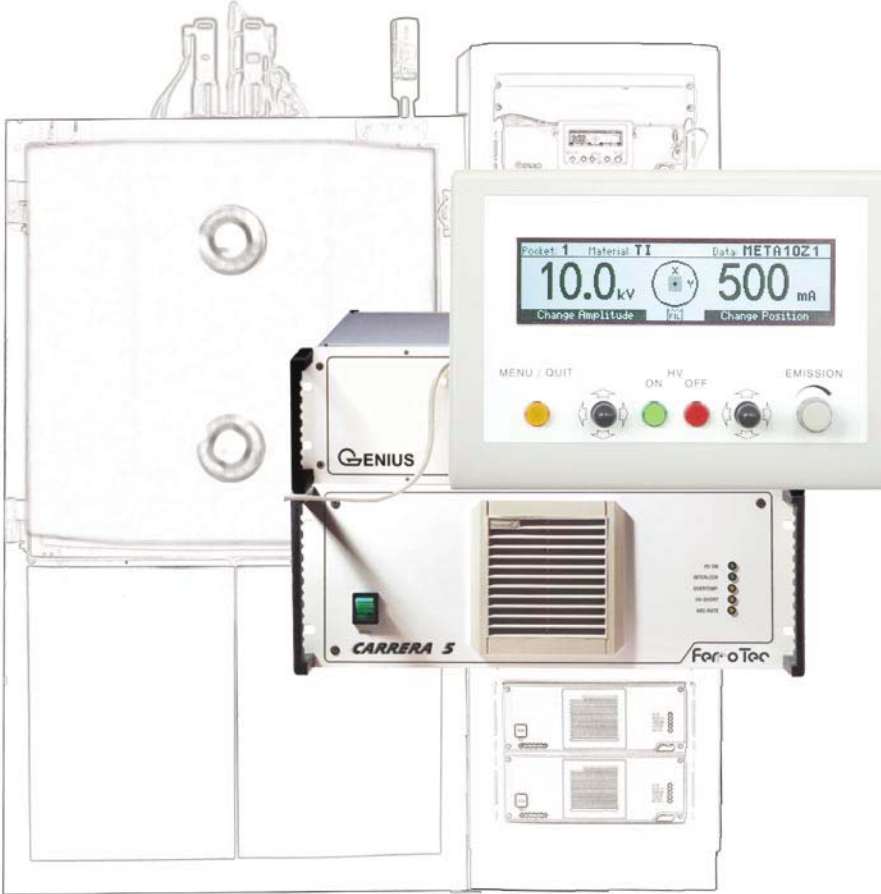


## Electron Beam Power Supplies & Evaporation Controllers





Ferrotec offers a full range of high quality, state-of-the-art electron beam evaporation products for the vacuum and thin film industry. These are developed and manufactured at Ferrotec's European headquarters in Germany. This modern facility is DIN EN ISO9001 certified to ensure high and consistent quality. Ferrotec's global organization provides sales and service on a local level, with Ferrotec companies and representative locations around the world and full sales and service capability in the US.

### Electron Beam Products by Ferrotec GmbH

- Manufactured at Ferrotec's European headquarters with 3 000 m<sup>2</sup> facility
- All products, including electronics, developed and tested in-house
- Worldwide sales & service network through Ferrotec companies and representatives
- Vacuum laboratory and test center
- Training facilities
- DIN EN ISO9001 certified



Ferrotec provides a full range of electron beam evaporation products including

- Single and multihearth evaporators
- High voltage power supplies from 3 kW to 12 kW
- Industry leading programmable control units
- A complete line of vacuum feedthroughs and accessories for installation and automatic operation.

A complete power supply system for electron beam evaporation consists of:

- CARRERA High Voltage Power Supply to accelerate the electrons and to deliver the beam power
- FPS Filament Power Supply to create the heating current for thermionic emission
- GENIUS Evaporation Controller to control all evaporation parameters and to sweep the beam

Ferrotec offers competent support through our sales organization and the newly established technical electron beam center in Germany. Training seminars for all Ferrotec products can be offered including hands-on practice in our vacuum laboratory.



All electron beam products are thoroughly tested on test benches and attached to a vacuum chamber to perform power tests in a real vacuum environment.

Ferrotec's CARRERA series of high voltage power supplies, together with the GENIUS evaporation controller, is ideally suited for use in production and R&D evaporation systems. A flexible range of modular elements allows almost all system configurations to benefit from this state of the art technology. These range from simple low power, single hearth laboratory systems, to complex production systems where simultaneous high power deposition from up to three multihearth evaporators may be required.

## CARRERA

The CARRERA high voltage power supply is extremely compact in size. By incorporating primary switched technology the power efficiency of this small unit is as high as 90%. The fast and tight regulation of the high voltage makes the CARRERA ideal for harsh conditions of vacuum applications.

The new modular design allows the CARRERA to be configured for applications over a wide power range from 3 kW to 12 kW.

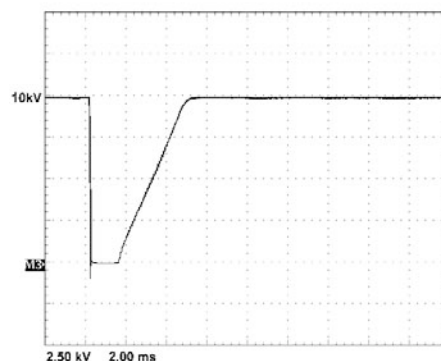
An optional built-in high voltage vacuum relay enables the unit to select an additional HV output e.g. to drive a glow discharge electrode.

### Flexible Interfacing

The CARRERA power supply incorporates a separate interface board which can be exchanged with different system configurations. For example, a power supply for remote operation also includes the filament-emission regulation and interlock circuit protection on board. The interface can even be designed pin-compatible to existing power supplies from other manufacturers.

### Arc Management

Through a combination of an intelligent arc recognition system and the high switching frequency of the power unit, arcs are extinguished extremely fast. This minimizes the energy that would otherwise continue to feed the arc. Full power is returned within 3 to 5 ms to allow the evaporation process to continue. The built-in arc management also supports processes with continuous arcing by either setting an arc rate threshold or by automatically switching into a robust recovery mode.



Typical high voltage recovery after an arc

### Electron Beam High Voltage Power Supplies

CARRERA 3  
CARRERA 5/6  
CARRERA 10/12



### CARRERA High Voltage Power Supply

- Output power from 3 kW to 12 kW
- Sequential or simultaneous supply for up to three evaporators
- Robust primary switched mode power supply
- Arc detection within 200 ns and suppression within 1  $\mu$ s
- Full arc recovery within 5 ms
- Controllable arc management system that withstands continuous arcing
- Continuously variable high voltage from 2 kV to 10 kV
- Up to 4 HV outputs for parallel operation
- Switchable HV output for glow discharge process (optional)
- Compact and lightweight design
- CE certified

The programmable GENIUS evaporation controller regulates all aspects of the electron beam deposition process. As well as controlling the high voltage and regulating the filament supply, the GENIUS also handles the magnet current supply to the coils of the electron beam evaporator.

## Electron Beam Evaporation Controller

GENIUS  
GENIUS Pro



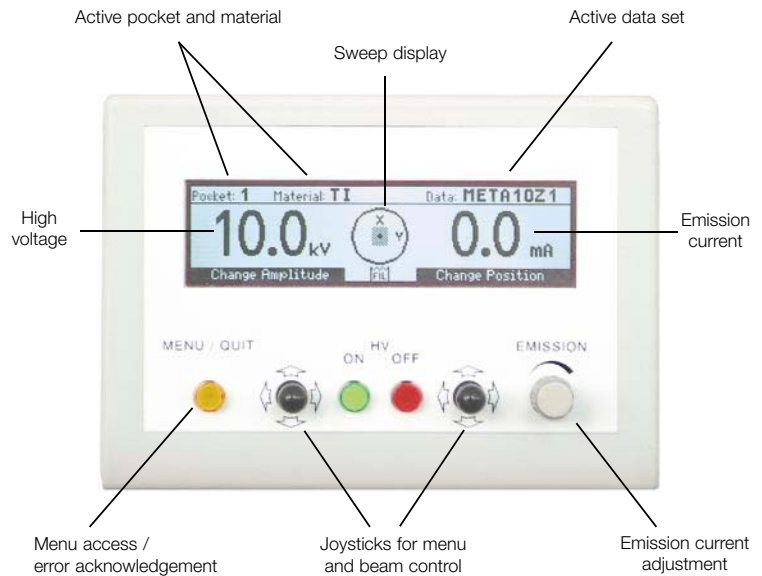
# GENIUS

All of the GENIUS functions are accessible from the handheld remote control which can be used to manually control the evaporation process as well as to set all process and system parameters.

Access to the menu functions may be limited with three password protected user levels (e.g. Operator, Standard, Service).

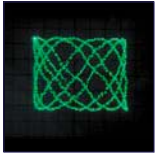
### Functionality of GENIUS controller

- Emission control
- High voltage control
- Filament current control
- Programmable sweep control with bipolar power output
- Pocket control for DC and stepper motors
- Sequential evaporation control
- Functional interlock circuit protection
- External I/O control e.g. shutter control
- Evaporation data storage
- Monitor for digital I/Os
- Logical I/O addressing
- Master-Slave mode for simultaneous evaporation



## Material Specific Evaporation Parameters

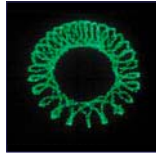
In order to achieve optimum film quality and uniform evaporant utilization, the GENIUS can store a wide variety of evaporation parameters including sweep parameters, high voltage values or safety limits. Up to 99 different data sets can be stored and these may then be applied to different phases of the process (e.g. material melting and various coating phases).



Lissajous mode



Spiral mode



Circle mode with sector adaptation and dynamic defocus



Star mode



Dwell matrix mode

The GENIUS already includes various modes to deflect the electron beam of an evaporator. The GENIUS PRO offers additional beam sweep and defocusing capabilities. For example, by applying the "spiral" and "circle" patterns, dielectric materials can be more homogeneously evaporated.

A unique feature of the GENIUS PRO is the dwell matrix functionality. It allows individual energy control at every position of the crucible. A dwell time pattern determines the energy distribution of the electron beam on the pocket surface and thus the removal of the evaporation material.

Data sets containing evaporation parameters can either be associated to an individual hearth or stored in memory for external assignment. Utilizing the I/O card it is possible to choose a particular data set dependent upon a signal from a deposition rate controller.

For each data set the following parameters are defined and saved:

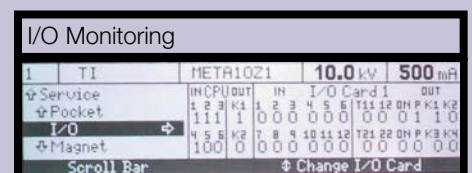
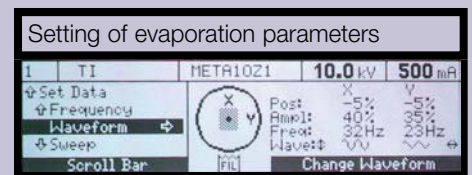
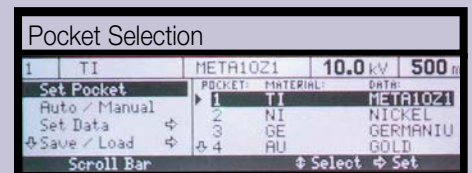
- Magnet deflection (position, amplitude, frequency, waveform, beam spot, limits)
- High voltage
- Safety limits (emission current limit and resolution for automatic operation)

The waveform can be set independently in both X and the Y axis. This enables an oscillation pattern defined by 32 coordinate positions to be established. This allows compensation for variations in the energy distribution to the hearth.

All digital inputs and outputs of the GENIUS controller can be monitored with the handheld remote control. Internal functions can be linked with signals from other devices to adapt the operation to the customers needs. For example the pocket of a ring hearth rotates as soon as high voltage is applied.



All functions can be accessed from the unique menu driven GENIUS remote control





## Flexible System Configuration

As a controller for the evaporation system, the GENIUS handles communication between the CARRERA high voltage power supply and the Filament Power Supply (FPS). The GENIUS is also compatible with virtually all other electron beam evaporators and deposition controllers. By using a variety of interface cards the GENIUS can be configured for integration into different systems. In addition, a process controller can be set to access all functions of the GENIUS and process data via the RS232 or an optional LAN interface.

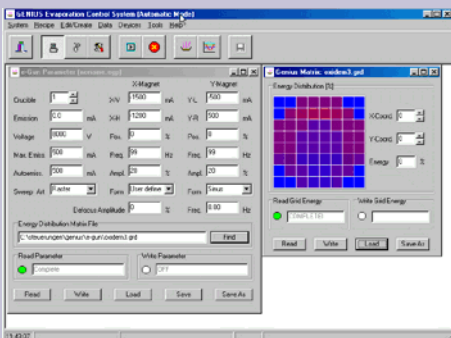
## Optional Interface Cards

- GRC Gun Rotation Card
- SMC Stepper Motor Card
- FSC Filament Switch Card
- LIC LAN Integration Card LIC



## Interface Possibilities

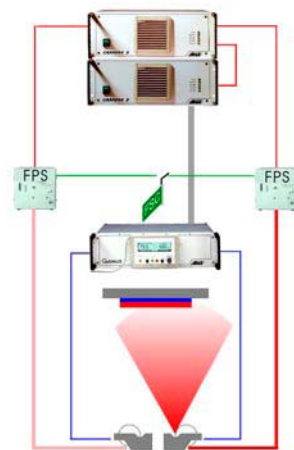
- Remote control via RS232, LAN and/or A/D-interface
- Integration of functional interlocks
- LAN integration via ethernet interface (optional)
- Pin-compatible to all Ferrotec electron beam products
- Operates with all standard evaporators by adapting emission-filament current characteristics
- Works with all standard process and deposition controllers
- Windows™ visualization available



CPU Card	RS232	<ul style="list-style-type: none"> <li>• Saving and loading of data sets and process parameters</li> <li>• Evaporation parameter protocolling</li> <li>• Real time control of evaporation parameters via PC</li> <li>• Loading and upgrading of new software / firmware</li> </ul>
	RS232 Slave	<ul style="list-style-type: none"> <li>• Communication between GENIUS controllers</li> </ul>
	Analog Input	<ul style="list-style-type: none"> <li>• Emission current regulation via an external rate controller (sensitivity adjustable)</li> </ul>
Magnet	Digital Inputs/Outputs	<ul style="list-style-type: none"> <li>• Monitoring of interlocks *</li> <li>• External selection / monitoring of control functions *</li> </ul>
	Magnet Card	<ul style="list-style-type: none"> <li>• 2-channel bipolar magnet current supply</li> <li>• Filament power supply interface</li> </ul>
Options	GRC	<ul style="list-style-type: none"> <li>• Control and positioning of the hearth assembly *</li> <li>• External pocket selection *</li> <li>• External selection / monitoring of control functions *</li> </ul>
	SMC	<ul style="list-style-type: none"> <li>• Control and positioning feedback of stepper motors *</li> </ul>
	FSC	<ul style="list-style-type: none"> <li>• Control of a second and third (FSC II) evaporator in sequential mode</li> </ul>
	LIC	<ul style="list-style-type: none"> <li>• Provides direct connection of the GENIUS serial port to a computer network</li> </ul>

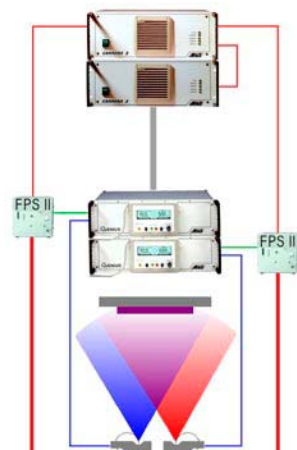
GENIUS Interfacing

\* User Programmable



## Sequential Deposition

A Filament Switch Card (FSC) can be installed in the GENIUS to enable selection and deposition from one of several evaporators within the vacuum chamber. This configuration requires a dedicated FPS for each evaporator.



## Simultaneous Deposition

For simultaneous evaporation from several electron beam evaporators each source is driven by a single GENIUS controller. As the emission current is directly monitored by the filament power supply FPS-X.2, the evaporators can be powered from a single CARRERA high voltage power supply.

## Specifications

High Voltage Power Supply	CARRERA3	CARRERA5	CARRERA6	CARRERA10	CARRERA12
Max. output power	3 kW	5kW	6kW	10 kW	12 kW
Emission current	0-300 mA	0-500 mA	0-600 mA	0-1000 mA	0-1200 mA
High voltage output	2 - 10 kV				
High voltage ripple	< ± 0,5 %				
High voltage regulation	< ± 0,5 %				
Cooling	forced air				
Mains voltage (Europe)	400 VAC, 3Ø, -10%/+6%, 50/60 Hz, 5-wire				
Mains voltage (US)	208 VAC, 3Ø, -10%/+6%, 50/60 Hz, 4-wire				

Filament Power Supply FPS	
Power stage	primary switched, 20 kHz
Filament supply	8-50 A @ 10 VAC, 50/60 Hz
Mains voltage	230 VAC, -10%/+6%, 50/60 Hz

Evaporation Controller GENIUS / GENIUS PRO	
Magnet output	
x-deflection	± 3 A @ 24 VAC; 0-100 Hz
y-deflection	± 3 A @ 24 VAC; 0-100 Hz
GENIUS sweep modes	Sine wave, triangle, square, waveform editor
add. GENIUS PRO sweep modes	Circle, spiral, stars, sector adapt., radial speed adj. Dwell matrix (8x8), dynamic defocus
Emission input	0-10 V; BNC socket; 12 Bit DAC; sensitivity adj.
Digital input	6 optoisolated inputs
Digital output	2 relay contacts (500 mA, 60 V)
Serial interface	2 x RS232 (Host, Slave); ASCII-protocol
Storage capacity	99 data sets; 20 material configurations
Max. No. of data sets per process	64
Mains voltage	85 - 264 VAC, 50/60 Hz

Gun Rotation Card GRC (optional)	
Max. No. of pockets	12
Freely programmable digital inputs	6 optoisolated inputs
Freely programmable digital outputs	4 relay contacts (500 mA;60 V), 2 trans. outputs

Stepper Motor Control SMC (optional)	
Power stage for bipolar control	500 steps/rev.
Max. voltage	24 V
Max. phase current	2,3 A

LAN Integration Card LIC (optional)	
Ethernet	BNC = 10 Base2, RJ45 = 10
TCP/IP	Socket, FTP, Telnet per client and server
Auxiliary protocols	ARP, RARP, PING, RIP

Dimensions (HxWxD); weight	
CARRERA3, CARRERA5/6	175 mm (4U) x 483 mm (19") x 550 mm; 28 kg
CARRERA10/12	350 mm (8U) x 483 mm (19") x 550 mm; 56 kg
FPS	220mm x 220mm x 200mm; 14,5 kg
GENIUS rack	131 mm (3U) x 483 mm (19") x 300 mm; 10 kg
GENIUS remote control	120 mm x 180 mm x 25 mm; 0,8 kg

Environmental specifications	
Ambient temperature	5 - 35° C
Humidity	< 65 %, non-condensing
Protective system	CARRERA: IP41
	FPS: IP22 (IP53 for HV section)
	GENIUS: IP 20

## Ordering information

Model	Part-Number	
	Europe	US
CARRERA3	1-44 01 00	1-44 01 05
CARRERA5	1-44 02 00	1-44 02 05
CARRERA6	1-44 02 50	
CARRERA10	1-44 03 00	1-44 03 05
CARRERA12	1-44 03 50	
FPS 3	1-44 07 50	1-44 07 55
FPS 3 (for CF HV Feedthrough)	1-44 06 50	1-44 06 55
FPS 3.2 (for simultaneous evaporation)	1-44 07 60	1-44 07 65
FPS 3.2 (for CF HV Feedthrough, sim. evap.)	1-44 06 60	1-44 06 65

Model	Part-Number
GENIUS	1-44 08 00
GENIUS w. GRC card	1-44 08 10
GENIUS PRO	1-44 09 00
GENIUS PRO w. GRC card	1-44 09 10
Gun Rotation Card GRC	1-44 08 50
Filament Switch Card FSC	1-44 08 51
Stepper Motor Control SMC	1-44 08 60
LAN Integration Card LIC	1-44 08 70

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