
19" / 4U High voltage power supply GPx 10 kW

x = n: Polarity negative; x = p: Polarity positive

Manual

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Attention!



- The unit must not be operated with the cover removed to avoid the possibility of lethal shock to the operator!
- We decline all responsibility for damages and injuries caused by an improper use of the module. It is strongly recommended to read the operator's manual before operation!

Note

All information in this document is subject to change without notice. We take no responsibility for any error in this document. We reserve the right to make changes in the product design without any notification to the users.

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1. Safety instructions

This High Voltage Power Supply has to be installed by skilled personnel only. Following instructions are made for the personal safety of the operator, the safe use of this product and the connected units.



Warning



Dangerous Voltage

This unit is supplied from 3-phase mains voltage and generates an output voltage up to 23 kV!

The disregard of this voltage condition can cause death, heavy injuries or material damage.

Before connecting to the local mains it must be proofed that the nominal line voltage of this unit is equal to the local mains.

The power input has to be fused with 25 A slow.

Caution: After system-assembly the guard connections have to be checked if they are connected correctly!

The HV cable has to be connected to the load properly and isolated with according proof-voltage. An air flow rate of 360 m³/h has to be guaranteed under any circumstances. Therefore do not cover any air input and output slots.



Warning

Before the cover of the unit will be removed the mains connection has to be disconnected, the discharge time of at least (> 3 min) of the output capacitance has to be kept and the discharge status has to be checked afterwards.

Only skilled and authorised people are allowed to do any service, repair or maintenance for this unit.

2. Functional description

Depending on the chosen unit the GPx 10 kW provide a high stable output voltage up to 20 kV or 10 A and is powered by a three-phase mains voltage (400 V - AC \pm 10%).

The unit can be controlled using analogue voltages of 0 V to 5 V for setting and read back of output voltage and current which are connected via a D-Sub 9 connector. The INHIBIT Pin is used to stop generation of high voltage. Various LEDs show the current operating mode of the unit.

A reference-voltage output with 5.15 – 5.2 V can be used for direct connection of two potentiometers (\geq 20 k Ω) to the set inputs

In the following, the working principle will be described:

Next to the mains net connection there is an internal filtering circuit. A three-phase electric contactor is separating the filtering circuit from the rectifier and the start-up-peak limitation.

The rectifier provides an intermediate circuit voltage which is buffered by an electrolytic capacitor battery. This voltage is transformed into a controllable sinusoidal AC-Voltage by an inverter with connected sine-resonance circuit. The following HV transformer with the connected rectifiers provides an output voltage corresponding to the external Set-voltage. Output voltage and current are measured with the help of high precision voltage dividers or a shunt and feed back to the regulating circuit. A damping resistor connected to the output capacities is limiting the output current during a load change or ARC.

The regulating circuit controls and limits the output voltage and current corresponding to the setting values. Monitor voltages for voltage and current are provided for read back. The regulating circuit is also monitoring the input voltage and the temperatures of cooling air and single components.

An ON/OFF circuit breaker is located on the front panel of the unit. The three-phase electric contactor is controlled via an Interlock-loop.

3. Technical Data

19" / 4U GPx ¹⁾ 10 kW	GPx ¹⁾ 010 109	GPx ¹⁾ 020 508	GPx ¹⁾ 050 208	GPx ¹⁾ 100 108	GPx ¹⁾ 200 507
Output voltage V _{OUTmax} [kV]	1	2	5	10	20
Output current I _{OUTmax} [A]	10	5	2	1	0.5
Output power P _{OUTmax} [kW]	10				
Efficiency	> 93% (P _{OUTmax})				
Svoltage stability	$\Delta u < 0,1\% * V_{OUTmax} (\Delta V_{IN}, 0 \leq I_{OUT} \leq I_{OUTmax})$				
Current stability	$\Delta i < 1\% * I_{OUTmax} (\Delta V_{IN} \text{ and short cut} \leq R_{LOAD} < \text{open circuit})$				
Ripple and noise	Voltage control: $\Delta u < 1\% * V_{OUTmax}$ Current control: $\Delta i < 2\% * I_{OUTmax}$				
Polarity, factory fixed	positive or negative				
HV-connection	GES HV-socket (Type HB 21 T)				
Control (REMOte) aIF	isolated analogue I/O V _{SET/MON} = 0 V to 5 V				
Supply voltage	V _{IN} = 3 x 400 V – AC ± 10% / I _{IN} = 21 A fused with 3 x 25 A / F, start-up peak limited internally to ca. 25 A				
Dimensions / Weight	4U – 19" / depth: 500 mm / ca. 25 kg				
Cooling	Forced cooling with integrated fan (≤ 360 m ³ /h)				
Protection	ARC, three-phase mains voltage, overload, overvoltage, short cut, temperature, Interlock				
Working conditions	temperature: 0°C to 50 °C humidity: 30% to 80%, no condensation				
Storage temperature	-10°C to 80°C				
Output capacity [µF]	10,0	2,5	0,4	<0,1	<0,1
Damping resistor [Ω]	<1	<2	10	40	250
Voltage ramp [kV/s], factory fixed	0,3	0,5	1,3	2,5	5

4. Pin-assignment

4.1 Sub-D-9 Plug

Pin	Sub-D-9 Stecker	
1:	GND	
2:	V_{I-MON}	current-Monitor
3:	INHIBIT	LOW ($\leq 2\text{ V}$) = active: $\Rightarrow V_{\text{OUT}} = 0$ HIGH ($\geq 5\text{ V}$) / open: $\Rightarrow V_{\text{OUT}}$ corresponding to SET value
4:	V_{I-SET}	Current SET-value
5:	HV	HV ready indication
6:	GND1	SET and Monitor GND
7:	V_{V-MON}	Voltage-Monitor
8:	V_{V-SET}	Voltage SET-value
9:	V_{REF}	+5.15 – 5.2 V Reference-voltage

4.2 power line

3 shrouded terminals, dimensions $\leq 6\text{ mm}^2$
PE (earth), via earth stud M5

ATTENTION! : the neutral wire is NOT connected to the unit

5. Features

5.1. Remote control

Set-voltages

A voltage between 0 and 5 V at PIN 8 of the D-Sub 9 connector regulates the output voltage between 0 and 20 kV. At PIN 4 there is the control of the output current between 0 and 10 A , also with 0 to 5 V. These voltages should be related to PIN 6 (GND1).

Voltage and current can also be controlled using two external potentiometers ($\geq 20\text{ k}\Omega$) connected between PIN 8 or PIN 4 and the reference voltage of 5.15 V – 5.2 V at PIN 9. Connection examples are shown in figure 1.

Monitor-voltages

There are monitor voltage outputs for output voltage (PIN 7) and current (PIN2) wit 0 to 5 V corresponding to the output values. These voltages are also related to PIN 6 (GND1).

Attention! In case of no supply voltages the monitor voltages can be zero even if internal or external capacities are not discharged already.

INHIBIT

The high voltage generation can be stopped with an external Signal or a relais or switch on INHIBIT input (PIN 3). When the voltage level at PIN 3 is higher than 5 V or the PIN is not connected, high voltage generation is activated. At a level of lower than 2 V (or GND connection) the high voltage generation is deactivated. During a restart of the voltage generation after INHIBIT switch off, the set voltage is reached with maximum power or the set maximum output current respectively.

During start of the unit, the high voltage generation is deactivated regardless of INHIBIT function. If INHIBIT PIN is open or connected to high level during start of unit, the LEDs „ERR“ and „OVP“ are lighting (see chapter 5.5).

Attention! Inhibit function may not be used as Interlock for safety function

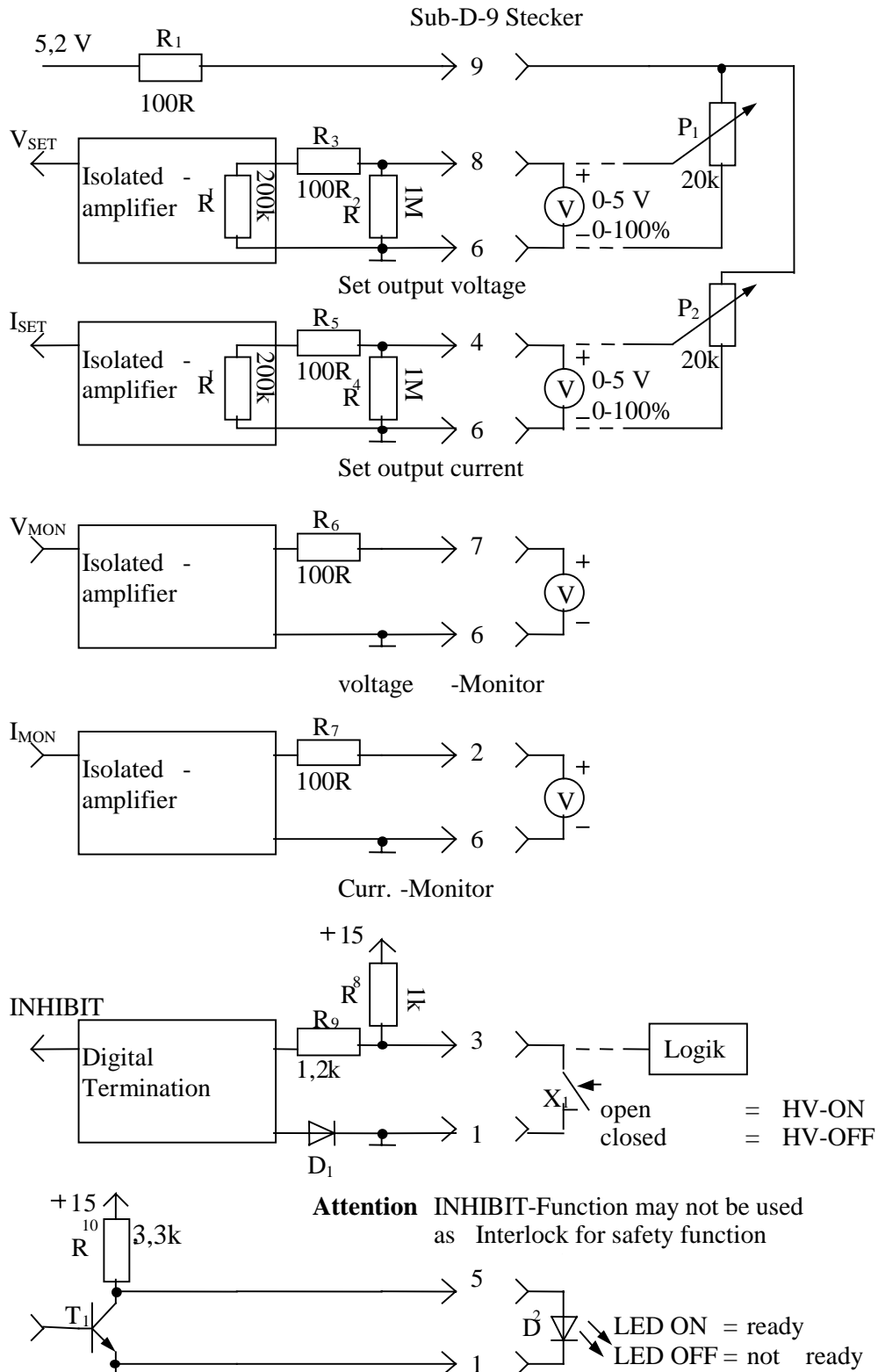


figure 1: working principle of Interface

HV

When high voltage generation is possible, a 4 mA current for driving of a LED will be available at PIN 5.

5.2 Protection

Voltage

The three-phase mains voltage and the internally used support voltages are monitored. If one of these voltages is out of its bounds, the high voltage generation is stopped. High voltage generation can only be restarted with a low-high flank of INHIBIT function.

The supporting circuit can also be working with two phases out of three only.

The maximum voltage value is monitored by the OVP-comparator. The threshold is set to 115 percent of maximum voltage at the factory. If threshold is reached (e.g. through a too high set value at PIN 8 or malfunction), high voltage generation is stopped. If HV was stopped by OPV-comparator, high voltage generation can only be restarted with a low-high flank of INHIBIT function.

Temperature

Temperature is monitored at several points within the unit. High voltage generation is stopped in case of external air temperature exceeds 50°C or internal temperature exceeds 80°C. High voltage generation can only be restarted with a low-high flank of INHIBIT function.

5.3 ARC-Management

High voltage generation is deactivated for 2 ms immediately after detection of an Arc. After this the voltage will be ramped up again and maximum voltage will be reached after 20 ms. Shut down of high voltage generation is initiated after detection of 25 Arcs within 5 s. After this event high voltage generation can only be restarted with a low-high flank of INHIBIT signal.

5.4 Interlock

If Interlock-Loop is opened, the three-phase electric contactor separates the rectifier from the mains net filtering circuit. Performance of supporting circuit is not affected through this.

5.5 LEDs

6 LEDs on front panel show current status of the unit:

- **ERR** LED is lighting if one of the following events is or was active:
 1. threshold (min/max) of at least one phase of three-phase input voltage exceeded
 2. threshold of a supporting voltage exceeded
 3. temperature threshold exceeded
 4. detection of 25 Arcs within 5 s
 5. maximum Value of output voltage exceeded
 6. INHIBIT open during switch On of unit

- **OVP** Over voltage protection, LED is lighting if one of the following events is or was active :
 1. maximum Value of output voltage exceeded
 2. INHIBIT open during switch On of unit

- **IL** Interlock, LED is lighting if Interlock-loop is closed

- HV HV ready indicator, LED is lighting if there is no ERR, Interlock-loop is closed and INHIBIT is open or high
- CV voltage regulation, LED is lighting if high voltage generation is active and unit is in voltage control mode
- CC current regulation, LED is lighting if high voltage generation is active and unit is in current control mode

6. Maintenance

For compliance of given accuracy of SET and MONITOR signals, the unit has to be recalibrated once a year.

Repair and maintenance may only be performed by skilled and authorized personnel.

7. Troubleshooting

- | | | |
|------------------------------------|---|---|
| No output voltage, No fan activity | ⇒ | - Check Supply voltage and connection |
| No output voltage, fan activity | ⇒ | - Check supply voltage
- check environmental temperature ($T_U \leq 50^\circ\text{C}$)
- Check SET voltages
- Check INHIBIT
- Check LEDs „ERR“ or „OVP“
- Check Interlock-loop |

If none of this actions has a result, the unit must be inspected by an authorized agent or must be shipped back to manufacturer for investigation