NI PS-25

24 V, 5 A, 120 W, Single Phase Input

NI PS-25 Power Supply

- AC 100-240 V Wide-Range Input
- Width only 32 mm
- Efficiency up to 94.3%
- Excellent Partial Load Efficiency
- 20% Output Power Reserves (PowerBoost)
- Easy Fuse Breaking – three times nominal current for 12 ms
- Safe Hiccup*PLUS* Overload Mode
- Active Power Factor Correction (PFC)
- Minimal Inrush Current Surge
- Full Power Between -25 °C and +60 °C
- DC OK Relay Contact
- 1 Year Warranty

Product Description

The NI PS-25 is a cost optimized power supply without compromising quality, reliability, and performance.

The NI PS-25 power supply comes with spring-clamp connection terminals, which are optimized for automated wiring.

The most outstanding features of this unit are the small size, the high efficiency, the electronic inrush current limitation, active PFC, and the wide operational temperature range. The device also offers PowerBoost: power reserves of 20%, which may even be used continuously at temperatures up to +45 °C. Additionally, they can deliver three times the nominal output current for 12 ms, which helps to trip fuses on faulty output branches.

High immunity to transients and power surges as well as low electromagnetic emission, a DC OK signal contact for remote monitoring, and a large international approval package for a variety of applications make this unit suitable for nearly every situation.

Short-form Data

Output voltage	DC 24 V	Nominal
Adjustment range	24–28 V	Factory setting 24.1 V
Output current	5.0–4.3 A	Up to +60 °C ambient
	3.8–3.2 A	At +70 °C ambient
	Derate linearly between +60 °C and +70 °C	
PowerBoost	6.0 A	Up to +45 °C ambient
	Linear decrease to nominal power between +45 °C and +60 °C	
Input voltage AC	AC 100–240 V	-15%/+10%
Mains frequency	50–60 Hz	±6%
Input current AC	1.09/0.6 A	At 120/230 Vac
Power factor	0.98/0.91	At 120/230 Vac
Input voltage DC	DC 110–150 V $^{\pm 20\%}$	
Input current DC	1.21 A	At 110 Vdc
AC Inrush current	5/6 A_{peak}	At 120/230 Vac
Efficiency	93.6/94.3%	At 120/230 Vac
Losses	8.2/7.3 W	At 120/230 Vac
Hold-up time	35/35 ms	At 120/230 Vac
Temperature range	-25 °C to +70 °C	
Size (WxHxD)	32 x 124 x 102 mm	Without DIN rail
Weight	440 g	

Order Numbers

Power Supply	NI PS-25	
Accessory	199429-01	Side mounting kit for NI PS-25

Main Approvals

For details and the complete approval list, see section 19.

c UL us LISTED — UL 61010-2-201

c UL us LISTED — Class I Div 2

TABLE OF CONTENTS

TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol ⏚.
Earth, Ground	This document uses the term “earth” which is the same as the U.S. term “ground”.
t.b.d.	To be defined, value or description will follow later.
AC 230 V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included. For example: DC 12 V describes a 12 V battery disregarding whether it is full (13.7 V) or flat (10 V)
230 Vac	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
50 Hz vs. 60 Hz	As long as not otherwise stated, AC 230 V parameters are valid at 50 Hz mains frequency.
may	A key word indicating flexibility of choice with no implied preference.
shall	A key word indicating a mandatory requirement.
should	A key word indicating flexibility of choice with a strongly preferred implementation.

1. INTENDED USE

This device is designed for installation in an enclosure and is intended for commercial use, such as in industrial control, process control, monitoring, measurement, audio/video, information or communication equipment, or the like.

Do not use this device in equipment where malfunctioning may cause severe personal injury or threaten human life without additional appropriate safety devices that are suited for the end-application.

If this device is used in a manner outside of its specification, the protection provided by the device may be impaired.

2. INSTALLATION INSTRUCTIONS

⚠ WARNING **Risk of electrical shock, fire, personal injury or death.**

- Turn power off before working on the device and protect against inadvertent repowering.
- Do not open, modify, or repair the device.
- Use caution to prevent any foreign objects from entering into the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surface may cause burns.

Obey the following installation instructions:

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect.

If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Install device in an enclosure providing protection against electrical, mechanical, and fire hazards.

Install the device onto a DIN rail according to EN 60715 with the input terminals on the bottom and the output terminals on the top of the device. Other mounting orientations require a reduction in output current.

Make sure that the wiring is correct by following all local and national codes. Use appropriate copper cables that are designed for a minimum operating temperature of 60 °C for ambient temperatures up to +45 °C, 75 °C for ambient temperatures up to +60 °C, and 90 °C for ambient temperatures up to +70 °C.

Ensure that all strands of a stranded wire enter the terminal connection. Use ferrules for wires on the input terminals.

The device is designed for pollution degree 2 areas in controlled environments. No condensation or frost is allowed.

The enclosure of the device provides a degree of protection of IP20. The housing does not provide protection against spilled liquids.

The isolation of the device is designed to withstand impulse voltages of overvoltage category III according to IEC 60664-1.

The device is designed as “Class of Protection I” equipment according to IEC 61140. Do not use without a proper PE (Protective Earth) connection.

The device is suitable to be supplied from TN, TT, or IT mains networks. The continuous voltage between the input terminal and the PE potential must not exceed 300 Vac.

The input can also be powered from batteries or similar DC sources. The continuous voltage between the supply voltage and the PE/ground potential must not exceed 360 Vdc.

A disconnecting means shall be provided for the input of the device.

The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid!

The device is designed for altitudes up to 5000 m. Above 2000 m, a reduction in output current and over voltage category is required.

Keep the following minimum installation clearances: 40 mm on top, 20 mm on the bottom, and 5 mm left and right side. Increase the 5 mm to 15 mm in case the adjacent device is a heat source. When the device is permanently loaded with less than 50%, the 5 mm can be reduced to zero.

The device is designed, tested, and approved for branch circuits up to 32 A (IEC) and 30 A (UL) without an additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 6 A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker.

The maximum surrounding air temperature is +70 °C. The operational temperature is the same as the ambient or surrounding air temperature and is defined 2 cm below the device.

The device is designed to operate in areas between 5% and 95% relative humidity.

Installation Instructions for Hazardous Location Areas

The device is suitable for use in Class I Division 2 Groups A, B, C, D locations.

⚠ WARNING EXPLOSION HAZARDS!

Installation in standard mounting orientation with the input terminals on the bottom of the unit. For non-standard mounting orientations, a reduction of output current is required.

Do not disconnect the device or operate the voltage adjustment unless power has been switched off or the area is known to be non-hazardous.

A suitable enclosure must be provided for the end product.

3. AC-INPUT

The device is suitable to be supplied from TN, TT, or IT mains networks with AC voltage. For suitable DC supply voltages, see section 4.

AC input	Nom.	AC 100–240 V	
AC input range		85–264 Vac	
		264–300 Vac	Occasionally for maximal 500 ms
Allowed voltage L or N to earth	Max.	300 Vac	Continuous, according to IEC 60664-1
Input frequency	Nom.	50–60 Hz	±6%
Turn-on voltage	Typ.	80 Vac	Steady-state value, see Fig. 3-1
Shut-down voltage	Typ.	74 Vac	Steady-state value, see Fig. 3-1
External input protection	See recommendations in section 2.		

		AC 100 V	**AC 120 V**	**AC 230 V**	
Input current	Typ.	1.30 A	1.09 A	0.60 A	At 24 V, 5 A, see Fig. 3-3
Power factor	Typ.	0.99	0.98	0.91	At 24 V, 5 A, see Fig. 3-4
Crest factor	Typ.	1.7	1.8	2.2	At 24 V, 5 A, the crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
Start-up delay	Typ.	420 ms	380 ms	385 ms	See Fig. 3-2
Rise time	Typ.	80 ms	80 ms	80 ms	At 24 V, 5 A const. current load, 0 mF load capacitance, see Fig. 3-2
	Typ.	100 ms	100 ms	110 ms	At 24 V, 5 A const. current load, 5 mF load capacitance, see Fig. 3-2
Turn-on overshoot	Max.	200 mV	200 mV	200 mV	See Fig. 3-2

Fig. 3-1 **Input voltage range**

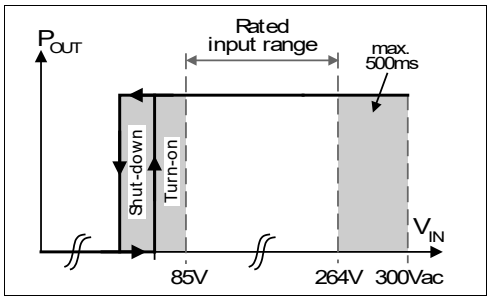


Fig. 3-2 **Turn-on behavior, definitions**

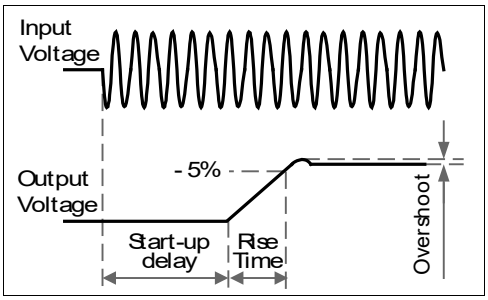


Fig. 3-3 **Input current vs. output current at 24 V output voltage**

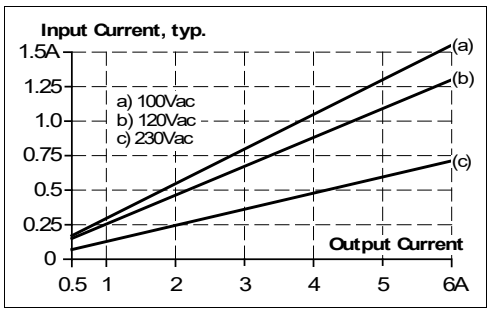
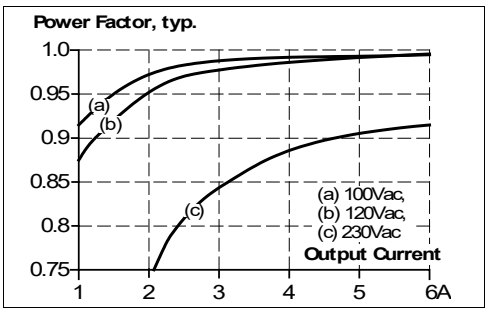


Fig. 3-4 **Power factor vs. output current at 24 V output voltage**



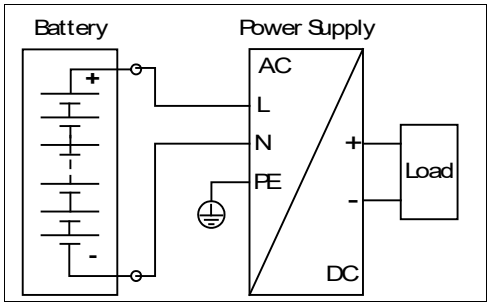
4. DC-INPUT

The device is suitable to be supplied from a DC input voltage. Use a battery or a similar DC source. A supply from the intermediate DC-bus of a frequency converter is not recommended and can cause a malfunction or damage the unit.

Connect +pole to L, –pole to N, and the PE terminal to an earth wire or to the machine ground.

DC input	Nom.	DC 110-150 V	±20%
DC input range		88-180 Vdc	
DC input current	Typ.	1.21 A	At 110 Vdc, at 24 V, 5 A
Allowed Voltage (+) or (-) input to Earth	Max.	360 Vdc	Continuous, according to IEC 60664-1
Turn-on voltage	Typ.	74 Vdc	Steady state value
Shut-down voltage	Typ.	67 Vdc	Steady state value

Fig. 4-1 **Wiring for DC Input**



5. INPUT INRUSH CURRENT

An active inrush limitation circuit (NTCs, which are bypassed by a relay contact) limits the input inrush current after turn-on of the input voltage.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

		AC 100 V	AC 120 V	AC 230 V	
Inrush current	Max.	8 A_{peak}	7 A_{peak}	7 A_{peak}	At 40 °C, cold start
	Typ.	5 A_{peak}	4 A_{peak}	4 A_{peak}	At 25 °C, cold start
	Typ.	5 A_{peak}	5 A_{peak}	6 A_{peak}	At 40 °C, cold start
Inrush energy	Max.	0.4 A^2s	0.5 A^2s	1 A^2s	At 40 °C, cold start

Fig. 5-1 **Typical turn-on behaviour at nominal load, 120 Vac input and 25 °C ambient**

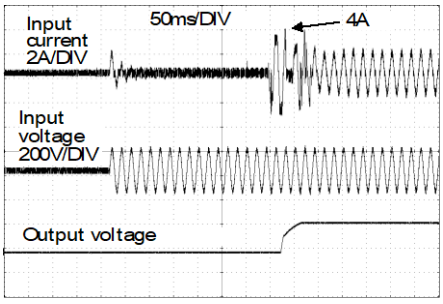
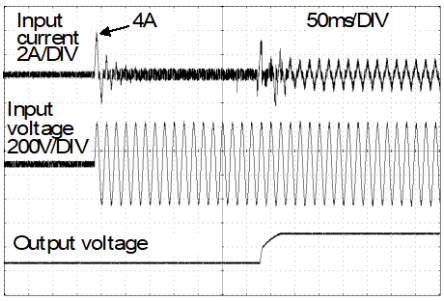


Fig. 5-2 **Typical turn-on behaviour at nominal load, 230 Vac input and 25°C ambient**



6. OUTPUT

The output provides a SELV/PELV rated voltage, which is galvanically isolated from the input voltage.

The output is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or “UltraCaps”) with a capacitance > 0.3 F are connected to the output, the unit might charge the capacitor in an intermittent mode.

The output is electronically protected against overload, no-load and short-circuits. In case of a protection event, audible noise may occur.

Output voltage	Nom.	24 V	
Adjustment range		24-28 V	Guaranteed value
	Max.	30.0 V	This is the maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not a guaranteed value which can be achieved.
Factory settings	Typ.	24.1 V	±0.2%, at full load and cold unit
Line regulation	Max.	10 mV	Between 85 and 300 Vac
Load regulation	Max.	50 mV	Between 0 A and 6 A, static value, see Fig. 6-1
Ripple and noise voltage	Max.	50 mVpp	Load >0.2 A, Bandwidth 20 Hz to 20 MHz, 50 Ohm
	Max.	200 mVpp	Load <0.2 A, Bandwidth 20 Hz to 20 MHz, 50 Ohm
Output current	Nom.	5 A	At 24 V and up to +60 °C ambient temperature
	Nom.	3.8 A	At 24 V and +70 °C ambient temperature
	Nom.	4.3 A	At 28 V and up to +60 °C ambient temperature
	Nom.	3.2 A	At 28 V and +70 °C ambient temperature
	Derate linearly between +60 °C and +70 °C, see section 16		
PowerBoost[1)]	Nom.	6 A	At 24 V and up to +45 °C ambient temperature
	Nom.	5.1 A	At 28 V and up to +45 °C ambient temperature
	PowerBoost decreases linearly to nominal power between +45 °C and +60 °C, see section 16		

Fuse breaking current	Typ.	15 A	Up to 12 ms once every five seconds, see Fig. 6-2. The fuse braking current is an enhanced transient current which helps to trip fuses on faulty output branches. The output voltage stays above 20 V.
Overload behaviour		Continuous current	For output voltage above 13 Vdc, see Fig. 6-1
		Intermittent current[2)]	For output voltage below 13 Vdc, see Fig. 6-1
Overload/short-circuit current	Max.	7.2 A	Continuous current, see Fig. 6-1
	Typ.	9 A	Intermitted current peak value for typ. 1 s Load impedance 50 mOhm, see Fig. 6-3 Discharge current of output capacitors is not included.
	Max.	3.5 A	Intermitted current average value (R.M.S.) Load impedance 50 mOhm, see Fig. 6-3
Output capacitance	Typ.	1 800 µF	Included inside the power supply
Back-feeding loads	Max.	35 V	The unit is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off. The absorbing energy can be calculated according to the built-in large sized output capacitor.

1) **PowerBoost:** This power/current is continuously allowed up to an ambient temperature of +45 °C.
Above +45 °C, do not use this power or current longer than a duty cycle of 10% and/ or not longer than 1 minute every 10 minutes.

2) At heavy overloads (when output voltage falls below 13 V), the power supply delivers continuous output current for 1 s. After this, the output is switched off for approx. 9 s before a new start attempt is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally. See Fig. 6-3.

Fig. 6-1 **Output voltage vs. output current, typ.**

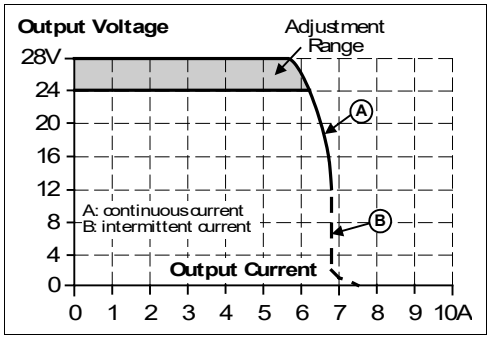


Fig. 6-2 **Dynamic output current capability, typ.**

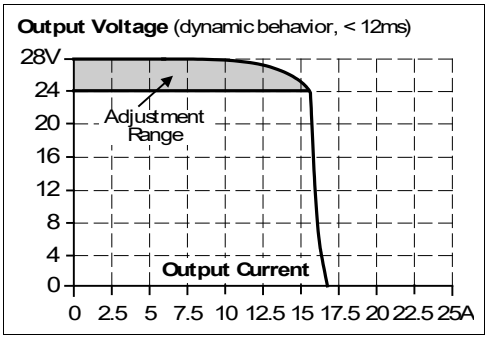
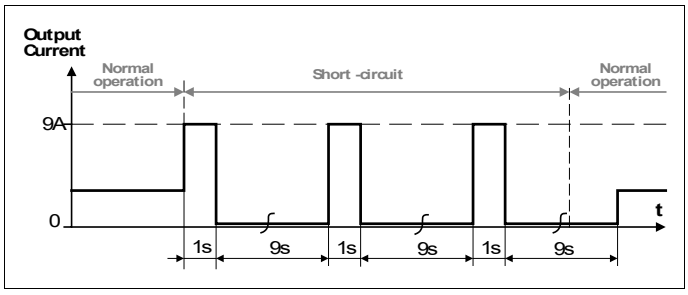


Fig. 6-3 **Short-circuit on output, Hiccup^{PLUS} mode, typ.**



7. HOLD-UP TIME

The hold-up time is the time during which a power supply's output voltage remains within specification following the loss of input power. The hold-up time is output load dependent. At no load, the hold-up time can be up to several seconds. The green DC OK LED is also on during this time.

		AC 100 V	AC 120 V	AC 230 V	
Hold-up Time	Typ.	70 ms	70 ms	70 ms	At 24 V, 2.5 A, see Fig. 7-1
	Min.	55 ms	55 ms	55 ms	At 24 V, 2.5 A, see Fig. 7-1
	Typ.	35 ms	35 ms	35 ms	At 24 V, 5 A, see Fig. 7-1
	Min.	27 ms	27 ms	27 ms	At 24 V, 5 A, see Fig. 7-1

Fig. 7-1 **Hold-up time vs. input voltage**

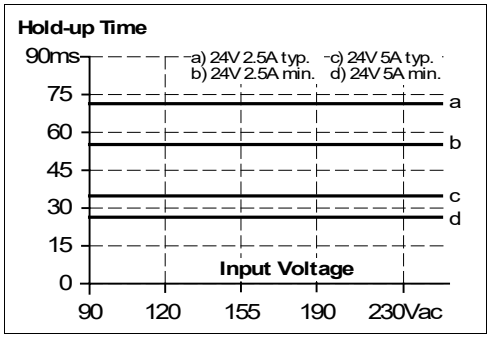
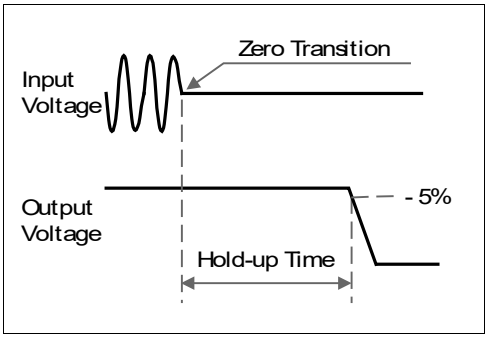


Fig. 7-2 **Shut-down behavior, definitions**

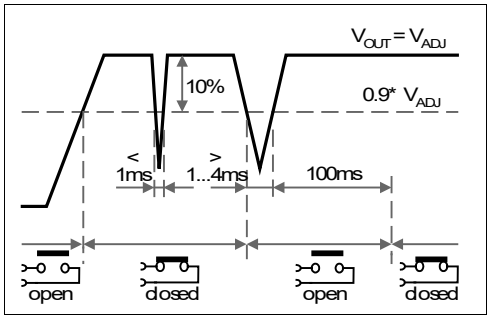


8. DC OK RELAY CONTACT

This feature monitors the output voltage on the output terminals of a running power supply.

Contact closes	As soon as the output voltage reaches typ. 90% of the adjusted output voltage level.
Contact opens	As soon as the output voltage dips more than 10% below the adjusted output voltage. Short dips will be extended to a signal length of 100 ms. Dips shorter than 1 ms will be ignored.
Switching hysteresis	Typically 0.7 V
Contact ratings	Maximal 60 Vdc 0.3 A, 30 Vdc 1 A, 30 Vac 0.5 A, resistive load Minimal permissible load: 1 mA at 5 Vdc
Isolation voltage	See dielectric strength table in section 18.

Fig. 8-1 **DC OK relay contact behavior**



9. EFFICIENCY AND POWER LOSSES

		AC 100 V	AC 120 V	AC 230 V	
Efficiency	Typ.	92.9%	93.6%	94.3%	At 24 V, 5 A
	Typ.	92.7%	93.5%	94.5%	At 24 V, 6 A (PowerBoost)
Average efficiency*)	Typ.	91.3%	91.7%	92.0%	25% at 1.25 A, 25% at 2.5 A, 25% at 3.75 A. 25% at 5 A
Power losses	Typ.	1.3 W	1.3 W	1.4 W	At 24 V, 0 A
	Typ.	4.6 W	4.4 W	4.1 W	At 24 V, 2.5 A
	Typ.	9.2 W	8.2 W	7.3 W	At 24 V, 5 A
	Typ.	11.3 W	9.8 W	8.4 W	At 24 V, 6 A (PowerBoost)

*) The average efficiency is an assumption for a typical application where the power supply is loaded with 25% of the nominal load for 25% of the time, 50% of the nominal load for another 25% of the time, 75% of the nominal load for another 25% of the time and with 100% of the nominal load for the rest of the time.

Fig. 9-1 **Efficiency vs. output current at 24 V, typ.**

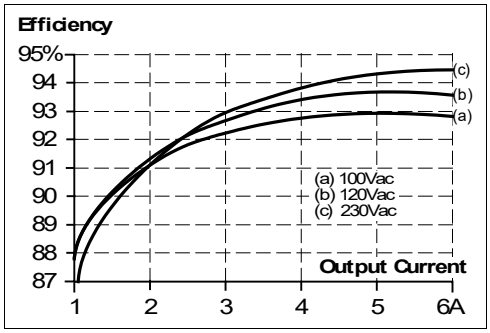


Fig. 9-2 **Losses vs. output current at 24 V, typ.**

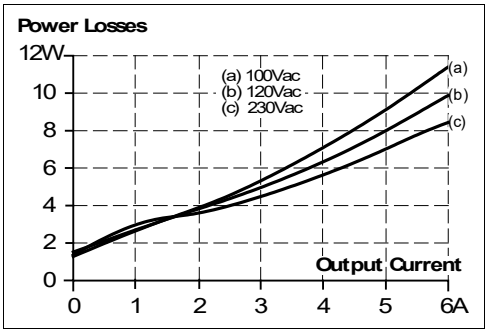


Fig. 9-3 **Efficiency vs. input voltage at 24 V, 5 A, typ.**

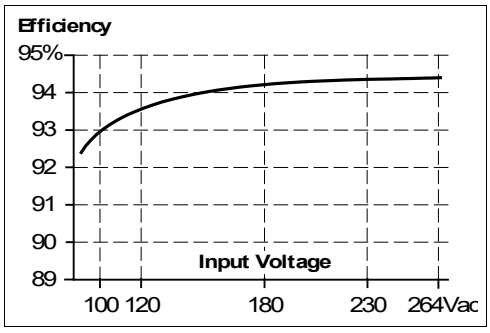
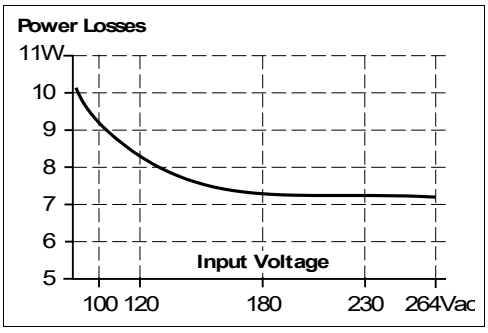
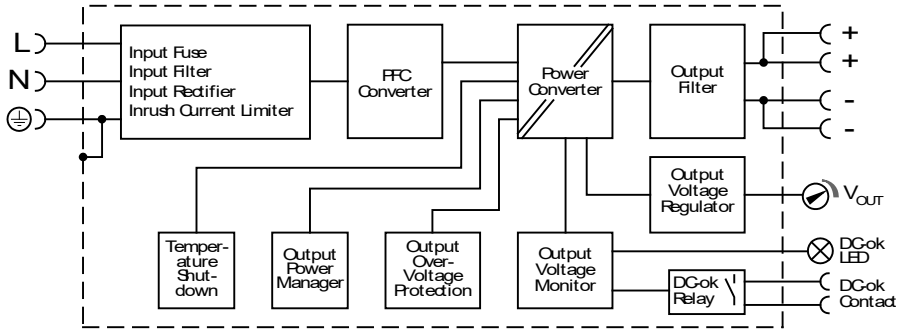


Fig. 9-4 **Losses vs. input voltage at 24 V, 5 A, typ.**



10. FUNCTIONAL DIAGRAM

Fig. 10-1 **Functional diagram**



11. FRONT SIDE AND USER ELEMENTS

A **Output Terminals**
Two identical + poles and two identical – poles
Spring-clamp terminals
+ Positive output
– Negative (return) output

B **Output Voltage Potentiometer**

C **DC OK LED** (green)
On when the output voltage is > 90% of the adjusted output voltage

D **DC OK Relay Contact**
The DC OK relay contact is synchronized with the DC OK LED. See section 8 for details.

E **Input Terminals**
N, L Line input
⏚ PE (Protective Earth) input

12. CONNECTION TERMINALS

The terminals are IP20 finger safe constructed and suitable for field- and factory wiring.

NI PS-25	Input	Output	DC OK-Signal
Type	Quick-connect spring-clamp terminal	Quick-connect spring-clamp terminal	Push-in terminal
Solid wire	Max. 6 mm^2	Max. 6 mm^2	Max. 1.5 mm^2
Stranded wire	Max. 4 mm^2	Max. 4 mm^2	Max. 1.5 mm^2
American Wire Gauge	AWG 20-10	AWG 20-10	AWG 24-16
Max. wire diameter (including ferrules)	2.8 mm	2.8 mm	1.6 mm
Wire stripping length	10 mm	10 mm	7 mm
Screwdriver	—	—	3 mm slotted to open the spring

Daisy chaining:

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the average output current through one terminal pin does not exceed 25 A. If the current is higher, use a separate distribution terminal block as shown in Fig. 12-2.

Fig. 12-1 **Daisy chaining of outputs**

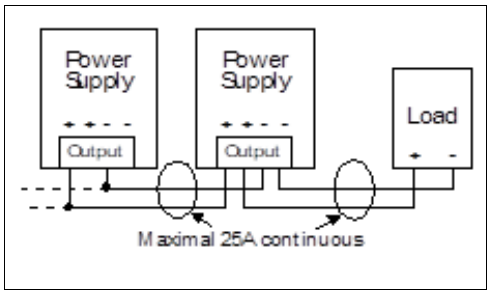
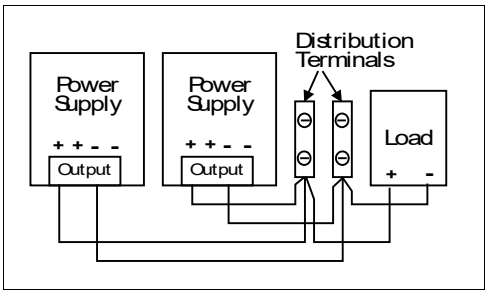


Fig. 12-2 **Using distribution terminals**



13. LIFETIME EXPECTANCY

The lifetime expectancy shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours and is calculated according to the capacitor's manufacturer specification. The manufacturer of the electrolytic capacitors only guarantees a maximum life of up to 15 years (131,400 h). Any number exceeding this value is a calculated theoretical lifetime which can be used to compare devices.

	AC 100 V	AC 120 V	AC 230 V	
Lifetime expectancy	265,000 h	270,000 h	274,000 h	At 24 V, 2.5 A and 40 °C
	748,000 h	764,000 h	775,000 h	At 24 V, 2.5 A and 25 °C
	128,000 h	143,000 h	166,000 h	At 24 V, 5 A and 40 °C
	363,000 h	405,000 h	469,000 h	At 24 V, 5 A and 25 °C
	81,000 h	96,000 h	119,000 h	At 24 V, 6 A and 40 °C
	228,000 h	271,000 h	336,000 h	At 24 V, 6 A and 25 °C

14. MTBF

MTBF stands for **M**ean **T**ime **B**etween **F**ailure, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of, for example, 1,000,000 h means that statistically one unit will fail every 100 hours if 10,000 units are installed in the field. However, it cannot be determined if the failed unit has been running for 50,000 h or only for 100 h.

For these types of units, the MTTF (**M**ean **T**ime **T**o **F**ailure) value is the same value as the MTBF value.

	AC 100 V	AC 120 V	AC 230 V	
MTBF SN 29500, IEC 61709	800,000 h	807,000 h	867,000 h	At 24 V, 5 A, and 40 °C
	1,402,000 h	1,414,000 h	1,510,000 h	At 24 V, 5 A, and 25 °C
MTBF MIL HDBK 217F	339,000 h	343,000 h	368,000 h	At 24 V, 5 A, and 40 °C; Ground Benign GB40
	490,000 h	496,000 h	529,000 h	At 24 V, 5 A, and 25 °C; Ground Benign GB25
	81,000 h	83,000 h	89,000 h	At 24 V, 5 A, and 40 °C; Ground Fixed GF40
	109,000 h	111,000 h	119,000 h	At 24 V, 5 A, and 25 °C; Ground Fixed GF25

15. EMC

The EMC behavior of the device is designed for applications in industrial environment as well as in residential, commercial, and light industry environments.

The device is investigated according to EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, and EN 61000-6-4.

EMC Immunity

Electrostatic discharge	EN 61000-4-2	Contact discharge	8 kV	Criterion A
		Air discharge	15 kV	Criterion A
Electromagnetic RF field	EN 61000-4-3	80 MHz-2.7 GHz	20 V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines	4 kV	Criterion A
		Output lines	2 kV	Criterion A
		DC OK signal (coupling clamp)	2 kV	Criterion A
Surge voltage on input	EN 61000-4-5	L → N	2 kV	Criterion A
		L → PE, N → PE	4 kV	Criterion A
Surge voltage on output	EN 61000-4-5	+ → -	1 kV	Criterion A
		+ / - → PE	2 kV	Criterion A
Surge voltage on DC OK	EN 61000-4-5	DC OK signal → PE	1 kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80 MHz	20 V	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 100 Vac	0 Vac, 20 ms	Criterion A
		40% of 100 Vac	40 Vac, 200 ms	Criterion C
		70% of 100 Vac	70 Vac, 500 ms	Criterion A
		0% of 200 Vac	0 Vac, 20 ms	Criterion A
		40% of 200 Vac	80 Vac, 200 ms, <4 A	Criterion A
		40% of 200 Vac	80 Vac, 200 ms, >4 A	Criterion C
		70% of 200 Vac	140 Vac, 500 ms	Criterion A
Voltage interruptions	EN 61000-4-11	0% of 200 Vac (=0 V)	5000 ms	Criterion C
Powerful transients	VDE 0160	Over entire load range	750 V, 0.3 ms	Criterion A

Performance criterions:

A: The device shows normal operation behavior within the defined limits.

C: Temporary loss of function is possible. The device may shut down and restarts by itself. No damage or hazards for the device will occur.

EMC Emission

Conducted emission input lines	EN 55011, EN 55032, FCC Part 15, CISPR 11, CISPR 32	Class B
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Limits for local DC power networks fulfilled
Radiated emission	EN 55011, EN 55032	Class B

Harmonic input current (PFC)	EN 61000-3-2	Fulfilled for Class A equipment
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with constant current loads, non-pulsing

This device complies with FCC Part 15 rules.
Operation is subjected to following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Switching Frequencies

PFC converter	30 kHz to 140 kHz	Input voltage and output load dependent
Main converter	60 kHz to 140 kHz	Output load dependent
Auxiliary converter	30 kHz to 60 kHz	Output load dependent

16. ENVIRONMENT

Operational temperature	-25 °C to +70 °C	Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2 cm below the unit.
Storage temperature	-40 °C to +85 °C	For storage and transportation
Output derating	3 W/K 0.33 A/1000 m or 5 K/1000 m	Between +60 °C and +70 °C For altitudes >2000 m, see Fig. 16-2
	The derating is not hardware controlled. The user has to take this into consideration to stay below the derated current limits in order not to overload the unit.	
Humidity	5 to 95% r.h.	According to IEC 60068-2-30
Atmospheric pressure	110-54 kPa	See Fig. 16-2 for details
Altitude	Up to 5000 m	See Fig. 16-2 for details
Over-voltage category	III	According to IEC 60664-1 for altitudes up to 2000 m
	II	According to IEC 60664-1, for altitudes above 2000 m
Degree of pollution	2	According to IEC 62477-1, not conductive
Vibration sinusoidal	2-17.8 Hz: ±1.6 mm; 17.8-500 Hz: 2 g 2 hours/axis	According to IEC 60068-2-6
Shock	30 g 6 ms, 20 g 11 ms 3 bumps per direction, 18 bumps in total	According to IEC 60068-2-27
	Shock and vibration is tested in combination with DIN rails according to EN 60715 with a height of 15 mm and a thickness of 1.3 mm and standard orientation.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload, or short circuit.	

Fig. 16-1 **Output current vs. ambient temp. (Inom 5A; Iout with PowerBoost = 6A)**

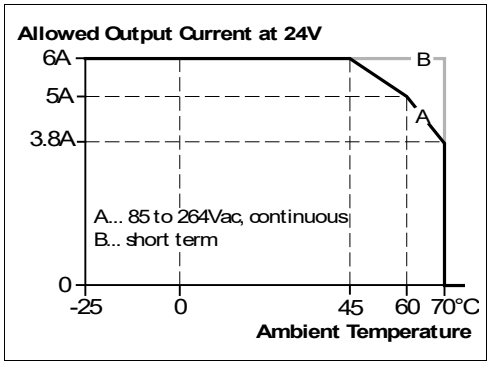
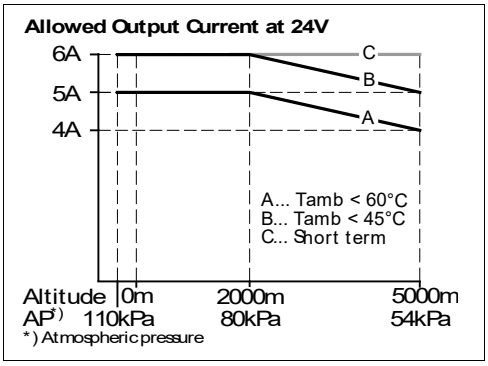


Fig. 16-2 **Output current vs. altitude**



17. SAFETY AND PROTECTION FEATURES

Isolation resistance	Min.	500 MOhm	At delivered condition between input and output, measured with 500 Vdc
	Min.	500 MOhm	At delivered condition between input and PE, measured with 500 Vdc
	Min.	500 MOhm	At delivered condition between output and PE, measured with 500 Vdc
	Min.	500 MOhm	At delivered condition between output and DC OK contacts, measured with 500 Vdc
PE resistance	Max.	0.1 Ohm	Resistance between PE terminal and the housing in the area of the DIN rail mounting bracket.
Output over-voltage protection	Typ.	30.5 Vdc	
	Max.	32.0 Vdc	
		In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and performs three restart attempts. If the failure continues, the output shuts down. Cycle input power to reset.	
Class of protection		I	According to IEC 61140 A PE (Protective Earth) connection is required
Degree of protection		IP 20	According to EN/IEC 60529
Over-temperature protection		Included	Output shut-down with automatic restart. Temperature sensors are installed on critical components inside the unit and turn the unit off in safety critical situations, which can happen, for example, when ambient temperature is too high, ventilation is obstructed, or the derating requirements are not followed. There is no correlation between the operating temperature and turn-off temperature because this is dependent on input voltage, load, and installation methods.
Input transient protection		MOV (Metal Oxide Varistor)	For protection values, see section 15 (EMC).
Internal input fuse		Included	Not user replaceable slow-blow high-braking capacity fuse
Touch current (leakage current)	Typ.	0.10 mA/0.27 mA	At 100 Vac, 50 Hz, TN-,TT-mains/IT-mains
	Typ.	0.13 mA/0.38 mA	At 120 Vac, 60 Hz, TN-,TT-mains/IT-mains
	Typ.	0.20 mA/0.60 mA	At 230 Vac, 50 Hz, TN-,TT-mains/IT-mains
	Max.	0.13 mA/0.35 mA	At 110 Vac, 50 Hz, TN-, TT-mains/IT-mains
	Max.	0.17 mA/0.51 mA	At 132 Vac, 60 Hz, TN-, TT-mains/IT-mains
	Max.	0.27 mA/0.81 mA	At 264 Vac, 50 Hz, TN-, TT-mains/IT-mains

18. DIELECTRIC STRENGTH

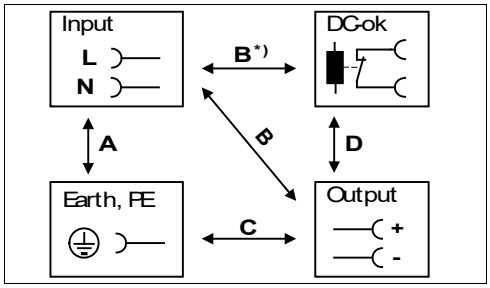
The output voltage is floating and has no ohmic connection to the ground.

The output is insulated to the input by a double or reinforced insulation.

Type and routine tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (2 s up and 2 s down). Connect all input-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.

We recommend that either the + pole or the – pole shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or cannot be switched off when unnoticed earth faults occur.

Fig. 18-1 **Dielectric strength**



		A	B	C	D
Type test	60 s	2500 Vac	3000 Vac	1000 Vac	500 Vac
Routine test	5 s	2500 Vac	2500 Vac	500 Vac	500 Vac
Field test	5 s	2000 Vac	2000 Vac	500 Vac	500 Vac
Field test cut-off current settings		> 10 mA	> 10 mA	> 20 mA	> 1 mA

B*)
When testing input to DC OK, ensure that the maximal voltage between DC OK and the output is not exceeded (column D). We recommend connecting DC OK pins and the output pins together when performing the test.

19. APPROVED, FULFILLED OR TESTED STANDARDS

UL 61010-2-201	c UL US LISTED	UL Certificate Listed equipment for category NMTR - Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment Applicable for US and Canada E-File: E330187
Class I Div 2	c UL US LISTED	UL Certificate Listed equipment for category NRAD - Listed equipment Industrial Control Equipment for Use in Hazardous Locations Applicable for US and Canada E-File: E536050 Temperature Code: T4 Groups: A, B, C and D
IEC 61558-2-16	Safety Isolating Transformer IEC 61558-2-16	Test Certificate Safety of transformers, reactors, power supply units, and similar products for supply voltages up to 1100 V Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units
SEMI F47	SEMI F47	Test Report Voltage Sag Immunity for Semiconductor Processing Equipment Tested for AC 208V L-L or L-N mains voltages, nominal output voltage, and nominal output load
VDMA 24364	LABS VDMA 24364-C1-L/W	Paint Wetting Impairment Substances Test (or LABS-Test) Tested for Zone 2 and test class C1 according to VDMA 24364-C1-L/W for solvents and water-based paints

20. REGULATORY PRODUCT COMPLIANCE

EU Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive - Low-voltage directive - RoHS directive
REACH Regulation (EU)	REACH ✓	Manufacturer's Declaration EU regulation regarding the Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) fulfilled. EU Regulation (EC) 1907/2006.
WEEE Regulation		Manufacturer's Declaration EU Regulation on Waste Electrical and Electronic Equipment Registered as business to business (B2B) products. EU Regulation 2012/19/EU

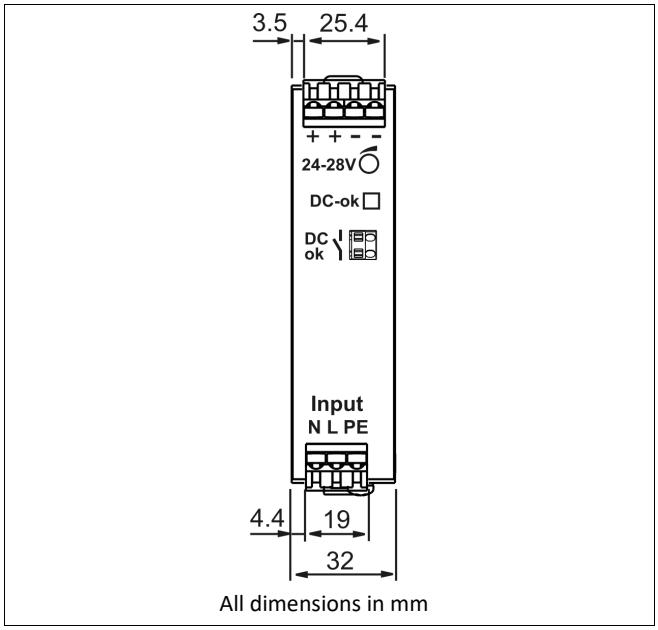
UKCA

UKCA Declaration of Conformity
Trade conformity assessment for England, Scotland and Wales
The UKCA mark indicates conformity with the UK Statutory Instruments
2016 No.1091,
2016 No.1107
2012 No.3032

21. PHYSICAL DIMENSIONS AND WEIGHT

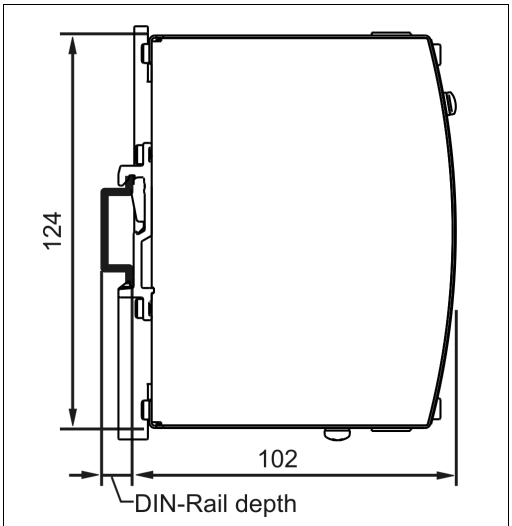
Width	32 mm
Height	124 mm
Depth	102 mm The DIN rail depth must be added to the unit depth to calculate the total required installation depth.
Weight	440 g
DIN rail	Use 35 mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15 mm.
Housing material	Body: Aluminium alloy Cover: Zinc-plated steel
Installation clearances	See section 2
Penetration protection	Small parts like screws, nuts, etc. with a diameter larger than 3.5 mm

Fig. 21-1 **Front view**



All dimensions in mm

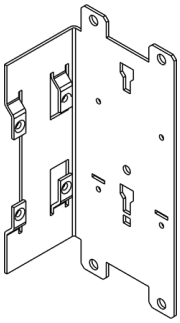
Fig. 21-2 **Side view**



All dimensions in mm

22. ACCESSORIES

22.1. SIDE MOUNTING BRACKET



This bracket is used to mount the power supply sideways with or without using a DIN rail.

The two aluminum brackets and black plastic slider of the unit must be detached, so that the steel brackets can be mounted.

For sideways DIN rail mounting, the removed aluminum brackets and the black plastic slider need to be mounted on the steel bracket.

Fig. 22-1 **Side mounting without DIN rail brackets**

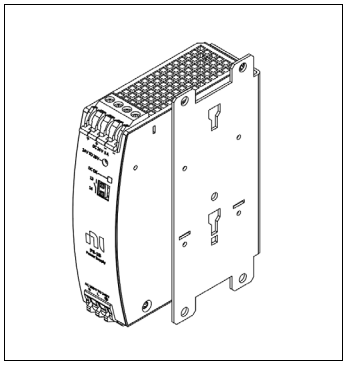


Fig. 22-2 **Side mounting with DIN rail brackets-**

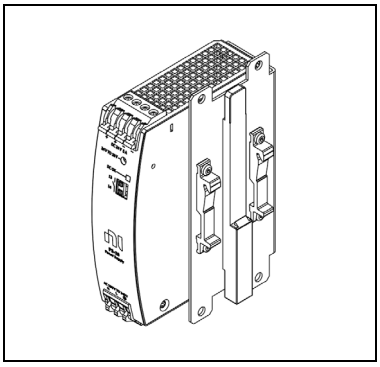
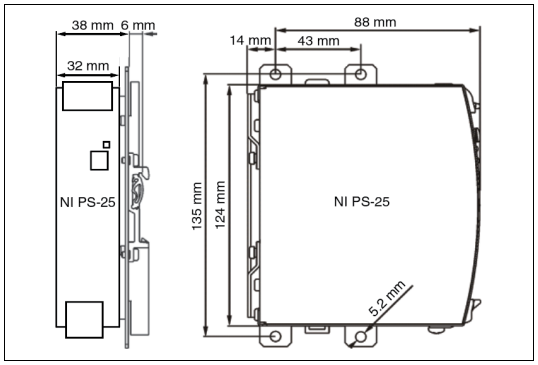


Fig. 22-3 **Mounting dimensions for side mounting bracket**



23. APPLICATION NOTES

23.1. PEAK CURRENT CAPABILITY

The unit can deliver peak currents (up to several milliseconds) which are higher than the specified short term currents.

This helps to start current demanding loads. Solenoids, contactors and pneumatic modules often have a steady state coil and a pick-up coil. The inrush current demand of the pick-up coil is several times higher than the steady-state current and usually exceeds the nominal output current. The same situation applies when starting a capacitive load.

The peak current capability also ensures the safe operation of subsequent circuit breakers of load circuits. The load branches are often individually protected with circuit breakers or fuses. In case of a short or an overload in one branch circuit, the fuse or circuit breaker need a certain amount of over-current to open in a timely manner. This avoids voltage loss in adjacent circuits.

The extra current (peak current) is supplied by the power converter and the built-in large sized output capacitors of the power supply. The capacitors get discharged during such an event, which causes a voltage dip on the output. The following three examples show typical voltage dips for resistive loads:

Fig. 23-1 **10A$_{peak}$ current for 50 ms , typ. (2x the nominal current)**

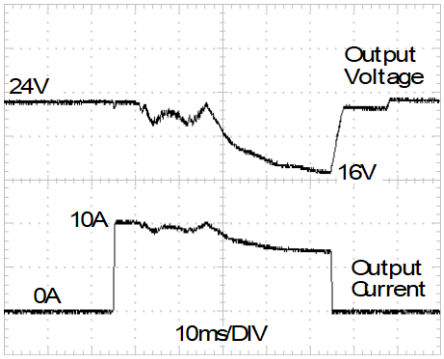


Fig. 23-2 **25A$_{peak}$ current for 5 ms , typ. (5x the nominal current)**

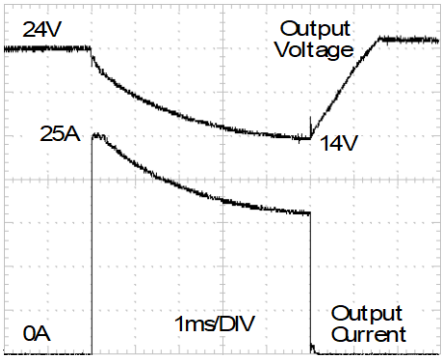
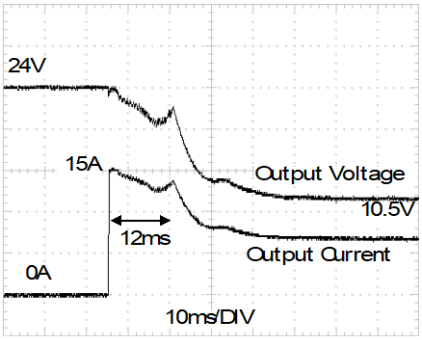


Fig. 23-3 **15A$_{peak}$ current for 12 ms , typ. (3x the nominal current)**



Please note: The DC OK relay triggers when the voltage dips more than 10% for longer than 1 ms.

Peak current voltage dips	Typically from 24 V to 16 V	At 10 A for 50 ms and resistive load
	Typically from 24 V to 16.5 V	At 25 A for 2 ms and resistive load
	Typically from 24 V to 14 V	At 25 A for 5 ms and resistive load

23.2. CHARGING OF BATTERIES

The power supply can be used to charge lead-acid or maintenance free batteries. Two 12 V SLA or VRLA batteries are needed in series connection.

Instructions for charging batteries:

a) Use only matched batteries when putting 12 V types in series.

b) Ensure that the ambient temperature of the power supply stays below 40 °C for mains voltage of AC 120 V or higher and 35 °C for a mains voltage of AC 100 V.

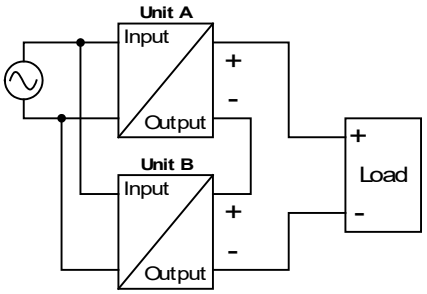
c) Use a 10 A circuit breaker or a blocking diode between the power supply and the battery.

d) Ensure that the output current of the power supply is below the allowed charging current of the battery.

e) The return current to the power supply is typically 8 mA. This return current can discharge the battery when the power supply is switched off except in case a blocking diode is utilized.

f) Set the output voltage, measured at no load and at the battery end of the cable, very precisely to the end-of-charge voltage. The voltage should be set to 27.8 V at 10 °C, 27.5 V at 20 °C, 27.15 V at 30 °C, and 26.8 V at 40 °C ambient temperature.

23.3. SERIES OPERATION



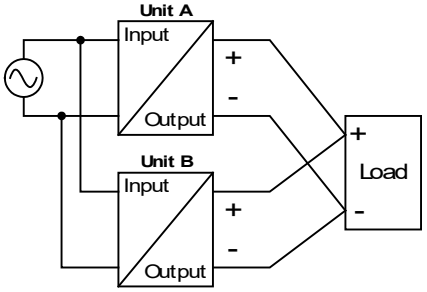
Devices of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150 Vdc. Voltages with a potential above 60 Vdc must be installed with a protection against touching.

Avoid return voltage (for example, from a decelerating motor or battery) which is applied to the output terminals.

Keep an installation clearance of 15 mm (left / right) between two power supplies and avoid installing the power supplies on top of each other. Do not use power supplies in series in mounting orientations other than the standard mounting orientation.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple devices.

23.4. PARALLEL USE TO INCREASE OUTPUT POWER



Devises can be paralleled to increase the output power. The output voltage shall be adjusted to the same value (±100 mV) with the same load conditions on all devices, or the devices can be left with the factory settings.

The ambient temperature is not allowed to exceed +40 °C.

If more than three devices are connected in parallel, a fuse or circuit breaker with a rating of 10 A is required on each output. Alternatively, a diode can also be utilized.

Energize all devices at the same time. It also might be necessary to cycle the input power (turn-off for at least five seconds) if the output was in overload or short circuits and the required output current is higher than the current of one unit.

Keep an installation clearance of 15 mm (left / right) between two devices and avoid installing devices on top of each other. Do not use devices in parallel in mounting orientations other than the standard mounting orientation or in any other condition where a reduction of the output current is required (for example, altitude).

Pay attention that leakage current, EMI, and inrush current will increase when using multiple devices.

23.5. PARALLEL USE FOR REDUNDANCY

1+1 Redundancy:
Devices can be paralleled for redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one device fails. The simplest way is to put two devices in parallel. This is called a 1+1 redundancy. In case one device fails, the other one is automatically able to support the load current without any interruption. It is possible that the defective unit will become a load of another power supply while configured in parallel usage.

1+1 redundancy allows ambient temperatures up to +70 °C.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple devices.

Recommendations for building redundant power systems:

- Use separate input fuses for each device.
- Use separate mains systems for each device whenever it is possible.
- Monitor the individual devices. Therefore, use the DC OK signal of the device.
- It is desirable to set the output voltages of all devices to the same value (± 100 mV) or leave it at the factory setting.

N+1 Redundancy:
Redundant systems for a higher power demand are usually built in a N+1 method. For example, four devices, each rated for 5 A, are paralleled to build a 15 A redundant system.

Pay attention that leakage current, EMI, inrush current, and harmonics will increase when using multiple devices.

Keep an installation clearance of 15 mm (left/right) between two devices and avoid installing the devices on top of each other.

Do not use devices in parallel in mounting orientations other than the standard mounting orientation or in any other condition, where a reduction of the output current is required.

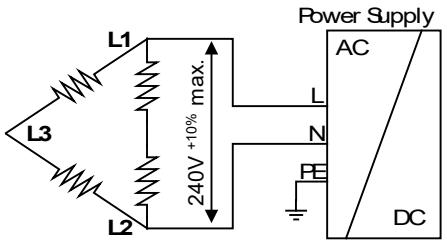
For N+1 redundancy, the ambient temperature is not allowed to exceed +40 °C.

23.6. OPERATION ON TWO PHASES

The power supply can also be used in two phases of a three-phase-system. Such a phase-to-phase connection is allowed as long as the supplying voltage is below 240 V$^{+10\%}$.

Ensure that the wire, which is connected to the N-terminal, is appropriately fused.

The maximum allowed voltage between a phase and the PE must be below 300 Vac.



23.7. USE IN A TIGHTLY SEALED ENCLOSURE

When the power supply is installed in a tightly sealed enclosure, the temperature inside the enclosure will be higher than outside. In such situations, the inside temperature defines the ambient temperature for the power supply.

The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure.

The power supply is placed in the middle of the box, and no other heat producing items are inside the box.

The temperature sensor inside the box is placed in the middle of the right side of the power supply with a distance of 1 cm.

The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure.

	Case A	**Case B**
Enclosure size	110 x 180 x 165 mm Rittal Typ IP66 Box PK 9516 100, plastic	110 x 180 x 165 mm Rittal Typ IP66 Box PK 9516 100, plastic
Input voltage	230 Vac	230 Vac
Load	24 V, 4 A; (= **80%**)	24 V, 5 A; (= **100%**)
Temperature inside the box	38.3 °C	39.6 °C
Temperature outside the box	26.1 °C	25.5 °C
Temperature rise	12.2 K	14.1 K

23.8. MOUNTING ORIENTATIONS

Mounting orientations other than input terminals on the bottom and output on the top require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature.

The listed lifetime and MTBF values from this datasheet apply only for the standard mounting orientation.

The following curves give an indication for allowed output currents for altitudes up to 2000 m.

Fig. 23-4
Mounting Orientation A (Standard orientation)

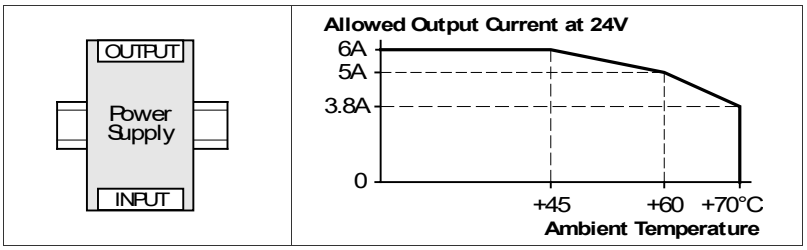


Fig. 23-5
Mounting Orientation B
(Upside down)

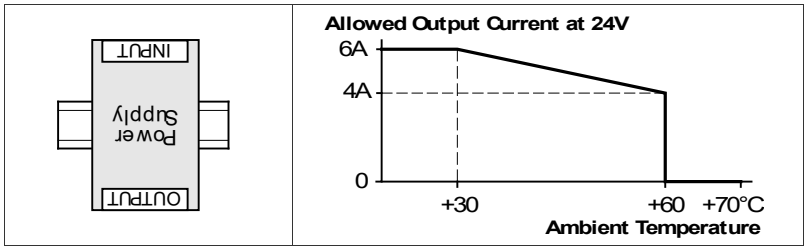


Fig. 23-6
Mounting Orientation C
(Table-top mounting)

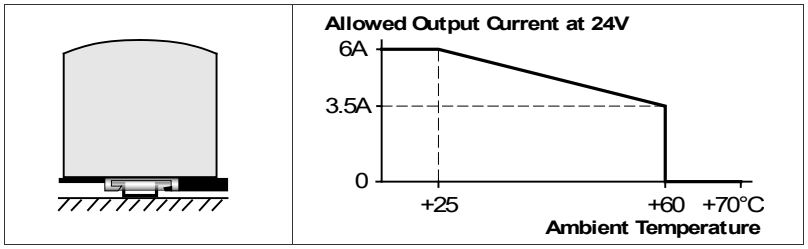


Fig. 23-7
Mounting Orientation D
(Horizontal cw)

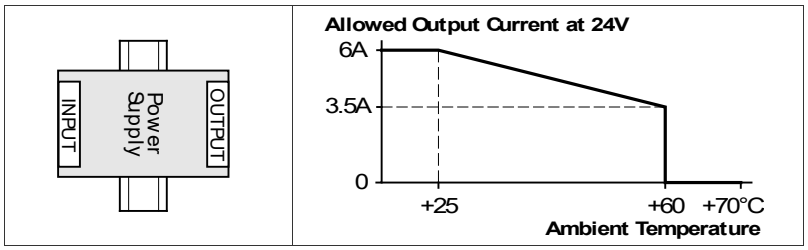


Fig. 23-8
Mounting Orientation E
(Horizontal ccw)