

Manual

High Voltage Power Supply Device Class GPS, 300 W / 800 W



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.**

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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, 300 W / 800 W are supplied from single phase mains voltage and generate an output voltage up to 15 kV (800 W device class) and 30 kV (300 W device class). 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 (300 W device) and 10 A (800 W device), with slow delay.

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

Warning!



For output voltages greater than 6 kV a LEMO-HV connector is used for the HV output. It is forbidden to switch on the device without a plugged in and fixed appropriate counter part.

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. It can be used as return if the connectors "0V" and "PE" are short circuited.

If the short circuit between the connectors "0V" and "PE" is removed, as return an additional wire has to be used. This wire has to be connected with "0V". The potential between the connector "0V" and the protective ground can be ± 400 V.

Warning!



The user has to ensure that no danger will occur because of the voltage between the return conductor and the protective ground!

Warning!



The control unit has the same potential as the connector "0V".

If the potential between the return conductor and the protective ground will be larger than $|400|$ V then the connectors will be short circuited via an electronically protection circuit to avoid damages of the power supply.

An air flow rate of 20 m³/h has to be guaranteed under any circumstances. Therefore do not cover any air input or output slots.

If the device is used as a desk top instrument, the enclosed distance pieces have to be installed at the bottom side of the device.

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, 300 W, 19"/1U

Device class GPS, 300 W, 19“/1U											
Output power P _{nom} [W]		300									
Output voltage V _{nom} [kV]		1	2	3	4	6	8	12	15	20	30
Output current I _{nom} [mA]		300	150	100	75	50	35	25	20	15	10
HV-connector		SHV					LEMO ERA1Y 660.0750-1			LEMO ERA3Y 660.0750-1	
Polarity		n → negative or p → positive									
Efficiency		> 80% (V _{in} = 230 V)									
Ripple and noise		ΔV _{out} < 0.01% * V _{nom} (> 10 Hz)						ΔV _{out} < 0.05% * V _{nom} (> 10 Hz)			
Stability		ΔV _{out} < 0.01% * V _{nom} (for 8 h with constant conditions, after ½ h warmup)									
Voltage regulation		ΔV _{out} < 0.01% * V _{nom} (ΔV _{in} , 0 ≤ I _{out} ≤ I _{nom} , 5 V ≤ V _{out} ≤ V _{nom})									
Current regulation		ΔI _{out} < 0.2% * I _{nom} (ΔV _{in} , 5 V ≤ V _{out} ≤ 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		0 V – 1 V		
							High level		3.5 V – 5 V or open		
Supply		V _{in} = 85 V – 264 V AC (PFC) I _{in} = 1.7 A (V _{in} = 230 V, P _{nom}); I _{in} = 3.5 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 (≤ 10 m³/h)									
Monitoring		Single phase mains voltage, auxiliary voltage, over voltage, temperature									
Working conditions		Temperature:		0°C to 35 °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		1U – 19" depth: 410 mm, ca. 4.8 kg									
Maximum complete discharges (ARC) per time		1/s									
Option Capacitor charger		Very low output voltage overshoot									
Electrically isolated return of the high voltage		Potential difference between return conductor and protective ground up to ± 400 V									

Table 2.2: Technical data, device class GPS, 800 W, 19"/1U

Device class GPS, 800 W, 19“/1U									
Output power P _{nom} [W]		800							
Output voltage V _{nom} [kV]		1	2	3	4	6	8	12	15
Output current I _{nom} [mA]		800	400	250	200	130	100	65	50
HV-connector		SHV					LEMO ERA1Y660.0750-1		
Polarity		n → negative or p → positive							
Efficiency		> 85% (V _{in} = 230 V)							
Ripple and noise		ΔV _{out} < 0.01% * V _{nom} (> 10 Hz)						ΔV _{out} < 0.05% * V _{nom} (> 10 Hz)	
Stability		ΔV _{out} < 0.01% * V _{nom} (for 8 h with constant conditions, after ½ h warmup)							
Voltage regulation		ΔV _{out} < 0.01% * V _{nom} (ΔV _{in} , 0 ≤ I _{out} ≤ I _{nom} , 5 V ≤ V _{out} ≤ V _{nom})							
Current regulation		ΔI _{out} < 0.2% * I _{nom} (ΔV _{in} , 5 V ≤ V _{out} ≤ 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		0 V – 1 V	
						High level		3.5 V – 5 V or open	
Supply		V _{in} = 85 V – 264 V AC (PFC) I _{in} = 4.5 A (V _{in} = 230 V, P _{nom}); I _{in} = 9 A (V _{in} = 115 V, P _{nom}) Line frequency 47 Hz < f _l < 63 Hz Internally fused with 2 x 10 A with slow characteristic Inrush current ca. 25 A							
Cooling		Forced cooling with integrated fans (≤ 20 m³/h)							
Monitoring		Single phase mains voltage, auxiliary voltage, over voltage, temperature							
Working conditions		Temperature:		0°C to 35 °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)							
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Safety standard		EN 61010-1 (VDE 0411)							
Dimensions, Weight		1U – 19" depth: 410 mm, ca. 5 kg							
Maximum complete discharges (ARC) per time		1/s							
Option Capacitor charger		Very low output voltage overshoot							
Electrically isolated return of the high voltage		Potential difference between return conductor and protective ground up to ± 400 V							

2.1 Electrical wiring of the high voltage output

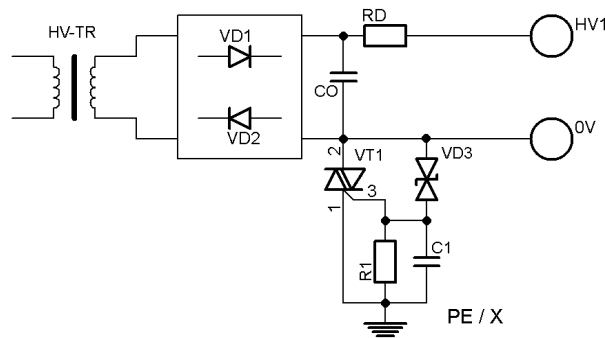


Figure 2.1: Electrical wiring of the high voltage output

2.2 Dimensions

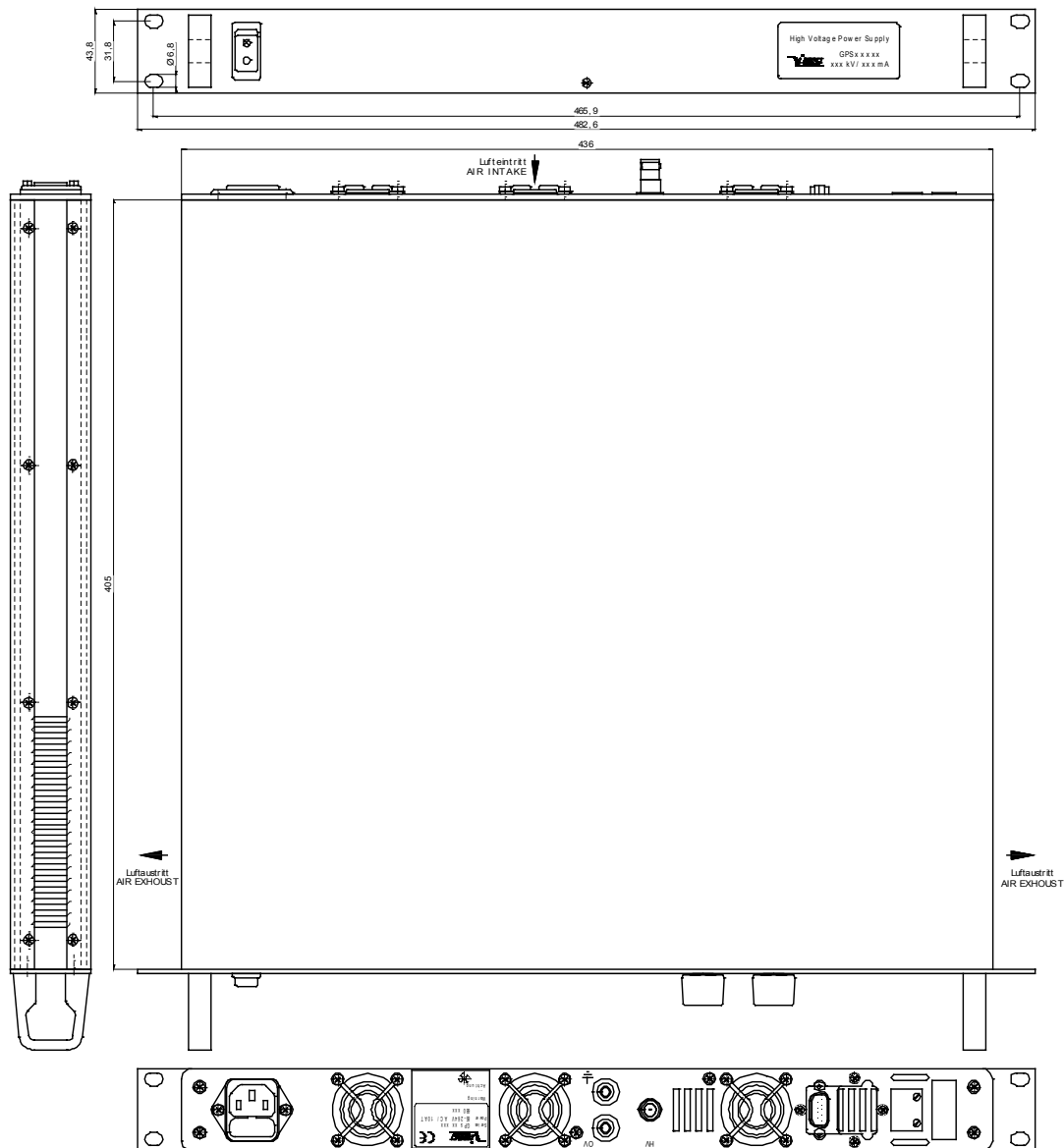


Figure 2.2: Dimensioned drawing, in mm

3 Functional description

High voltage power supplies of the device class GPS, 300 W / 800 W are supplied from single phase mains voltage and generates an output voltage up to 30 kV (300 W device class) and 15 kV (800 W device class) as well as an output current up to 300 mA (300 W device class) and 800 mA (800 W device class).

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.

The power supply is turned ON/OFF with a switch installed at the front panel of 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_{set_v} ($V_{mon_i} < V_{set_i}$).
2. Constant current control CC:
Control of output current according to set value V_{set_i} ($V_{mon_v} < V_{set_v}$).

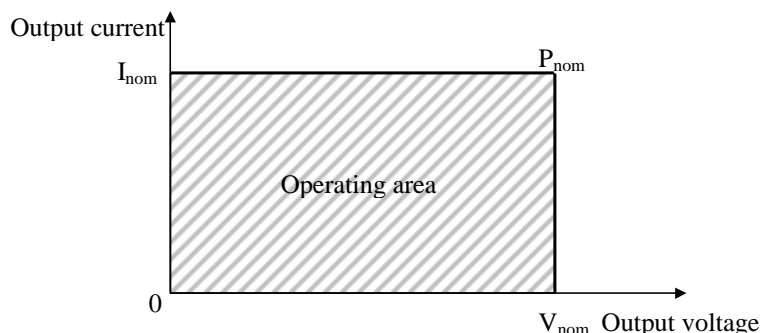


Figure 4.1: Operating area of the device.

4.2 Monitoring

Voltage

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

For devices of the class GPS with option capacitor charger, 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).

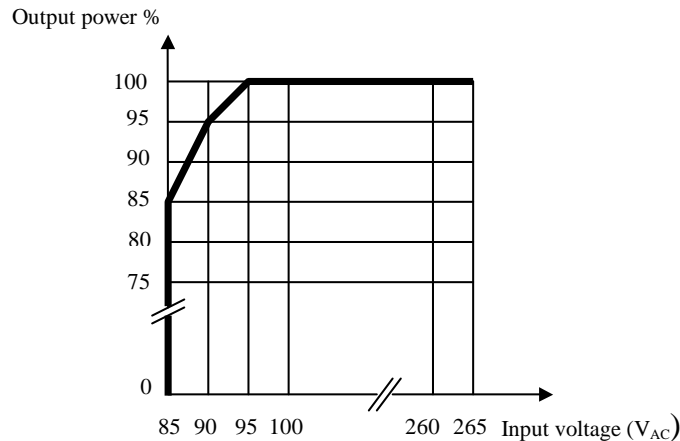


Figure 4.2: Power reduction vs. input voltage

Temperature

Temperature is monitored at several points within the unit. High voltage generation is stopped in case the external air temperature exceeds 35°C or internal temperature of several modules exceeds a predefined limiting value.

5 Pinout

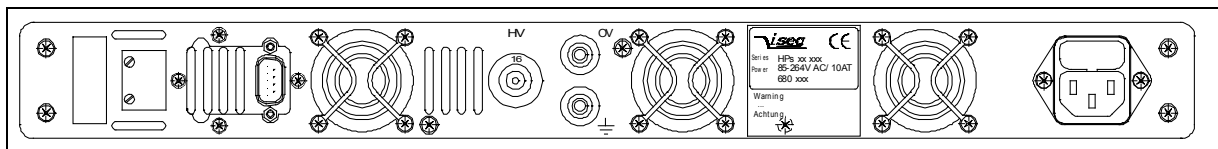


Figure 5.1: Back panel of the device

5.1 Supply

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

Warning!



For output voltages greater than 6 kV a LEMO-HV connector is used for the HV output. It is forbidden to switch on the device without a plugged in and fixed appropriate counter part.

The shield of the HV cable is always connected to the housing. It can be used as return if the connectors "0V" and "PE" are short circuited.

5.3 OV connection

If the short circuit between the connectors "0V" and "PE" is removed, as return an additional wire has to be used. This wire has to be connected with "0V". The potential between the connector "0V" and the protective ground can be $\pm 400\text{ V}$.

Warning!



The user has to ensure that no danger will occur because of the voltage between the connectors "0V" and "PE"!

Warning!



The control unit has the same potential as the connector "0V".

If the potential between the return conductor and the protective ground will be larger than $|400|\text{ V}$ then the connectors will be short circuited via an electronically protection circuit to avoid damages of the power supply.

5.4 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 back side of the device. The pin assignment of these connectors 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_{mon_i} (0 .. 5 V)	Monitor output current
Pin 3	INHIBIT	Digital input signal
Pin 4	V_{set_i} (0 .. 5 V)	Set value output current
Pin 5	ON	Digital input signal
Pin 6	GND	Return of pins 2-9
Pin 7	V_{mon_v} (0 .. 5 V)	Monitor output voltage
Pin 8	V_{set_v} (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.

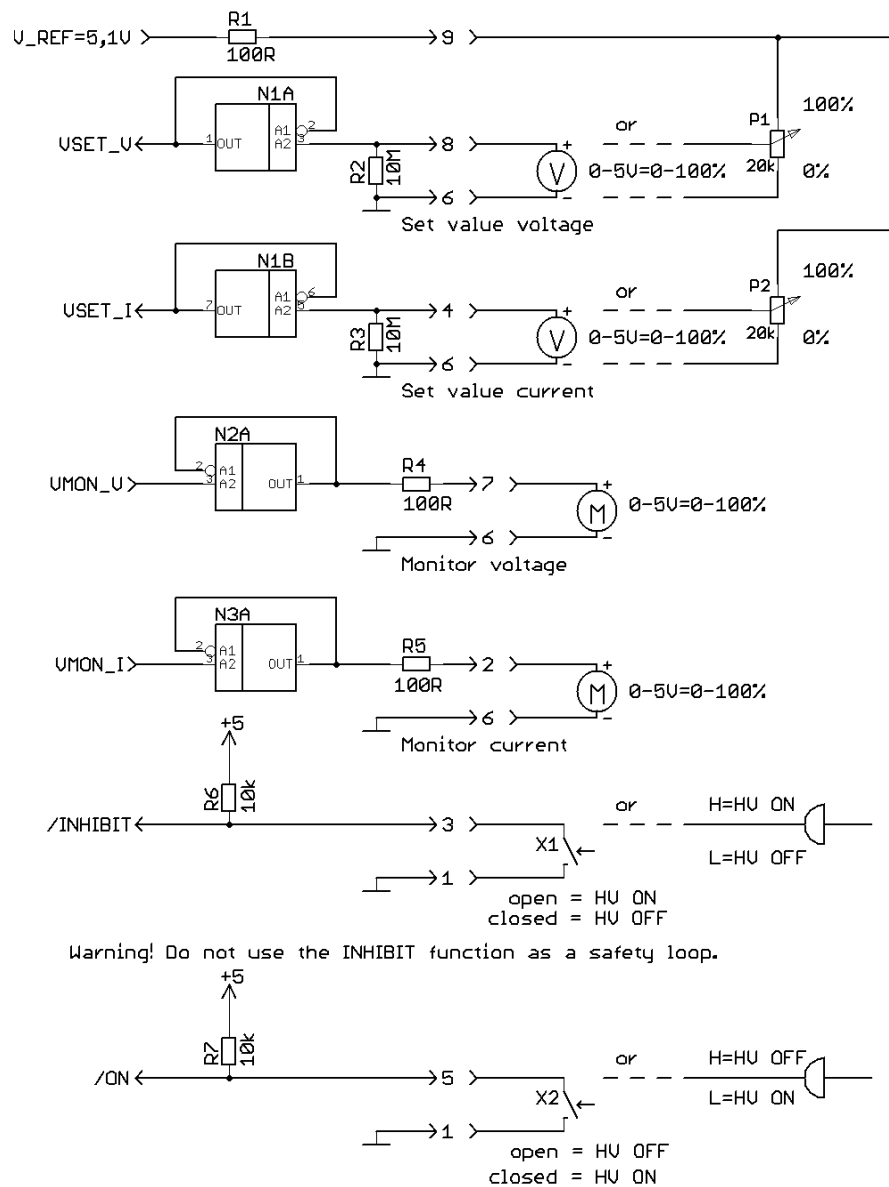


Figure 6.1: Electrical wiring of the analogue and digital in- and outputs

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_{set_v} Pin 8 of the connector "AIO") or until the set value of the output current is reached (V_{set_i} 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 ($T_u \leq 35^\circ\text{C}$) - 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.

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