Ferro Tec

Mounting instruction

Evaporation Controller Type Genius

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Version 2.0.6   Translation of the original mounting instruction

> **NOTICE!** *This Mounting instruction is an integral part of the evaporation system and must be available at all times to operating personnel. The safety instructions contained in it must be obeyed. If the machine is resold, the Mounting instruction must always be delivered with it as well.*

Liability

The manufacturer's liability for the *GENIUS* is based on the principles of German law. The manufacturer accepts no liability for damage and losses due to:

- improper use (see chapter. 2.2 Page 8);
- operation by unauthorised personnel;
- failure to follow safety regulations ;
- failure to heed the information in the Mounting instruction.

Translation

If the machine is sold to a country in the EEA, this Mounting instruction must be translated into the language of the country in which the machine is to be used. Should the translated text be unclear, the original mounting instruction (German) must be consulted or the manufacturer contacted for clarification.

Copyright

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Intended Use

This mounting instruction is intended for all people who work with and on the *GENIUS* controller, especially the operating personnel. The mounting instruction contains an exact description of the product, but does not warrant certain properties or success of use. The instruction handbook was inspected carefully before publication. The authors guarantee that the mounting instruction does not contain errors that cancel or reduce the value or suitability of the device for its intended use. The publishers, however, accept neither explicitly nor implicitly any liability for damage or consequential losses resulting from use of the mounting instruction. We are thankful for notification of errors and for recommendations and criticism. Where not stated otherwise, the technical state at the time of joint delivery of product and mounting instruction by Ferrotec GmbH is definitive. We reserve the right to make technical changes without prior notice. All previous instruction manuals then lose their validity.

Copyright

The controller and this mounting instruction are protected by copyright. Copying of the devices will be prosecuted. All rights to this mounting instruction are reserved, including reproduction in any conceivable form, be it photo mechanical, by printing, on any data carrier whatsoever or in translated form. Reproduction of this mounting instruction, also in excerpts, is only permitted with the written consent of Ferrotec GmbH.

Publisher

Do you have any questions? Or problems installing or starting your device? Please call us! We will be glad to help you!

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Publisher

Content

1.1 Declaration of Conformity

Declaration of Incorporation

Manufacturer's Name: Ferrotec GmbH
Manufacturer's Address: Seerosenstraße 1
72669 Unterensingen
Germany

Declares that the product:

Product Name: High Voltage Power Supply CARRERA
Filament Power Supply FPS
Evaporation Controller GENIUS

Conforms to the following Directives:

2004/108/EG	Electromagnetic Compatibility Directive
2006/95/EG	Low Voltage Directive
98/37/EC, Annex II B	Machinery Directive

Uses the following standards:

EN 60204-1:2007	Safety of Machinery- Electrical Equipment of Machines, Part 1
EN 60204-11:2001	Safety of Machinery- Electrical Equipment of Machines, Part 11
EN 55011: 2007	Radiation and Conducted Emission
EN 61000-3-2:2010	EMC Directive - Harmonics
EN 61000-3-3:2009	EMC Directive – Voltage Fluctuations & Flicker Emission
EN 61000-6-2:2006	General Standards – Immunity Standard for Industrial Environment
EN 61000-6-4:2007	General Standards – Emission Standard for Industrial Environment

The High Voltage Power Supply CARRERA, the Filament Power Supply FPS and the Evaporation Controller GENIUS *may only be put into operation when it has been ensured that all safety equipment is operative and the total installation of the vacuum system comply with EU directives.*

Unterensingen, 2011-11-17

FerroTec GmbH

Jürgen Pfähler
General Manager Vacuum Solution Division

Authorized person for the technical documentation:

Mr. Alfred Mutscheller

Product manager EB Evaporator

Ferrotec GmbH
Seerosenstrasse 1
72669 Unterensingen

2 Overview and Intended Use
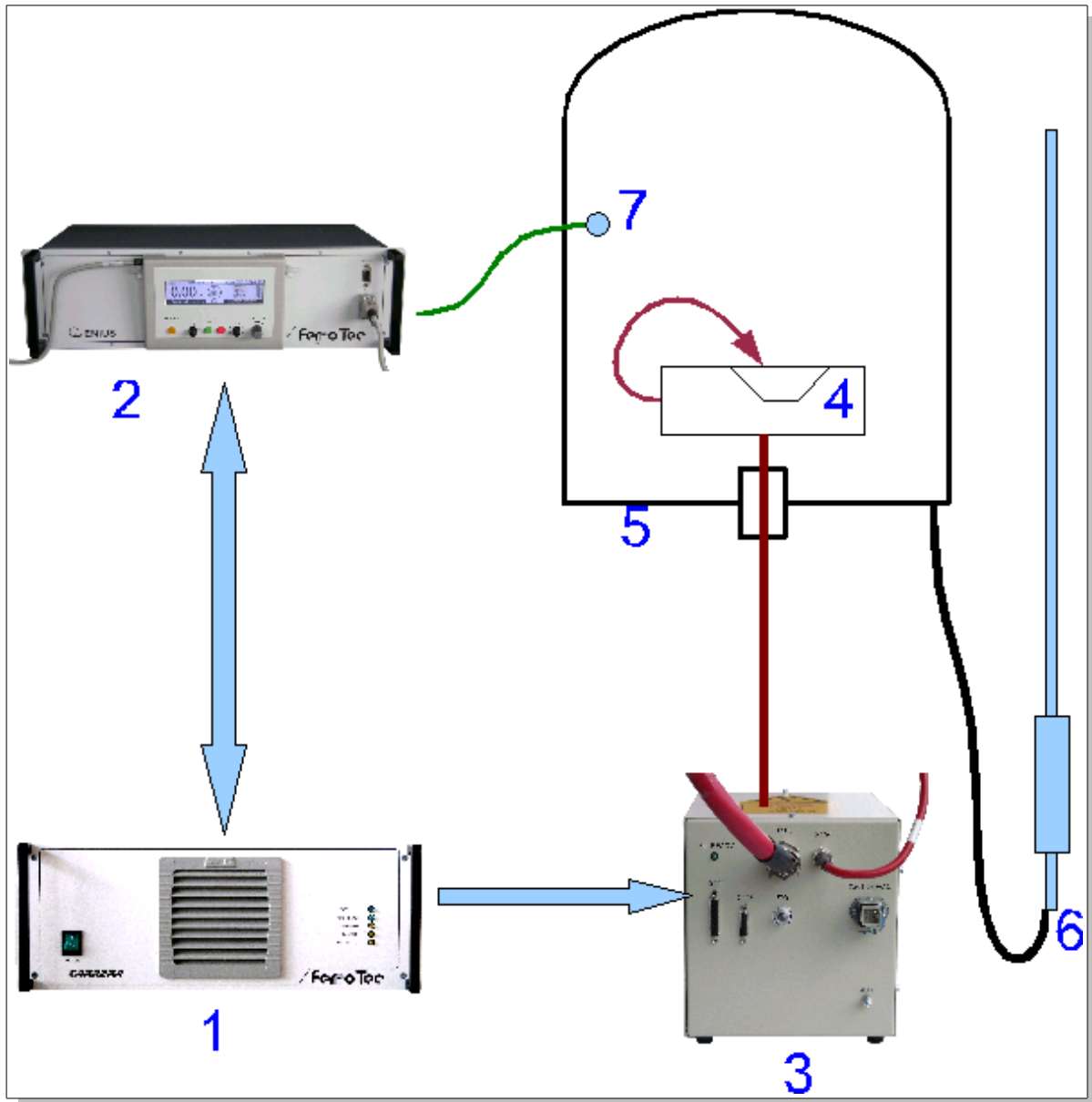
2.1   Overview of a vacuum evaporation system

Fig. 1: Overview of a vacuum evaporation system

A complete evaporation system consists of the following components:

1. High voltage power supply HVP
2. Evaporation controller *Genius* including hand remote control
3. Filament power supply (FPS)
4. Electron beam evaporator
5. Vacuum chamber
6. Grounding rod
7. Deposition controller including sensor

2.2 Intended Use

The evaporation controller *Genius* is part of a group of devices for the operation of an electron beam evaporator installed in a vacuum chamber.

The group of devices consists of:

1. High voltage power supply (HVP)
2. Evaporation controller (*Genius*) including hand remote control
3. Filament power supply (FPS)
4. Grounding rod

Use of the evaporation controller *Genius* other that in combination with this group of devices is not allowed. The evaporation controller *Genius* is intended solely for the control of this group of devices. Use of the evaporation controller for any other purpose requires the approval of the manufacturer. This Mounting instruction deals only with the design and operation of the evaporation controller *Genius*. Please see the relevant operation manuals for operation of the other devices in the group. These devices were developed, designed and build solely for commercial/industrial use. Proper use in accordance with its designated use includes compliance with the manufacturer's operating maintenance and repair instruction.

> ⚠️ **WARNING!** *Access to the electron beam evaporator is to be secured by the unit controller in such a way that it is possible to ensure that both the rotary crucible movement and the high-voltage power supply are stopped. To do this, there are the relevant external connection options at the high-voltage supply and at Genius controller available. The person setting up the entire unit is required to integrate this safety function in accordance with the performance level determined in the functional safety.*

> ⚠️ **DANGER!** *The evaporation controller Genius is intended solely for the purpose described above. Any other use or modification of the evaporation controller Genius without the written consent of the manufacturer is deemed improper. The manufacturer accepts no liability for resultant damage. The risk is borne solely by the operator.*

> ☝️ **NOTICE** *on application of the EMC Directive 2004/108/EG in the manufacturer's declaration. The evaporation controller Genius is only allowed to be operated in Industrial environment.*

2.3　Explanation of terms

CARRERA/HVP	device designation for the high voltage power supply (High Voltage Power Supply)
GENIUS	device designation for the evaporation controller GENIUS
FPS	device designation for the filament power supply (Filament Power Supply)

2.4　Technical specifications

2.4.1　Product specific data

> ⚠ **DANGER!** *The materials/media needed for operation of the electron beam evaporator in compliance with its intended use are procured and used by the operator of the electron beam evaporator. Proper handling of these materials/media and the related dangers are the sole responsibility of the operator. The operator must supply his operating personnel with information and instructions on dangers and disposal. The safety data sheets of the material/media manufacturers must be observed*

Control	Micro controller Siemens C167, 16 Bit
Memory:	256 kB Flash-EPROM
Firmware-Version:	see page 29
Modes of operation:	• **Manual**: All settings are made with the LCD-remote control. • **Auto**: The emission current is set by a rate controller via X111. • **RS232**: The evaporation controller is remote-controlled via the RS 232 interface (e.g. by a PC)
Cooling:	Forced air cooling by internal fan
Operation:	User-friendly, menu-driven operation
Control panel:	Remote control with CFL-illuminated LCD-display (64x256 pixel), emission controlled, illuminated control buttons, 2 digital joysticks
Battery:	Lithium cell, expected lifetime 10 years

2.4.2　Dimensions and weight

Width	483 mm (equals 19")
Height	132,5 mm (equals 3 HE)
Depth	200 mm (+100 mm minimum distance to backdoor of the cabinet)
Total weight	7 Kg

2.4.3　Electrical specifications

Electrical specifications, GENIUS - evaporation controller

Power consumption	0,6 kVA
Mains power supply	85 ... 264 VAC
Mains frequency	50 ... 60 Hz

Electrical specifications, Magnet power supply

Output voltage	24 V
Output current	± 3 A
X-deflection	± 3 A
Y-deflection	± 3 A

2.4.4   General specifications

Ambient temperature   -10 up to 35 °C
Air humidity max.:   65 %
Noise level   LpA < 70 dB (A)

3   Safety

3.1   Notes / Explanations

DANGER warns of dangerous situations. Avoid these dangerous situations ! Otherwise they could result in severe injury or death.

WARNING warns of dangerous situations. Avoid these dangerous situations! Otherwise they could result in severe injury or death.

CAUTION in connection with this warning symbol warns of dangerous situations. Avoid these dangerous situations! Otherwise they could result in severe injury or death.

NOTICE gives you recommendations for action, and there is no risk of injury if you fail to comply with them. However, follow these recommendations for action to avoid damage and annoyance

„mounting instruction mandatory" framed and marked with a book symbol.

„Notice" are marked with the word „NOTICE". This informs you about further literature.

3.1.1   Explanation of used safety symbols

Danger from electric current are framed and marked with the symbol shown .

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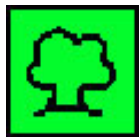|	
	Danger of burns are framed and marked with the symbol shown adjacent.
	Danger of your hands being crushed or injured are framed and marked with the symbol shown adjacent.
	Danger from magnetism are framed and marked with the symbol shown adjacent.
	Danger for people with cardiac pacemakers (and with insulin pumps and people with active or passive prostheses and ferromagnetic or conductive foreign bodies) are marked with the symbol shown adjacent.
PE	***Protective conductor connection*** *is marked at the connection points by the symbol shown adjacent.*
	Environment sign*, marks actions to protect the environment.*
	Wear personal safety equipment "safety glasses".
	This instruction handbook is an integral part of the deposition controller and must be kept readily at hand for the operating personnel at all times. The safety instructions contained in it must be obeyed. If the deposition controller is resold, the instruction handbook must always be delivered with it as well.

3.1.2 Machine Identification

3.1.2.1 Serial number

The identification plate including the serial number is attached on the side of the evaporation controller. Important for any further inquiry is the:

- Type
- Serial number

We can only process your inquiry properly and quickly if this information is correct.

3.1.3   Warranty from the manufacturer

3.1.3.1 Conditions of the warranty

FerroTec products are produced and inspected in accordance with our quality management system. Warranty must be claimed immediately after the notice of the failure including the serial number of the deposition controller. The manufacturer guarantees warranty of the product of 12 months to be free on defects caused by material failure or failures caused by the manufacturing process. If a fault occurs during this time period the manufacturer guarantees free of charge repair in regards of parts and labor time.

3.1.3.2 Warranty exclusions

Damages caused by improper or not intended use (see Chapter 2.2 page 8) or unauthorized alterations into the GENIUS are excluded from this warranty.

3.2   Integrated safety systems

> **NOTICE!** *The evaporation controller GENIUS is intended soley for the operation in combination with other devices to operate an electron beam evaporator. The safety systems are designed accordingly. Use of the evaporation controller GENIUS for any other purpose requires the approval of the manufacturer. The operator is responsible for the safe operation of the evaporation controller. It is in his responsibility to find out what legal rules and regulations must be complied with and to apply them.*

The evaporation controller is equipped with

- a **mains fuse** to protect the device.
- **confusion-safe** connectors

The evaporation controller GENIUS is connected by using a IEC male socket.

Interlock status indication of the operation modes (HV-off menu):

The vacuum chamber door, the vacuum of the vacuum chamber, the water flow of the cooling water into the electron beam evaporator, the deflection current of the magnetic deflection coils and one external interlock can be monitored (external interlock circuit).

> **DANGER!** *The evaporation controller controls the individual groups of devices, which are operated with deadly high voltage. It is strictly forbidden to render any of the safety devices inoperative. Violation can result in personal injury and damage to the equipment.*

The integrated safety systems must be checked at regular intervals.

3.2.1.1.1.   *Mains isolator (mains switch)*

`Test interval: yearly functional test`

The evaporation controller has to be integrated in a master emergency stop system that immediately puts the evaporation controller and the high voltage power supply into a safe operating state when actuated and isolates this from the mains power.

> **DANGER!** *When the main switch is switched off for cleaning, maintenance and repair work, it must be locked with a padlock to prevent unauthorized switching on.*

3.2.1.1.2. Emergency stop system

`Test interval: monthly functional test`

The evaporation controller has to be integrated in a master emergency stop system that immediately puts the evaporation controller and the high voltage power supply into a safe operating state when actuated.

3.2.1.1.3. Safety system

`Test interval: monthly functional test`

- Discharge rod,
- Safety switch at the vacuum chamber for evaporator,
- Safety latch for interlocks,
- Flow controller,
- Vacuum monitor,
- Blocking valve at the cooling water supply.

3.2.1.1.4. Vacuum machine control system

`Test interval:yearly sight -, functional - and measurement test`

The machine control system has to be equipped internally with a three-phase, five wire supply system with current carrying mid-point conductor and separate ground conductor (with YELLOW/GREEN insulation)

> **DANGER!** The owner is required to ensure that the unauthorized persons (i.e., who are not operating or maintenance personnel) are prevented from entering the operating area.

> **DANGER!** The electrical cabinet can only be opened with a special key. This special key is allowed to be handed over only to authorized personnel. Any door or flap must be keep closed. It may be opened only by qualified personnel for the purpose of maintenance or technical service.

The operating and maintenance personnel are trained in the use of the machine at its point of installation by personnel from Ferrotec GmbH. Should you have any questions or be uncertain about anything, please contact Ferrotec GmbH

> **NOTICE!** It is strictly forbidden to render any of the safety systems inoperative or to modify their action.

> **NOTICE!** This Mounting instruction is an integral part of the electron beam evaporator and must be kept readily at hand for the operating personnel at all times. The safety instructions contained in it must be obeyed. If the electron beam evaporator is resold, the Mounting instruction must always be delivered with it as well.

> **NOTICE!** The type, scope and action of the safety systems were arranged with the operator.

3.3 Interfaces

I/O-INTERFACE (X110)	
Digital inputs	
Level »1«	10 V ...30 V
Level »0«	0 V ...5 V
Input current (I_E)	max. 10 mA
Digital outputs	
Max. current	500 mA
Max. voltage	60 V
Version	
Plug type	PHOENIX-Combicon 2 x 8 pin-connector system coded

BNC-INPUT (X111)	
Analog inputs	
Input voltage	0...10 V
Input resistance (R_{Emin})	9,4 kOhm

RS-232 Interface (X112, X113)	
Baud rate	19200 Baud
Design	
Type	X112: SUB D socket, 9-pin X113: SUB D socket, 9-pin

I/O-Interface on the GRC Card (X118/X119)	
Digital inputs and outputs	
Level »1«	10 V ... 30 V; (4 V ...10 V für 5 V-Logic)
Levell »0«	0 V ... 5 V; (0 V . ..3 V für 5 V-Logic)
Input current (I_E)	Max. 10 mA
Relay outputs	4
Max. current	500 mA
Max. voltage	60 V
Transistor outputs	4
Max. current	1000 mA
Voltage	24 V
Version	
X118	15-pol. SUB-D socket
X119	PHOENIX-Combicon 2 x 8 pin-connected system coded

3.4 Safety precautions (by the operator)

The operator must:

- instruct his **operating and m**aintenance personnel in the use of safeguards of the electron beam evaporator and the evaporation controller
- ensure the safety precautions are being observed including the use of personal protective equipment.
- The owner must ensure that the entry to the hazard area of the machine (into which the evaporation controller has been build in) by unauthorized persons (no operating and maintenance personal) is prevented.

This mounting instruction must be kept in a safe place for future reference. The frequency of inspections and checks must be observed. The work described in this Mounting instruction is explained in such a way that

- in the chapters on operation and modes of operation can be understood by an instructed person and
- those on transport, installation and assembly, maintenance and troubleshooting by a skilled person.

The chapters on transport, installation and assembly, maintenance and troubleshooting are intended for skilled persons only. Work described in these chapters may only be carried out by such skilled persons.

Instructed person — A person familiarised with and, if applicable, trained in his or her particular duties by a skilled person and advised of the risks of improper conduct and about the necessary safeguards and safety precautions.

Skilled person — A person with relevant technical training, know-how, experience and knowledge of applicable standards to enable him or her to assess the work assigned to him or her and to perceive potential risks.

Definitions based on EN 60204-1: 2006.

3.5 Responsibilities of the operator

> **NOTICE!** *In the EEA (European Economic Area) national implementation of the framework directive 89/391/EEC and corresponding individual directives, in particular the directive 2009/104/EEC concerning the minimum safety and health requirements for the use of work equipment by workers at work, as amended, are to be observed and adhered to. In Germany the Plant Safety Ordinance of October 2002 must be observed (translation of the above-mentioned directive into national law).*

The operator must obtain any local operating permits required and observe the provisions contained therein. In addition to this he must observe local laws and regulations on

- personnel safety (accident prevention regulations),
- safety of work materials and tools (safety equipment and maintenance),
- disposal of products (laws on wastes),
- disposal of materials (laws on wastes),
- cleaning (cleaning agents and disposal)
- environmental protection.

In addition, the owner must note:

- A constant hazard evaluation of the workplaces (danger of hands being crushed, danger of stumbling) is to be carried out. The measures are to be defined in work instructions and the working personnel are to be instructed accordingly.
- The supervisors must check compliance with the measures stated in the work instructions.
- Ensure that the operating personnel are suitably trained.
- Work on electrical equipment is only to be carried out by suitably trained persons. The connecting cables and terminals must be properly insulated and covered.
- The switching and safety facilities for setting up, testing, shutting down (including shutting down in an emergency), operation, maintenance, cleaning and servicing are to be installed and verified by the person setting up the entire unit. This includes also lockable main switches and emergency shut off switches.
- The operator must ensure that there is adequate and uniform lighting in all areas of use of the electron beam evaporator. The recommended illumination is 300 Lux (maintenance value; ASR 7/3 applies in Germany).
- The owner must ensure that the operating stations are not affected by waste gases (such as diesel engine exhaust fumes) or a lack of oxygen.
- The workplaces are to be assessed by the owner in accordance with the noise and vibration regulations. Any noisy areas are to be marked, the employees are to be instructed about them and must use hearing protection.
- The owner is required to provide suitable safety measures for protection against fire such as suitable fire extinguishers of the stipulated number and size at easily accessible points and is to instruction his employees about protection against fire.
- The warning notes from the documentation for modules supplied by other companies are to be complied with and integrated into the workplace-related hazard evaluations
- The operator is required to ensure that the evaporation controller is only operated when it is in perfect working order
- Before starting the evaporation controller the operator must ensure that only specifically trained personnel are used for installation and start-up if this work is done by the operator himself and that local rules and laws are followed in the way this is installed.

3.6   Safety inspections and tests

Factory inspections and tests by the manufacturer:
1. Airborne noise measurement according to Machinery Directive, (Position 1.7.4/f)
2. Tests and inspections in terms of DIN EN 60204-1 (Edition 2007)

- Check whether the electrical equipment corresponds to the technical documentation.(chap. 18.1)
- Continuous connection of the protective conductor system (chap. 18.2)
- Insulation resistance tests (chap. 18.3)
- Voltage checks (chap. 18.4)
- Protection against residual voltage (chap. 18.5)
- Function tests (chap. 18.6)

The function of the electrical equipment, especially the safety related parts, has been tested.

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4   General Warnings

4.1   Danger in the operating area

The safety systems and safety instructions described in this handbook must be heeded accordingly. The machine is operated from the control unit in combination with the electron beam evaporator, the C*ARRERA* – high voltage power supply and the overall plant. The danger zone of the control unit is defined by the danger zone of the overall plant in which this control unit is integrated.

> *N O T I C E !* Keep the danger zone around the machine free of objects. Lay cables in such a way that they cannot be tripped over. The operator must ensure that access to the danger zones by unauthorized persons is prevented.

> *D A N G E R !* Pay attention to the danger of electric shock when carrying out adjustment, maintenance and repair work! Before touching the electron beam evaporator, discharge it with the grounding rod.

> *D A N G E R !* Pay attention to the dangers from magnetism when using and handling the electron beam evaporator. People with cardiac pacemakers (and with insulin pumps and people with active or passive prostheses and ferromagnetic or conductive foreign bodies) must keep clear of the electron beam evaporator! The limits of how close they may approach the machine must be clearly marked.

4.2   Operating Areas and Danger Zones at the Machines

The operating area is defined by the operator (overall plant). The danger zone during adjustment and maintenance work is the immediate area around the high voltage power supply.

> *W A R N I N G !* The danger zone during adjustment, maintenance and repair work extends 1 m around the electron beam evaporator. The area needed to open the switch cabinet doors must be taken into account. Keep the danger zone around the machine free of objects. Lay cables in such a way that they cannot be tripped over! The operator must ensure that access to the danger zones by unauthorised persons is prevented.

The danger zones may only be entered for cleaning, maintenance and repair work by skilled personnel under compliance with applicable safety regulations.

4.2.1   Operating and Maintenance Personnel

The operating and maintenance personnel are those people responsible for the transport, assembly, installation, operation, adjustment and cleaning of the machine as well as for troubleshooting.

1. The machine may only be operated by trained and authorized personnel.
2. The different responsibilities in the operation of the machine must be clearly defined and observed so that no confusion with respect to responsibilities arises, thus endangering safety.
3. Whenever any work (operation, maintenance, repair, etc.) is carried out, the shutdown procedure specified in this Mounting instruction must be followed.
4. The operating personnel may not apply any working methods that impair the safety of the machine.
5. The operating personnel are co-responsible for ensuring that no unauthorized person works with or on the machine.
6. The operating personnel must immediately report any changes in the machine that impair its safety to the responsible executive.

4.3 Spare and wearing parts

Spare parts and accessories that have not been supplied by us have also not been tested and approved by us. The fitting and/or use of such products could therefore negatively affect the design characteristics of your machine. Ferrotec GmbH accepts no liability for damages arising from the use of non-original parts and non-original accessories.

> **DANGER!** *Fundamentally speaking, it is forbidden to make any repairs within the unit.*
> *Danger: high voltage!*

4.4 Shutdown Procedures

> **NOTICE!** *The shut down procedure may only be initiated by skilled personnel according to the definition in DIN EN 60 204.*

> **DANGER!** *The following procedure for switching off is to be followed without fail before carrying out any cleaning, repair or maintenance work*

1. *Switch off the unit:*

2. *Switch off the high voltage unit with the HV-off button at Genius hand remote.*

3. *Turn off the On/Off switch located in the back of the Genius (X101).*

4. *Turn off the On/Off mains device switch at the front of the high voltage power supply.*

5. *Switch off the main circuit breaker at the back of the high voltage power supply*

6. *Pull out the mains plugs at the controll device Genius X101, the filament power supply FPS X201 and the high voltage power supply HVP X301.*

7. *Wait for at least 3 minutes before starting work on the electrical equipment. The capacitors must discharge themselves*

For maintenance and repair ensure that nothing is still electrically live. Use an earthing rod to earth all the high-voltage feedthroughs. Close the door of the electrical cabinet during cleaning to ensure no dust or water can enter into the cabinet.

5   Installation

5.1   Scope of delivery
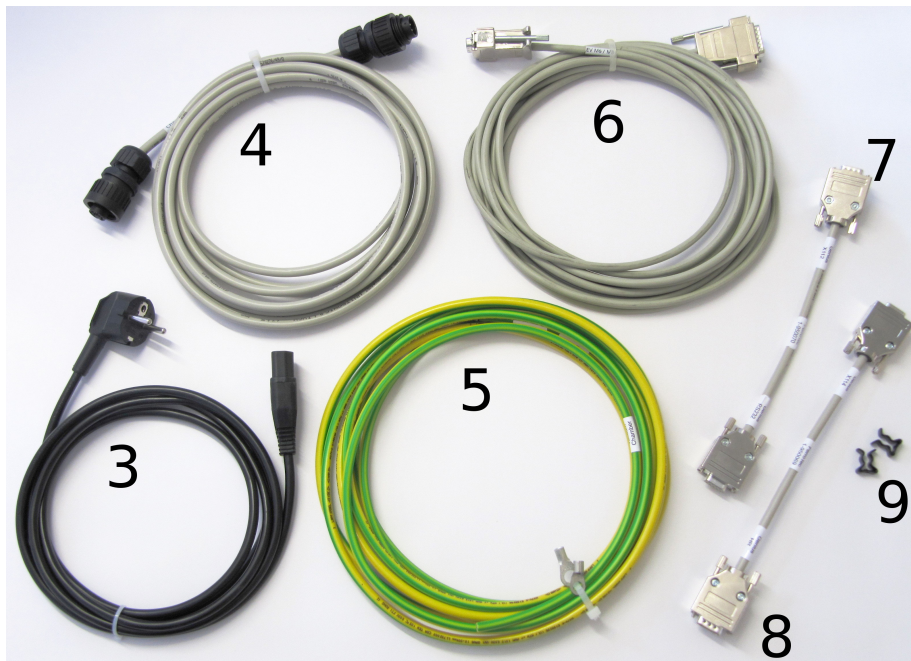

Fig. 2: Scope of delivery, GENIUS and hand remote

Fig. 3: Scope of delivery

The scope of delivery includes:

1. Evaporation controller GENIUS including hand remote (Fig. 2)
2. Mounting instruction (No picture)
3. Mains power cord P/N. 1-950024 (type of plug depends on customer specification)
4. Magnet-connection cable P/N. 1-950003
5. Ground cable P/N. 1-950001
6. EVM type drive cable for evaporator 1-950054 (multi pocket evaporator)
7. Link cable for RS-232
8. Hand remote front panel link cable
9. Mounting parts for hand remote

5.2   Transport and packaging

Machines, devices and other equipment from Ferrotec GmbH are carefully inspected and packed before shipment. In case the delivered goods are damaged or defective upon receipt a proper notice of defects must be initiated to assure proper protection of your interests.

NOTICE! *The packaging material is to be suitable to meet the requirements for safe transport of the Evaporation controller Genius. It is therefore recommended that you keep the packaging material for a possible move of the Evaporation controller Genius or if it needs to be sent in for maintenance purposes.*

5.2.1   Delivery (also for Spare and replacement parts)

Reiceiving Inspection

- Check the shipment against the packing list to ensure that it is complete!

If the Packaging is damaged

- Check the shipment itself for damage (visual inspection)!

Complains

If the shipment was damaged during transit:

- Immediately contact the last carrier!
- Keep the packaging material (for possible inspection or return shipment)

Packaging for return shipment

Use the original packaging material as far as possible. If it is no longer available

- Use the services of a packaging company with suitably competent personnel.
- If you have any questions on packing and transport, please contact Ferrotec GmbH

NOTICE! *The packaging material is to be suitable to meet the requirements for safe transport of the Evaporation controller Genius. It is therefore recommended that you keep the packaging material for a possible move of the Evaporation controller Genius or if it needs to be sent in for maintenance purposes. If the device is sent back to us in any other packaging than the original packaging, the consignor is responsible for all transport damage caused through the use of improper packaging. Proper packaging is not only the original packaging, but also other packaging appropriate for preventing damage to the device.*

5.3   Intermediate Storage

The freight packaging of the Evaporation controller Genius and spare and replacement parts is designed for a storage period of three months from delivery.

Storage conditions: Closed and dry room with a room temperature of -10° C to + 35° C.
The relative humidity allowed is max. 80% (not condensing)

5.4   Transportation to the point of Installation (by the Operator)

After unpacking of the Evaporation controller Genius, transport it to the intended place of installation.

NOTICE! *The weight of the Evaporation controller Genius is approx. 7 kg.*

The device is equipped with two handles in the front for holding purposes.

5.5   Assembly, Installation, Initial start up.

Assembly and initial start-up must be carried out by skilled personnel from Ferrotec GmbH or the customer's skilled personnel who have been especially trained for this work. Consult the Mounting instruction and technical reference material supplied for assembly and install-ation of the Evaporation controller GENIUS.

> **DANGER!** *The electrical installation of the Evaporation controller GENIUS must be carried out only by trained, skilled personnel.*

5.5.1   Assembly

- The Evaporation controller GENIUS is designed for a mounting rack (19"-Rack).
- The device is equipped with 2 handles on the front for holding purposes.
- Make sure the rack is set up so that the operation of the evaporation controller by remote control of the evaporation controller is possible with simultaneous visual con-tact with the evaporator in the vacuum chamber.
- Free access to the remote control must be guaranteed.

5.5.2   Electrical connection

Connection requirements

- Only use the connection cables delivered with the evaporation controller.
- The standard cable connection between GENIUS and FPS ist 5 m long, that between GENIUS and HVP 2,5 m.
- The remote control is connected to the evaporation controller with a 2,5 m long cable.
- Make sure the protective ground is connected as prescribed. The cable is 5 m long; it might have to be shortened (do not lay in loops).
- Make sure there is a protective fault current circuit.
- Integrate the evaporation controller into the emergency-stop system of the overall system.

> **DANGER!** *Please, note that before the connection of the evaporation controller to the mains voltage is made the complete cabling of the vacuum system, the electron beam evaporator, the filament power supply and the Genius control unit must be installed.*
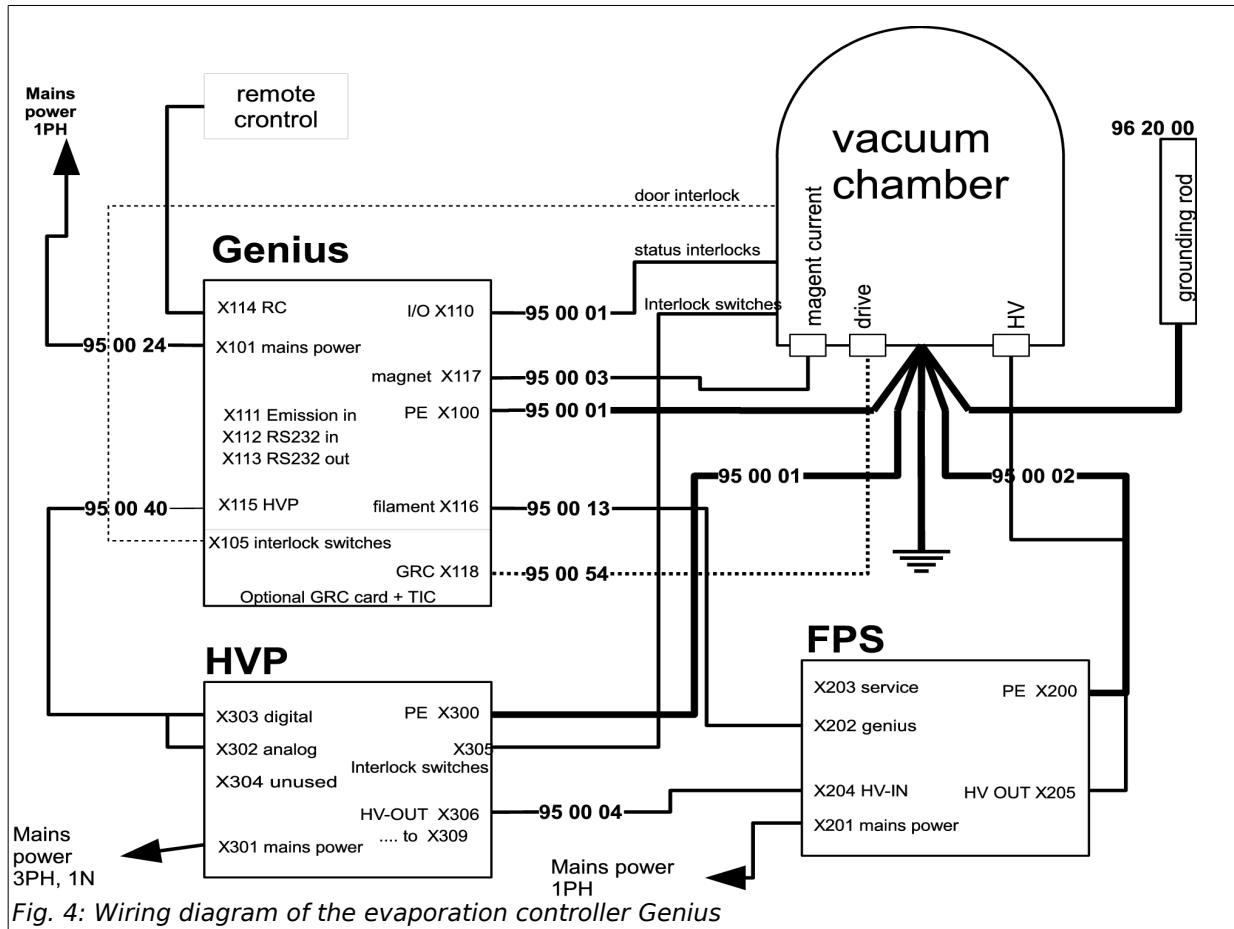
5.5.2.1 Wiring diagram

In Fig. 5-2 a typical standard wiring is shown for a vacuum system including a a electron beam evaporator.

> **NOTICE!** *On special versions the wiring diagram attached in the Appendix is valid in these case of these designs.*

The wiring diagram contains all connections. The plugs are marked with X...; you will find this marking on the devices as well. The marking of the cables is 95 .. .. At the same time these are part numbers for ordering spare parts.

Fig. 4: Wiring diagram of the evaporation controller Genius

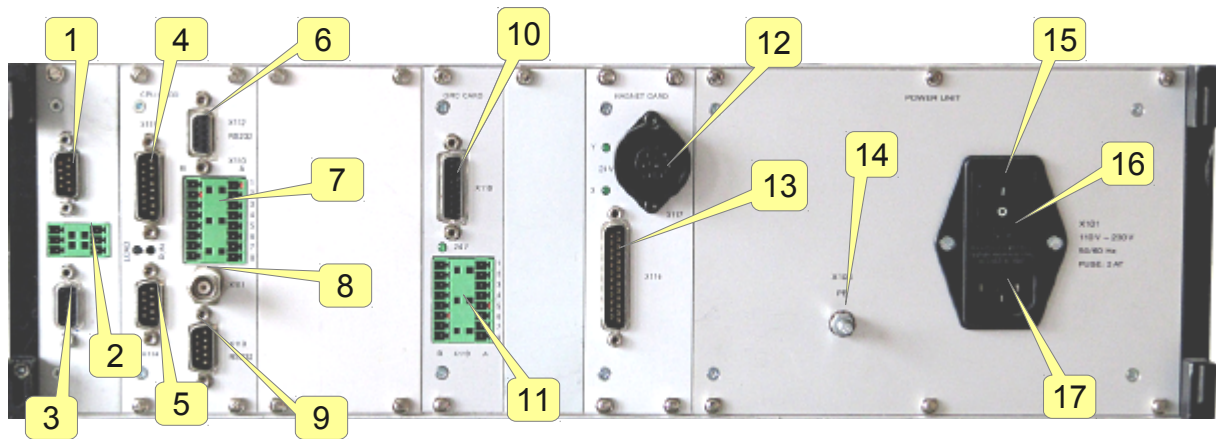### 5.5.2.2 Overview of electrical connections (back side)

Fig. 5: Rear view of evaporation controller

On the back side of the evaporation controller GENIUS-housing are the following connections:

1. **X103** RS-232 interface (patched to front side connector)
2. Safety interlock for crucible rotation **X105**
3. Connection for remote control **X102** (patched to front side connector)
4. SUB-D connector **X115** for connection to HVP
5. Connection for remote control **X114**
6. RS-232 Interface (Master) **X112**
7. PHOENIX-connector for I/O- data cable **X110**
8. BNC-connector for deposition controller **X111**
9. RS-232 Interface (Slave) **X113**
10. Connector **X118** for motor actuation of a multi pocket
11. PHOENIX-connector **X119** for I/O- data cable (GRC Card)
12. Control cable to magnet leadthrough **X117** for connection of the deflector coils X and Y
13. SUB-D Connector **X116** for connection to FPS
14. Ground stud **X100**
15. On / Off switch for mains power supply
16. Mains fuse
17. Mains connection **X101**

Fig. 6: Front view of the evaporation controller

5.5.2.3 Overview of the elements of the front view

1. Evaporation controller
2. Hand remote, removable
3. Transport handles
4. Connector connected to **X103** on the back side
5. Connector connected to **X102** on the back side

5.5.2.4 Connection of the evaporation controller

Connect the evaporation controller according to the connection plan:

The following connectors need to be connected:

1. Grounding to **X100**
2. Safety interlocks to **X110**
3. Control cable to magnet feed through to **X117**
4. Hand remote to **X114**
5. Emission set point input **X111**
6. Mains to **X101**
7. **X105** in combination with a GRC card

5.5.3   Grounding cable

1. Connect the grounding stud **X100** of the evaporation controller to the grounding rail of the vacuum system.
2. For this purpose use a cable with cable lugs, green/yellow wire sheathing and the cross-section of 10 mm^2. The grounding lead need to be connected the shortest way to the vacuum chamber. No coils are allowed. Shorten the cable accordingly.
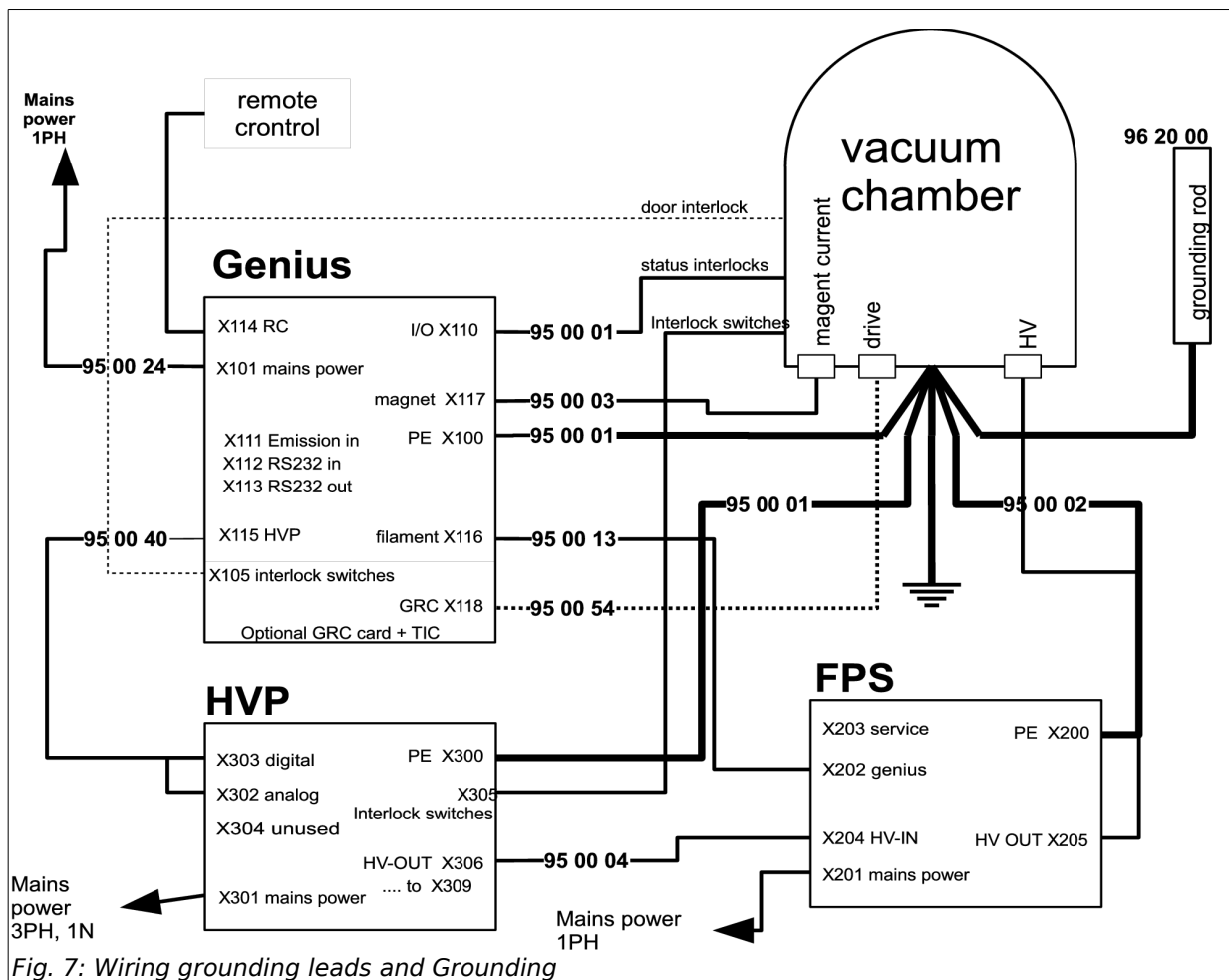

Fig. 7: Wiring grounding leads and Grounding

The wiring of the grounding leads for the grounding is shown in Fig. 7.

> **DANGER!** *Be reminded that all grounding leads are connected to one terminal directly at the vacuum chamber. Improper installation of the grounding may lead to destruction of the system. Damages due to improper installation are not covered by the warranty.*

5.5.4   Control line

The control cables connect the evaporation controller G$_{ENIUS}$ to the individual devices. Connect the devices in accordance with the overview of the electrical connections (Fig. 5: Rear

view of evaporation controller Page 22) and the connection plan C*ARRERA*-System (Fig. 4: Wiring diagram of the evaporation controller Genius Page 22).

> ⚠ **D A N G E R !** *If the evaporation controller is being connected to the high voltage power supply C*ARRERA* the connection plan for the evaporation controller G*ENIUS* is to be used. The interlock connection **X305** must then be connected directly to the safety switches of the system, while only the status of the interlocks is connected via the contacts on **X110.**

Check the connection cable for the remote control. The connection is located on the back of the evaporation controller. Further information on the connections is to be found in chapter 3.3, Interfaces page 14.

5.5.5   Power supply cable

The power supply cable connects the evaporation controller to the mains power supply. Plug the power supply cable into the mains connection on the evaporation controller.

> **N O T I C E !** *The plugs are **not** confusion-safe, plugs may fit into sockets they are not provided for.* ⓘ

6   Functional description, Variants

6.1   Functional description

The functional elements on the front and rear side of the G*ENIUS* are described in chapter 5.5.2.2 on page 22.

6.1.1   Function

The evaporation controller is responsible for the control of the high voltage power supply, electron beam evaporator and filament power supply. The high voltage and emission current are set with the evaporation controller. The evaporation controller also monitors the evaporation processes in the vacuum system. Data interchange between the evaporation controller and the individual devices is effected along the control cables. All the operating elements are arranged on the remote control of the evaporation controller. Faults are indicated in the LCD display of the remote control together with the fault number and a description of the fault.

The evaporation controller is designed for mounting in a 19" rack cubicle. All the settings for manual operation are made with the remote control. The remote control can be fastened to the evaporation controller with the hook on the front panel. It can be taken off the evaporation controller when needed (see Fig. 6). It is connected to the evaporation controller by a connection cable.

> **N O T I C E !** *For a complete overview of the mode of operation of the evaporation controller, please see the operating manuals for the high voltage power supply HVP and filament power supply FPS in combination with the electron beam evaporator and vacuum system.* ⓘ

6.2 Variants, Optional extras

6.2.1 Variants

The evaporation controller is available in the variants G_ENIUS and G_ENIUS P_RO. The variants only differ in their internal control programs (firmware). The G_ENIUS P_RO-Version has additional menu functions.

G_ENIUS   Standard version of the evaporation controller.
G_ENIUS P_RO   Evaporation controller with extended sweep functionality.

6.2.2 Options

The evaporation controller G_ENIUS can come with the following options.

6.2.2.1 I/O-Interface Card Gun Rotation Card– GRC Card

6.2.2.1.1. Gun Rotation Card

The gun rotation card GRC serves with the interface **X118** to control the drive of multi-pocket evaporators.

6.2.2.1.2. Digital I/O ports (I/Os)

The GRC card has with the **X119** Interface additional freely programmable digital in- and outputs for connection to rate controllers or other control components.

6.2.2.1.3. Safety Interlock for the rotation of the crucible

The safety interlock for the Gun Rotation Card is supplied for a safe integration into the overall control system of the rotation of the crucible when the vacuum chamber is open.

6.2.2.2 Filament Switch Card - FSC

6.2.2.2.1. Evaporator switchover

The filament switch card FSC serves to control two evaporators in sequential operation of a evaporation controller. One evaporator is controlled by the emission control, while the other can be operated in rest mode. Two FSC cards can be combined for alternating operation of three evaporators.

7 Operation

> ⚠️ **WARNING!** *The evaporation controller may only be operated by trained personnel.* ⚠️

7.1 Commissioning

The commissioning of the evaporation controller is together with the commissioning of the overall deposition system. The components of the overall deposition system:

- Evaporation controller (G_ENIUS)
- High voltage power supply (HVP)
- Filament power supply(FPS)
- Vacuum system
- Electron beam evaporator

must be completely set up and connected before commissioning begins. Carry out the following inspections as part of commissioning:

1. Check
   - the ground connections
   - the power supply cable,
   - the control cables and
   - the high voltage cable

   for correct cabling and firm connection.
2. Check the safety circuit.
3. Check the emergency-stop system.

> **DANGER!** *If the evaporation controller GENIUS is being operated via an external control system, it is possible that there is already a high voltage at the output of the HVP when the mains power is switched on if the system is set on automatic operation.*

> **DANGER!** *Depending on the magnet current setting selected, a current of up to +/- 3A can already exist at the magnet current output **X117** when the mains power has been switched on. Pay attention to the specifications of the magnet coils and limit the output current in the menu "Set Data-Limits" if necessary before connecting the output **X117***.

7.2   General operation

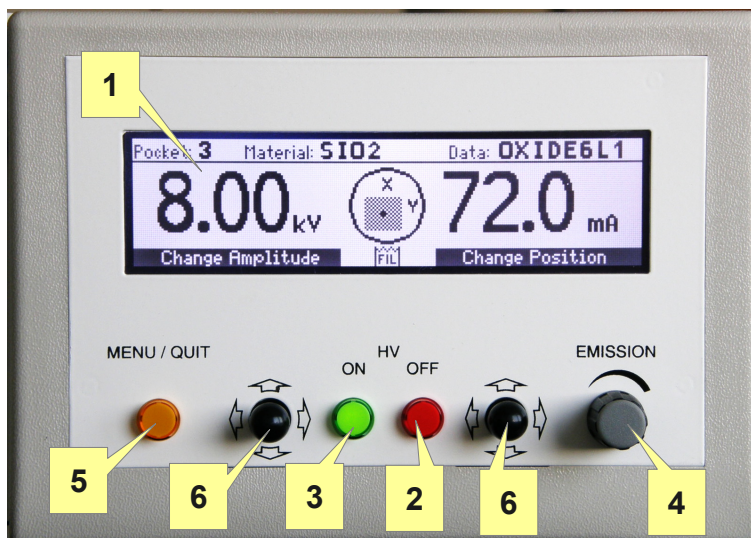### 7.2.1   Operating – and display elements

Fig. 8: LCD-remote control

The remote control is fastened to a hook on the front panel of the evaporation controller. It can be taken off the evaporation controller when needed.

1. **LCD-Display:** The LCD display serves to display all the information for operation of an electron beam evaporator. The different display modes are explained on the basis of photos in chapter 7.9.
2. **HV OFF button** (red illuminated): Switches off the high voltage when pressed. The button then lights up.
3. **HV ON button** (green illuminated): Switches on the high voltage when pressed. The button then blinks.
4. **EMISSION potentiometer**: The set point for the emission current is set by turning the potentiometer.
5. **Menu/Quit** button (yellow illuminated): Switches the menu functions on or off when pressed. Warnings or error messages in the status line are also cleared with this button.
6. **Joysticks:** The two digital joysticks are used to control the menu, enter data and vary the magnet current parameters. The respective function is shown in the bottom status line of the LCD display.

7.2.1.1 LCD-Display

The actively illuminated LCD display serves to display actual values, adjustable set points and error messages. The parameters for the evaporation process are accessed by way of a menu structure. The display is subdivided into different sections.

7.2.1.1.1.   Sweep Display

The sweep display symbolizes the sweep area of the electron beam on the active pocket by a grid area.

7.2.1.1.2.   Top status line

The parameters for pocket number, material name and data set name are shown constantly in the top status line. In menu mode the actual values for high voltage and emission current are also shown.

7.2.1.1.3.   Bottom status line

The function of the joysticks or in the event of a fault or warning the corresponding message is shown in the bottom status line
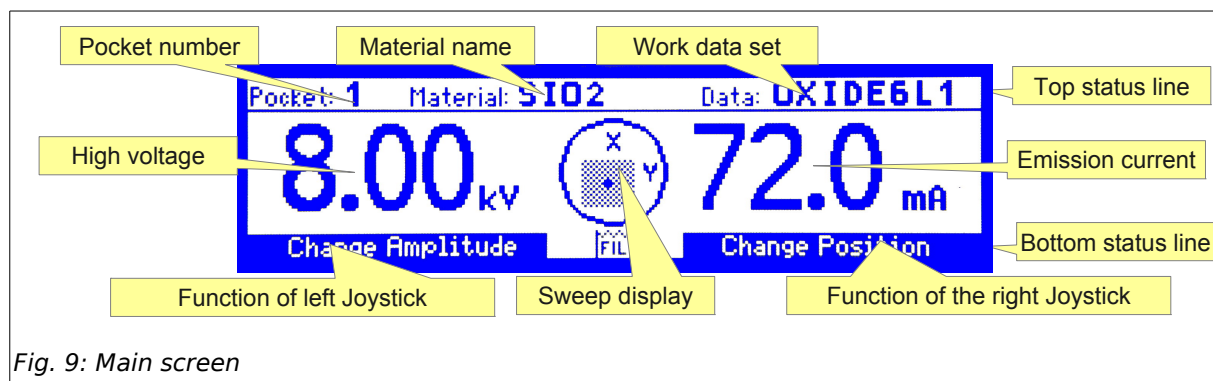

Fig. 9: Main screen

7.2.1.1.4.   Menu screen

The menu section shows a part of the menu structure. The selected menu point is displayed inversely. The menu points are selected with the left joystick.

7.2.1.1.5.   Data section

The data section shows the data for the selected menu point. It is changed with the right joystick.

7.2.1.1.6.   Work data set

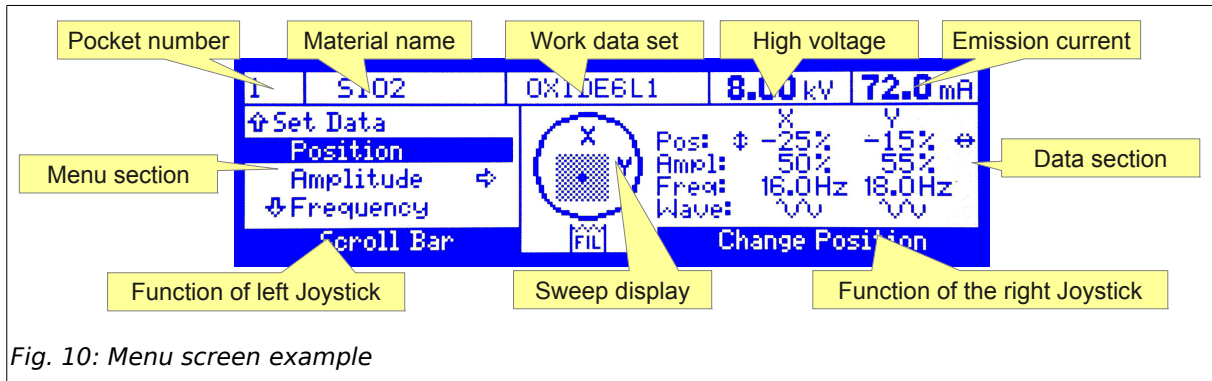The work data set is a working copy of the selected data set.

Fig. 10: Menu screen example

7.2.2 Control program

7.2.2.1 Firmware

The evaporation controller is controlled by an internal program (FIRMWARE) stored in a Flash-EPROM. This program can be updated via a computer connected to the module. The stored process data can be transferred. When it is switched on, the evaporation controller takes over all the settings as they were before it was last switched off. The settings can be changed when the evaporation controller is on by way of the remote control or interfaces. When it is switched off, the active settings are stored in a battery buffered RAM. The actual version of the firmware is displayed in a welcome screen for about three seconds when the evaporation controller is switched on.

7.2.2.2 Welcome screen

7.3 Setup

> **NOTICE!** *Setup of the system is described in the mounting instruction for the electron beam evaporator.*
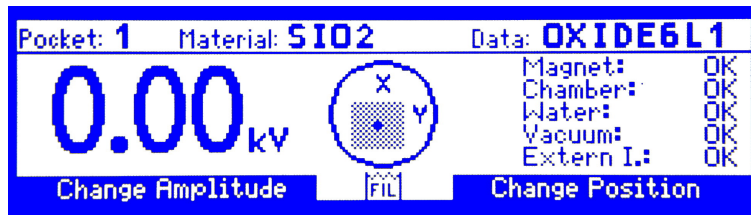
7.4 Switching on
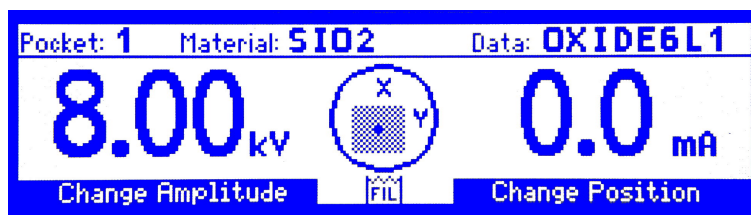
Switch on the system as follows::

> **NOTICE!** *The LCD display only attains its operating brightness and greatest reading angle after about 5 minutes. The functions are not impaired in any way in this time.*

1. Switch on the on/off switch on the back of the evaporation controller.
2. Switch on the on/off switch **MAIN** on the HVP.
3. Check that the green LED **INTERLOCK** (Safety switch) on the high voltage power supply is on.
4. Check on the remote control that the status for all interlocks is **OK**.

Press the green button **HV ON** on the remote control to switch on the high voltage. It blinks when the high voltage is on and the high voltage setting is shown. An emission current does not flow.

> *NOTICE!* Consider the operation manuals of the components of the overall system.

7.5 Switching off

Switch off the system as follows:
1. Switch off the high voltage by pressing the button **HV-OFF** on the remote control. The **HV-OFF** button lights up.
2. Switch off the mains power supply with the on/off switch on the back of the evaporation controller.

> *NOTICE!* Consider the operating manuals of the components of the overall system.

> *DANGER!* Ground the electron beam evaporator with the grounding rod, before touching it to discharge any charges that might have built up.

7.6 Data structure

All data is stored in the structure illustrated in Fig. 11

```
                    Process
              Pocket1   <= Data set A
                         Position      High voltage
                         Amplitude     Emission limit
                         Frequency     Emission sensitivity
                         Waveform      ...
                         Limits
              Pocket1A <= Data set A
                         Position      High voltage
                         Amplitude     Emission limit
                         Frequency     Emission sensitivity
                         Waveform      ...
                         Limits
```

Fig. 11 Data structure

7.6.1 Data definitions

Data set A data set is subdivided into the parameters listed in the menu point "Set Data". They include all magnet current parameters (position, amplitude, etc.), the high voltage set point and the emission limit. Depending on the firmware version installed, the data set contains other parameters like, for example, settings for arc management. Up to 99 data sets can be stored in the evaporation controller.

Pocket The pockets are marked by a pocket number and a pocket letter.

Real Pocket A distinction is drawn between real and virtual pockets. Real pocket designates the evaporator pocket. To simplify identification of the evaporator pocket, a material name is used as remark.

Virtual Pocket This configuration allows the data set and thus the evaporation parameters to be changed without a change of pockets. The same applies to external control by a deposition gauge or process control system that controls the selection of pockets. If such a device supports the selection of more evaporator pockets than actually available, virtual pockets can then also be selected with the evaporation controller GENIUS.

> **NOTICE!** *Virtual pockets are treated in the data structure like real pockets. An evaporator pocket can therefore be allocated several data sets.*

Process A process defines the allocation of pockets and data sets. Every pocket (real and virtual) can be allocated a data set from the total of data sets stored in the module. A process therefore corresponds to a certain configuration of the pocket with materials. Up to 20 processes, each consisting of a maximum of 64 data sets, can be stored in the evaporation controller.

> **NOTICE!** *A process only contains the links to data sets but not the data set itself. Thus any modification of a data set will influence all processes which contain links to this data set.*

System data The system data contains information on the type of evaporator installed in the vacuum system (number of pockets, type of pocket, filament adjustment, etc.) and on the equipment of the

high voltage system (type of device, additional cards, etc.). Besides this, the system constants like water off times allow adjustment of the evaporation controller to the overall system.

Work data set   The work data set is a working copy of the selected data set. A change, which is indicated by a **?** behind the data set name, does not have an effect on the original stored in the module until it is overwritten by saving in the "SAVE/LOAD" menu.

7.7   Main screen operation

In addition to controlling the emission current, the main screen can also be used to change the deflection of the electron beam in position and amplitude with the joysticks. The sweep display then gives an indication of the sweep area on the active pocket. The main screen is accessed by switching on the high voltage with the **HV ON** button. The high voltage set point is stored in the active data set.

> *NOTICE!* *The emission current is automatically reset to 0 mA every time the high voltage is switched on to avoid uncontrolled evaporation.*

Setting of the emission current

The emission current is controlled with the digital potentiometer **Emission**. The electron beam must be observed during setting. If the electron beam cannot be seen in the pocket, check the setting for magnet current LIMITS.

7.7.1   Setting of the magnet current

7.7.1.1 Position

The position of the magnet current is defined by specifying the magnet currents for x-deflection and y-deflection. The position value is formed by the center around which the magnet current can be deflected (offset value).

7.7.1.2 Amplitude

The amplitude of the magnet current defines the extend of deflection of the electron beam around the position value.
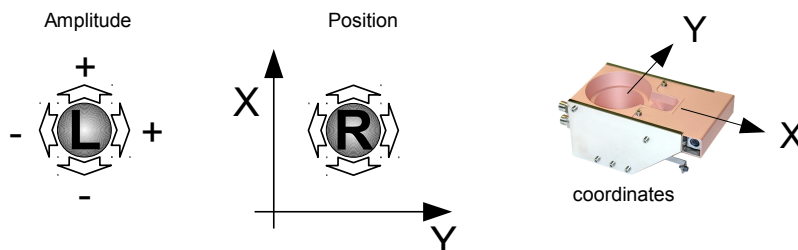
7.7.1.3 Joystick function

Fig. 12: Joystick functions magnet current

Fig. 12 shows the function of the right Joystick **R** and the left Joystick **L**. The change in magnet current deflection can be observed in the sweep display.

> **NOTICE!** *The magnet current regulator limits the deflection of the electron beam to the permissible sweep area defined by the magnet current LIMITS. The amplitude and position can therefore only be changed within the given limits.*

If the magnet current position is outside the center of the sweep area, the position is moved to the center when trying to set the amplitude exceeding the limits. The maximum permissible amplitude for x and y-magnet current deflection can be set in this way.

7.8 Menu operation

7.8.1 General operation

The menu functions are switched on and off with the button **Menu/Quit**. The button lights up when **Menu** operation is active The left Joystick **L** is used to select menu points, the right Joystick **R** to change the corresponding data.
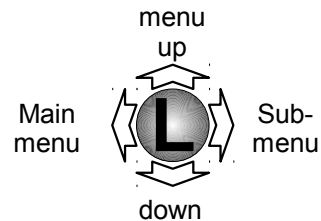

Abb. 13: Joystick links

7.8.1.1 Menu control - Left Joystick L

The active menu point is displayed inversely. The movement of the Joystick **L** corresponds to the direction in the menu structure: One moves to menu points up or down in the menu structure by moving the joystick up or down. If there is no upper menu point available in the selected level, a press of the joystick up also moves the user to the next higher menu point, which is shown at the top left edge of the menu section.

The character ⇨ shown with an inversely displayed menu point indicates that there is a sub menu to this point, which is then selected by pressing the Joystick L to the right. Pressing the Joystick L to the left moves the user to the next higher menu. The characters ⇧ and ⇩ in the LCD display indicate that there are further menu points in the selected level that are not being displayed. To return directly to the main screen simply press the button **Menu/Quit.**

7.8.1.2 Jump function

The button **Menu/Quit** can also be used to jump directly from the main screen to the last menu point activated. For this the button must be pressed for longer than one second. This enables quick changing between the main screen and widely branched menu points.

7.8.1.3 Menu control - right Joystick R

The right Joystick **R** is used to change the data assigned to the active menu point. The function of the Joystick is displayed in the lower status line.

Pressing the Joystick up increases the shown value, pressing the Joystick down decreases the shown value. For the parameters (position, amplitude, frequency, waveform and limits) of the magnet this assignment is for the x-values only. The y- values are changed by pressing the Joystick to the right (increase of the values) of by pressing the Joystick to the left (decrease of the values). The Joystick function is indicated by the symbol ⇔ for the y-value changes and by the symbol ⇕ for the x–value changes. The step width of the changes of the values is stored in the Menu **Options** / **Step** and can be changed there.
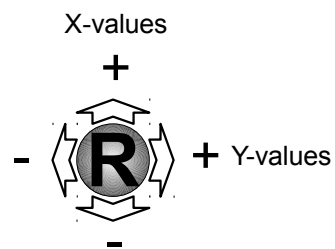

Abb. 14: Right Joystick

NOTICE! *Apart of functions in the „SAVE/LOAD" menu all data of the working data set is immediately set without further request.*

Any change of the working data set versus the stored parameters is displayed by a »**?**« behind the working data set.
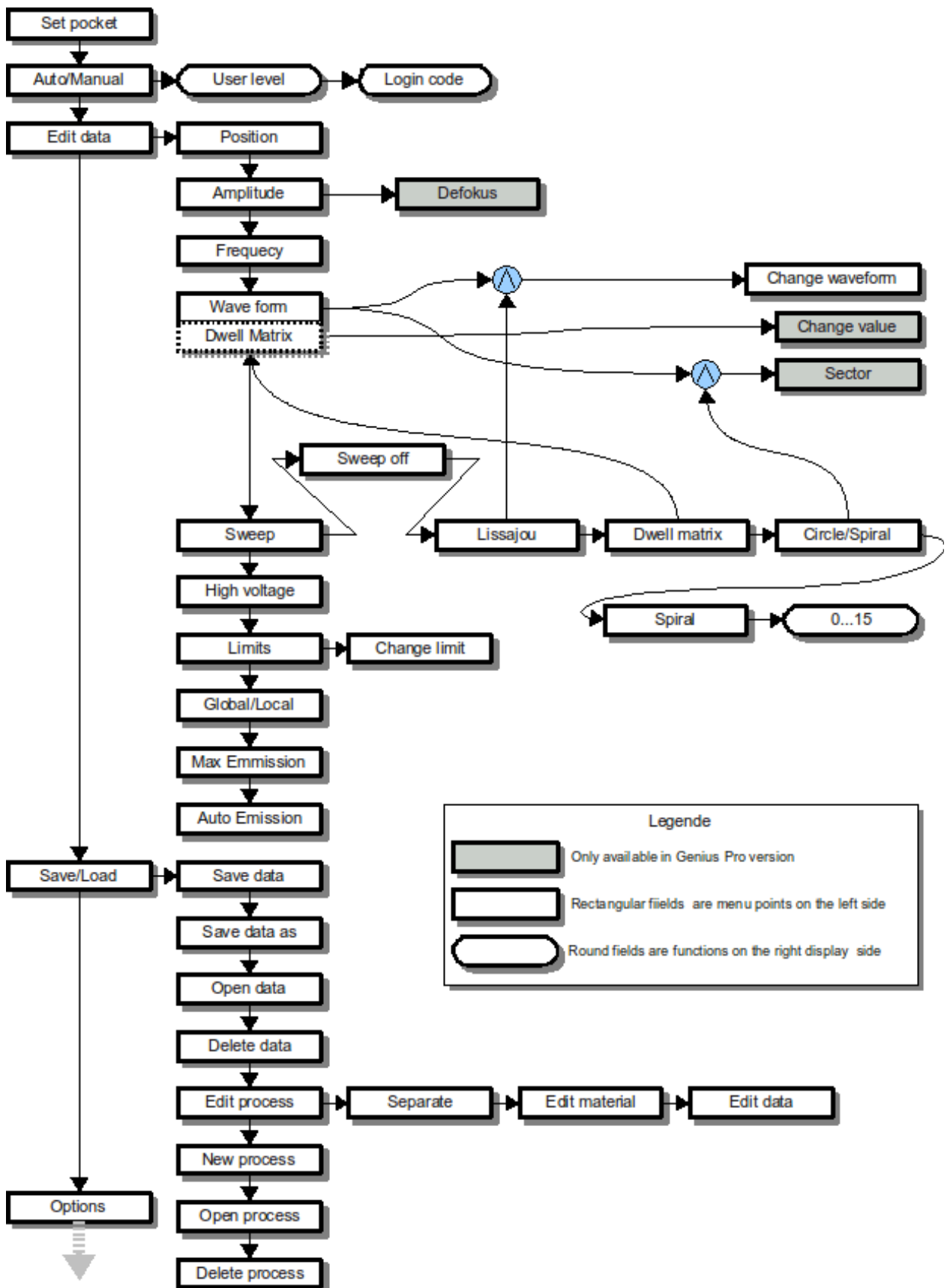
7.9   Menu structure
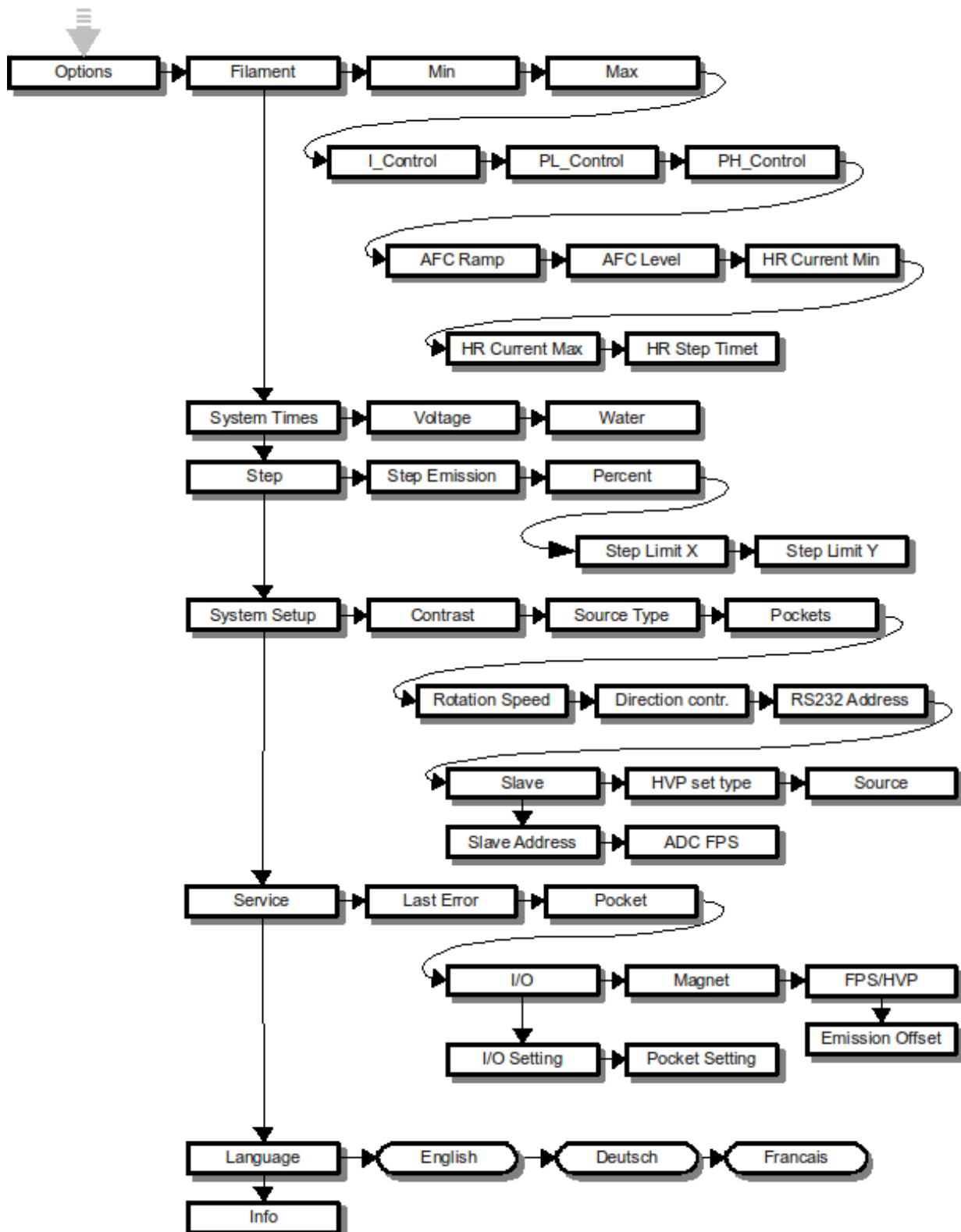

Fig. 15: Menu structure Genius (1 of 2)

Fig. 16: Menu structure Genius (2 of 2)

Operation of the evaporation controller by remote control is menu driven. The menu structure for manual operation is shown in figure Fig. 15. Depending on the mode of operation and the active user level, some sub menus are not available.

The description of the menu functions which are only accessible in the user level **Service** or in version *GENIUS PRO* (gray shaded sub menus) is continued in the appendix.

7.9.1   Set pocket

The main menu **Set pocket** is used to select the evaporator pocket. The active pocket (No.1; SIO2) is highlighted in the data section. A new pocket, which can have a different data set, is selected using the right joystick. The triangular markers at the edge of the data section serve as selection pointers. The selected pocket is activated by manipulating the right joystick to the right.

```
┌─────────────────────────────────────────────────────┐
│ 1 │   SIO2   │ OXIDE6L1 │ 8.00 kV │ 0.0 mA           │
│ ┌───────────────────┐ POCKET:  MATERIAL:  DATA:      │
│ │ Set Pocket        │ ▶ 1      SIO2       OXIDE6L1 ◀ │
│ │ Auto / Manual     │   2      AL         META1OZ1   │
│ │ Set Data        ⇨ │   3      SIO2       OXIDE6L1   │
│ │ ⇩Save / Load    ⇨ │   4      AL         METAL8Z1   │
│ └───────────────────┘                                │
│     Scroll Bar              ⬍ Select  ⇨ Set          │
└─────────────────────────────────────────────────────┘
```

> ☞ **NOTICE!** *In the case of single-pocket evaporators data sets can also be changed by selecting virtual pockets.* 🛈

The message **–SEARCH–** is displayed in the top status line during the evaporator position search run. The emission current is reset to 0 mA.

```
┌─────────────────────────────────────────────────────┐
│ 3 │  –SEARCH– │ OXIDE6L1 │ 0.00 kV │ 0.0 mA          │
│ ┌───────────────────┐ POCKET:  MATERIAL:  DATA:      │
│ │ Set Pocket        │   1      SIO2       OXIDE6L1   │
│ │ Auto / Manual     │   2      AL         META1OZ1   │
│ │ Set Data        ⇨ │ ▶ 3      SIO2       OXIDE6L1 ◀ │
│ │ ⇩Save / Load    ⇨ │   4      AL         METAL8Z1   │
│ └───────────────────┘                                │
│     Scroll Bar              ⬍ Select  ⇨ Set          │
└─────────────────────────────────────────────────────┘
```

When the position has been found the new pocket and corresponding data set are shown.

```
┌─────────────────────────────────────────────────────┐
│ 3 │   SIO2   │ OXIDE6L1 │ 0.00 kV │ 0.0 mA           │
│ ┌───────────────────┐ POCKET:  MATERIAL:  DATA:      │
│ │ Set Pocket        │   1      SIO2       OXIDE6L1   │
│ │ Auto / Manual     │   2      AL         META1OZ1   │
│ │ Set Data        ⇨ │ ▶ 3      SIO2       OXIDE6L1 ◀ │
│ │ ⇩Save / Load    ⇨ │   4      AL         METAL8Z1   │
│ └───────────────────┘                                │
│     Scroll Bar              ⬍ Select  ⇨ Set          │
└─────────────────────────────────────────────────────┘
```

> ☞ **NOTICE!** *If the work data set differs from the data set stored in the process, the stored data set is not shown inversely in the data section.* 🛈

7.9.2   Auto/Manual – Change of Operation Mode and User Level

In the main menu **Auto/Manual** is used to change the mode of operation and the User Level. In **Manual Operation** the emission current is controlled exclusively by the emission regulator on the LCD remote control. In **Automatic Operation** a rate controller can take over automatic control via the BNC input **X111**. The emission regulator then no longer has an influence.

Depending of the Mode of Operation access to the menu items is limited. Starting from Firmware Version 1.2 three user levels are available:
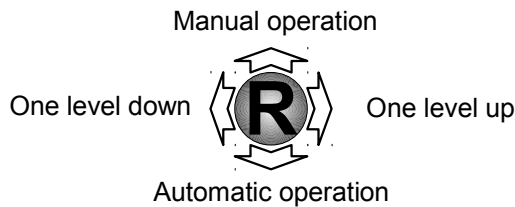
7.9.2.1 Operator (lowest Level)

Access only to menus **Auto/Manual** and **Set pocket**. This user level is to be set for standardized production processes. The modification of process parameters is disabled.

7.9.2.2 Standard

Extended access to menu functions **Data change**, **Save** and **Options**. Access to the **Options** menu is restricted. This user level is to be set for changing evaporation conditions. All evaporation parameters can be modified.

7.9.2.3 Service (highest level)

Manual operation

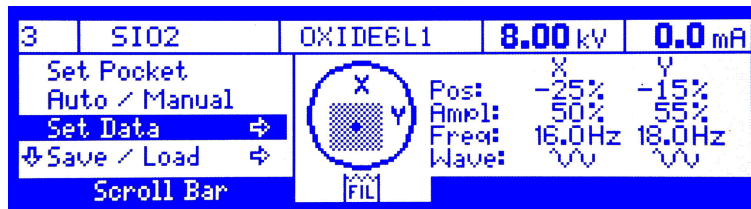One level down   One level up

Automatic operation

Unrestricted access to all menus. This user level is to be set only for system configuration and service. Additionally to the **Standard** level this level enables the modification of system parameters.

The change into a higher level requires a 4 digitcode. After login the referring user level is activated. The factory preset code is listed in the appendix. The code can be changed via the RS232 interface.

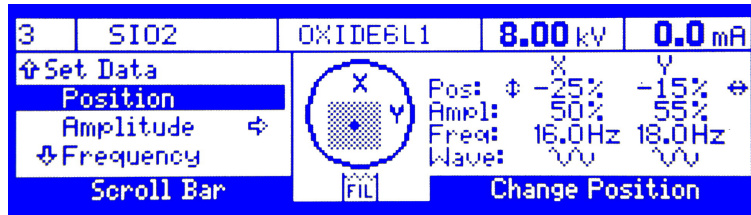## 7.9.3   Set data - Setting of evaporation parameters

The main menu **Set data** is used to set and display the evaporation parameters. All evaporation parameters refer to the active data set (work data set) and can thus be stored separately for every pocket.

The position, amplitude, frequency and basic waveform for magnet current deflection in x and y-directions are displayed in the data section. The evaporation parameters of the active data set (work data set) shown in the top status line can be changed in the sub menus to **Set data**. The sub menus are selected by pressing the left joystick **L** to the right.

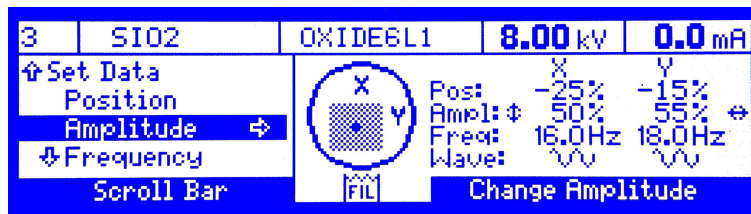### 7.9.3.1 Position – Setting of magnet current position

The sub menu **Position** is used to set the position of magnet current deflection. The value is specified in percent of the **Limits** that have been set. The values for the magnet current can be changed in a maximum range of -100% to +100% with the right joystick. A value of 100% corresponds to the magnet current limit. A value of 0% specifies the middle between the magnet current limits that have been set.

> **N O T I C E !** *The magnet current regulator limits the deflection of the electron beam to the permissible sweep area defined by the magnet current LIMITS. The amplitude and position can therefore only be changed so far that the electron beam is always inside the limits.*
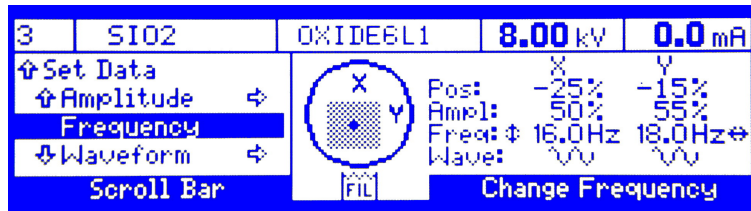
7.9.3.2 Amplitude – Setting of magnet current amplitude

The submenu **Amplitude** is used to set the **Amplitude** of magnet current deflection of the electron beam. The value is specified in percent of the limits that have been set by **Limits**. The values for the magnet current can be changed in a maximum range of -100% to +100% with the right joystick.

7.9.3.3 Frequency – Setting of magnet current frequency

The sub menu **Frequency** is used to set the frequency of magnet current deflection. The values for this frequency can be changed in a range of 0.5 Hz to 100 Hz with the right joystick. The step width can be set in the menu OPTIONS.

> **N O T I C E !** *Depending on the characteristics of the magnet coils, an increase of the deflection frequency can lead to a reduction of the amplitude.*
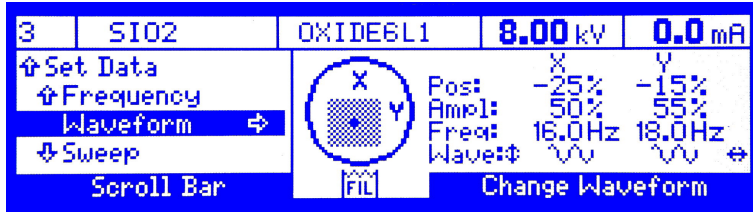
7.9.3.4 Waveform – Setting of magnet current waveform

The sub menu **Waveform** is used to set the **Waveform** of the magnet current deflection.

> **N O T I C E !** *The sub menu is only available for the sweep pattern* **Lissajous, Circle** *und* **Spiral.**

The following waveforms are available as basic functions::
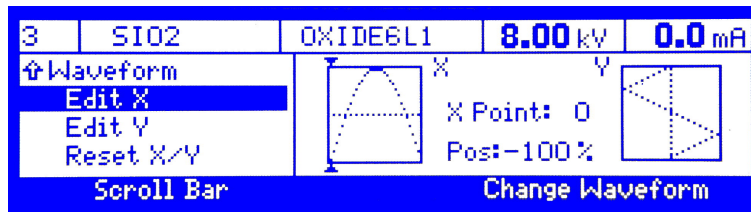
- Square,
- Sine,
- Delta
- Rectified sine

The functions can be selected with the right joystick. A wave symbol indicates the waveform that has been selected. In addition to the pre-set functions, the deflection forms can also be changed in detail in the sub menus **Edit X** and **Edit Y**. They are selected by pressing the left joystick **L** to the right.
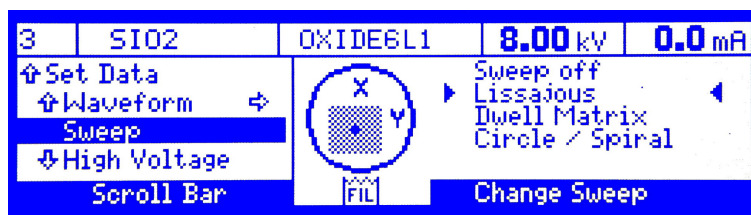
7.9.3.5 Edit X / Edit Y – Waveform Editor

The sub menus **Edit X** and **Edit Y** are used to define the waveform of magnet current deflection on the basis of a graphic display. The waveforms of a period for x and y-deflection are shown next to each other in a grid. The waveform of a period is defined over 32 points. The active co-ordinate is selected with the triangular marker at the edge of the grid. It is specified in the data section with the point number "X Point" or "Y Point") and point value ("Pos."). The allocated value can be moved in the required direction with the right joystick. The value range is standardized and extends from -100% to +100%.

7.9.3.6 Sweep – Switching magnet current amplitude on an off

The sub menus **Sweep** is used to define the sweep mode. The selection of different sweep modes is only available in version *GENIUS PRO*.

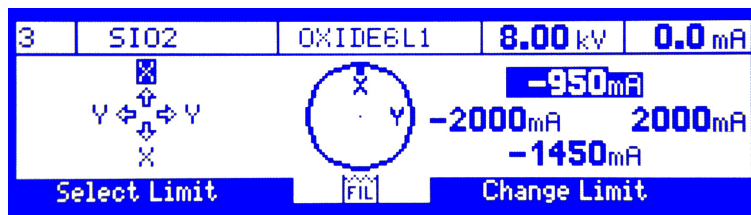### 7.9.3.7 Limits – Setting of magnet current limits

The sub menu **Limits** shows the limits for magnet current deflection. The limits define the maximum current for magnet current deflection (position value + amplitude value). They typically define the pocket rim and prevent the electron beam from extending on to the copper body of an evaporator. The left joystick **L** is to be pressed to the right to change the limit values.

```
3    SIO2     OXIDE6L1   8.00 kV   0.0 mA
⇧ Set Data                      -950 mA
  ⇧ High Voltage        X
  Limit            ⇨    ( ●Y  -2000 mA   2000 mA
  ⇩ Global / Local               -1450 mA
       Scroll Bar      FIL
```

DANGER! *The sweep amplitude is zeroed in the limits menu. This leads to increased energy density of the beam. When selecting the limits in the limits menu the emission is reset to 0 mA. The adjustments of the limits must be done at very low emission current to avoid any damage to the system.*

NOTICE! *The scope of validity of the limits for individual or all pockets can be set via the parameter **Global / Lokal** (see chapter page 41).*

The active limit is selected with the left joystick. The inversely shown limit can be changed with the right joystick. The value range extends from -3 A to +3 A. The step width and direction can be changed in the menu **Options / Step / Step Emission**.
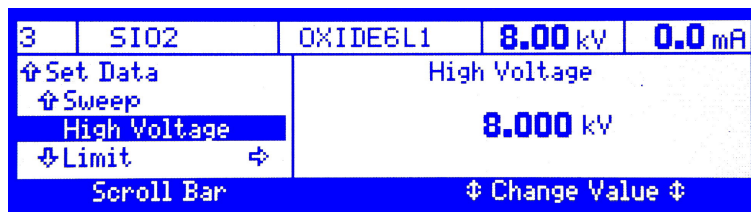
```
3    SIO2     OXIDE6L1   8.00 kV   0.0 mA
            ⊠
            ⇧              X        -950 mA
        Y ⇦ ⟐ ⇨ Y    ( ● Y  -2000 mA   2000 mA
            ⇩              X        -1450 mA
            X
     Select Limit    FIL    Change Limit
```

To exit the sub menu **Limits** press **Menu / quit**.

NOTICE! *The direction of deflection can be reversed by intersecting the x- and y-limits.*

7.9.3.8 High voltage – Setting of the high voltage

The sub menu **High voltage** is used to set the high voltage. The high voltage can be set in a range of 4 000 V to 10 000 V. The step width is 50 V.
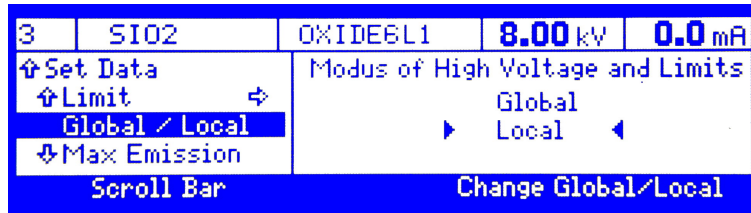
```
3    SIO2     OXIDE6L1   8.00 kV   0.0 mA
⇧ Set Data              High Voltage
  ⇧ Sweep
  High Voltage           8.000 kV
  ⇩ Limit          ⇨
      Scroll Bar         ⇕ Change Value ⇕
```

DANGER! *change of High Voltage influences the position of the electron beam on the pocket. The **limits** must be adapted accordingly.*

See also chapter 7.9.3.9 on page 42 regarding the scope of validity of the setting

7.9.3.9 Global / Local – Setting of scope of validity

The sub menu **Global / Local** is used to define the scope of validity of the **high voltage** and the **limits**. The variable simplifies programming for complex multi pocket configurations.

Global	The limit settings for magnet current **limits** and **high voltage** are valid for all pockets in the process which are marked **Global**
Local	The limit settings for magnet current **limits** and **high voltage** are valid for the current pocket

The change from **Local** to **Global** leads to the following selection:

Copy global values to data file ? - and overwrite actual settings?
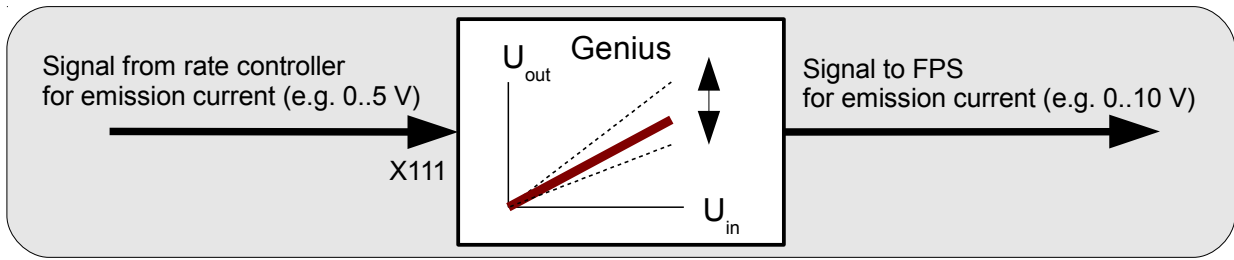Overwrite global values ? - with the actual settings

> **DANGER!** *Changing the current values as new **global** values will overwrite all values in the data set for the high voltage and the limits.*

7.9.3.10   Max. Emission – Setting of emission current limit

The sub menu **Max. Emission** is used to set the emission current limit. In this protective function an emission current value that may not be exceeded in manual or automatic mode is defined. This setting has influence to the step width of the emission current (see chapter 7.9.6.3 page 46).

7.9.4   Auto Emission – Setting of control sensitivity

The sub menu **Auto Emission** is used to calibrate the emission current in automatic mode. The setting defines the emission current value that should be processed as emission current when +10 V is applied to the input **X111** (See also 9.1.2, Emission setpoint input X111 Page 51). The setting only has an influence in automatic mode.

7.9.5   Save / Load - Loading and Saving of data sets and processes

The main menu **Save/Load** is used to save data sets and define and load processes. The active process and data set name is shown in the data section. This combination can be saved, deleted and edited in the sub menus.

7.9.5.1 Save data – Saving of data set

The sub menu **Save data** is used to save the work data set. A press of the right joystick **R** to the right saves the work data set under the same name. The question mark »?« in the top status line disappears.

7.9.5.2 Save data as – Saving of data set as new data set

The sub menu **Save data as** is used to save a work data set under a new name. The last character of the name is shown inversely and can be changed by moving the right joystick up and down. The characters that can be used include all alphanumeric characters and some special characters. The step width of the change is increased by holding of the joy-sticks in the top/bottom position. The first character (character in the sequence before the

letter »A«) deletes the active and all following characters. The position of the character is changed by moving the joystick **R** left and right.

```
3 |   SIO2   | OXIDE6L1 | 8.00 kV | 0.0 mA
⇧Save / Load
  Save Data              OXIDE6L1
  Save Data As
⇩Open Data
   Scroll Bar      ⇔ ⇕ Change Character ⇕ ⇨
```

> **NOTICE!** *A data set name may consist of a maximum of eight characters to guarantee compatibility to older computer operating systems. A maximum number of 99 data sets can be stored.*

The data set name is taken over by pressing the right joystick **R** to the right behind the last character twice.

7.9.5.3 Open data – Select a data set

The sub menu **Open data** is used to select a data set for the active pocket.
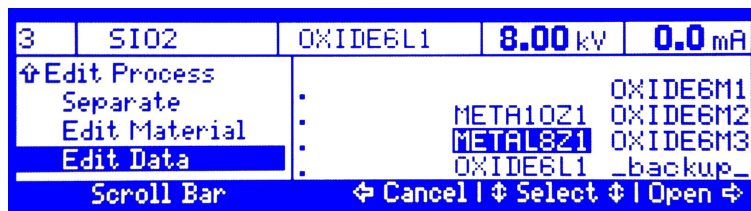
7.9.5.4 Delete data – Deletion of data set

The sub menu **Delete data** is used to delete data sets.

7.9.5.5 Edit process – Editing of active process

The sub menu **Edit process** is used to edit the active process. The allocation of pocket number, pocket material and data set is shown in the data section. The active pocket is shown inversely, while the allocation of the pocket that is to be changed can be selected with the triangular marker (identical in this example)

```
3 |   SIO2   | OXIDE6L1 | 8.00 kV | 0.0 mA
⇧Save / Load      POCKET: MATERIAL:   DATA:
 ⇧Delete Data    ⇧2      AL         META1OZ1 ⇧
   Edit Process ⇨ ▶3     SIO2       OXIDE6L1 ◀
 ⇩New Process     4      AL         METAL8Z1
   Scroll Bar    ⇩1A     SIO2                ⇩
          ⇔ Material | ⇕ Select ⇕ | Data ⇨
```

The material name of the real pocket can be changed by pressing the right joystick **R** to the left. The data set allocated to the virtual pocket can be selected from a list of stored data sets by pressing the joystick to the right.

```
3 |   SIO2   | OXIDE6L1 | 8.00 kV | 0.0 mA
⇧Edit Process   :            OXIDE6M1
  Separate      :   META1OZ1 OXIDE6M2
  Edit Material :   METAL8Z1 OXIDE6M3
  Edit Data     :   OXIDE6L1 _backup_
   Scroll Bar     ⇔ Cancel | ⇕ Select ⇕ | Open ⇨
```

The selection can only be made by vertical joystick movement, take-over by pressing to the right.

> **NOTICE!** *The work data set is retained even if a different data set is allocated to the active virtual pocket. The new data set is only activated after take-over in the menu **Set Pocket** .*

7.9.5.6 New process, Open process, Delete process

The sub menu **New process**, **Open process** and **Delete process** can be used to create, load or delete processes. The name is entered in the same way as described or the sub menu **Save data as,** see Chapter 7.9.3 page 38. The evaporation controller enables the storage of up to 20 processes.

7.9.6   Options – Setting of system configuration

The menu **Options** is used to configure and monitor the system.

7.9.6.1 Filament – Setting of filament current limits

The sub menu **Filament** is used to set the limits for the filament current. The lower limit **Min**. defines the filament current at no emission.

The parameters **PL_CONTROL**, **PH_CONTROL** and **I_CONTROL** are used to adapt the regulation characteristics of the evaporator.

PL_CONTROL   defines the P-Control part for small emission current.
PH_CONTROL   defines the P-Control part for high emission current.
I_CONTROL   defines the integral part of the control loop.

The parameter **AFC Ramp** (Automatic Filament Control) and **AFC Level** is used to control the filament current in case of the high voltage dropping below the set point.

AFC Ramp defines the drop in the filament current in case the high voltage drops below the high voltage limit of **AFC Level**.

AFC Level defines the limit in percent of the set high voltage upon drop below of this the filament current is ramped down with the set **AFC Ramp**. A **AFC Level** value of 0% switches off the regulation.

7.9.6.2 System Times – Setting of system timeout

The sub menu **System Times** is used to set system timeout parameters in case of high voltage drop and water flow failure on the evaporator.

Pocket

By setting the **pocket**-parameter the pocket can be rotated in manual mode. By pressing the joystick **R** to left or right the **pocket** stops. After exiting the menu the pocket will automatically index into the selected position.

```
3    SIO2       OXIDE6L1    0.00 kV    0.0 mA
⇧Service              Rotation Speed
   Last Error              0 %
   Pocket
⇩I/O          ⇨
   Scroll Bar              ⇔ Off  ⇕ Set
```

I/O

The I/O-menu is used to show the status of the digital I/Os. The status of up to 5 I/O cards can be shown.

```
3    SIO2       OXIDE6L1    0.00 kV    0.0 mA
⇧Service       IN CPU OUT   IN     I/O Card 1      OUT
   ⇧Pocket     1 2 3 K1  1 2 3  4 5 6 T11 12 ON P K1 K2
               1 1 1  0  0 0 0  0 0 0  0 0  0 1  1 0
   I/O      ⇨  4 5 6 K2  7 8 9 10 11 12 T21 22 ON P K3 K4
   ⇩Magnet     1 0 0  0  1 1 1  0 1 0  0 0  0 0  0 0
   Scroll Bar              ⇕ Change I/O Card
```

I/O-Logic

The menu **I/O-Logic** is used to link systems functions to distinctive I/O conditions.

```
3    SIO2       OXIDE6L1    0.00 kV    0.0 mA
⇧I/O           Output    Logic    Input
   I/O Setting CPU I/O K1 =    HV ON
   Pocket Setting HV ON   =    IN5 CPU
               HV OFF     =    IN6 CPU
   Scroll Bar  ⇕ Change ⇨ | ⇦ ⇕ ⇨ | ⇦ Change ⇕
```

The row **Output** shows a list of output conditions and signals which are assigned with a **logic** function to an **input**.

⚠ ***DANGER!*** *The preset table of I/O links must only be changed by trained qualified service personnel. Faulty settings may lead to severe damage of the system. The high voltage can switch on uncontrolled by faulty assignment of the I/Os.* ⚠

Crucible logic

By selecting the parameters the output coding of the crucible is defined on **X119**.

```
3    SIO2       OXIDE6L1    0.00 kV    0.0 mA
⇧I/O                   0
   I/O Setting   0 = Input 1 ... -> Pocket 1 ...
   Pocket Setting 1 = Binary Code starts with 0
                  2 = Binary Code starts with 1
   Scroll Bar           ⇕ Change Value ⇕
```

0 = individual assignment of inputs 1-6 to pockets No. 1-6

1 = binary code, pocket 1= Code (000 000)

2 = binary code starting with 1, **pocket** 1= Code (000 001)

Magnet

The service menu **Magnet** is used to monitor the status of the x- and y – magnet current parameter. The magnet power supply can be switched on and off independently of the high voltage.

FPS/HVP   The service menu **FPS/HVP** is used to monitor the status of the HVP and the FPS. The FPS can be switched on and off independently of the high voltage.

Languange   The menu **Language** is used to change the language of the menu structure.

7.10   Troubleshooting, corrective actions

> 📖 **⚠️**
> *NOTICE!* The faults and corrective action for warnings and error
> messages described in this mounting instruction are explained in such
> a way that they can be understood by qualified technicians with training in
> Electrical engineering/electronics and Mechanical engineering/maintenance.
> These technicians are to be equipped with the proper tools and test materials. The
> shutdown procedure must be followed before any maintenance or repair work is
> carried out. Should the specified measures not prove successful, please contact
> Ferrotec GmbH.

Error messages and warnings are shown in the bottom status line of the LCD display together with their number and a description. A distinction is drawn between warnings and errors.

7.10.1 Error messages

In the operating status **HV ON** the high voltage is switched off immediately as soon as an error is detected, after which the corresponding error message is shown in the LCD display. The **Menu/Quit** button blinks. The high voltage can not be switched on again until the error has been eliminated and the message cleared by pressing the **Menu/Quit**-button. If there is a further error, it is displayed after the last error has been cleared. If an error occurs in the operating status **HV OFF**, the error message appears immediately.

7.10.2 Warnings

Warnings are given in the event of faults, that do not impair the evaporation process strongly. The high voltage is not switched off. Warnings are cleared like error messages with the button **Menu/Quit**.

Error / Warning	Description
Error 01	XTERN INTERLOCK OPEN: Open contact or no voltage between contact A4 and B4 on **X110** (factory setting)
Error 02	CHAMBER INTERLOCK OPEN:Open contact or no voltage between contact A3 and B3 **X110** (factory setting)
Error 03	VACUUM INTERLOCK OPEN: Open contact or no voltage between contact A2 and B2 on **X110** (factory setting)
Error 04	WATER INTERLOCK OPEN: Open contact or no voltage between contact A1 and B1 on **X110** for **more than 3 seconds**. (factory setting).
Warning 04	WATER INTERLOCK OPEN: Open contact or no voltage between contact A1 and B1 on **X110** for **less than 3 seconds**. (factory setting).
Error 05	MAGNET FAILED Magnet current has not reached set point
Error 06	HIGH VOLTAGE MINIMUM: Voltage undercuts set point by more than 500 V
Error 07	REMOTE CONTROL NOT CORRESPONDING: No connection to remote control
Error 08	DATA NOT EXISTING, DEFAULT DATA LOADED: Data set not existing
Warning 09	DATA ALREADY SAVED: Data set already saved
Warning 10	FILE ALREADY EXISTS, DATA NOT SAVED Data set already exists
Warning 11	MEMORY FULL, DATA NOT SAVED: Memory full in GENIUS
Warning 12	DATA ALREADY ACTIVE: Data already active, can not be deleted
Error 13	INVALID POCKET DETECTION: Gun drive supplies invalid signals
Error 14	SLAVE NOT AVAILABLE: No communication to slave unit
Error 15	MASTER NOT AVAILABLE: No communication to master unit
Error 16	SLAVE INTERLOCK OPEN: Slave interlock is missing
Error 17	MASTER INTERLOCK OPEN: Master interlock is missing
Error 18	EMISSION DETECTION FPS2: ADC Converter for FPS II out of limits (Filament broken? Fiber optics not in place? Emission current to high? ADC power failure?)
Error 19	NO FILAMENT CURRENT: Filament broken ?
Error 20	CHECK SYSTEM CONSTANTS:System setup has been changed
Error 21	Internal Error, possible reasons are arcing during evaporation
Error 22	SYSTEM RESET
Error 23	-
Warning 24	Limits ARE NOT FOR THIS SOURCE Limits for 2nd source are identical ->change limits, only with FSC card
Error 25	RS-232 Error
Error 26	POCKET JAMMED: Time for pocket indexing exceeded

NOTICE! *In the event of faults in the devices high voltage power supply HVP, evaporation controller GENIUS or the filament power supply FPS call the customer service of Ferrotec GmbH*
phone +49 7022 9270-0

> **DANGER!** It is strictly forbidden to open the devices.

8 Cleaning / Maintenance

> **DANGER!** This chapter on maintenance is intended for qualified technicians only. Maintenance, cleaning and repair work may only be carried out by such qualified technicians.

Maintenance and cleaning work to the evaporation controller is restricted to cleaning of the housing

8.1 Visual inspection

The evaporation controller should be subjected to a general visual inspection regularly.

- Check the evaporation controller for corrosion.
- Check the evaporation controller for dust deposits as a result of air cooling.
- Check the plug connections on the back for firm connection and fading as a result of heat.

8.2 Cleaning

Clean the housing with a damp cloth monthly.

> **NOTICE!** Do not use any aggressive cleaning additives or sharp objects. Make sure no water gets inside the evaporation controller.

9 Interface cards / Interfaces for external components

All interfaces of the evaporation controller are located on cards plugged into the device from the back.

9.1 The CPU-Card

The standard evaporation controller is equipped with the cards »CPUCard« and »Magnet Card«. The gun rotation card »GRC« and the filament switch card »FSC« are optional.

The interfaces responsible for the communication besides the CARRERA Systems are described below.

9.1.1 I/O Interface X110

The I/O-Interface is designed as 16-pin Phoenix-plug with screw terminals. Both outputs and four of the six inputs are freely programmable. The functions are allocated on the basis of codes described in the appendix.

Function of the plug connector:

Two digital relay outputs (normaly open).

- Output 1: A7 and B7 (function freely programmable)
- Output 2: A8 and B8 (function freely programmable)

Six optocoupled digital inputs (high = 10 V to 30 V, non-polar)

- Input 1: A1 and B1 (status water)
- Input 2: A2 and B2 (status vacuum)
- Input 3: A3 and B3 (freely programmable)
- Input 4: A4 and B4 (freely programmable)
- Input 5: A5 and B5 (freely programmable)
- Input 6: A6 and B6 (freely programmable)

The digital inputs are volt-free via optocouplers and designed for a voltage of 24 VDC. An electrically isolated voltage of 24 V (80 mA) between pins B6 and B5 can be used to supply the control cables.
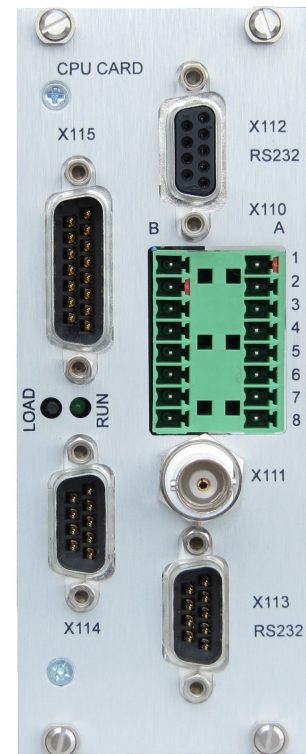

Fig. 17: CPU-Card

9.1.1.1 Configuration example:

Pin	Function	Externally connected to:	Pin	Function	Connected to:
B1	Input 1	connect to Pin B5	A1	Input 1	Status water
B2	Input 2	connect to Pin B5	A2	Input 2	Status vacuum
B3	Input 3	connect to Pin B5	A3	Input 3	Status chamber
B4	Input 4	connect to Pin B5	A4	Input 4	Status external interlock
B5	0 V for Input 5 Input 6	To the actuators for "Ready" and "HV on"	A5	Input 5	HV ON
B6	24 V, 80 mA	To the switches for water, vacuum, …	A6	Input 6	HV off
B7	Output 1	connect to Pin B6	A7	Output 1	HV ON
B8	Output 2	connect to Pin B6	A8	Output 2	ERROR

9.1.2 Emission setpoint input X111

A rate deposition controller can be connected to the evaporation controller at the emission setpoint BNC input **X111**. The analog signal is standardized on a level of 0…10 V. The sensitivity of the emission regulator can be changed with the menu point **Set data** / **Auto Emission**. The analog input is activated by the selection of **Auto/Manual operation**.
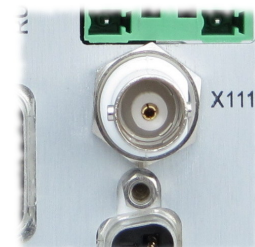

Fig. 18: X111 Input

9.2 Magnetcurrent card

The magnet current connection (**X117**) is used to supply the magnet coils of an electron beam evaporator. The cable (article no. 1-950003) included in the scope of delivery must be used for evaporators from Ferrotec.

The magnet current connection **X117** of the evaporation controller is designed as seven-pin round plug with the following PIN configuration.

1	X-deflection
2	X-GND
3	-
4	-
5	Y-GND
6	Y-deflection
Center	GND

Data of coil actuation:

Output current:	-3 A to +3 A
Minimum resolution:	10 Bit = 6 mA
Switching frequency:	80 kHz
Voltage:	24 V
Deflection frequency:	0,2 Hz up to 100 Hz (waveform and amplitude adjustable); max. 150 Hz for defocus option

Fig. 19: Magnet-Card

9.3 Gun rotation card GRC (Option)

X118 is used to drive the motor of the multi pocket evaporator. The pin assignment is predefined for the operation with an Ferrotec multi pocket evaporator. To adapt a different model of evaporator using menu **Options** / **System Setup** / **I/O** the pin assignment is free selectable. **X119** is used for the comunication with external devices. By means of the menu **Options** / **System Setup** / **I/O** it is possible to configure each signal individually.

9.3.1 GRC Card, configuration of the GRC X118

Type of connector: 15-pin SUB-D-socket.

Function and pin layout of the connector:

Pin 6,7,8,14 are predefined to control the multi pocket evaporators.

6 optocoupled digital inputs (high = 8 V to 30 V, non polarity)

- Input 7: 1 - 11
- Input 8: 2 - 11
- Input 9: 3 - 11
- Input 10: 4 - 11
- Input 11: 9 - 11
- Input 12: 10 – 11

Electrically isolated voltage of 24 V/2 A and +15 V/100 mA, which is used to supply the transistor outputs and can be used for the control cables. The pin layout is listed in the attachments.

9.3.2 Relay Input- and Output X119

Conector type: 16 pin Phoenix-Connector with screw terminals

Functions and pinouts of the plug connector.

Fig. 20: GRC Card

4 Relayoutpts 24 V/500 mA (momentarily 2 A) short circuit proof.

- Output K1: B1 - B5
- Output K2: B2 - B5
- Output K3: B3 - B5
- Output K4: B4 - B5

2 digital transistor outputs 24 V/500 mA (temporarily 2 A) short circuit proof.

- Output T21: B6, PWM capable
- Output T21: B7, can actuate a motor with output 5

6 optocoupled digital inputs (high = 8 V to 30 V, non polarity)

- Input 1: A1 - A7
- Input 2: A2 - A7
- Input 3: A3 - A7
- Input 4: A4 - A7
- Input 5: A5 - A7
- Input 6: A6 - A7

Electrically insulated voltage of 24 V/2 A and. +15 V/100 mA

9.4   Safety (Interlock) Card X102, X 103, X105

Using **X102** the connection for the hand remote (**X114**) can be patched to the front panel.

Using **X103** the connection for the RS-232 (**X112**) can be patched to the front panel.

Using **X105** a safe switch can be integrated for the rotation of the pocket on a multi pocket evaporator when the vacuum chamber is open. (The rotation is only possible when an addition button is pressed.)

The pocket rotation is only possible if the contacts B2 A2 are supplied with 24 Volt DC. The voltage therefore is supplied on contact B1 and A1 and can be guides through a so called safe switch. The status of the relay is given on the contacts (normally open). If two evaporation controllers are used for co-evaporation the connections are in parallel. Only one voltage supply is allowed to be used.

Pin assignment **X105**

+ 24 VDC	B 1	0 VDC	A 1
Relay Coil	B 2	Relay Coil	A 2
Feedback status (normally closed)	B 3	Feedback status (normally closed)	A 3

Fig. 21: Safety interlock card

10   Appendix

10.1   Pin assignment X110

Pin assignment X110

X110			
PIN NO.	Function		
A1 - B1	Input 1	Status water interlock (1=ok)	
A2 - B2	Input 2	Status vacuum interlock (1=ok)	
A3 - B3	Input 3	Status chamber interlock* (1=ok)	
A4 - B4	Input 4	Status external interlock* (1=ok)	
A5 - B5	Input 5	HV ON * (pos. slope)	
A6 - B5	Input 6	HV OFF * (1=HV off)	
A7 - B7	Output K1	relaycontact with B7;	

		HV switched on* (1=HV on)
A8 - B8	Output K2	relaycontact with B8; Error message* (1=Error)
B6	+24 V, 80 mA	Control voltage

*Factory default setting

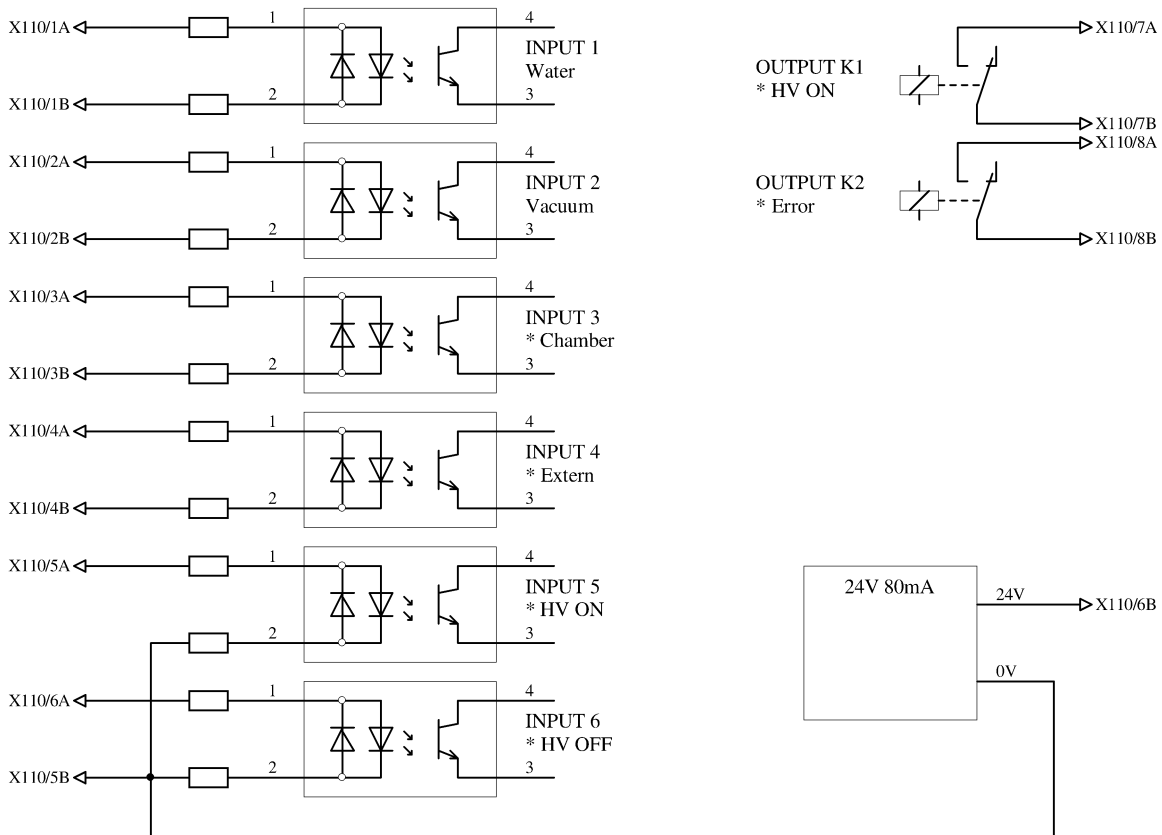Fig. 22: Circuit diagram X110

10.2 Pin assignment X119

Pin assignment X119

X119		
PIN NO.	Funcion	
A1	Input 1	pocketposition 1; *
A2	Input 2	pocketposition 2; *
A3	Input 3	pocketposition 3; *
A4	Input 4	pocketposition 4; *
A5	Input 5	pocketposition 5; *
A6	Input 6	v 6; *
A7	COM IN	COM IN; Reference for Inputs
A8	24 V 1,5 A	voltage for outputs
B1	Output K1	relaiscontact with B5; pocket in position*
B2	Output K2	relaiscontact with B5
B3	Output K3	relaiscontact with B5
B4	Output K4	relaiscontact with B5
B5	COM OUT	Common out for relaiscontact 1-4
B6	Ausgang T21	Transistorised output
B7	Ausgang T21	Transistorised output
B8	0 V	Common out 0: V referenz for output
	or	or

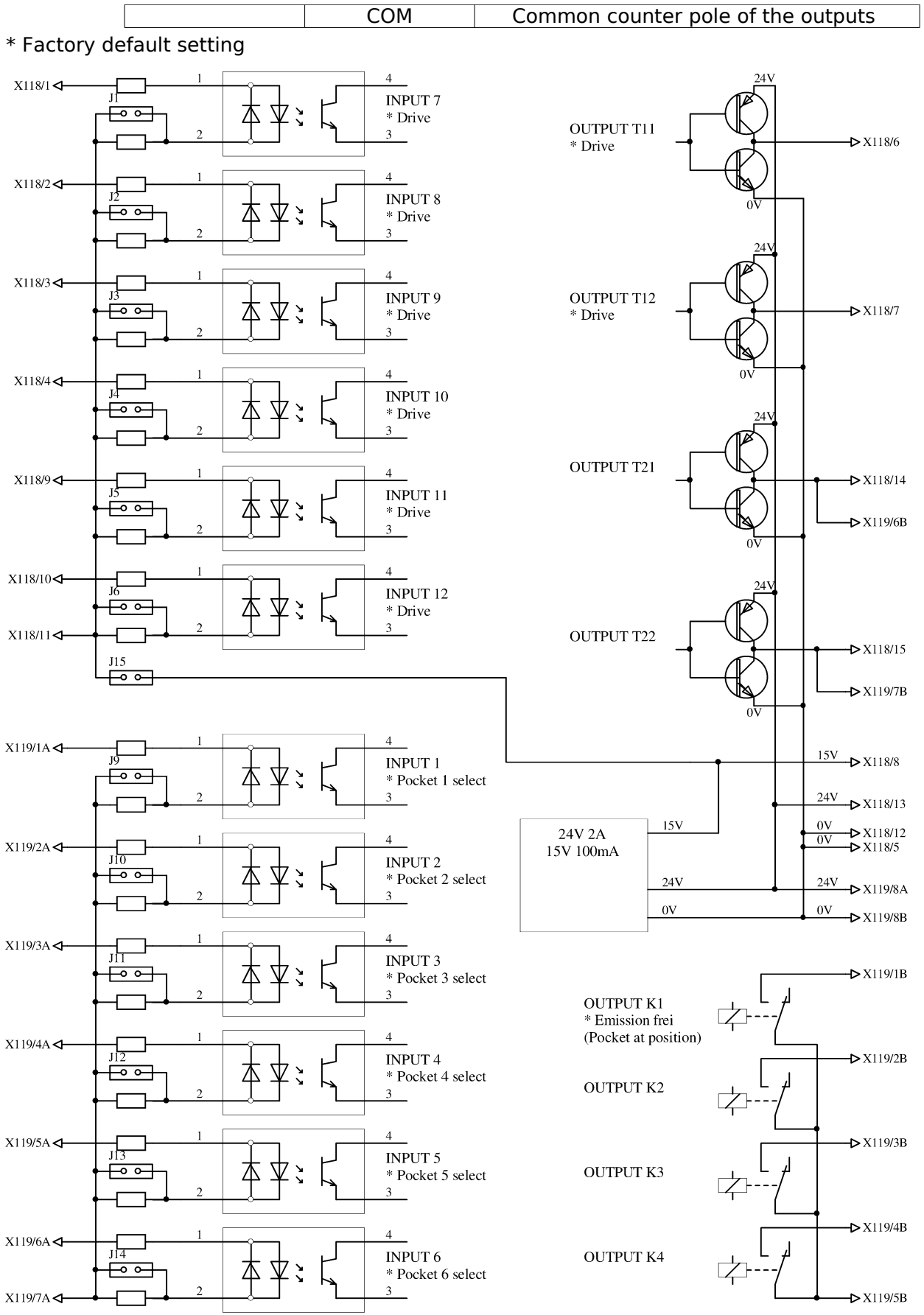|	COM	Common counter pole of the outputs

* Factory default setting

Fig. 10-23   Circuit diagram X118/X119

The factory settings for the jumper J1...J6, J9...J14 is open. On jumper J15 the factory setting is closed. By closing the jumper J9...J14 the inputs input1...input 6 on **X119** can be activated with 5 V instead of 24 V. By closing the jumper J1...J6 the inputs input7...input 12 on **X119** can be activated with 5 V instead of 24 V.

The following pin assignment is valid for the setting »POCKET_IN_SELECT=2« (binary coded pocket selection signals):

10.2.1 Pin assignment for 4-hearth crucible assignment

X119							
Input	**Pocket**	**PIN**					
		A6	A5	A4	A3	A2	A1
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	1
2	2	0	0	0	0	1	0
3	3	0	0	0	0	1	1
4	4	0	0	0	1	0	0
5	1A	0	0	0	1	0	1
6	2A	0	0	0	1	1	0
7	3A	0	0	0	1	1	1
8	4A	0	0	1	0	0	0
..							
63	3E	1	1	1	1	1	1

10.2.2   Pin assignment for 6-hearth crucible assignment

X119							
Input	**PocketI**	**PIN**					
		A6	A5	A4	A3	A2	A1
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	1
2	2	0	0	0	0	1	0
3	3	0	0	0	0	1	1
4	4	0	0	0	1	0	0
5	5	0	0	0	1	0	1
6	6	0	0	0	1	1	0
7	1A	0	0	0	1	1	1
8	2A	0	0	1	0	0	0
..							
63		1	1	1	1	1	1

10.2.3   Pin assignment for disc crucible assignment

X119							
Input	**Pocket**	**PIN**					
		A6	A5	A4	A3	A2	A1
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	1
2	1A	0	0	0	0	1	0
3	1B	0	0	0	0	1	1
4	1C	0	0	0	1	0	0
5	1D	0	0	0	1	0	1
6	1E	0	0	0	1	1	0
7	1F	0	0	0	1	1	1
8	1G	0	0	1	0	0	0
..							

10.3   RS-232 Interface (X112/X113)

10.3.1 Hardware

All the control signals of the control module can be read and written through the RS-232 interface. Every *GENIUS-* evaporation controller is equipped with two RS-232 interfaces. meaning a data chain can be created with several control modules and a computer. The interface isolates the control module and computer electrically.

> **DANGER!** *The plugs and cables connected to the interface must be shielded. The shielding must be connected to the housing ground.*

Every *GENIUS* can take over the function of the master (starts transmission) or slave (replies to the master) at both interfaces. An overriding computer always has the status of master.

10.3.1.1   Assignment of RS-232 Interface

Pin	Master-Interface X112 (9 pin female socket)	Slave- Interface X113 (9 pin, male socket)
1		
2	TxD	RxD
3	RxD	TxD
4	Connected to Pin 6	Connected to Pin 6
5	RS232_GND	RS232_GND
6	Connected to Pin 4	Connected to Pin 4
7	Connected to Pin 8	Connected to Pin 8
8	Connected to Pin 7	Connected to Pin 7
9		

10.3.2 Protocol

The protocol of the RS-232 interface is described in a separate document. It is not necessary for the operation and initial start up.

10.4 IO-Control

The IO-Control logically assigns the digital inputs and outputs to the status of the GENIUS. The assignments are free programmable.

The IO-control controls signals from different sources in the GENIUS and signals applied from outside to the GENIUS. According to the configuration these signals are linked to the corresponding outputs. Each input signal (source name) and each output signal (destination name) is identified by its name. The link in the menu **I/O Logic** (I/O Setting) is based on this names. The link is either the direct signal or its inverted value (**NOT**) and is stored in a register. An overview of all names is shown on the figure IO control.

10.4.1 Fixed level

10.4.1.1 Input

Input signal	Function	Function if „NOT" is set
Low	The output is always inactive if this is set to **Low**	The output is always active if this is set to **NOT Low**
Open	The output is not influence by the IO-control. The output can be change for example by the RS-232 or by an internal function.	No defined function!

Example:
*The GENIUS shall stay always in **Auto** mode. (in the menu **Auto/Manual** any changes shall be blocked). The relay output 1 of the CPU-CARD shall be controlled by the RS-232 (the IO-control shall not be allowed to change this)*

Ausgang	Logik	Input
Set Auto	= NOT	Low
Set Manual	=	Low
CPU I/O K1	=	Open

10.4.2 HV ON/OFF control

The HV ON/OFF control is responsible for the switch ON/OFF of the magnet current power supply, the filament power supply (filament) and the high voltage as well as the control of the emission of the emission current.

If the filament is switched ON always the magnet current will be switched ON. If the high voltage is switched ON always the magnet current and the filament will be switched ON. The high voltage and the filament can only be switched ON if the **safety control** and **error control** are enabled. The emission will be enabled if the high voltage is switched ON and the **pocket rotation control** status is that the pocket is in its position.

10.4.2.1 Input

Input signal	Function	Function if „NOT" is set

HV ON	The high voltage is switched ON	The high voltage is OFF
Emission	The emission is enabled	The emission is not enabled, e.g. the pocket is not in position.

10.4.2.2   Output

Output signal	Function
HV ON	It **safety control and error control** are enabled a change from logic value '0' to '1' switches ON the high voltage.
HV OFF	If this signal is active (1) the high voltage will be shut OFF. The high voltage can not be switched ON again as long as this signal is (1) (even not with the hand remote).
FIL ON	1 = filament switch ON, 0 = filament switch OFF, »open« = filament is switched with the remote control or RS-232
Magnet ON	1 = magnet switch ON, 0 = magnet switch OFF »open« = Magnet is switched with the remote control or RS-232
Gun ON	1 = evaporator switch ON, 0 = evaporator switch OFF => Water, FPS and magnet status will not be checked. »open« = evaporator is switched with the RS-232
Emission	1 = the Emission can be switched ON 0 = the Emission can not be switched ON

Example:
The relay output 2 of the CPU-card shall be switched ON once the high voltage is switched ON.
Using the CPU-Input 5 the high voltage shall be switched ON and OFF. (a change from 0 to 1 switches the high voltage ON the level 0 switches it OFF)
The pocket is selected from a external device which gives a 1 signal to CPU-Input 6 if the pocket is in position. The emission shall be blocked if the pocket is not in position.

Input	Logic	Output
HV ON	=	CPU I/O K2
IN5 CPU	=	HV ON
IN5 CPU	= NOT	HV ON
IN6 CPU	=	Emission

10.4.3 Safety control (Interlock Control)

If the high voltage or the filament is switched ON the following signals (Inputs) are checked constantly:

- Magnet current
- FPS status
- HVP status
- Water interlock; the signal is fix assigned to CPU-Input 1 (IN1 CPU).
- Vacuum interlock; the signal is fix assigned to CPU-Input 2 (IN2 CPU).
- Chamber interlock, this signal is freely programmable.
- External interlock; this signal is freely programmable.

10.4.3.1   Input

Input signal	Function	Function if „NOT" is set
Safety interlock	**safety control** enables the high voltage	At least one saftey interlock is not activated

Magnet	The status of the magnet is OK	The status of the magnet was not OK the last time it was checked
FPS	The status of the FPS is OK	The status of the FPS was not OK the last time it was checked
HVP	The status of the HVP is OK	The status of the HVP was not OK the last time it was checked

10.4.3.2 Output

Output signal	Function
Chamber	1 = the chamber is closed (»OK« displayed on hand remote)
External	1 = the external interlock is closed (»OK« displayed on hand remote)

Example
The relay output 2 of the CPU-Card shall be switched if a interlock circuit is broken
The external interlock is not used at all.

Output	Logic	Input
CPU I/O K2	= NOT	Safety interlock
External	= NOT	Low

10.4.4 Auto / Manual Register

10.4.4.1 Input

Input signal	Function	Function if „NOT" is set
Auto	Operation mode **Auto**	Operation mode **Manual**

10.4.4.2 Output

Output signal	Function
Set Auto	1 = Switch to operation mode **Auto**
Set Manual	1 = Switch to operation mode **Manual**

Example
*Using the CPU-Input 4 the operation mode shall be switched from **Auto** to **Manual.***

Output	Logic	Input
Set Auto	=	IN4 CPU
Set Manual	= NOT	IN4 CPU

10.4.5 Error control

10.4.5.1 Input

Input Signal	Function	Function if „NOT" is set
Error	A error message is shown	No error message is shown
Warning	A warning message is shown	No warning message is shown

10.4.5.2　　　Output

Output signal	Function
Error Quit	A positive slope (0 --> 1) confirms the displayed error or warning message

Example
The relay output 2 of the CPU-Card shall be switched if an error has occurred.

Output	Logic	Input
CPU I/O K2	=	Error

10.4.6 Emission Control

10.4.6.1　　　Input

Input signal	Function	Function if „NOT" is set
Emission>0	The emission current is enabled	emission current= 0

Example
A disc shaped crucible shall rotate once the emission is enabled.

Ausgang	Logik	Eingang
Pocket rot.	=	Emission>0

10.4.7 Pocket Drive Control

The pocket drive control receives from the pocket control the set position for the pocket to rotate to. If a multi pocket evaporator is equipped with only one pocket this one pocket crucible is a disc type crucible. In this case the parameter Pocket rot determine if the pocket rotates. If using a multi pocket evaporator the setting must be for **IO 1 T1_ON** to **Drive**. Is a second multi pocket evaporator together with a FSC-Card used additionally the setting for **IO2 T1_ON** must be **Drive**.

10.4.7.1　　　Input

Input signal	Function	Function if „NOT" is set
Drive	The transistor is used for the pocket pocket rotation. (**Drive** is only forr **IO 1 T1_ON**, **IO 1 T2_ON**, **IO 2 T1_ON**, I**O 2 T2_ON**, **IO 3 T1_ON** and **IO 3 T2_ON** defined.)	No function defined.

10.4.7.2　　　Output

Output signal	Function
Pocket rotation	Only valid if a disc type crucible is used. 1 = crucible rotates; 0 = crucible does not rotate

10.4.8 Pocketcontrol / Datacontrol

To switch the pocket or the data set the signals are coded from the control unit. The way of coding depends on the value of the variable **Pocket Setting**. Depending of the value (0, 1 or 2) the output is defined according to the following table. If the decode output is 0 the switch of the pocket- or the switch in the data set can be made by the hand remote or the RS-232.

Pocket control (Pocket Control) is controlled with the signals **Pocket set**, **Pocket set1**... . **Data control** receives the signals **pocket control** (**Data link to Pocket**). If data and pocket are separated **Data control** will switch to the signals **Data set**, **Data set1**.

10.4.8.1 Decoder

Only at Decoder for Pocket													Output at Mode:		
IN12	IN11	IN10	IN9	IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1	ena ble.	0	1	2
x	x	x	x	x	x	x	x	x	x	x	x	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	1
0	0	0	0	0	0	0	0	0	0	1	0	1	2	3	2
0	0	0	0	0	0	0	0	0	0	1	1	1	1*	4	3
0	0	0	0	0	0	0	0	0	1	0	0	1	3	5	4
0	0	0	0	0	0	0	0	0	1	0	1	1	1*	6	5
0	0	0	0	0	0	0	0	0	1	1	0	1	2*	7	6
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
0	0	0	0	0	0	1	0	0	0	0	0	1	6	33	32
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
0	0	0	0	0	0	1	1	1	1	1	1	1	1*	64	63
0	0	0	0	0	1	0	0	0	0	0	0	1	7	0	64
0	0	0	0	0	1	0	0	0	0	0	1	1	1*	0	0
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
0	0	0	0	1	0	0	0	0	0	0	0	1	8	0	0
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
0	0	0	1	0	0	0	0	0	0	0	0	1	9	0	0
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
0	0	1	0	0	0	0	0	0	0	0	0	1	10	0	0
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
0	1	0	0	0	0	0	0	0	0	0	0	1	11	0	0
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...
1	0	0	0	0	0	0	0	0	0	0	0	1	12	0	0

* = Multi selection possible,   x = Value has no influence on result

10.4.8.2 Output

Output signal	Function
Pocket set	0 = pocketselection by RS-232 or hand remote 1 = pocketselection by IO-control
Pocket1 set	Input IN1 assigned for decoder
Pocket2 set	Input IN2 assigned for decoder
...	...
Pocket12 set	Input IN12 assigned for decoder
Data set	Only if Data and crucible are separate 0 = seletion of data by RS-232 or hand remote 1 = seletion of data by IO-control
Data set1	Input IN1 assigned for decoder
Data set2	Input IN2 assigned for decoder
...	...
Data set6	Input IN6 assigned for decoder

10.4.8.3   Input Input

Input signal	Function	Function if „NOT" is set
Pocket1 Pos	Feedback of current pocket.	Signal inverting
Pocket2 Pos	Depending on »Pocket Setting« one signal per pocket binary coded	
...		
Pocket6 Pos		

Example 1: A evaporator with 4 pockets
In total 8 pockets should be selectable. Pocket 1 to 4 (real pockets) pocket 1A to 4A (virtual pocket). In manual mode shall the pocket selection be made by the hand remote. In automatic mode shall the pocket selection be made by 8 inputs. If pocket 1 is selected relay 1 on the CPU-card should be activated.
Settings:
In Menu Edit Process: Data and pockets are connected
In Menu Service I/O: Pocket Setting = 0

Output	Logic	Input
Pocket set	=	Auto
Pocket set1	=	IN1 Card1
Pocket set2	=	IN2 Card1
Pocket set3	=	IN3 Card1
Pocket set4	=	IN4 Card1
Pocket set5	=	IN5 Card1
Pocket set6	=	IN6 Card1
Pocket set7	=	IN5 CPU
Pocket set8	=	IN6 CPU
Pocket set9	=	Low
Pocket set10	=	Low
Pocket set11	=	Low
Pocket set12	=	Low
CPU I/O K1	=	Pocket1 Pos

Example 2: A evaporator with 12 pockets.
48 pockets should be possible to select. Pocket 1 to 12 (real pockets) pockets 1A to 12C (virtual pockets). The pocketselection is done by 6 Inputs, binary coded.
Input 1 = pocket 1 ...
Settings:
IIn Menu Edit Process: Data and pockets are connected
In Menu Service I/O: Pocket Setting = 2

Output	Logic	Input
Pocket set	= NOT	Low
Pocket set1	=	IN1 Card1
Pocket set2	=	IN2 Card1
Pocket set3	=	IN3 Card1
Pocket set4	=	IN4 Card1
Pocket set5	=	IN5 Card1
Pocket set6	=	IN6 Card1

Pocket set7	=	Low
Pocket set8	=	Low
Pocket set9	=	Low
Pocket set10	=	Low
Pocket set11	=	Low
Pocket set12	=	Low

Example 3: A evaporator with 4 pockets.
Without affecting the pocket between two data sets shall be switched if the
CPU Input 5 = 0: The pocketselection and the selection of the data set is done by the hand remote under the
condition that the CPU Input 5 = 1: The pocketselection is done by using 4 inputs. The selection of the data
set is done by using 2 inputs.
Settings:
IIn Menu Edit Process: Data and pockets are disconnected
In Menu Service I/O: Pocket Setting = 0

Output	Logic	Input
Pocket set	=	IN5 CPU
Pocket set1	=	IN1 Card1
Pocket set2	=	IN2 Card1
Pocket set3	=	IN3 Card1
Pocket set4	=	IN4 Card1
Pocket set5	=	Low
...	=	...
Pocket set12	=	Low
Data set	=	IN5 CPU
Data set1	=	IN5 Card1
Data set2	=	IN6 Card1
Data set3	=	Low
...	=	...
Data set6	=	Low

10.4.9 Switch Register

There are four Register whic ae programable by the RS-232 with 1 or 0. Register 1 (Switch 1) in adition can be changed using the hand remote. In case »Switch 1« is used this is indicated in the menu **pocketIslection** (set pocket) with the corresponding function.

10.4.9.1 Input

Input signal	Function	Function if „NOT" is set
Switch 1	Register is 1	Register is 0
Switch 2	Register is 1	Register is 0
Switch 3	Register is 1	Register is 0
Switch 4	Register is 1	Register is 0

10.4.9.2 Output

Outputsignal	Function
Set Switch1	1 = set Switch1 to 1
Res. Switch1	1 = set Switch1 t 0

Tog. Switch1	Change from 0 to 1 => change the status of Switch1 (from 0 to 1 or from 1 to 0)
Set Switch2	1 = set Switch2 to 1
Res. Switch2	1 = set Switch2 to 0
Tog. Switch2	Change from 0 to 1 => change the status of Switch2

Example
The rotation of the disc type crucible shall be controlled by the hand remote. (Switch 1). The start of the rotation shall be done by a button connected to CPU Input 5. The stop of the rotation shall be done by a button connected to CPU Input 6. The relay output 1 of the CPU shall be controlled with the RS-232 with Switch 2. (In opposite to the example »Fixed level« bit operations are required).

Output	Logic	Input
Pocket rot.	=	Switch 1
Set Switch1	=	IN5 CPU
Res. Switch1	=	IN6 CPU
CPU I/O K1	=	Switch 2

10.4.10 Logic

The IO-control has 6 Logicgats which can be used to make additional logical combinations.

10.4.10.1 Input

Input signal	Function	Function if „NOT" is set
Logic AND1	All three Inputs are 1	At least one Input is 0
Logic AND2	All three Inputs are 1	At least one Input is 0
Logic OR1	At least one Input is 1	All three Inputs are 0
Logic OR2	At least one Input is 1	All three Inputs are 0
Logic MUX1	One out of two sources	Invert signal
Logic MUX2	One out of two sources	Invert signal

10.4.10.2 Output

Output signal	Function
AND1 INPUT1	Signal for 1. Input of 1. AND-Function
AND1 INPUT2	Signal for 2. Input of 1. AND-Function
AND1 INPUT3	Signal for 3. Input of 1. AND-Function
AND2 INPUT1	Signal for 1. Input of 2. AND-Function
AND2 INPUT2	Signal for 2. Input of 2. AND-Function
AND2 INPUT3	Signal for 3. Input of 2. AND-Function
OR1 INPUT1	Signal for 1. Input of 1. OR-Function
OR1 INPUT2	Signal for 2. Input of 1. OR-Function
OR1 INPUT3	Signal for 3. Input of 1. OR-Function
OR2 INPUT1	Signal for 1. Input of 2. OR-Function
OR2 INPUT2	Signal for 2. Input of 2. OR-Function
OR2 INPUT3	Signal for 3. Input of 2. OR-Function
MUX1 Funk	0 = »MUX1 IN Low« used and routed to »Logic MUX1«. 1 = »MUX1 I. High« used and routed to »Logic MUX1«.
MUX1 IN Low	Signal is used if »MUX1 Funk« = 0

MUX1 I. High	Signal is used if »MUX1 Funk« = 1
MUX2 Funk	0 = »MUX2 IN Low« used and routed to »Logic MUX2« gegeben. 1 = »MUX2 I. High« used and routed to f »Logic MUX2« gegeben.
MUX2 IN Low	Signal is used if »MUX2 Funk« = 0
MUX2 I. High	Signal is used if »MUX2 Funk« = 1

Example
Two safety interlocks shall be integrated using the external interlock. Using CPU Input 4 the high voltage cable shall be integrated and using CPU-Input 5 a feedback signal generated by a dome rotation shall be integrated. A disc type crucible shall rotate while high voltage is switch ON and the CPU-Input 3 shall be activated. The relay output 1 of the CPU shall control a shutter. In automatic mode the shutter shall be controlled using the CPU-Input 6 in manual mode using the hand remote (Switch 1).

Output	Logic	Input
Extern	=	Logic AND1
AND1 INPUT1	=	IN4 CPU
AND1 INPUT2	=	IN5 CPU
AND1 INPUT3	= NOT	Low
Pocket rot.	=	Logic OR1
OR1 INPUT1	=	HV ON
OR1 INPUT2	=	IN3 CPU
OR1 INPUT3	=	Low
CPU I/O K1	=	Logic MUX1
MUX1 Funk	=	Auto
MUX1 IN Low	=	Switch 1
MUX1 I. High	=	IN6 CPU

10.4.11   CPU Card X110

The CPU-Input 1 is the input for the signal of water interlock status.

The CPU-Input 2 is the input for the signal of vacuum interlock status.

10.4.11.1   Input

Input signal	Function	Function if „NOT" is set
IN1 CPU	On Input 1 voltage is applied	On Input 1 no voltage is applied
IN2 CPU	On Input 2 voltage is applied	On Input 2 no voltage is applied
IN3 CPU	On Input 3 voltage is applied	On Input 3 no voltage is applied
IN4 CPU	On Input 4 voltage is applied	On Input 4 no voltage is applied
IN5 CPU	On Input 5 voltage is applied	On Input 5 no voltage is applied
IN6 CPU	On Input 6 voltage is applied	On Input 6 no voltage is applied

10.4.11.2   Ausgang (Output)

Output signal	Function
CPU I/O K1	1 = relaiscontact 1 closed
CPU I/O K2	1 = relaiscontact 2 closed

Mounting instruction Genius

10.4.12 First crucible rotation card (1st GRC Card) X118 / 119

10.4.12.1 Input

Input signal	Function	Function if „NOT" is set
IN1 Card1	On Input 1 voltage is applied	On Input 1 no voltage is applied
IN2 Card1	On Input 2 voltage is applied	On Input 2 no voltage is applied
...	...	...
IN12 Card1	On Input 12 voltage is applied	On Input 12 no voltage is applied

10.4.12.2 Output

Outputsignal	Function
IO Card1 K1	1 = relaiscontact 1 closed
IO Card1 K2	1 = relaiscontact 2 closed
IO Card1 K3	1 = relaiscontact 3 closed
IO Card1 K4	1 = relaiscontact 4 closed
IO 1 T2_ON	0 = Output T21 and T22 are open. 1 = Output T21 and T22 are controlled by **IO 1 T21** and **IO 1 T21**
IO 1 T21	0 = Output voltage: 0 V; 1 = Output voltage: 24 V
IO 1 T22	0 = Output voltage: 0 V; 1 = Output voltage: 24 V
IO 1 T2_PWM	The Output T21 is operated in PWM-Mode. Using RS-232 the puls width can be set. (actual values: **PWM_Wert_T2**).
IO 1 T1_ON	0 = Output T11 and T12 are open. 1 = Output T11 and T12 are controlled using **IO 1 T11** and **IO 1 T11**
IO 1 T11	0 = Output voltage: 0 V; 1 = Output voltage: 24 V
IO 1 T12	0 = Output voltage: 0 V; 1 = Output voltage: 24 V
IO 1 T1_PWM	The output T11 is operated in PWM-Mode. Using RS-232 the puls width can be set. (actual values: **PWM_Wert_T1**).

Example
T11 and T12 shall control the pocket rotation. The hand remote shall control a shutter (Switch 1). The output T21 shall be used therefore.

Output	Logic	Input
IO 1 T1_ON	=	drive
IO 1 T11 / IO 1 T12 / IO 1 T1_PWM	=	If T1_ON = drive the outputs are assigned to the drive unit.
IO 1 T2_ON	= NOT	Low
IO 1 T2_PWM	=	Low
IO 1 T21	=	Switch 1

10.4.13   2nd … 5th pocket rotation card X118 / 119

In general it is possible to integrate up to 5 pocket rotation cards (GRC) into the GENIUS. The function is the same like described in the chapter10.4.12 First crucible rotation card (1st GRC Card) X118 / 119 page 68.

10.5   Factory settings

10.5.1 Codes for user levels

The following four digit codes are preset for access to the different user level:

User level	Code
OPERATOR	No code necessary
STANDARD	1111
SERVICE	2031

The preset codes can be changed via the RS-232 interface.

10.6   GENIUS PRO, Features and Operation

The GENIUS PRO evaporation controller features extended sweep functionality beyond the standard version of the GENIUS. A standard GENIUS can be upgraded by exchanging the remote control into a version that grants access to the additional functions

In the following all additional features are described and examples given to get a uniform depletion for different kinds of materials.

10.6.1 Sweep – Sweep mode settings

The submenu Set-Data-SWEEP is used to switch between the following sweep modes:

For all sweep modes a further circular path can be superimposed with the *Dynamic Defocus* »dynamic defocus« function.

10.6.1.1   Sweep off

If the mode sweep off is activated then no dynamic sweep is applied to the beam. This setting is equivalent with setting the value for »amplitude« (incl. *»dynamic amplitude«**) to zero. Only a static deflection of the beam with the corresponding position offset according to the »position« parameter will occur.

10.6.1.2   Lissajous

The Lissajous mode is the standard and conventional mode to deflect a beam dynamically. The dynamic sweep is generated by superimposing the static beam with a dynamic deflection in both x- and y-direction. Both channels can be supplied with frequencies from 0..100 Hz. There's no fixed phase relation between the channels.

While one deflection coil forces the beam to go up and down the other coil makes the beam to cycle between the right and left border. The individual *amplitude* setting define the expansion of the beam path for both directions.

N O T I C E ! *Make sure that the frequency for x- and y- deflection isn´t in a fixed ratio like 1:3 to avoid standing waves which can result in beam tunneling*

10.6.1.3   Waveform–Editor

The GENIUS supports on both channels 4 predefined waveforms (Sine, Triangle, Square, rectified Sine) and user defined waveforms which are generated out of 32 points for sequential repetition. The functions can be selec-

ted with the left joystick. A wave symbol indicates the waveform that has been selected. If »??« is displayed instead of a predefined waveform then a user defined waveform is active.

The sub menus **Edit X** and **Edit Y** are used to define the waveform of the magnetic current deflection with a graphic display. The waveform of a period for x- and y-deflection are shown next to each other in a grid. The waveform of a period is defined over 32 points. The active co-ordinate is selected with the triangular marker at the edge of the grid. It is specified in the data section with the point number »X Point« or »Y Point«) and point value (»Pos.«). The allocated value can be moved in the required direction with the right joystick. The value range is standardized and extends from -100% to +100%.

> **NOTICE!** *Use this mode for all standard materials which have a good melting characteristics and which don't sublime.*

This mode is also useful for permanently rotating crucible e.g. SiO_2-discs to compensate different radial speeds with appropriate beam speed along the longitudinal (x-) deflection.

In this example the beam moves fast in the upper area (near the rotating hearth´s center) and slows down while approaching the lower area (outer rim of the crucible).

10.6.1.4   Circle/Spiral

The Circle mode is used to generate rotating beam paths in various configurations. In contrast to the Lissajous mode the Circle mode uses a fixed phase relation between the two superimposed deflection channels. If the Circle mode is selected a sub menu will appear that also enables the beam to move into the center in different ways.

10.6.1.4.1.   Circle: parameter 0

Setting the sweep parameter to 0 the beam will follow a circular path with a circulation frequency f_c that is shown as x-deflection frequency f_x. The y-deflection frequency f_y is disregarded in this **Circle** mode. A circular path is only generated if the deflection waveform is sinusoidal for both channels. The circle can be stretched and compressed to an ellipse by varying the amplitudes correspondingly.

In this graph the circulation frequency f_c (=f_x) equals 16Hz and both channels operate in sine mode.

Triangular or rectangular waveforms lead to a distortion of the circle according to the following pictures:

10.6.1.4.2. Spiral / Star: parameter 1 – 15

Setting the sweep parameter can vary between 1-15 for the spiral. It determines by radial dwell time the radial distribution of the power density and thereby concentrating the thermal input to the center or to the outer edge.

In the example above the pulsation frequency f_p would equal 2 Hz. With $f_p << f_c$ a spiral beam path is generated. While the beam makes 30 revolutions (per second) it gravitates 2 times into its center. With a sweep parameter set to 15 (center hot) the thermal power input is concentrated to the center.

With a sweep parameter set to 1 (center cold) the thermal power input is concentrated to the outer edge. With a value of 8 the thermal power input homogeneous.

With $f_p >> f_c$ a propeller beam path is generated. The example on the left (sweep parameter = 15; center cold) shows a frequency ratio of $f_p = 5$ x f_c meaning that the beam gravitates 5 times into its center during one revolution.

The sweep parameter 1 (center hot) would make the beam move into its center in a linear mode and thus applying more energy there.

10.6.1.4.3. Dynamic Defocus

For all sweep modes a so called dynamic defocus can be applied. This mode superimposes a circle of the defocus frequency f_d with an amplitude A_d onto any beam path. The defocus amplitude A_d can be increased to a maximum of 25% of the set limits with a maximum defocus frequency f_d of 150 Hz.

The example shows a circle with superimposed deflection frequency f_d >> f_c. The beam is dynamically defocused.

At reduced circle amplitude the beam contracts while keeping the defocus amplitude at same level.

A spiral with a superimposed high frequency deflection (f_d >> f_c >> f_p) would cover a complete disc. The sweep parameter (1-15) can be used to modify the radial beam intensity distribution.

The example on the left shows a circle with superimposed deflection frequency f_d **<<** f_c. The beam also appears dynamically defocused but generally rather with a smoothening effect on the rastered area.

10.6.1.4.4. Sector-Adaption

The **Sector-Adaption** mode unique to the *GENIUS PRO* while using the Circle/Spiral/Propeller sweep mode. It is basically used to compensate radial depending different beam densities on the crucible surface. The crucible is divided int 8 sectors (like 8 pieces of a cake). For each sector the dwell time can be shortened or extended.

In this example the beam takes twice the time on the upper area (170%) compared to the area near the filament area (85%) e.g. if the beam density is higher in the latter area.

The effect on a dynamically defocused circle and a spiral are show below:

10.6.1.4.5.   Dwell Matrix

The **Dwell-Matrix** mode is special mode that supports different beam dwell time patterns which determine the energy distribution of the electron beam on the pocket surface und thus the depletion of the evaporation material. Every desired material can be treated with its own evaporation characteristics to achieve uniform material depletion and optimum results for the deposition.

Having selected the Matrix mode the waveform editor menu will disappear and a new submenu »**Dwell-Matrix**« is displayed instead.

The *GENIUS PRO* software includes 8 predefined dwell matrix patterns which can be modified into new user defined patterns. Move the left joystick to select one of the quadrants and modify its value between 0 –200% by using the right joystick up and down (the cell changes its intensity from white to black). Pushing to the right or left copies the value of the corresponding neighboring cell. A sophisticated algorithm in the *GENIUS PRO* software deflects the electron beam according to the programmed dwell matrix pattern without the need for additional beam path programming. Basically the beam dwells twice as long within one cells area compared to a different cell with half of the value. The frequencies defined in the *Set Data-Frequency* menu determine the relative speed of the beam in both directions.

Fig. 24: Disc pattern matrix at 15 Hz

Fig. 26: Disc pattern matrix at 40 Hz

Fig. 27: Circle shapped matrix

Fig. 25: Square shapped matrix

11   Fault, Cause, Remedy

DANGER! *The situations and information on faults, their causes and correction in this chapter are described in such a way that they can be understood by skilled person (see definition on chapter 3.4 „Safety precautions (by the operator)") with training in electrical engineering/electronics and mechanical engineering/maintenance. These technicians must be equipped with the proper tools and test materials. The shutdown procedure (see chapter. 4.4 page 18) must be carried out before all maintenance and repair work. If the measures described below do not prove successful, please contact Ferrotec GmbH.*

Fault	Cause	Remedy
Power supply cannot be switched ON	Disconnected mains plug	Connect the mains plug Plug
	The high-voltage connector is not connected and locked	Connect and lock the high-voltage connector
	Safety conditions are no met	Check safety interlock circuit

12 Emergency

In the event of an emergency press the **emergency stop button** on the master control unit. Switch off the main switch if necessary. The emergency stop button is released by pulling out or turning anticlockwise/clockwise.

13 Dismantling / Disposal

13.1 Dismantling

Dismantling may only be performed by skilled personnel. Make sure the shut down procedure is followed before beginning dismantling work.

13.2 Disposal

The disposal must be of in accordance with local environmental protection regulations for electrical equipment. Oil and cleaning materials must be disposed of in accordance with the local laws and the instructions given in the material safety data sheets. Contaminated cleaning tools (brushes, cloths, etc.) must also be disposed of in accordance with the manufacturer's instructions.

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