

Low Voltage Power Supplies

NTN - Series

*Table-top and Plug-in units
up to power class 4200W*

***certified according to
DIN EN ISO 9001***

Operating Instructions

This instruction is only dedicated to electrical experts and people with a suitable technical education, which are familiar with electrical risks and can keep the risk for themselves and other people as low as possible.

For the operation of this unit only a.m. persons are admitted.

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1. Safety Instructions

Depending on type the units of the series NTN deliver voltages up to 350V and partly very high power!

Ensure that nothing, and nobody, will be endangered by this High Voltage before putting the unit into operation!

- Before putting into operation** Make sure that you have read and understood the operating instruction manual! Ensure that you observe all the hints and warnings contained within it. In not following the operating instructions, you contravene the safety regulations for operating units of this type. FuG accepts no liability for consequences arising from the failing to follow these safety instructions.
- Mains voltage** Check whether the input voltage for your power supply, noted at the type label, corresponds to your actual mains voltage.
- Output** The output terminals up to 20 A are connectors at the front panel. Higher nominal currents > 20A to 300A have clamps on the rear. For more than 300A copper bars are used.
Take care for adequate voltage and power connections!
- Earth** The unit is provided with a safety earth (German safety class I). For protection against electric shocks, the unit must be connected to the mains via a suitable 3, 4 or 5-pole cable with a non-fused earth conductor. For electrical potential equalization to the load, and to the center of the AC-supply, the earth stud must be used.
- Operating environment** The units may only be operated in a clean, dry environment. Please make sure that no objects or liquids can enter the casing through the ventilating aperture. Because of the risk of sparks, the unit should not be operated in the vicinity of flammable gases or fumes.
- Cooling** To ensure a adequate cooling, the ambient temperature should not exceed **40°C**. This unit is air cooled by convection or at units >140W by forced ventilation. Therefore, please ensure an adequate air-flow is available, and ensure that nothing is placed either above or below the unit which may impede this air-flow. Don't operate table top units without the mounted legs. Do not expose the unit directly to solar radiation.
If the unit is used as a plug-in component, sufficient air-flow must be provided, (1HU = 44,5 mm must be free above, below, left and right).
- Opening the unit** **Before opening, ensure that the unit is disconnected from the mains!** The unit may be opened by operating personnel only for the purpose of operating switches as described in the operating instructions, (e.g. address switch IEEE 488 bus, which is inside in some types).
- ATTENTION!** **The unit contains capacitors, which discharge only very slowly (typical discharge time 5 min) or, in worst case, do not discharge at all.**
For switch over use isolated tools only.
Maintenance or repair of this unit should only be carried out by trained service personnel who are aware of the inherent dangers of such equipment.

Symbols



Adhere strictly to the operating instructions before you either change switches, or connect sockets, marked with this symbol!



Symbol for HIGH VOLTAGE OUTPUTS



Symbol for chassis earth, potential safety earth.

2. General

The units of the series NTN (Transistor regulated with thyristor prestabilisation) are high stable DC- power supplies with low ripple.

Output

ATTENTION. Depending on type the units supply up to 350V output voltage and partly very high power !

Polarity

Both output terminals are floating (not with option analog programming), either the positive or the negative pole may be connected to earth.

Output Isolation

each output terminal may float against earth not more than ± 500 V.

Short-circuit Protection

All units are short-circuit proof. The maximum current can be supplied for all output voltages, even into a short-circuit.

Kind of Loads

The type of load is not critical. All passive linear controlled loads can be connected.

Series Connection

Power supplies of the series NTN may be connected in series, even with different nominal voltages. The center point has to be connected to earth.

Parallel Connection

Parallel connection is possible, an evenly current source is not given.

ATTENTION!

By serial connection of units with different nominal current and by parallel connection of units with different nominal voltages must be ensured, that the limit values of the weaker unit are not exceeded.

Type Number

From the type number you can see both the power class and the maximum output voltage of the unit.

Example: **NTN 350 - 65** = Power class 350W / Nominal voltage 65V

Modified types with differing electrical or mechanical data are indicated by a "M" within the type number, or are marked with a sticker

 "modifiziert " or  „MODIFIED“ (e.g. NTN 350M - 65).

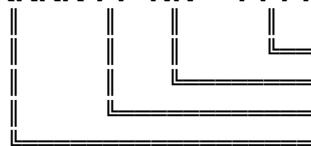
(In this case pay attention to the description in section 8. "Special Models")

Serial Number

The label on the rear of the unit, the technical manual and the circuit diagrams show the serial number.

It has the following content:

Serial.- No.: KKKKK-PP-NN YYYY/MM



Delivery Year / Month

Consecutive number out of this item

Item number

Internal order number

IMPORTANT

Please indicate on all further enquiries for warranty, service or spare parts orders the serial number, as well as the model number, of the unit.

2.1. Setup Information

Operating position	The units may only be operated in a horizontal position.
Pollution level	The units are designed for a pollution level 2. (Usual, non-conducting pollution).
Transportation	If the power supply is equipped with carrying devices or handles, the weight must be shared to these devices or handles for transportation.
EMC	The units are built according to the current standards.

2.2. Preparation for Installation

Mains Voltage	Check whether the input voltage for your power supply, noted at the type label, corresponds to your actual mains voltage.												
Earth, Safety Conductor	<p>The unit is provided with a safety earth (German safety class I). For protection against electric shocks, the unit must be connected to the mains via a cable with a non-fused earth conductor.</p> <p>up to 1400W : three-wire mains cable; from 2800W to 4200W : five-wire mains cable</p> <p>Cable assignment (at 400V connection two-phase / three-phase)</p> <table> <thead> <tr> <th>fife-wire cable: two-phase</th> <th>fife-wire cable: three-phase</th> </tr> </thead> <tbody> <tr> <td>black</td> <td>black = L1</td> </tr> <tr> <td>black</td> <td>black = L2</td> </tr> <tr> <td>(brown n.c.)</td> <td>brown = L3</td> </tr> <tr> <td>blue</td> <td>blue = N</td> </tr> <tr> <td>green/yellow</td> <td>green/yellow = PE, safety earth</td> </tr> </tbody> </table>	fife-wire cable: two-phase	fife-wire cable: three-phase	black	black = L1	black	black = L2	(brown n.c.)	brown = L3	blue	blue = N	green/yellow	green/yellow = PE, safety earth
fife-wire cable: two-phase	fife-wire cable: three-phase												
black	black = L1												
black	black = L2												
(brown n.c.)	brown = L3												
blue	blue = N												
green/yellow	green/yellow = PE, safety earth												
Return Current	<p>The return current must not flow back via mains earth!</p> <p>For electrical potential equalization to the load, and to the center of the AC-supply, the earth stud must be used</p>												
Fuses	<p>Internal: See type label.</p> <p>External: On mains side next higher size, characteristics <u>delay-action</u> or if automatic cut-out is used, characteristics "<u>G</u>" or "<u>K</u>".</p>												
Output Terminals	<p>Take care for an adequate power connection!</p> <p>Up to 20A nominal current the terminals are 4 mm safety connectors at the front panel.</p> <p>For nominal currents higher than 20A the terminals are clamps at the rear.</p> <p>Other connector terminals are only for measurement purposes.</p>												
Sense Terminals	<p>Sense terminals are measuring terminals, they have to be connected with separate lines directly to the load and will compensate the voltage lost on the power line.</p> <p>Sense lines have to be protected against electrical irradiation, otherwise the output voltage would be modulated. The line must be screened or twisted</p> <p>If an irradiation is not available, bypass capacitors (appr. 1µF) have to be connected between F+ and A+ as well as F- and A-</p>												
Attention:	A wrong connection of the sense lines can cause full output voltage, independent of the set value. <u>That would not be indicated by the DVM!</u>												

Use only safety connectors according to IEC 1010-1 or VDE 0110.

2.3. Description

NTN Power supply series are double stabilized. The thyristor regulation is followed by a transistor regulation. They will be delivered in 19" table-top cases. Rack adapters are available as accessories.

Features

Short-circuit proof, from 700W nominal power on starting current limitation, sense connectors, voltage and current control, indicators for operating mode

Options

Analog programming, isolated analog programming, computer interface's, higher stability, DVMs with higher resolution.

2.4. Assembly

The sub-unit TNRG... contains the control electronics.
The power final stages up to 140W are on the PCB TLG . . . ;
- stages with higher power are free wired.

2.5. Operating Mode

The mains voltage is transformed, pre-stabilized by a phase angle control circuit, rectified and filtered. The transistor power stage takes over the fast tuning. It can consist of a number of parallel connected power transistors. This control mode allows a very good efficiency. Beside the smoothing capacitors a dynamic circuit is provided with effect on the transistor output stage, to improve the residual ripple.

Voltage measuring

A precision voltage divider delivers the measuring voltage for the control circuit. The divided voltage will be normalized by an integrated amplifier to $\pm 10V = \pm V_{nominal}$.

Voltage control

The normalized voltage forms the actual value for the voltage control amplifier. The voltage control amplifier compares this voltage with the setting value (by voltage potentiometer divided reference voltage or extern programming voltage). The difference will be amplified and used as control signal for the serial regulation.

Monitor

The normalized actual value ($0 - 10V = 0 - nominal$ value) is also the reference for the measuring voltage to the monitor terminal (only by option external programming).

Current measuring

The current in the positive pole is flowing over the current shunt. This voltage drop also will be normalized by an integrated amplifier, ($10V = nominal$ current).

Current control

This normalized voltage is used as actual value for the current control and feeds also the current measuring instrument. The control amplifier for the output current control compares this voltage with the setting value. The difference will be amplified and used as control signal.

Overtemperature

Force cooled power component's are temperature monitored.

2.6. Thyristor Control

The thyristor controlled source mainly consists of the mains transformer, the mains chock, the controlled rectifier (depending on type middle point or bridge rectifier) and the filter capacitor.

The thyristors are triggered in a way, that the necessary voltage to balance the ripple on the series transistor is available, independent of the output voltage.

The ignition pulses for the thyristors are supplied from a pulse stage with ignition transformer. It is triggered by comparators. Their input voltages are a mains synchronized sawtooth signal and the output voltage of the control amplifier for the collector - emitter voltage.

To inhibit the ignition pulses several safety circuits intervene in the control amplifier.

2.7. Transistor Control

The transistor regulation mainly consists of the serial transistor(s), its driver(s), the current measuring shunt and the voltage measuring resistors.

The serial transistors are controlled by integrated amplifiers in such a way, that the output voltage or the output current is kept constant to the set values.

This regulation is based on 3 independent control loops (current, voltage, failure report sense terminal). In or-configuration always only one of them is active.

The actual values for current and voltage are normalized by control amplifiers and compared with the set values.

Set values are forming voltages, which have been divided from the internal reference voltage by adjusting potentiometers or by voltages from the external analog programming.

3. Operation

**Depending on type the unit delivers dangerously Output-Voltage and -Current!
Did you follow the safety instructions in Section 1.
Please notice in particular point 2.2. Output terminals .**

Internal Operation

If your power supply supports one of the options analog or digital programming, then set the switch for programming to "OFF".

Switching On

With the mains switch (at the left side of the front panel) you switch on the power supply. In switch-on condition the switch lights red

Voltage-and Current Adjustment

Voltage and Current adjustment by 10turn potentiometer at the front panel. Constant voltage mode or constant current mode is possible. .The operation mode is shown on LEDs. The transition occurs automatically

Control Mode Voltage Regulation

In this mode with potentiometer „Control set value“ an output voltage and with potentiometer „Limit set value“ a limit current can be adjusted symmetrically to zero.

Control Mode Current Regulation

In this mode sets the potentiometer „control set value“ the output current and the „limit set value“ a voltage limitation symmetrically to zero.

The transition from regulation to limitation occurs automatically.

The operation mode will be indicated by LEDs beside the potentiometers.

Wrong Adjustment

Not following these items the power supply delivers no output voltage or jumps into another control mode.

Remark:

No LED on = disturbed operation. Internal fuse defective?

Both LEDs on = possible, if current and voltage potentiometers are set to zero.

Thermo Switch

Further more the temperatures of the forced cooled, on heatsinks mounted power semiconductors are monitored. In case of a fault the unit switches off and the LED "overtemperature" is on. This status remains latched.

Sense Terminals

Sense terminals are provided in units **up to 350V nominal voltage**.

In switch position „sense off“ the sense terminals are connected to the output terminals.

In switch position „sense on“ the voltage at the sense inputs is measured and herewith directly at the load (power less) assumed the sense inputs are connected to the load.

Voltage drops on the load lines herewith will be compensated. Compensation till 5% of the nominal voltage, but min. 1 Vper line.

Safety circuit for wrong sense connection

At a not connected or reverse poled sense line an additional circuit is limiting the output voltage to 5% of the nominal voltage.
An interrupted load line causes the same limitation.

ATTENTION!

The voltage meter measures the voltage on the sense inputs. If they are not connected results no display of the remaining voltage.

Caution!

Wrong or not connected sense lines in switch position „sense on“ can cause an output voltage higher than the nominal value (max. 1,1 x Vnom). In this case the output voltage does not correspond to the value shown by the DVM!

ATTENTION!

If the unit is switched off or mains fails eventually existing output figures will **not** be displayed.

! Please pay attention to the discharging time !

3.1. Maintenance

Generally the series "NTN" does not need any special maintenance.

Filter Mats

Partly (depending on type) behind the fan cover are air filter mats, which have to be cleaned or exchanged depending on the air pollution.

4. Technical Data

All here stated data are valid for voltage and current control in internal operation.

Changes of the technical data with the options analog and digital programming see section 5.1.

AC - Input	230V ±10% 47 - 53 Hz or 400V ±10% 2 phase 47 - 53 Hz, depending on the type, see type label. Overvoltage category II according to IEC664. N-connection and PE (non fused earth) always necessary!
EMC Standards	for single phase systems EN 50 081 - 1 EN 50 082 - 1 Length of signal- and control lines ≤ 3m for two or three phase systems EN 50 081 - 2 EN 50 082 - 2
Safety	The units are in accordance with EN 61010 (VDE 0411)
Environment Conditions	Operating room : Only for indoor usage (see section 2.1.) Temperature : 0 °C to 40 °C Air humidity : Max. relative humidity 80% until 31 °C, linear decreasing until 50% relative humidity with 40 °C Atm press : Height until 2000 m over NN Contamination : 2, according to IEC664
Protection Class	IP20
Output Voltage / Current	See front panel of the power supply.
Output Polarity	potential free - each output terminal may be connected to earth.
Output Isolation	each output terminal may float up to ±500V with respect to earth.
Setting Range Voltage	0,1% to 100% nominal value
Current	0,1% to 100% nominal value
Reproducibility	± 1 x 10 ⁻³ from nominal value
Setting Resolution	With potentiometer at the front panel ±1x10 ⁻⁴ from nominal value
Ripple	< 1 x 10 ⁻⁴ pp from nominal value +10mVpp
Deviation	< ±1 x 10 ⁻⁵ from nominal value, for ±10% mains voltage variation < 2 x 10 ⁻⁴ from nominal value, for 0 to 100% load variation < ±1 x 10 ⁻⁴ from nominal value, over 8 h < ±1 x 10 ⁻⁴ /K from nominal value,
Recovery Time	
Voltage regulation	< 50µs for load variation from 10% to 100% or 100% to 10%
Current regulation	< 50 ms at < 10 % load variation, depending on type. Units from 65V nominal voltage on are switching off for a short period at larger load variations.
Setting Time	100 ms to 500 ms, depending on type, for changes of the output voltage from 10% to 90 % or from 90% to 10 %.
Discharging Time Constant at unloaded output	ATTENTION ! The discharging time constant unloaded output can last 2 s to 60 s, depending on type!
Display	DVM 3½ digits for voltage and current. Negative polarity will be indicated. At 20V, 200V or 20A, 200A nominal value the display is max. 1999 to reach the full display range. At the upper end value it may occur to an overflow of the display, than the display shows "1". LEDs for status report voltage-control / current-control / overtemperature.
ATTENTION!	<u>If the unit is switched off or mains fails eventually existing output figures will not be displayed.</u>
Starting Current Limitation	From 700W on standard.
Sense Terminals	Standard
Mechanics	Depending on type, changes reserved.

4.1. Calibration

Certificate of Calibration

All guaranteed data for our power supplies are tested in the factory and documented in an internal test protocol. Furthermore we offer within the scope of our DIN EN ISO 9001 certified quality system a calibration in our plant. The customer receives a certificate of calibration. We certify the output data and the compliance with our catalog data.

The blue calibration sticker refers to the next recommended date of calibration.

Subsequent Calibration

Generally we recommend an annual subsequent calibration.

4.2. Certificate of Conformity

CE

The power supply has the CE-sign.

The **EU certificate of conformity** confirms, that the units comply with the provisions of the Directive of European Union on the approximation of the laws of the Member States, relating to electromagnetic compatibility (89/336/EEC with the respective actual revision).

The conformity is proven by compliance with the following standards:
EN 50081-1; EN 50082-1 or EN 50081-2; EN 50082-2

Furthermore we comply the accordance with the "Low Voltage Directions" (electrical operating supplies to be used within certain voltage limits 73/23/EEC revised by 93/68/EEC).

The conformity is proven by compliance with the standard EN 61010.

5. Options

5.1. Programming (options)

External Operation

Select the operation mode with the programming switch at the front panel. Only the built-in options are selectable, other positions are blocked.

Analog Programming

Voltage and current can be adjusted with standardized analog signals (0 to 10 V) or by external potentiometers.

By a special internal wiring the operation intern/extern can be combined.

Analog Floating Programming

Like analog programming, but potential free.

Digital Programming

Control of the power supply via IEEE-488/IEEE-488.2 or RS232
see also section 5.1.3 and the optional operating manual for the PROBUS

5.1.1. Analog Programming (Option)

Set the switch for programming into position "ANALOG".

=> Controlling at front side disabled.

Programming via Sub-D15- connector at the rear is active.

ATTENTION!

The reference point "0V" (pin 6 or 9) for all external programming voltages is DC connected to the output terminal „A+“.

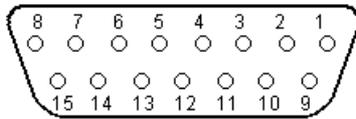
Depending on the load configuration the terminal „A+“ can float up to 500 V with respect to earth! The mating connector, the cable and all equipment's connected to the 0V potential must have the necessary dielectric strength of 500 V.

(a suitable connector with 500 V dielectric strength is included).

(Exception: Option "potential isolated programming" and "digital programming" see section 5.1.2. + 5.1.3.)

Cable Screening

The connection lines to the interface terminals must be screened. The screen has to be connected to the earth point of the connector. The mounting studs of the programming sockets lie on earth.



Pin configuration:

Solder side of the plug

1) I-Reg	Status report "Current control"	Regulating active Δ apx. +15V
2) U-Reg	Status report "Voltage control"	Regulating active Δ apx. +15V
3) I-MON	Monitor output current	0.. nominal Δ 0..+10V. $R_i = 10k\Omega$ (always positive, independent of the output polarity)
4) UPS	Slider of the potentiometer "voltage adjustment"	(not with "floating analog programming").
5) IPS	Slider of the potentiometer "current adjustment"	(not with "floating analog programming").
6) 0V-dig	Reference for digital signals	
7) n.c.		
8) U-Soll	Rated value for voltage adjustment (Input)	0..+10V Δ 0..nominal
9) 0V	Reference for analog signals	
10) +10VR	Reference voltage +10V	(against Pin 9 max. 2mA loadable).
11) U-Mon	Monitor voltage (Output)	0.. nominal Δ 0..+10V. $R_i = 10k\Omega$ (always positive, independent of the output polarity)
12) Ger.Ein	Power supply ON Connection with Pin 6 Δ ON	(Attention! Only Output-Voltage ON/OFF => No mains disconnection!)
13) n.c.		
14) n.c.		
15) I-Soll	Rated value for current limitation (Input)	0..+10V Δ 0..nominal

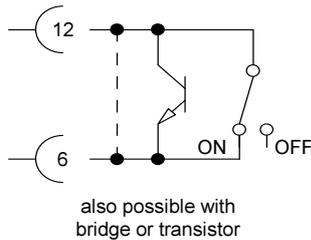
Remarks to setting voltage or current

An external control set value implicitly requires the wiring of the limit set value and vice versa..

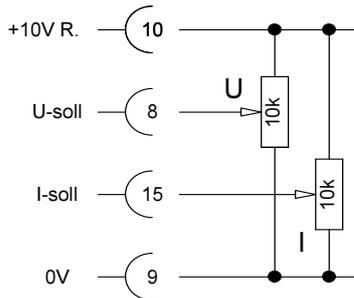
Also the ON/OFF- command (12-6) implicitly must be wired.

Examples for programming possibilities:

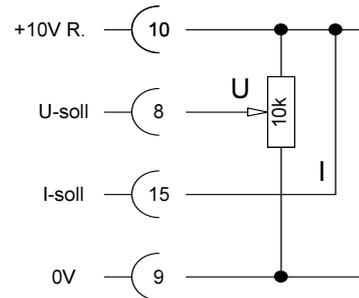
external potentiometers for current and voltage



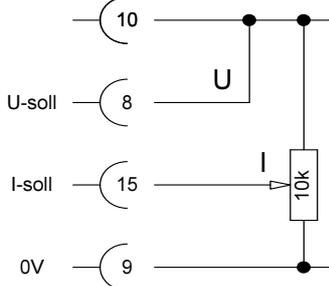
external potentiometer for voltage and current



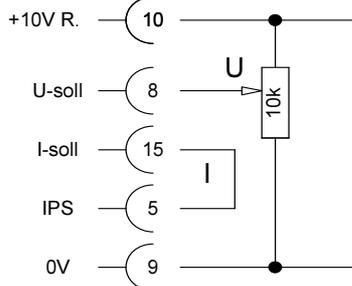
external potentiometer for voltage and current at maximum



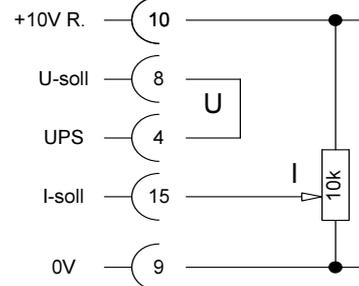
external potentiometer for current and voltage at maximum



external potentiometer for voltage and internal potentiometer for current



external potentiometer for current and internal potentiometer for voltage



The reference voltage of +10V or the set values may be provided alternatively also from other voltage sources. (connect 0V !)

No LED on:

Perhaps ON-command (12-6) not connected

For information only
(These switches are set to position "2" by the factory. They don't need to be changed usually.)

On the electronic board (remove side wall) you will find wire switches:
"A1" position "1" = pin 15 disabled
"A2" position "1" = pin 8 disabled
"A3" position "1" = pin 12 disabled

5.1.2. Analog programming potential free (Option)

Pin Configuration	Function and pin configuration corresponding to analog programming, but pins 4 and 5 are not connected.
Potential Isolated	The floating analog programming has no DC connection between the 0V-potential of the programming voltage and the output terminals. The output of the power supply is floating as described in section 2. The "0V" terminal of the programming interface may float $\pm 30V$ DC against earth.
Accuracy, Linearity, and Stability	$< \pm 5 \times 10^{-4}$ in relation to the nominal value (10V)
Temperature Coefficient	$< \pm 1,5 \times 10^{-4} /K$ in relation to the nominal value (10V); typ. $5 \times 10^{-5} /K$
ATTENTION	Floating the output > 500V DC by an external source, please note the following restriction for this external source: - max. stored energy 50Ws - max. current 10A

5.1.3. Digital Programming (Probus) (Option)

IEEE488; RS232	The microprocessor controlled computer interface IEEE488 / IEEE488.2- or RS232 allows a comfortable programming of the power supply.
Clear Text Programming	Set values, monitor values, status messages and ON/OFF-command can be set or read out by an external computer. For Details please see Operation Manual „Probus“
Resolution	Resolution 16 bit, plus polarity sign.
Programming Overview	If your unit has this option, you will find a programming overview IEEE488 and RS232 at NTN-units in the appendix.
Software Demo Programs	Enclosed you will find a floppy disc with a demo program running under "Windows" for a very simple programming. Moreover you will find examples for programming in "BASIC" and "TURBO PASCAL" on the disc.
Operating Instruction Probus	The factory sets the IEEE488 - interface to address "8" . More details you will find in the description "Probus ".

6. Accessories

6.1. Rack Adapter

19"- rack mounting adapters, different heights, fitting to table top units.

Attention! Before opening the power supply, disconnect from mains!
The front panel handles must be exchanged separately. (Please don't exchange together, because the front panel would not be fixed).
Is the power supply only be used as plug-in unit, the stands may be removed.
For that remove the bottom sheet and remove them using cross recessed screw driver and place back the bottom sheet.
Caution!! After removing the stands, the power supply may not longer be used as a table-top unit, because no convection cooling is possible, risk for overheating.

7. Warranty, Repairs

Your high voltage power supply has been assembled and tested under stringent quality assurance procedures.
We provide a 2 years warranty, commencing with the delivery date stated in the serial number.
This warranty does not cover misuse or attempted repair by untrained personnel.



*Enclosed you will find one set of circuit diagrams for service purposes.
In all further enquiries for service or spare parts, please provide both the model and serial number of the unit.*

8. Special Models

not applicable for standard units.

FUG Power Supplies are distributed in Austria exclusively by:

SMT - Setzer Messtechnik e.U.
Buchenweg 4
2362 Biedermannsdorf
AUSTRIA
+43 / 2236 / 71 04 79
www.smt.at
office@smt.at