

**PULS**

**PRELIMINARY**

**PIM90.245**

**PIANO-Series**

**24V, 3.8A, 90W, SINGLE PHASE INPUT**



**POWER SUPPLY**

- 100-240V Wide Range Input
- Cost Optimized without Compromising Quality or Reliability
- Width only 36mm
- Efficiency up to 93.8%
- Low No-load Power Losses
- Full Power Between -10°C and +60°C
- Large Screw Terminals
- 3 Year Warranty

**PRODUCT DESCRIPTION**

The PIANO series units are extraordinarily compact industrial grade DIN-rail power supplies that focus on the essential features needed in today's industrial applications. The excellent cost/performance ratio presents many new and exciting opportunities without compromising quality or reliability.

The mechanically robust housing is made of a high-grade, reinforced molded material, which permits the units to be used in surrounding temperatures up to +70°C.

The PIM90.245 is equipped with large sized screw terminals for an easy wiring.

**SHORT-FORM DATA**

Output voltage	DC 24V	Nominal
Adjustment range	24 – 28V	Factory setting 24.1V
Output current	3.8 – 3.2A	Below +60°C ambient
	2.8 – 2.4A	At +70°C ambient
	Derate linearly between +60°C and +70°C	
Input voltage AC	AC 100-240V	±10%
Mains frequency	50-60Hz	±6%
Input current AC	1.45 / 0.95A	At 120 / 230Vac
Power factor	0.58 / 0.45	At 120 / 230Vac
Input inrush current	18 / 40A peak	At 40°C 120 / 230Vac
Efficiency	92.1 / 93.8%	At 120 / 230Vac
Losses	7.9 / 6.0W	At 120 / 230Vac
Hold-up time	25 / 119ms	At 120 / 230Vac
Temperature range	-10°C to +70°C	
Size (W x H x D)	36x90x91mm	Without DIN-Rail
Weight	270g / 0.6lb	

**ORDER NUMBERS**

Power Supply **PIM90.245**

**MAIN APPROVALS**

For details and a complete approval list see chapter 18.



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Packaging and packaging aids can and should always be recycled. The product itself may not be disposed of as domestic refuse.

## TERMINOLOGY AND ABBREVIATIONS

<b>PE and <math>\oplus</math> symbol</b>	PE is the abbreviation for <b>Protective Earth</b> and has the same meaning as the symbol $\oplus$ .
<b>Earth, Ground</b>	This document uses the term "earth" which is the same as the U.S. term "ground".
<b>T.b.d.</b>	To be defined, value or description will follow later.
<b>AC 230V</b>	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually $\pm 15\%$ ) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
<b>230Vac</b>	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
<b>50Hz vs. 60Hz</b>	As long as not otherwise stated, AC 100V and AC 230V parameters are valid at 50Hz mains frequency. AC 120V parameters are valid for 60Hz mains frequency.
<b>may</b>	A key word indicating flexibility of choice with no implied preference.
<b>shall</b>	A key word indicating a mandatory requirement.
<b>should</b>	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 and measurement equipment or the like.

Do not use this power supply in equipment, where malfunction may cause severe personal injury or threaten human life.

## 2. INSTALLATION INSTRUCTIONS

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

- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as high voltages are present inside.
- Use caution to prevent any foreign objects from entering 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 surfaces 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 the 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 of the device.

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.

Unused screw terminals should be securely tightened.

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

The enclosure of the device provides a degree of protection of IP20.

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- and IT mains networks. The voltage between the L or N terminal and the PE terminal must not exceed 300Vac continuously.

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 5000m (16400ft). See additional requirements in this document for use above 2000m (6560ft).

Keep the following minimum installation clearances: 40mm on top, 20mm on the bottom, 0mm left and right side. Increase the 0mm to 15mm in case the adjacent device is a heat source.

The device is designed, tested and approved for branch circuits up to 32A (IEC) and 30A (UL) without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 6A B- or 4A C-Characteristic to avoid a nuisance tripping of the circuit breaker.

The maximum surrounding air temperature is +70°C (+158°F). The operational temperature is the same as the ambient or surrounding air temperature and is defined 2cm below the device.

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

### 3. AC-INPUT

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

AC input	Nom.	AC 100-240V	
AC input range	Min.	90-264Vac	Continuous operation
	Min.	264-300Vac	For maximum 500ms
Allowed voltage L or N to earth	Max.	300Vac	Continuous according to IEC 62477-1
Input frequency	Nom.	50–60Hz	±6%
Turn-on voltage	Typ.	55Vac	Steady-state value, see Fig. 3-1
Shut-down voltage	Typ.	47Vac	Steady-state value, see Fig. 3-1
External input protection	See recommendations in chapter 2.		

		AC 100V	AC 120V	AC 230V	
Input current	Typ.	1.69A	1.45A	0.95A	At 24V, 3.8A, see Fig. 3-3
Power factor	Typ.	0.6	0.58	0.45	At 24V, 3.8A, see Fig. 3-4
Start-up delay	Typ.	50ms	50ms	50ms	See Fig. 3-2
Rise time	Typ.	21ms	21ms	20ms	At 24V, 3.8A constant current load, 0mF load capacitance, see Fig. 3-2
	Typ.	42ms	42ms	40ms	At 24V, 3.8A constant current load, 2mF load capacitance,, see Fig. 3-2
Turn-on overshoot	Max.	100mV	100mV	100mV	See Fig. 3-2

Fig. 3-1 Input voltage range

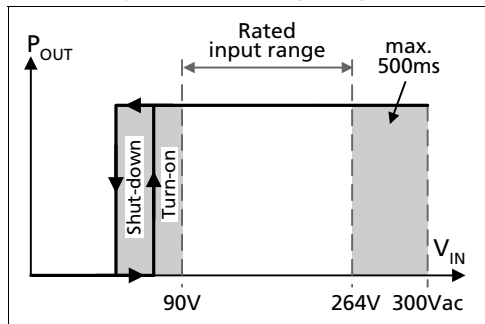


Fig. 3-2 Turn-on behavior, definitions

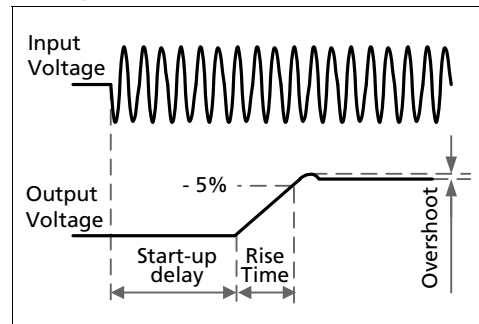


Fig. 3-3 Input current vs. output load at 24V output voltage

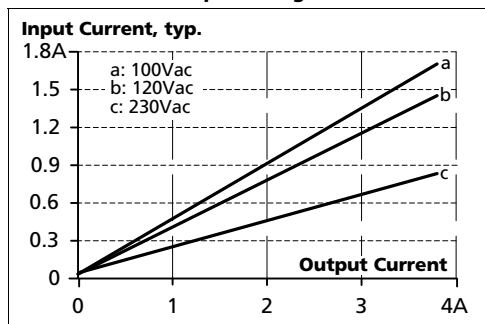
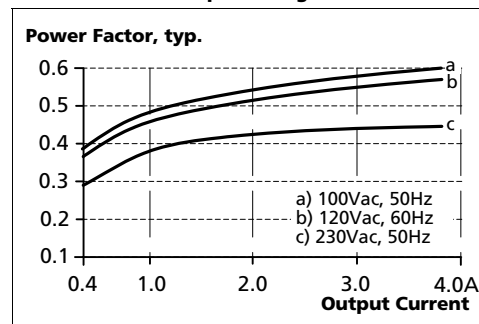


Fig. 3-4 Power factor vs. output load at 24V output voltage



## 4. DC-INPUT

Do not operate this power supply with DC-input voltage.

## 5. INPUT INRUSH CURRENT

A NTC limits the input inrush current after turn-on of the input voltage. The inrush current is input voltage and ambient temperature dependent. The output load has no impact on the inrush current value.

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

		AC 100V	AC 120V	AC 230V	
Inrush current	Max.	17A <sub>peak</sub>	22A <sub>peak</sub>	48A <sub>peak</sub>	At 40°C ambient, cold start
	Typ.	14A <sub>peak</sub>	18A <sub>peak</sub>	40A <sub>peak</sub>	At 40°C ambient, cold start
	Max.	15A <sub>peak</sub>	20A <sub>peak</sub>	43A <sub>peak</sub>	At 25°C ambient, cold start
	Typ.	12A <sub>peak</sub>	16A <sub>peak</sub>	35A <sub>peak</sub>	At 25°C ambient, cold start
Inrush energy	Max.	0.3A <sup>2</sup> s	0.4A <sup>2</sup> s	1.7A <sup>2</sup> s	At 40°C ambient, cold start

Fig. 5-1 Typical turn-on behavior at 230Vac and 25°C ambient

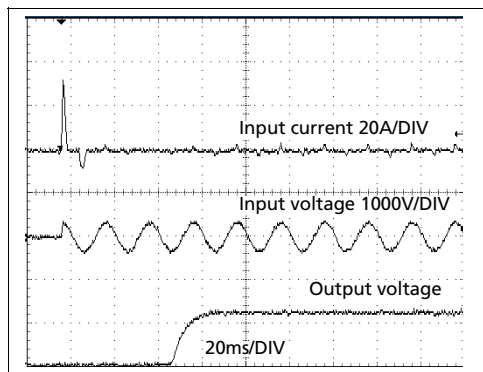


Fig. 5-2 Zoom into the first inrush peak

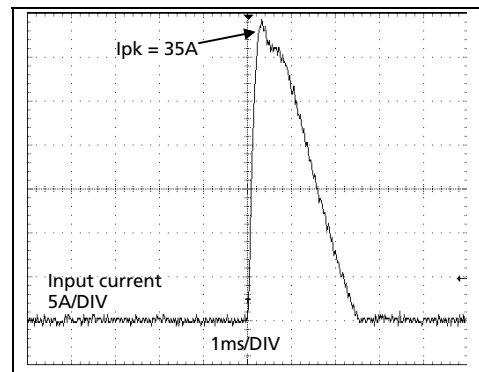


Fig. 5-3 Typical turn-on behavior at 120Vac and 25°C ambient

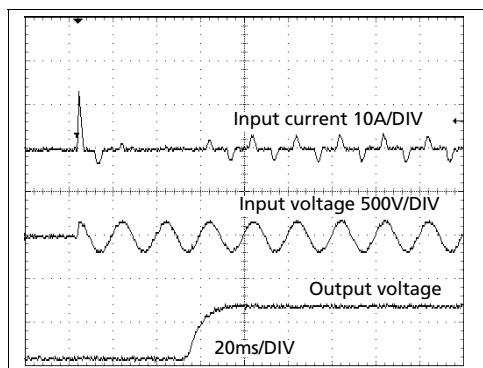
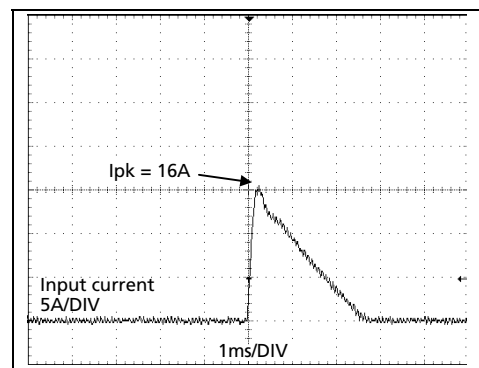


Fig. 5-4 Zoom into the first inrush peak



## 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 unlimited inductive loads. Capacitive loads should not be larger than 5500 $\mu$ F with 3.8A or 7000 $\mu$ F with 1.9A additional current load.

Output voltage	Nom.	DC 24V	
Adjustment range	Min.	24-28V	Guaranteed value
	Max.	29.0V	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.	24.1V	$\pm 0.2\%$ , at full load and cold unit
Line regulation	Max.	10mV	Between 85 and 300Vac
Load regulation	Max.	100mV	Between 0 and 3.8A, static value, see Fig. 6-1
Ripple and noise voltage	Max.	100mVpp	Bandwidth 20Hz to 20MHz, 50Ohm
Output current	Nom.	3.8A	At 24V and an ambient temperature below 60°C
	Nom.	3.2A	At 24V and 70°C ambient temperature
	Nom.	2.8A	At 28V and an ambient temperature below 60°C
	Nom.	2.4A	At 28V and 70°C ambient temperature
Overload protection		Included	Electronically protected against no-load, overload and short circuit. In case of a protection event, audible noise may occur.
Overload behaviour		Continuous current	Output voltage >14Vdc, see Fig. 6-1.
		Intermittent current <sup>1)</sup>	Output voltage <14Vdc, see Fig. 6-1.
Overload/ short-circuit current	Max.	6.7A	Continuous current, see Fig. 6-1.
	Typ.	8.6A	Intermittent current peak value for typ. 20ms Load impedance 150mOhm, see Fig. 6-2. Discharge current of output capacitors is not included.
	Max.	3.2A	Intermittent current average value (R.M.S.) Load impedance 150mOhm, see Fig. 6-2.
Output capacitance	Typ.	1 600 $\mu$ F	Included inside the power supply
Back-feeding loads	Max.	35V	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) At heavy overloads (when output voltage falls below 14V), the power supply delivers continuous output current for 20ms. After this, the output is switched off for approx. 160ms 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. 6-2.

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

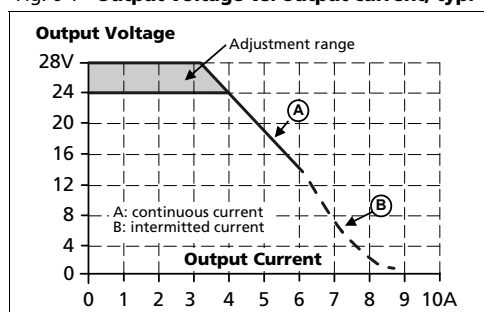
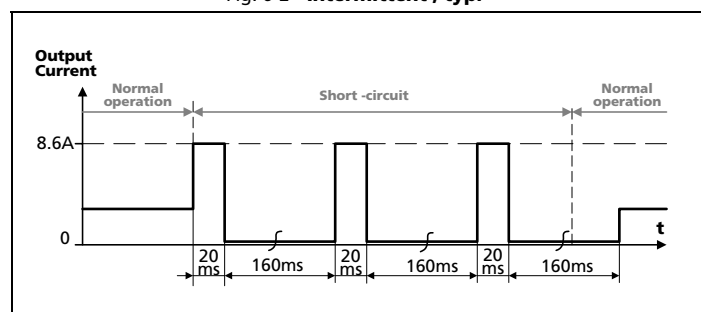


Fig. 6-2 Intermittent, typ.



### 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 lamp is also on during this time.

		AC 100V	AC 120V	AC 230V	
Hold-up Time	Typ.	40ms	60ms	242ms	At 24V, 1.9A, see Fig. 7-1
	Min.	32ms	48ms	194ms	At 24V, 1.9A, see Fig. 7-1
	Typ.	14ms	25ms	119ms	At 24V, 3.8A, see Fig. 7-1
	Min.	11.5ms	20ms	95ms	At 24V, 3.8A, see Fig. 7-1

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

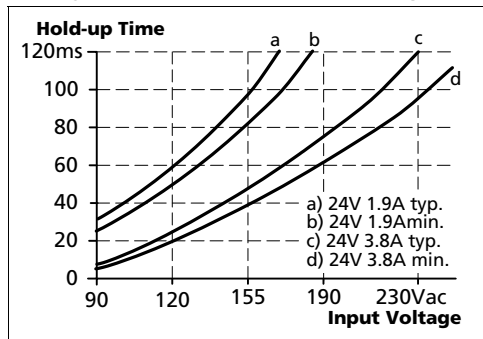
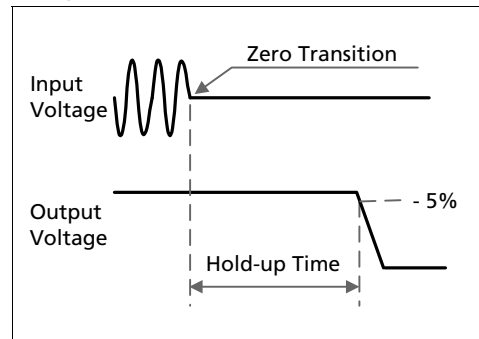


Fig. 7-2 Shut-down behavior, definitions





## 8. EFFICIENCY AND POWER LOSSES

		AC 100V	AC 120V	AC 230V	
Efficiency	typ.	90.6%	92.1%	93.8%	At 24V, 3.8A (full load)
Average efficiency <sup>1)</sup>	typ.	90.5%	91.6%	92.0%	25% at 0.95A, 25% at 1.9A, 25% at 2.85A, 25% at 3.8A
Power losses	typ.	0.3W	0.3W	0.4W	At no load
	typ.	5.0W	4.3W	3.8W	At 24V, 1.9A (half load)
	typ.	9.5W	7.9W	6.0W	At 24V, 3.8A (full load)

1) 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. 8-1 Efficiency vs. output current at 24V, typ.

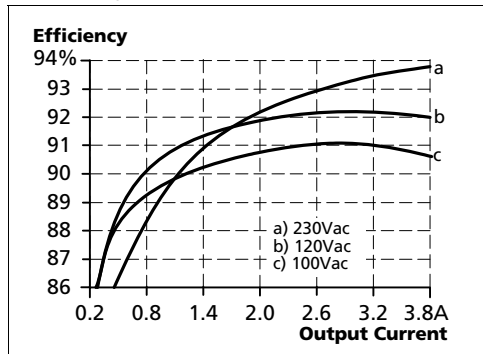


Fig. 8-2 Losses vs. output current at 24V, typ.

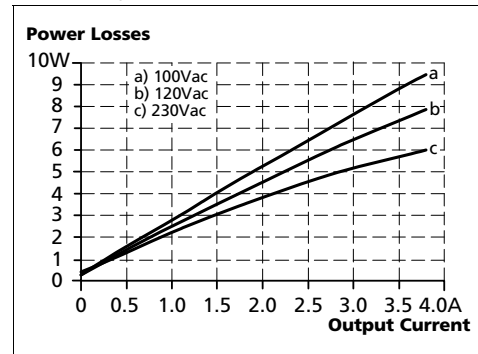


Fig. 8-3 Efficiency vs. input voltage at 24V, 3.8A, typ.

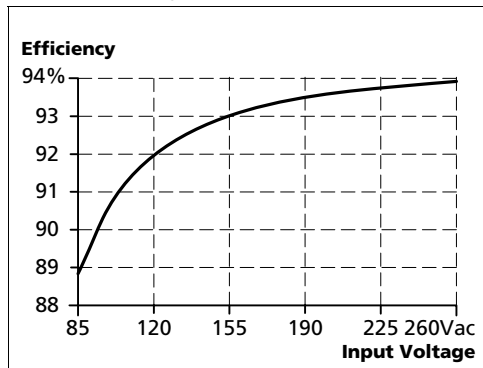
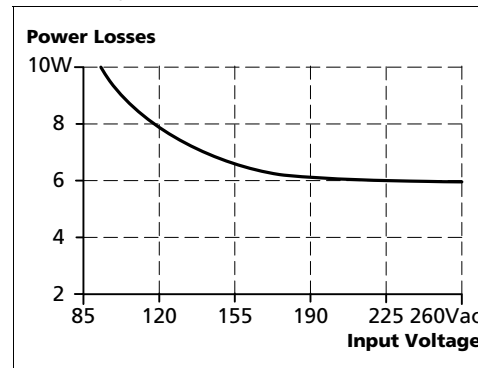
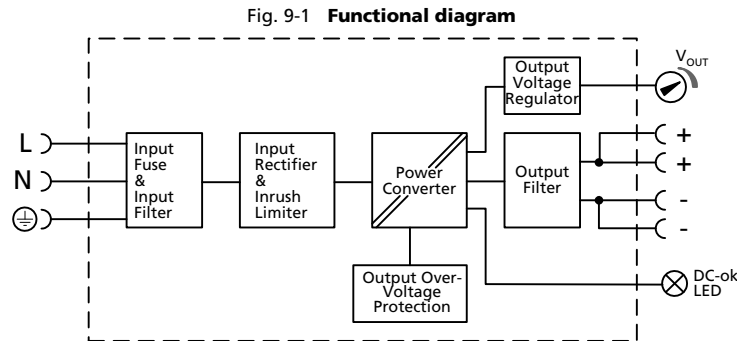


Fig. 8-4 Losses vs. input voltage at 24V, 3.8A, typ.

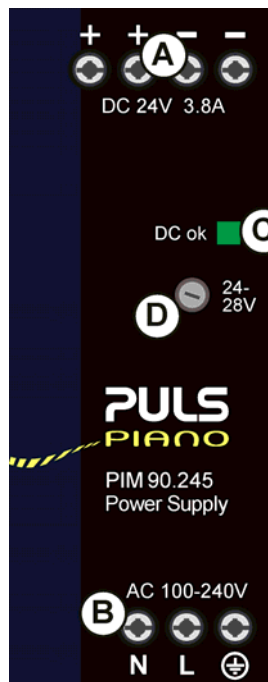


## 9. FUNCTIONAL DIAGRAM



## 10. FRONT SIDE AND USER ELEMENTS

Fig. 10-1 **Front side**



**A Output terminals** (Push-in terminals)

Dual terminals for the negative and positive pole. Both poles are internally connected

- + Positive output
- Negative (return) output

**B Input terminals** (push-in terminals)

- L Phase (Line) input
- N Neutral conductor input
- ⊕ PE (Protective Earth) input

**C DC-ok LED** (green)

The LED is on, when the output voltage is >18V.

**D Output voltage potentiometer**

## 11. CONNECTION TERMINALS

The terminals are IP20 Finger safe constructed and suitable for field- and factory wiring. Ensure that all strands of a stranded wire enter the terminal connection! The use of ferrules is recommended.

Type	Screw terminals
Solid wire	Max. 6mm <sup>2</sup>
Stranded wire	Max. 4mm <sup>2</sup>
American Wire Gauge	AWG 20-10
Max. wire diameter (including ferrules)	2.8mm
Wire stripping length	7mm / 0.28inch
Recommended tightening torque	1Nm, 9lb.in
Screwdriver	3mm slotted or Phillips No 1

## 12. 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 400h). Any number exceeding this value is a calculated theoretical lifetime which can be used to compare devices.

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy	260 000h	292 000h	309 000h	At 24V, 1.9A and 40°C
	640 000h	720 000h	815 000h	At 24V, 1.9A and 25°C
	39 000h	64 000h	102 000h	At 24V, 3.8A and 40°C
	91 000h	147 000h	287 000h	At 24V, 3.8A and 25°C

## 13. 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 e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

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 100V	AC 120V	AC 230V	
MTBF SN 29500, IEC 61709	T.B.D.	T.B.D.	T.B.D.	At 24V, 3.8A and 40°C
	T.B.D.	T.B.D.	T.B.D.	At 24V, 3.8A and 25°C
MTBF MIL HDBK 217F	T.B.D.	T.B.D.	T.B.D.	At 24V, 3.8A , 40°C; Ground Benign GB40
	T.B.D.	T.B.D.	T.B.D.	At 24V, 3.8A , 25°C; Ground Benign GB25
	T.B.D.	T.B.D.	T.B.D.	At 24V, 3.8A , 40°C; Ground Fixed GF40
	T.B.D.	T.B.D.	T.B.D.	At 24V, 3.8A , 25°C; Ground Fixed GF25

## 14. 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 Air discharge	8kV 8kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-2.7GHz	10V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines DC-OK Signal (coupling clamp)	4kV 2kV 2kV	Criterion A Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N N / L → PE	2kV 4kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + / - → PE	1kV 1kV	Criterion A Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	10V	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 100Vac 40% of 100Vac 70% of 100Vac 0% of 120Vac 40% of 120Vac 70% of 120Vac 0% of 200Vac 40% of 200Vac 70% of 200Vac	0Vac, 20ms 40Vac, 200ms 70Vac, 500ms 0Vac, 20ms 48Vac, 200ms 84Vac, 500ms 0Vac, 20ms 80Vac, 200ms 140Vac, 500ms	Criterion B Criterion C Criterion A Criterion C Criterion A Criterion A Criterion A Criterion A Criterion A
Voltage interruptions	EN 61000-4-11		0Vac, 5000ms	Criterion C
Powerful transients	VDE 0160	Over entire load range	750V, 1.3ms	Criterion A

### Criteria:

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

**B:** The device operates continuously during and after the test. During the test minor temporary impairments may occur, which will be corrected by the device itself.

**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 55022, FCC Part 15, CISPR 11, CISPR 22	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 55022, CISPR 11, CISPR 22	Class B
Harmonic input current	EN 61000-3-2	Fulfilled (Class A)
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with non pulsing constant current loads.

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

Main converter	40kHz to 140kHz	Input voltage and output load dependent
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## 15. ENVIRONMENT

Operational temperature	-10°C to +70°C (14°F to 158°F)	The operational temperature is the ambient or surrounding temperature and is defined as the air temperature 2cm below the device.
Storage temperature	-40°C to +85°C (-40°F to 185°F)	For storage and transportation
Output de-rating	0.1A/°C 0.25A/1000m or 5°C/1000m The de-rating is not hardware controlled. The user has to take this into consideration to stay below the de-rated current limits in order not to overload the unit.	Between +60°C and +70°C (140°F to 158°F) For altitudes >2000m (6560ft), see Fig. 15-2
Humidity	10 to 90% r.H.	According to IEC 60068-2-30 No condensation allowed.
Atmospheric pressure	110-47kPa	See Fig. 15-2 for details
Altitude	Up to 6000m (20 000ft)	See Fig. 15-2 for details
Over-voltage category	III	For altitudes up to 2000m according to IEC 60664-1
	II	For altitudes above 2000m according to IEC 60664-1
Degree of pollution	2	According to IEC 62477-1, non conductive
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	According to IEC 60068-2-6
Shock	T.B.D.	According to IEC 60068-2-27
	3 bumps / direction, 18 bumps in total Shock and vibration is tested in combination with DIN-Rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard mounting orientation.	
LABS compatibility	As a rule, only non-silicon precipitating materials are used. The unit conforms to the LABS criteria and is suitable for use in paint shops.	
Corrosive gases	Compliant to ISA-71.04-1985, Severity Level G3 and IEC 60068-2-60 Test Ke Method 4 for a service life of minimum 10 years in these environments.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit.	

Fig. 15-1 Output power vs. ambient temp.

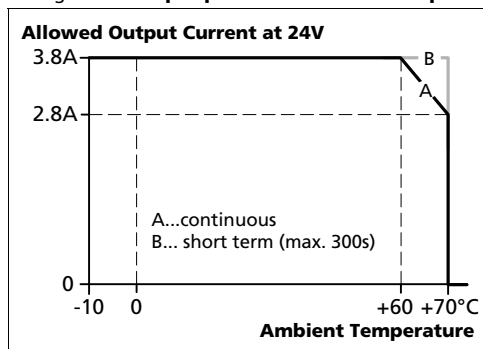
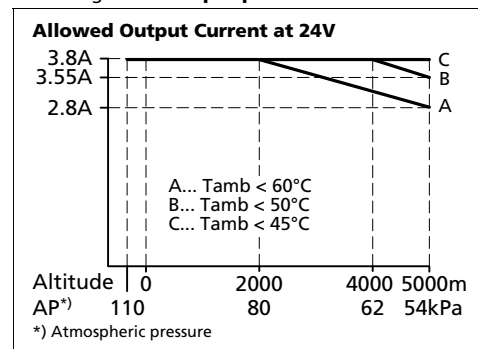


Fig. 15-2 Output power vs. altitude



## 16. SAFETY AND PROTECTION FEATURES

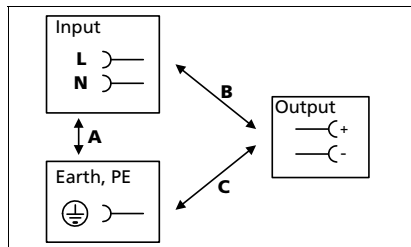
Isolation resistance	Min.	500MΩ	At delivered condition between input and output, measured with 500Vdc
	Min.	500MΩ	At delivered condition between input and PE, measured with 500Vdc
	Min.	500MΩ	At delivered condition between output and PE, measured with 500Vdc
Output over-voltage protection	Typ.	30.5Vdc	In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
	Max.	32Vdc	
Class of protection		I	According to IEC 61140
Degree of protection		IP 20	According to EN/IEC 60529
Over-temperature protection		Not included	
Input transient protection		MOV (Metal Oxide Varistor)	For protection values see chapter 14 (EMC).
Internal input fuse		Included	Not user replaceable slow-blow high-braking capacity fuse
Touch current (leakage current)	Typ.	T.B.D. / T.B.D.µA	At 100Vac, 50Hz, TN-,TT-mains / IT-mains
	Typ.	T.B.D. / T.B.D.µA	At 120Vac, 60Hz, TN-,TT-mains / IT-mains
	Typ.	T.B.D. / T.B.D.µA	At 230Vac, 50Hz, TN-,TT-mains / IT-mains
	Max.	T.B.D. / T.B.D.µA	At 110Vac, 50Hz, TN-,TT-mains / IT-mains
	Max.	T.B.D. / T.B.D.µA	At 132Vac, 60Hz, TN-,TT-mains / IT-mains
	Max.	T.B.D. / T.B.D.µA	At 264Vac, 50Hz, TN-,TT-mains / IT-mains

## 17. DIELECTRIC STRENGTH

The output voltage is floating and has no ohmic connection to the ground. It is recommended 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 can not be switched off when unnoticed earth faults occur.

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 (2s up and 2s down). Connect all phase-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.

Fig. 17-1 Dielectric strength



		A	B	C
Type test	60s	2500Vac	3000Vac	1000Vac
Routine test	5s	2500Vac	2500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac
Cut-off current setting for field test		> 2mA	> 2mA	> 6mA

## 18. APPROVALS

EC Declaration of Conformity planned



The CE mark indicates conformance with the  
 - EMC directive and the  
 - Low-voltage directive and the  
 - RoHS directive

IEC 60950-1  
 2<sup>nd</sup> Edition  
 planned



CB Scheme for I.T.E.  
 Information Technology Equipment

IEC 61010-2-201  
 2<sup>nd</sup> Edition  
 planned



CB Scheme for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment

ANSI/UL 61010-2-201  
 (former UL 508)  
 planned



Listed as Open Type Device for use in Control Equipment  
 UL Category NMTR, NMTR7  
 E-File: E198865

EAC TR Registration planned



Registration for the Eurasian Customs Union market  
 (Russia, Kazakhstan, Belarus)

## 19. OTHER FULFILLED STANDARDS

REACH Directive



Directive 1907/2006/EU of the European Parliament and the Council of June 1<sup>st</sup>, 2007 regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals

IEC/EN 61558-2-16  
 (Annex BB)

Safety Isolating Transformer

Safety Isolating Transformers corresponding to Part 2-6 of the IEC/EN 61558

## 20. PHYSICAL DIMENSIONS AND WEIGHT

Width	36mm 1.42"
Height	90mm 3.54"
Depth	91mm 3.58"
	The DIN-rail height must be added to the unit depth to calculate the total required installation depth.

Weight	270g / 0.6lb
DIN-Rail	Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Housing material	High-grade polycarbonate/ ABS blend material
Installation clearances	See chapter 2
Penetration protection	Small parts like screws, nuts, etc. with a diameter larger than 4.2mm.

Fig. 20-1 Front view

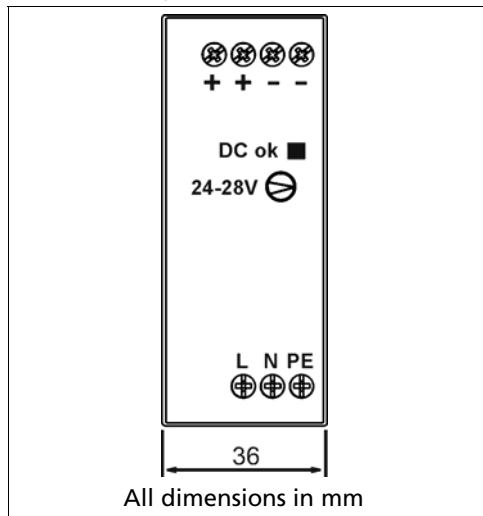
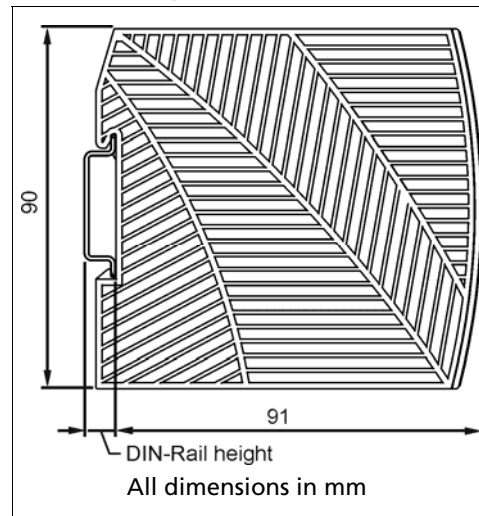


Fig. 20-2 Side view





## 21. APPLICATION NOTES

### 21.1. 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 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 two examples show typical voltage dips for resistive loads:

Fig. 21-1 **7.6A peak current for 50ms , typ.**  
(2x the nominal current)

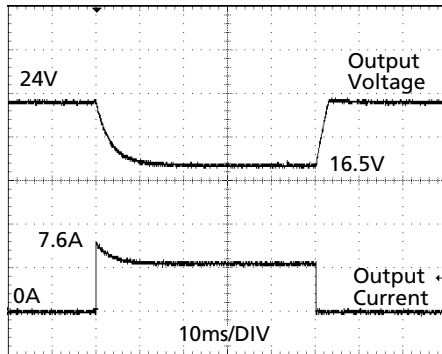
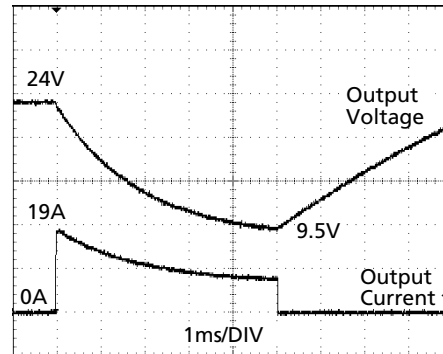


Fig. 21-2 **19A peak current for 5ms , typ.**  
(5x the nominal current)



Peak current voltage dips	Typically from 24V to 16.5V Typically from 24V to 13.5V Typically from 24V to 9.5V	At 7.6A for 50ms and resistive load At 19A for 2ms and resistive load At 19A for 5ms and resistive load
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## 21.2. CHARGING OF BATTERIES

Do not use the power supply to charge batteries.

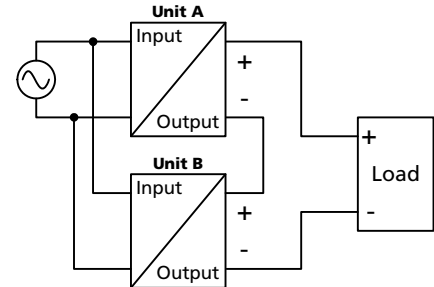
## 21.3. SERIES OPERATION

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 150Vdc. Voltages with a potential above 60Vdc must be installed with a protection against touching.

Avoid return voltage (e.g. from a decelerating motor or battery) which is applied to the output terminals.

Keep an installation clearance of 15mm (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.



## 21.4. PARALLEL USE TO INCREASE OUTPUT POWER

Do not use the power supply in parallel to increase the output power.

## 21.5. PARALLEL USE FOR 1+1 REDUNDANCY

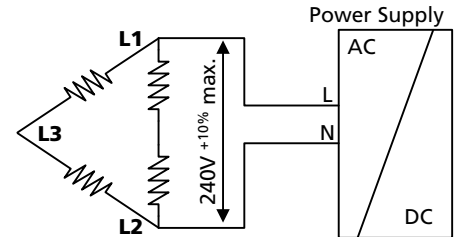
Devices can be paralleled for 1+1 redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one device fails. The simplest way is to put two devices in parallel. This is called a 1+1 redundancy. In case one device fails, the other one is automatically able to support the load current without any interruption. It is essential to use a redundancy module to decouple devices from each other. This prevents that the defective unit becomes a load for the other device and the output voltage cannot be maintained any more.

This device does not incorporate means to report a defective or non functional power supply. Since this is essential for redundant systems, chose a redundancy module which monitors and reports an insufficient input voltage or use a power supply, which has a DC-OK signal included.

## 21.6. OPERATION ON TWO PHASES

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

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



## 21.7. USE IN A TIGHTLY SEALED ENCLOSURE

When the device 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 device.

In the following test setup, the device is placed in the middle of the box, no other heat producing items are inside the box. The load is placed outside 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 1cm.

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

	Case A	Case B
Enclosure size	110x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic	110x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic
Input voltage	230Vac	230Vac
Load	24V, 3.04A (=80%)	24V, 3.8A; (=100%)
Temperature inside the box	34.2°C	35.9°C
Temperature outside the box	24.9°C	25.2°C
Temperature rise	9.3K	10.7K