Via Acquanera, 29 22100 COMO
tel. 031.526.566 (r.a.) fax 031.507.984
info@calpower.it www.calpower.it

high voltage iseg Spezialelektronik GmbH

Manual

High Voltage Power Supply

Device Class GPS (KPS), 350 W, Compact

iseg Spezialelektronik GmbH
Bautzner Landstr. 23
D - 01454 Radeberg/ Rossendorf

Email: sales@iseg-hv.de
http://www.iseg-hv.de

Tel ++ 49 (0)351 / 26 996 - 0
Fax ++ 49 (0)351 / 26 996 - 21

Attention

The unit must not be operated with the cover removed to avoid the possibility of lethal shock to the operator!

There are no user maintainable parts inside the power supply!

Unit may only be operated with protective ground conductor connected.

We decline all responsibility for damages and injuries caused by an improper use of the device. It is strongly recommended to read the manual before operation!

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.

Warning! **notes in the text call attention to hazards in operation of these units that could lead to possible injury or death.**

Caution! **notes in the text indicate procedures to be followed to avoid possible damage to equipment.**

Revision: 2013-08-19 eng

Table of Contents

List of Figures

List of Tables

1 Safety instructions

This High Voltage Power Supply has to be installed by trained and qualified personnel only.

Following instructions are made for the personal safety of the operator, the safe use of this product and the connected devices.

Warning!  **High voltage power supplies of the device class GPS (KPS), 350 W, Compact are supplied from single phase mains voltage and generate an output voltage up to 70 kV. The disregard of this voltage condition can cause death, heavy injuries or material damage.**

Before connecting to the local mains it must be made sure that the nominal line voltage of this unit matches to the local mains.

The power input has to be fused with not less than 6.3 A, with slow delay.

After system assembly the connections with the protective ground have to be checked for proper connection!

The HV cable has to be connected to the load properly and isolated according to proof-voltage.

The shield of the HV cable is always connected to the housing.

An air flow rate of 70 m³/h has to be guaranteed under any circumstances. Therefore do not cover any air input or output slots.

The unit can be installed in a rack, with the provided fixing points. The maximum depth of engagement of M4 screws is 5 mm.

If the unit is used as a desk top instrument, the enclosed distance pieces have to be installed at the bottom side of the unit. The minimum distance between the unit and the installation surface has to be 10 mm.

Warning!  **It is strictly forbidden to remove the cover of the power supply, to avoid the possibility of lethal shock to the operator! Before operations at the load or the high voltage output of the power supply are started, the high voltage output of the power supply must be properly grounded.**

2 Technical data

Table 2.1: Technical data, device class GPS (KPS), 350 W, compact

Device class GPS (KPS), 350 W, Compact														
Output power P_{nom} [W]		350												
Output voltage V_{nom} [kV]		1	2	3	5	8	10	15	20	25	30	40	50	60	70
Output current I_{nom} [mA]		350	150	120	70	45	35	23	18	14	12	9	7	6	5
HV-connector		GES HB11		Shielded HV-cable								Special connector			
Polarity		x, n → negative or p → positive													
Efficiency		> 80% (V_{in} = 230 V)													
Ripple and noise (GPS)		$\Delta v_{out} < 0.2\% * V_{nom}$ (> 10 Hz)													
Stability		$\Delta v_{out} < 0.01\% * V_{nom}$ (for 8 h with constant conditions, after ½ h warmup)													
Voltage regulation		$\Delta v_{out} < 0.02\% * V_{nom}$ (Δv_{in}, $0 \le I_{out} \le I_{nom}$, $5\ V \le V_{out} \le V_{nom}$)													
Current regulation		$\Delta I_{out} < 0.2\% * I_{nom}$ (Δv_{in}, $5\ V \le V_{out} \le V_{nom}$)													
Accuracy		Voltage: < 1% ∗ V_{nom} for one year Current: < 1% ∗ I_{nom} for one year													
Temperature coefficient		< 2 ∗ 10^{-4} /K													
Remote control	AIO	Analogue signals								Level	0 V – 5 V				
		Digital signals								Low level High level	0 V – 1 V 3.5 V – 5 V or open				
Supply		V_{in} = 85 V – 264 V AC (PFC) I_{in} = 1.8 A (V_{in} = 230 V, P_{nom}); I_{in} = 3.9 A (V_{in} = 115 V, P_{nom}) Line frequency 47 Hz < f_l < 63 Hz Internally fused with 2 x 6.3 A with slow characteristic Inrush current approx. 25 A													
Cooling		Forced cooling with integrated fans (≤ 70 m³/h)													
Monitoring		Single phase mains voltage, auxiliary voltage, over voltage, temperature													
Working conditions		Temperature: 0°C to 50 °C Humidity: 20% to 90%, no condensation													
Storage conditions		Temperature: -25°C to 80 °C Humidity: 20% to 90%, no condensation													
Electromagnetic compatibility	Emission	EN 55011 (curve B)													
	Immunity	EN 61000 4-2, EN 61000 4-3, EN 61000 4-4, EN 61000 4-8													
Safety standard		EN 61010-1 (VDE 0411)													
Dimensions, Weight		1 kV ≤ V_{nom} ≤ 30 kV: 254 / 81 / 254 mm³, ca. 3.0 kg 30 kV < V_{nom} ≤ 70 kV: 254 / 106 / 254 mm³, ca. 3.5 kg													
ARC Management		Fixed ARC parameters (ARC-Number, ARC-Wait time, ARC-Ramp time)													
Series KPS		Very low output voltage overshoot													

2.1 Electrical wiring of the high voltage output

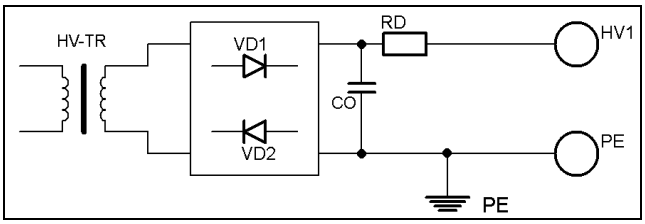

Figure 2.1: Electrical wiring of the high voltage output

2.2 Dimensions

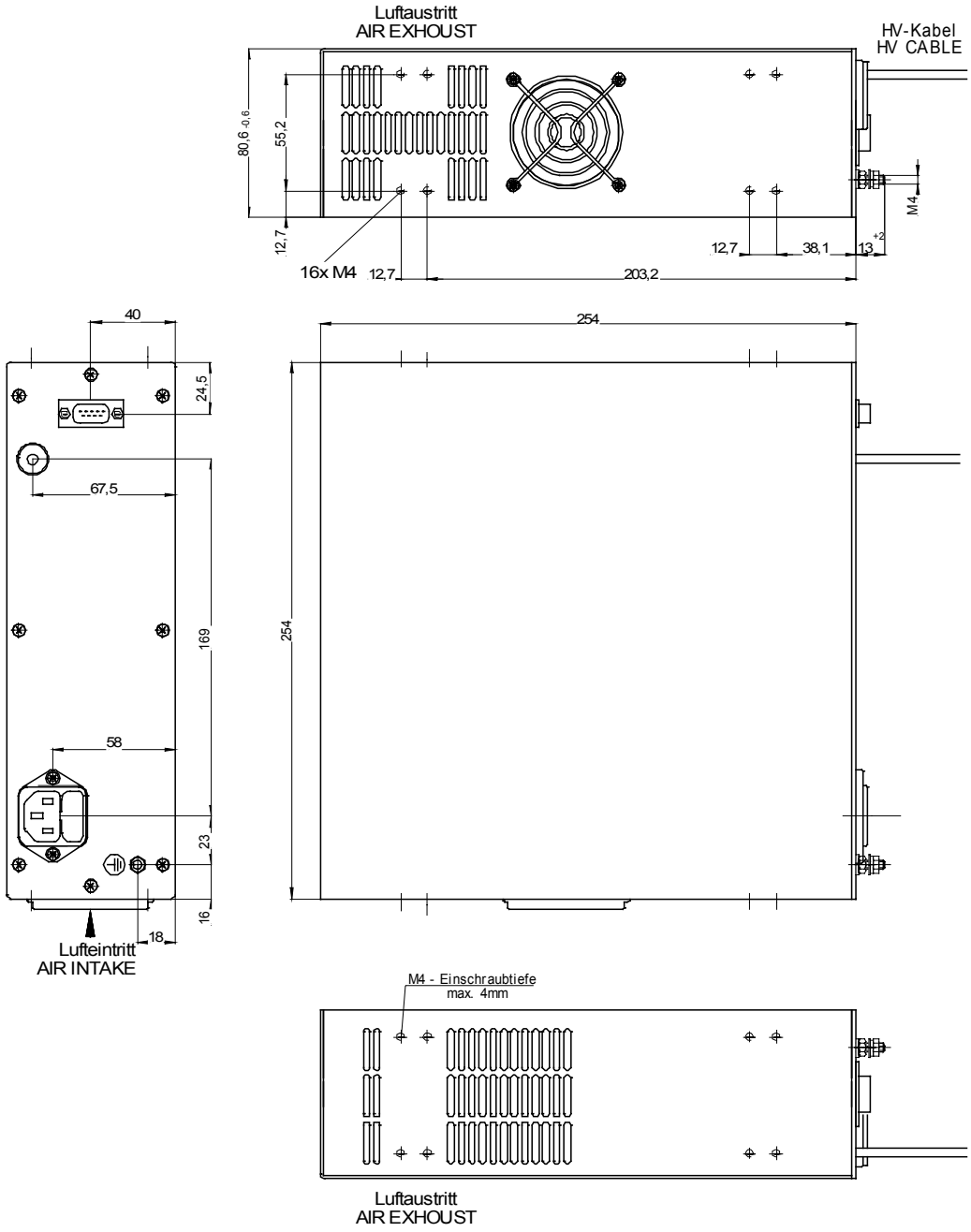

Figure 2.2: Dimensioned drawing (in mm), 1 kV ≤ V_{nom} ≤ 30 kV

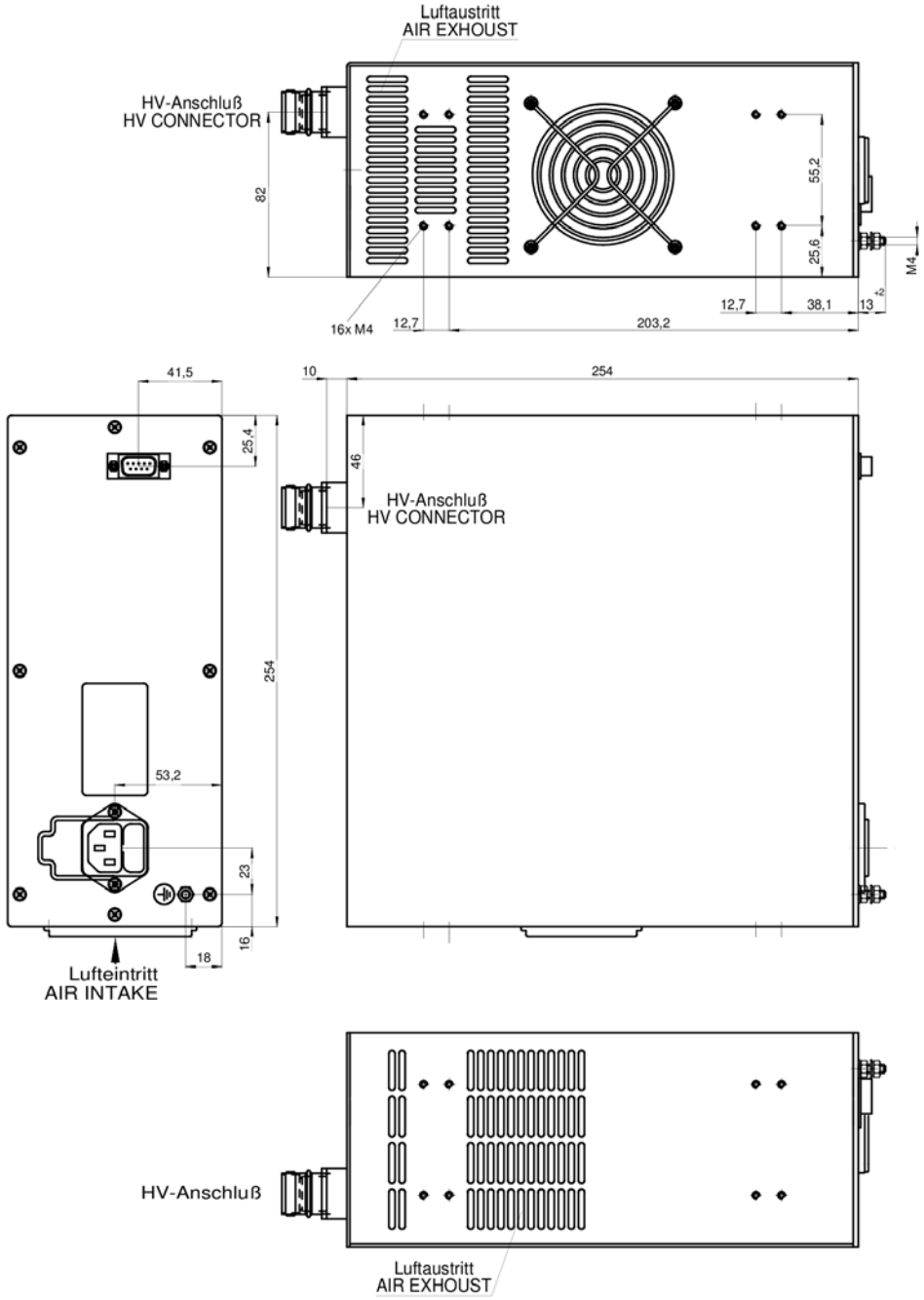

Figure 2.3 Dimensioned drawing (in mm), 30 kV < V_{nom} ≤ 70 kV

3 Functional description

High voltage power supplies of the device class GPS (KPS), 350 W, Compact are supplied from single phase mains voltage and generates an output voltage up to 70 kV as well as an output current up to 350 mA.

The unit can be controlled via one D Sub 9 connector with analogue and digital signals. The INHIBIT function is used to disable and block the generation of high voltage.

In the following, the working principle of the power supply will be described:

Next to the mains there is a EMI/RFI filter, which feeds the power factor correction unit (PFC) and the inrush current limitation circuit. The PFC draws sinusoidal currents from the mains, which are in phase with the supply voltage. Furthermore the PFC provides a DC link voltage, that is buffered by an electrolytic capacitor battery. An inverter with a connected resonance circuit transforms the DC-Link voltage into a controllable sinusoidal voltage. The HV transformer and HV rectifier provide an output voltage corresponding to the external set voltage. Output voltage and current are measured by high precision voltage dividers and a shunt and are fed back to the control circuit. A damping resistor connected to the output capacitance limits the output current during a load change or ARC.

High voltage power supplies of this class work with a fixed switching frequency. The output parameters are controlled via a pulse width modulation (PWM).

The control circuit controls and limits the output voltage and current corresponding to the set values. Normalized monitor voltages for voltage and current are provided for read back. The control circuit is also monitoring the input voltages, auxiliary voltages and the temperatures of cooling air and single components.

An ARC-management with fixed parameters is installed in the power supply.

4 Features

4.1 Operation states

The device is remote controlled via the analogue interface. Figure 4.1 shows the operating area of the device. There are two modes for high voltage generation:

1. Constant voltage control CV:
   Control of output voltage according to set value V_{Vset} ($V_{Imon} < V_{Iset}$).
2. Constant current control CC:
   Control of output current according to set value V_{Iset} ($V_{Vmon} < V_{Vset}$).

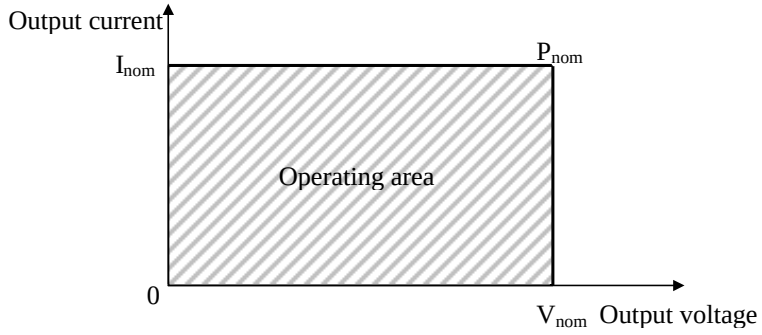

Figure 4.1: Operating area of the device.

4.2 Monitoring

Voltage

The single phase mains voltage and the internal auxiliary voltages are monitored. If one of these voltages is out of it's limits, the high voltage generation is stopped.

For devices of the class KPS, the maximum voltage value is monitored by the OVP-comparator. The threshold is set to approx. 110 percent of nominal voltage at the factory. If this threshold is reached (e.g. through an internal defect), high voltage generation is stopped.

The output power of the unit will be reduced, if the input voltage is smaller than 95 V_{AC} (see Figure 4.2).

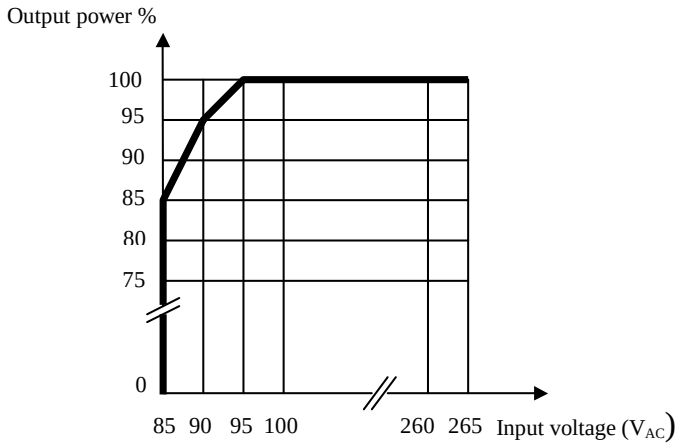

Figure 4.2: Power reduction vs. input voltage

Temperature

Temperature is monitored at several points within the unit. High voltage generation is stopped in case the external air temperature exceeds 55°C or internal temperature of several modules exceeds a predefined limiting value.

Warning! **High voltage generation is released, if the monitored temperatures are again in their allowed limits.**

4.3 ARC Management

The HV power supply is equipped with an ARC Management. Figure 4.3 shows the working principle of the ARC Management.

An ARC is defined as an output current greater than $1.5 * I_{nom}$.

After an ARC was detected, the control signals of the inverter are blocked within some µ-seconds for the blanking time (ARC-Wait, $t_{ARC\text{-}Wait} = t_1 - t_0$).

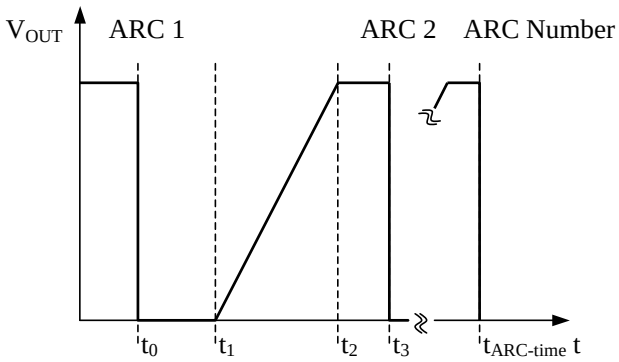

Figure 4.3: ARC Management

At the same time, the internal set value for the output voltage is set to 0. At the time instance $t = t_1$, the internal set value of the output voltage is increased with the voltage ramp (ARC-Ramp).

The parameters of the ARC-Management are shown in Table 4.1.

Table 4.1: Parameters of the ARC Management

	GPS	KPS ($V_{nom} \leq 2$ kV)	KPS ($V_{nom} > 2$ kV)
ARC-Number / second	1	10	5
ARC-Wait	200 ms ± 10%	12 ms ± 10%	25 ms ± 10%
ARC-Ramp time	800 ms ± 10%	88 ms ± 10%	175 ms ± 10%

5 Pinout

5.1 Supply

The unit is connected to mains net using the power connector on the front panel.

5.2 HV connection

The unit has one HV output. The HV cable has to be connected to the load properly and isolated according to proof-voltage.

5.3 AIO connection

See section 6 Analogue I/O interface (AIO).

6 Analogue I/O interface (AIO)

All control inputs and outputs are located at the male D Sub 9 connector labelled “AIO” on the front side of the device. The pin assignment of this connector is described in the following table.

Table 6.1: Pin assignment male D Sub 9 connector

AIO, male D Sub 9 connector			
Pin 1	GND		Return of pins 2-9
Pin 2	V_{Imon}	(0 .. 5 V)	Monitor output current
Pin 3	INHIBIT		Digital input signal
Pin 4	V_{Iset}	(0 .. 5 V)	Set value output current
Pin 5	ON		Digital input signal
Pin 6	GND		Return of pins 2-9
Pin 7	V_{Vmon}	(0 .. 5 V)	Monitor output voltage
Pin 8	V_{Vset}	(0 .. 5 V)	Set value output voltage
Pin 9	V_{ref}	5.1 V	Reference

Figure 6.1 shows the electrical wiring of the analogue and digital in- and outputs.

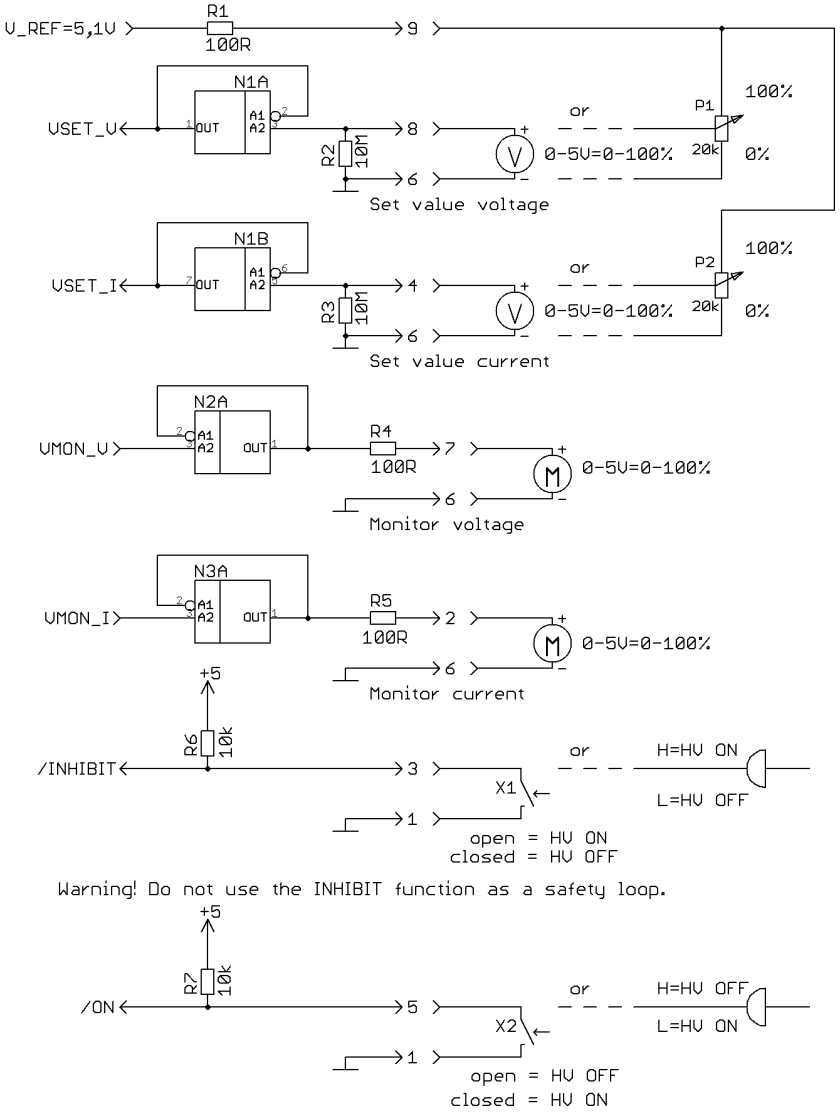

Figure 6.1: Electrical wiring of the analogue and digital in- and outputs

The high voltage is turned on/off with the analogue interface control signals “ON” and/or “INHIBIT”.

Set values

A voltage between 0 - 5 V at Pin 8 (reference potential Pin 6) of the connector “AIO” controls the output voltage between 0 – V_{nom}. Similarly, at Pin 4 the output current is controlled between 0 - I_{nom}.

Monitor voltages

Monitor voltages (0 - 5 V) proportional to the output voltage and output current are available at Pin 7 and Pin 2 of the connector “AIO”, respectively (reference potential Pin 6).

INHIBIT

By applying a low level signal at pin 3 of the connector “AIO“, the high voltage generation will be shut off immediately and will be blocked. High voltage generation is activated with a high level signal or open contact at pin 3 of the connector “AIO“.

Warning! **Do not use the INHIBIT function as a safety loop.**

By applying a low level signal at Pin 5 of the connector “AIO“, the high voltage ramps down with the specified voltage ramp speed.

After a rising edge of a signal at pin 5 of the connector “AIO“ the output voltage increases with the ramp speed or the given output current to its set value (V_{Vset} Pin 8 of the connector “AIO”) or until the set value of the output current is reached (V_{Iset} Pin 4 of the connector “AIO”).

7 Errors

Table 7.1: Errors

Unit does not provide output voltage and the fan is not working	⇒	- Check supply voltage and connection
Unit does not provide output voltage but the fan is working	⇒	- Check supply voltage - Check environmental temperature ($T_U \leq 50°C$) - Check control - Check INHIBIT function
External fuses trip during switch on.	⇒	- Use fuses with slow characteristic (inrush current 25 A)

If these instructions do not lead to a good result, this unit must be checked by an authorised agent or shipped to the factory.

8 Maintenance

For compliance of the specified accuracy of set and monitor signals, the unit has to be recalibrated once a year.

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