

FERROVAC GMBH

ULTRA HIGH VACUUM TECHNOLOGY

HSAS40-HSEBOM

Electron Bombardment
Sample Heating Stage

Instruction
Manual

Version 1.2

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Warranty

Ferrovac GmbH warrants this product to be free of defects in material and workmanship for a period of 12 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
- 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 warranty of merchantability implied or fitness for a particular use. The remedies provided herein are buyer's sole and exclusive remedies.

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Terms and Symbols

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



A triangle with explanation mark indicates a passage in the manual with information that is crucial for the operator. **READ THESE PARAGRAPHS CAREFULLY** or the product might be damaged by misuse.



The high voltage symbol, if found on a product or accessory of a product, indicates voltages that are potentially lethal.

WARNING!

The **WARNING** heading in a manual explains dangers that may result in personal injury or death. Read the associated information always very carefully.

CAUTION!

The **CAUTION** heading in a manual explains hazardous situations that could damage the product. Such damage may invalidate warranty.

Normal Use

The product described in this manual must always be used:

- With original cable sets supplied by Ferrovac which are explicitly specified for the use with the product described in this publication
- With all cabling connected and secured, if applicable
- With all electronic equipment switched on after all cables are connected properly
- In an indoor research laboratory environment
- By personnel qualified for operation of delicate scientific equipment
- In accordance with all related manuals.



Warning: lethal voltages!!

Any adjustment, fault finding procedure, installation and maintenance of the products described in this manual must be carried out by authorized personnel, fully qualified to handle potentially lethal voltages.



CAREFULLY READ THE SAFETY INFORMATION AND ALL RELEVANT MANUALS BEFORE USING THE PRODUCT AND ANY RELATED INSTRUMENTATION!

Safety Precautions

The following safety precautions must be observed at all times before using the product described in this manual and any associated instrumentation.

The product described in this manual is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions necessary to avoid possible injury.

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 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 the manual and must be observed at all times.

Service Personnel are trained to work on live circuits and 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.

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

CAUTION: Always check for correct mains voltage before connecting any equipment!

WARNING: Lethal Voltages! Adjustments and fault finding measurements may only be carried out by authorised service personnel. Lethal Voltages may be present on parts of the instrument during operation.

WARNING:

- **Always** use the configured cables delivered with the product for electrical connections.
- **Always** disconnect the mains supplies of all electrically connected units before venting, pumpdown, opening the vacuum chamber, touching any part of the in-vacuum components.
- **Always** observe and strictly follow the safety notes and regulations given in this and related documentations.
- **Always** have in mind, that a connected thermocouple is on high voltage!
- **Never** operate the high voltage supply when the heating stage is **not fully wired and under vacuum**.
- **Never** operate the heating stage in a **pressure above 1*10E-6mbar**.

WARNING:

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

- Room temperature lies between 5°C/41°F and 40°C/104°F
- Mains supply voltage fluctuations must not exceed $\pm 10\%$ of the nominal voltage

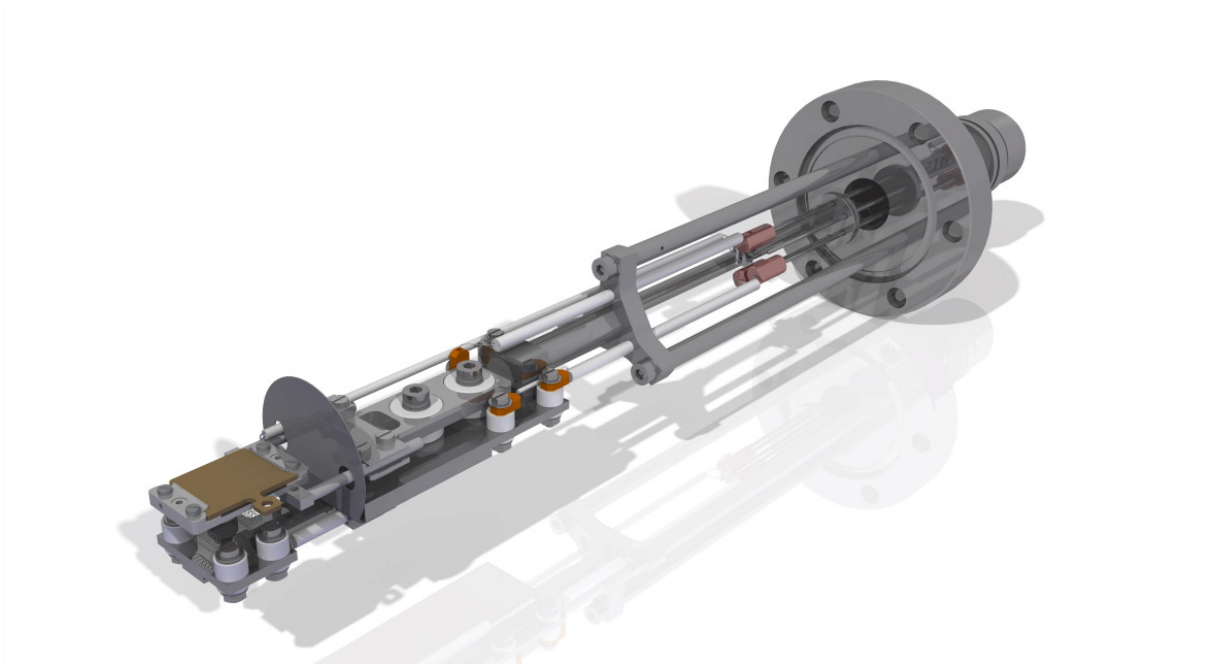


Fig1: HSAS40-HSEBOM(P)-HSEFM12P7(K)

1. Introduction

HSAS40-HSEBOM heating stage assembly for Omicron sample plates. It can be used for a wide range of materials at operating pressures in the lower 10E-10 mbar range. The sample plate is heated by the principle of electron bombardment. The electrically heated filaments emit in their glowing condition free electrons, which accelerate by a positive high voltage up to 1kV onto the sample plate (high voltage applied to the sample!). With this very effective way of heating by electron impacts on the sample plate, temperatures of ~2000°C can be reached within a few seconds. For moderate heating up to ~500°C, irradiation of the sample plate by the tungsten filament is sufficient.

2. Unpacking and Inspection

HSAS40-HSEBOM are shipped clean and ready to use in UHV. Prepare a sufficiently clean workspace and wear surgical gloves when unpacking and inspecting the heating stage. Check for any visible damage of the package, heating stage and accessories. Compare the contents of the package with the delivery note. Any damage or missing items must be reported to Ferrovac within 48 hours after delivery.

3. Setup and Installation

3.1 Electrical Connections

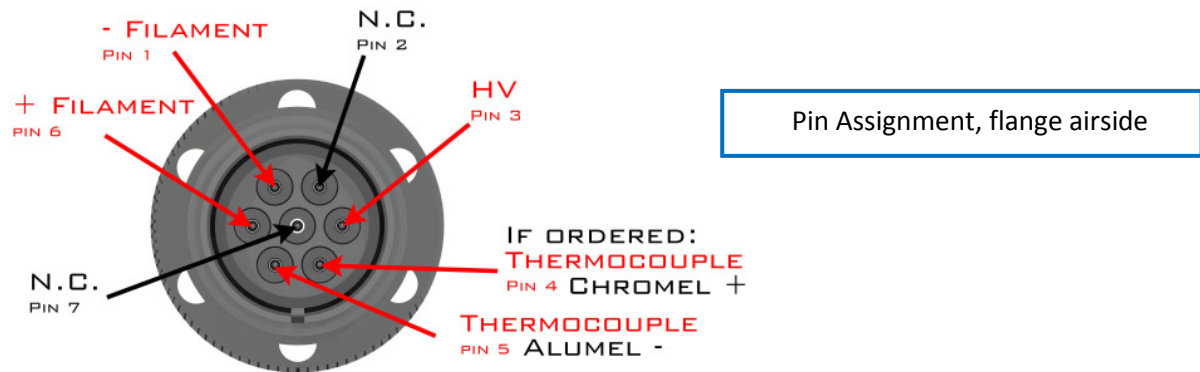


Fig2: Pin assignment

Example for connection configuration

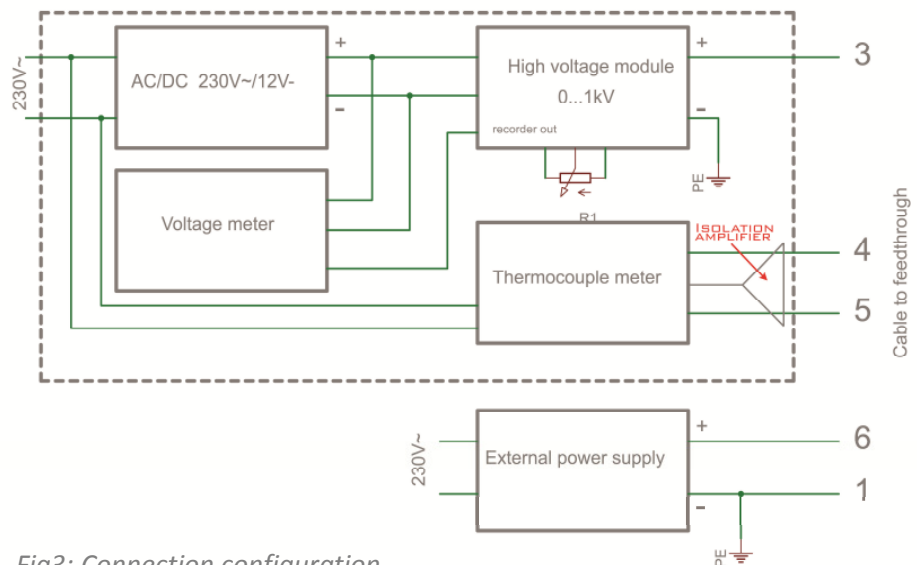


Fig3: Connection configuration

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3.2 Thermocouple

The thermocouple (TC) is optionally installed. The air side cable does not include the TC connections. Since the thermocouple measures directly the temperature of the sample receptor, it is floating at high voltage! The additional pins for the MS-type Plug are provided.



Warning: lethal voltages!!

By connecting a thermocouple on the sample receptor, the thermocouple is **floating** at high voltage!

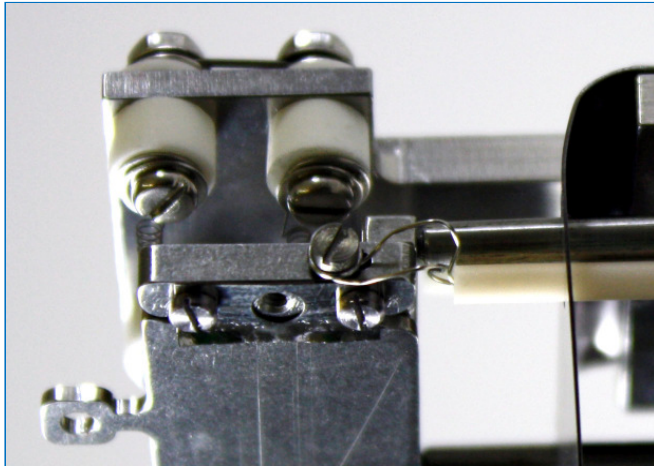


Fig4: Installing the thermocouple

For the electrical connection use a Molybdenum or Tantalum screw for fastening the thermocouple on the sample receptor and pull it through the provided ceramic tube.

To avoid an electrical breakdown at airside, it is mandatory to separate the electrical current galvanically by using an isolation amplifier, such as the AD202K from Analog devices (datasheet below) for example with an internal isolated supply for the input part and an adjustable gain (max. 100).

(datasheet ISO122: <http://pdf1.alldatasheet.com/datasheet-pdf/view/47966/AD/AD202K.html>)

Because the thermocouple is on high voltage at the contact point, an instrumentation amplifier (working as a preamplifier) obtrudes itself. A suitable instrumentation amplifier would be the INA126 from Burr Brown, adjusted with a gain of 50. See the circuit suggestion below.

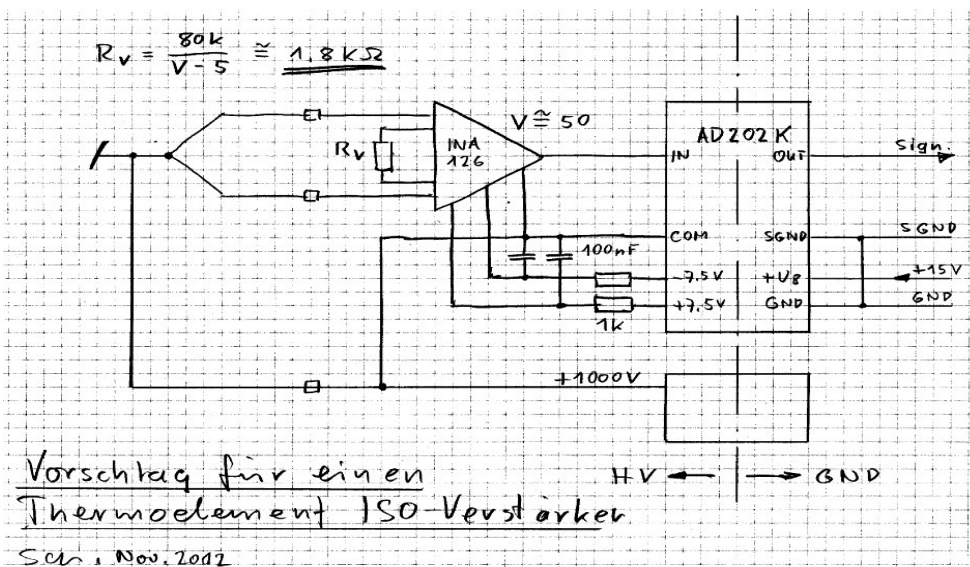


Fig5: Circuit for a preamplifier for the thermocouple



WARNING: Electrical feedthrough is NO TC-pair feedthrough.

3.3 Power Supplies

The **CE marked** HV supply should have a DC voltage range from 0-1000V positive polarity with a recommended power of 200W. An adjustable current limit should be provided and an accurate reading of the output current with 1mA resolution. Make sure that the output connector is of type SHV 5kV.



WARNING: Any high voltage supply with a high power output can cause a **potentially lethal** electric shock if operated by unqualified personnel!

The **CE marked** low voltage DC power supply (conventional lab PSU) should have a voltage range from 0-30V with a recommended power of 100W. An adjustable current limit should be provided and a reading of the output current. Make sure that the output connectors are of type 4mm banana plug. The negative output of the power supply must be connected to earth potential.



WARNING: Make sure that the negative output of the filament power supply is connected to earth potential! Ensure that all power supply chassis are connected to earth.

3.3 Wiring



CAUTION: Use only the configured cables delivered with the heating stage!

A configured cable is delivered with each heating stage. The cable is wired for the operation of two installed Tungsten filaments which are connected in series.

The cables supplied with the HSAS40-HSEBOM have an MS-Type 7 pin HV-Plug at one end and an SHV-plug, plus a red and black 4mm banana plug at the other end. The earth connection leads through the SHV-plug. Further it is connected to the chassis of the MS-Type 7 pin plug.



WARNING: Always connect the SHV cable to a power supply with a proper earth connection.

Connect the MS plug to the heating stage which have to be installed to a vacuum system with a working pressure below $1 \cdot 10^{-6}$ mbar. Connect the SHV plug to the output of a properly earthed high voltage supply. Connect the red banana plug to the positive output of the filament supply and the black banana plug to the negative output, which additionally has to be connected to chassis ground (earth potential).



WARNING: Never operate the high voltage supply when the evaporator is not fully wired and under vacuum!



The filament cable **must** be connected with the low-voltage power supply unit!

In case of a short circuit of filaments and sample, the security-banana plugs can be at high voltage!

4. Conditioning for the heating process

4.1 Operating the heating stage

- Mount the heating stage to a UHV chamber and pump down to a working pressure of about $1 \cdot 10^{-9}$ mbar.
- Establish electrical connections to the power supplies or control unit. For safety reasons, use only the cables originally delivered with the heating stage.
- Increase the high voltage slowly up to (+1kV) while observing the vacuum gauge.
No pressure increase and no voltage breakdown should be observed.
- Turn on the filament power supply in current limited mode and slowly increase the filament current. While slowly increasing the filament current, check for emission current on the HV-supply current display and keep an eye on the chamber pressure.



CAUTION: Do not operate the heating in a pressure above $1 \cdot 10^{-6}$ mbars .

- Measure the temperature by using a thermocouple.



CAUTION: The typically used thermocouple Type K operates only up to temperatures of $\sim 1300^{\circ}\text{C}$. This is the limited operating temperature.

- Hold the filament current at the wanted heating temperature.
- For higher operating temperatures, the thermocouple should be dismantled consequently.
In this case it is recommended to use a Pyrometer for temperature measurement.

4.2 Shutdown of the heating stage

- Switch off the filament current by decreasing the current slowly by the control unit.
- Switch off the high voltage the same way.