sample into the FIB Helios



PRINT THIS PAGE AND ENSURE THAT EVERY USER STRICTLY FOLLOWS THESE STEPS

6 Maintenance

6.1 Venting and Pumpdown



Caution!

- If vented through pressurized dry gas, make sure that the pressure does not exceed 1000 mbar. Overpressure may damage the bellows, viewports or other pressure sensitive components. If the vented volume is still under pressure after every vent, slightly increase the pressure on the pressure regulator of the pressurized dry gas bottle
- Make sure that all parts of the affecting system are strictly at room temperature before venting!
- CF knife-edges are very sensitive! Avoid using any sharp instrument in the vicinity of the knife-edge. CF flanges must be handled by qualified personnel only!

6.2 Bakeout



Caution!

Never perform a bakeout of UHV equipment on the docking station of the FIB Helios! The FIB Helios, as well as the Ferrovac docking station, are both strictly designed to operate at room temperature. Bakeouts of any UHV related components (such as a Ferrovac VSN40S suitcase) are strictly prohibited on the docking station and will lead to unforeseeable and unpredictable damages on both the Thermo Fisher Helios and the Ferrovac Docking Station. Ferrovac

7 Options and Upgrades

For details about options and upgrades regarding the IAKTHFIHELIOS dock, visit our website www.ferrovac.com or get directly in contact with us by phone or email.

8 Additional Information

8.1 Return of Defective Items

Ferrovac AG requires a completed declaration of contamination form and will issue an RMA (Return of Materials Authorization) form, before any items are factory returned. Please contact us beforehand. You will be given an RMA number and information on how to proceed with the return of defective items.

8.2 Downloads

The latest version of this manual can be downloaded from our website www.ferrovac.com. For any suggestions or questions concerning this manual, please don't hesitate to contact us.

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