ML15.051

5V, 3A, SINGLE PHASE INPUT



POWER SUPPLY

- 100-240V wide range input
- NEC CLASS 2 compliant
- Adjustable output voltage
- Efficiency up to 77.2%
- Compact design, width only 22.5mm
- Full output power between -10°C and +60°C
- Large international approval package
- 3 Year warranty

PRODUCT DESCRIPTION

A compact size, light weight, simple mounting onto the DIN rail and the utilization of only quality components are what makes the MiniLine power supplies so easy to use and install within seconds.

A rugged electrical and mechanical design as well as a high immunity against electrical disturbances on the mains provides reliable output power. This offers superior protection for equipment which is connected to the public mains network or is exposed to a critical industrial environment.

The MiniLine series offers output voltages from 5 to 56Vdc and a power rating from 15W to 120W.

SHORT-FORM DATA

Output voltage	DC 5V	nominal
Adjustment range	5 – 5.5V	factory setting 5.1V
Output current	3A	up to +60°C
	2.25A	at +70°C ambient
Input voltage	AC 100-240V	-15% / +10%
Mains frequency	50-60Hz	±6%
AC Input current	0.32 / 0.19A	at 120 / 230Vac
Power factor	0.51 / 0.44	at 120 / 230Vac
Input voltage DC	DC 110-300V	-20% / +25%
Input current DC	0.18 / 0.06A	at 110 / 300Vdc
AC Inrush current	typ. 13 / 26A$_{peak}$	at 120 / 230Vac, +40°C and cold start
Efficiency	76.8 / 77.2%	at 120 / 230Vac
Power losses	4.6 / 4.5W	at 120 / 230Vac
Temperature range	-10°C to +70°C	operational
Hold-up time	typ. 45 / 186ms	at 120 / 230Vac
Dimensions	22.5x75x91mm	WxHxD
Weight	130g	

ORDER NUMBERS

Power Supply **ML15.051** 5V Standard unit

MAIN APPROVALS

For details and the complete approval list, see chapter 18.

UL 508 | UL 60950-1 | Class I Div 2

Marine | Marine

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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 230V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
230Vac	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
50Hz vs. 60Hz	As long as not otherwise stated, AC 100V and AC 230V parameters are valid at 50Hz and AC 120V parameters are valid at 60Hz mains frequency.

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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 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 re-powering.
- 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 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. Unused screw terminals should be securely tightened.

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

The housing 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 300Vac.

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 375Vdc. Connect the +pole to L and the -pole to the N terminal.

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. Above 2000m a reduction in output current and overvoltage category is required.

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.

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The device is designed, tested and approved for branch circuits up to 20A without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 6A B- or 3A 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 2cm below the device.

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

2.1. HAZARDOUS LOCATION AREAS

Do not use with DC input voltages or above +60°C ambient temperature.

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

WARNING EXPLOSION HAZARDS!

Substitution of components may impair suitability for this environment.

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.

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3. AC-INPUT

AC input	nom.	AC 100-240V	-15% / +10%, TN/TT/IT-mains
AC input range		85-264Vac	
		264–300Vac	< 0.5s
Allowed voltage L or N to earth	max.	300Vac	
Input frequency	nom.	50–60Hz	±6%
Turn-on voltage	typ.	59Vac	steady-state value, see Fig. 3-1
Shut-down voltage	typ.	54Vac	steady-state value, see Fig. 3-1

		AC 100V	AC 120V	AC 230V	
Input current (rms)	typ.	0.38A	0.32A	0.19A	at 5V, 3A see Fig. 3-3
Power factor *)	typ.	0.52	0.51	0.44	at 5V, 3A see Fig. 3-4
Crest factor **)	typ.	3.45	3.53	3.94	at 5V, 3A
Start-up delay	typ.	630ms	630ms	630ms	see Fig. 5 2
Rise time	typ.	10ms	10ms	10ms	at 5V, 3A, see Fig. 3-2
Turn-on overshoot	max.	100mV	100mV	100mV	see Fig. 3-2

*) The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.
**) The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.

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

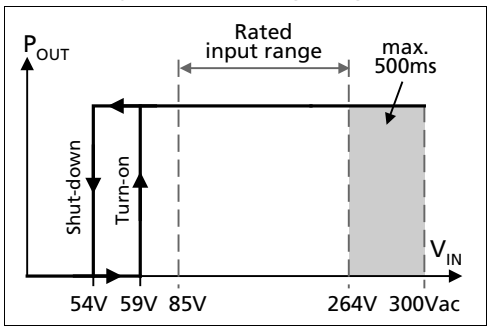


Fig. 3-2 **Turn-on behavior, definitions**

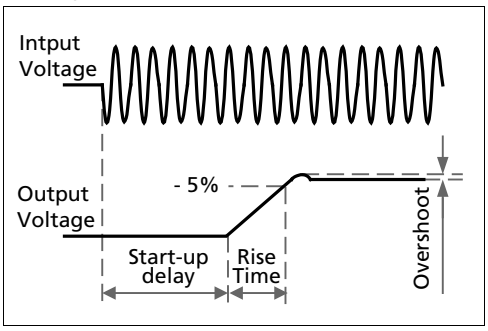


Fig. 3-3 **Input current vs. output load**

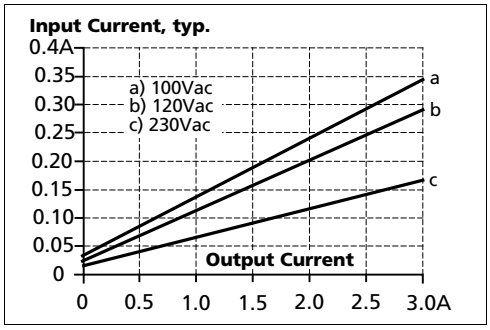
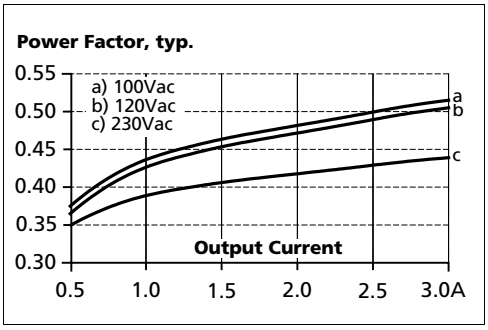


Fig. 3-4 **Power factor vs. output load**

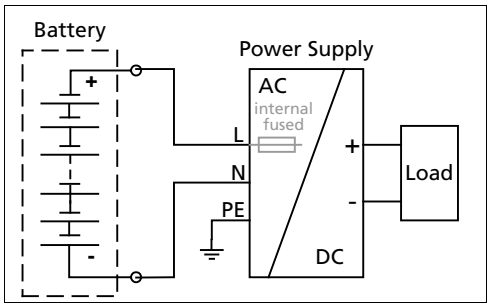


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4. DC-INPUT

DC input	nom.	DC 110-300V	-20%/+25%
DC input range		88-375Vdc	
DC input current	typ.	0.16A / 0.057A	110Vdc / 300Vdc, at 5V, 3A
Turn-on voltage	typ.	80Vdc	steady state value
Shut-down voltage	typ.	60Vdc	steady state value

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



Instructions for DC use:

a) Use a battery or similar DC source.
   For other sources contact PULS
b) Connect +pole to L and –pole to N.
c) Connect the PE terminal to an earth wire or to the machine ground.

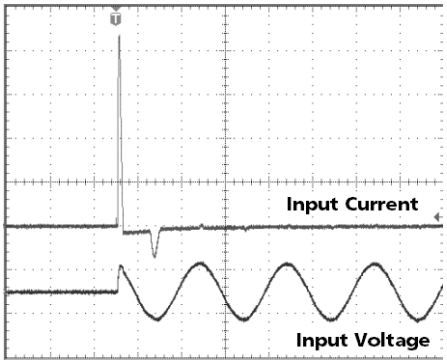
5. INPUT INRUSH CURRENT

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

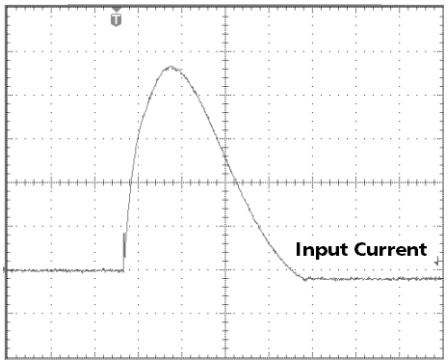
		AC 100V	AC 120V	AC 230V	
Inrush current	max.	$13A_{peak}$	$16A_{peak}$	$31A_{peak}$	+40°C ambient, cold start
	typ.	$11A_{peak}$	$13A_{peak}$	$26A_{peak}$	+40°C ambient, cold start
Inrush energy	max.	$0.1A^2s$	$0.1A^2s$	$0.4A^2s$	+40°C ambient, cold start

Fig. 5-1 **Input inrush current, typical behavior**



Input: 230Vac
Output: 5V, 3A
Ambient: 25°C
Upper curve: Input current 5A/DIV
Lower curve: Input voltage 500V/DIV
Time basis: 10ms / DIV

Fig. 5-2 **Input inrush current, zoom into first peak**



Input: 230Vac
Output: 5V, 3A
Ambient: 25°C
Input current curve: 5A/DIV, 500µs / DIV
Ipeak 23A

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6. OUTPUT

Output voltage	nom.	5V	
Adjustment range		5-5.5V	guaranteed
	max.	6V *)	at clockwise end position of potentiometer
Factory setting		5.1V	±0.2%, at full load, cold unit
Line regulation	max.	10mV	85-264Vac
Load regulation	max.	100mV	static value, 0A → 3A
Ripple and noise voltage	max.	50mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	4 800µF	
Output current	nom.	3A	at 5V, see Fig. 6-1
	nom.	2.72A	at 5.5V, see Fig. 6-1
Output power	nom.	15W	
Short-circuit current	min.	hiccup mode	see Fig. 6-2
	max.	3A rms-current	short circuit impedance <10mOhm, unit makes start-up attempts at short-circuit (hiccup-mode)

*) 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. The typical value which can be achieved by turning the potentiometer to the clockwise end position is 5.8V.

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

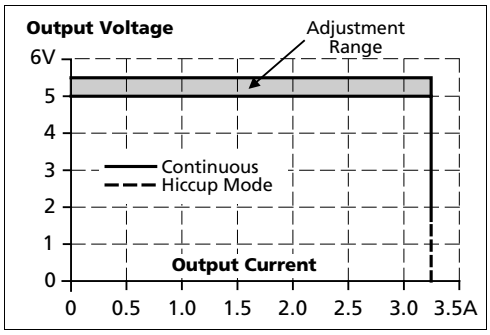
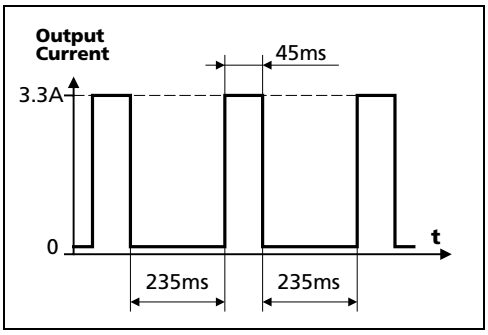


Fig. 6-2 **Hiccup mode; output current at shorted output, 230Vac, typ.**



Peak current capability (up to several milliseconds)

The power supply can deliver a peak current which is higher than the specified short-term current. This helps to start current demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the power supply. During this event, the capacitors will be discharged and causes a voltage dip on the output. Detailed curves can be found in chapter 21.1.

Peak current voltage dips	typ.	from 5V to 2.4V	at 6A for 50ms, resistive load
	typ.	from 5V to 1.0V	at 15A for 2ms, resistive load
	typ.	from 5V to 0.8V	at 15A for 5ms, resistive load

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7. HOLD-UP TIME

		AC 100V	AC 120V	AC 230V	
Hold-up Time	typ.	61ms	93ms	340ms	at 5V, 1.5A, see Fig. 7-1
	typ.	29.5ms	45ms	186ms	at 5V, 3A, see Fig. 7-1

Note: At no load, the hold-up time can be up to several seconds. The green DC-OK LED is also on during this time

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

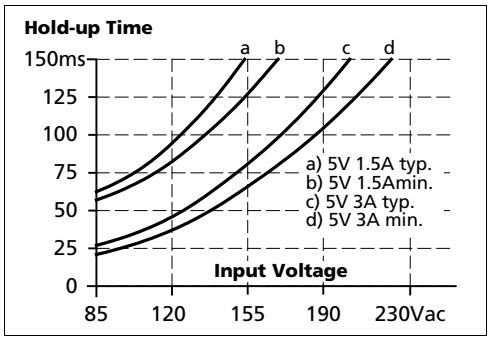
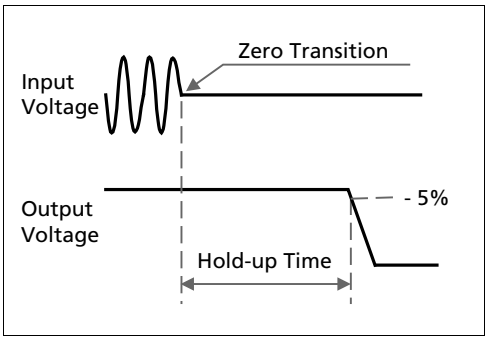


Fig. 7-2 **Shut-down behavior, definitions**



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8. EFFICIENCY AND POWER LOSSES

		AC 100V	AC 120V	AC 230V	
Efficiency	typ.	75.8%	76.8%	77.2%	at 5V, 3A (full load)
Power losses	typ.	0.2W	0.3W	0.6W	at 0A
	typ.	2.3W	2.3W	2.4W	at 5V, 1.5A (half load)
	typ.	4.9W	4.6W	4.5W	at 5V, 3A (full load)

Fig. 8-1 **Efficiency vs. output current at 5V, typ.**

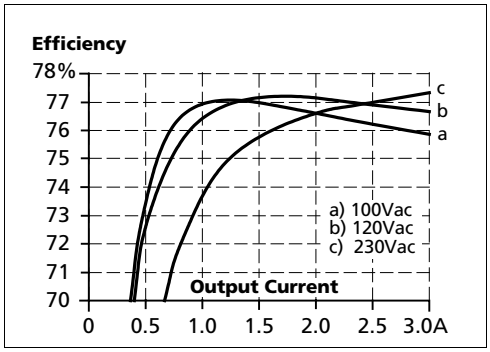


Fig. 8-2 **Losses vs. output current at 5V, typ.**

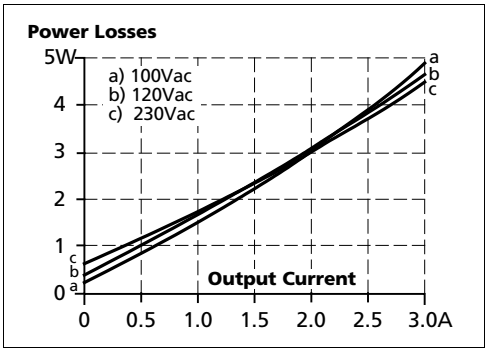


Fig. 8-3 **Efficiency vs. input voltage at 5V, 3A, typ.**

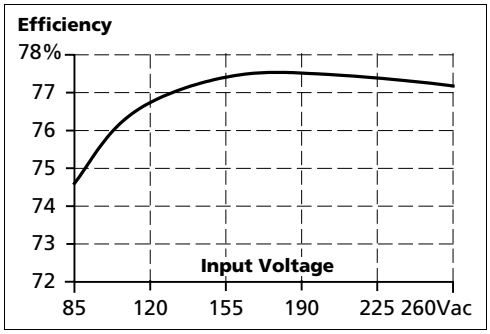
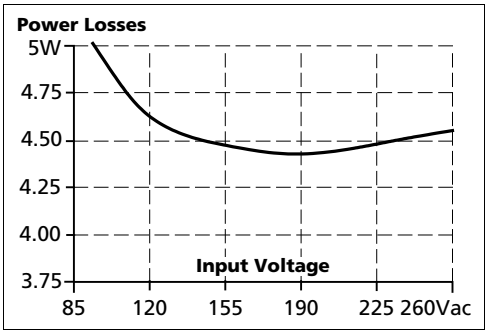


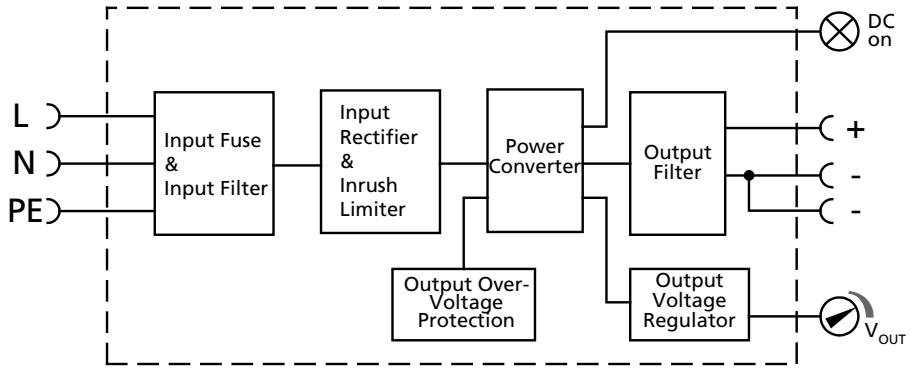
Fig. 8-4 **Losses vs. input voltage at 5V, 3A, typ.**



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9. FUNCTIONAL DIAGRAM

Fig. 9-1 **Functional diagram**



10. FRONT SIDE AND USER ELEMENTS

Fig. 10-1 **Front side**



A **Output Terminals**
Screw terminals,
Dual terminals for the negative pole allows an easy earthing of the output voltage
+ Positive output
- Negative (return) output

B **Input Terminals**
Screw terminals
L Phase (Line) input
N Neutral conductor input
⏚ PE (Protective Earth) input

C **DC-on LED** (green)
On when the voltage on the output terminals is > 2V

D **Output voltage potentiometer**
Turn to set the output voltage. Factory set: 5.1V

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11. TERMINALS AND WIRING

All terminals are easy to access when mounted on the panel. Input and output terminals are separated from each other (input below, output above) to help in error-free wiring.

	Input	Output
Type	screw terminals	screw terminals
Solid wire	0.5-6mm²	0.5-6mm²
Stranded wire	0.5-4mm²	0.5-4mm²
American Wire Gauge	20-10 AWG	20-10 AWG
Wire stripping length	7mm	7mm
Screwdriver	3.5mm slotted or Pozidrive No 2	3.5mm slotted or Pozidrive No 2
Recommended tightening torque	1Nm	1Nm

Instructions:

a) Use appropriate copper cables that are designed for minimum operating temperatures of:
60°C for ambient up to 45°C and 75°C for ambient up to 60°C minimum.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Up to two stranded wires with the same cross chapter are permitted in one connection point (except PE wire).
e) Do not use the unit without PE connection.
f) Screws of unused terminal compartments should be securely tightened.
g) Ferrules are allowed.

12. LIFETIME EXPECTANCY AND MTBF

These units are extremely reliable and use only the highest quality materials. The number of critical components such as electrolytic capacitors has been reduced.

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy *)	66 000h	70 000h	93 000h	at 5V, 3A and +40°C
	> 15 years	> 15 years	> 15 years	at 5V, 1.5A and +40°C
	> 15 years	> 15 years	> 15 years	at 5V, 3A and +25°C
MTBF **) SN 29500, IEC 61709	2 479 000h	2 838 000h	2 686 000h	at 5V, 3A and +40°C
	4 066 000h	4 654 000h	4 405 000h	at 5V, 3A and +25°C
MTBF **) MIL HDBK 217F	1 175 000h	1 251 000h	1 145 000h	at 5V, 3A and +40°C; Ground Benign GB40
	1 575 000h	1 676 000h	1 534 000h	at 5V, 3A and +25°C; Ground Benign GB25

*) 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 prediction model allows only a calculation of up to 15 years from date of shipment.

) **MTBF stands for **M**ean **T**ime **B**etween **F**ailures, 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. An 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.

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13. EMC

The power supply is suitable for applications in industrial environment as well as in residential, commercial and light industry environment.

Without additional measures to reduce the conducted emissions on the output (e.g. by using a filter), the device is not suited for applications in residential environments unless the maximum length of the DC output line is 12m. No restrictions apply for industrial environments.

EMC Immunity	Generic standards: EN IEC 61000-6-1 and EN IEC 61000-6-2			
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8kV 8kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-6GHz	10V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines	4kV 2kV	Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N N → PE, L → PE	2kV 4kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + → PE, - → PE	500V 2kV	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 200Vac 40% of 200Vac 70% of 200Vac	0Vac, 20ms 40Vac, 200ms 70Vac, 500ms 0Vac, 20ms 80Vac, 200ms 140Vac, 500ms	Criterion A Criterion C Criterion A Criterion A Criterion A Criterion A
Voltage interruptions	EN 61000-4-11		0Vac, 5000ms	Criterion C
Input voltage swells	PULS internal standard		300Vac, 500ms	Criterion A
Powerful transients	VDE 0160	over entire load range	750V, 1.3ms	Criterion A

Criterions:

A: Power supply shows normal operation behavior within the defined limits.

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

EMC Emission	Generic standards: EN IEC 61000-6-3 and EN IEC 61000-6-4	
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 according EN IEC 61000-6-3 for DC power ports fulfilled for a maximum output line length of 12m
Radiated emission	EN 55011, EN 55032	Class B
Harmonic input current	EN 61000-3-2	Not applicable below 75W input power
Voltage fluctuations, flicker	EN 61000-3-3	fulfilled

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 frequency	Constant, typ. 65kHz

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14. ENVIRONMENT

Operational temperature *)	-10°C to +70°C	Reduce output power according Fig. 14-1
Storage temperature	-40 to +85°C	For storage and transportation
Output derating	0.4W/°C	Between +60°C and +70°C
Humidity **)	5 to 95% r.H.	IEC 60068-2-30
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	IEC 60068-2-6
Shock	30g 6ms, 20g 11ms 3 bumps / direction, 18 bumps in total	IEC 60068-2-27
Altitude	0 to 5000m	Reduce output power or ambient temperature above 2000m sea level.
Altitude derating	1W/1000m or 5°C/1000m	above 2000m, see Fig. 14-2
Overvoltage category	III	IEC 62103, EN 50178, altitudes up to 2000m
	II	Altitudes from 2000m to 5000m
Degree of pollution	2	IEC 60664-1, not conductive

*) Operational temperature is the same as the ambient temperature and is defined as the air temperature 2cm below the unit.
**) Do not energize while condensation is present

Fig. 14-1 **Output power vs. ambient temp.**

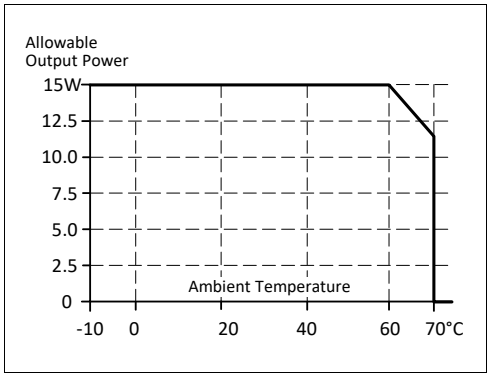
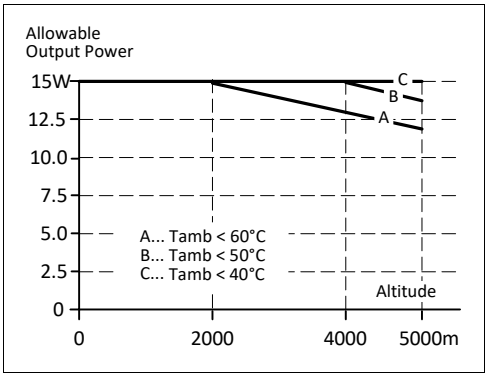


Fig. 14-2 **Output power vs. altitude**



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15. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits *)	
Output overvoltage protection	typ. 8.7Vdc max. 9.6Vdc	In case of an internal power supply fault, a redundant circuit limits the maximum output voltage. In such a case, the output shuts down and stays down until the input voltage is turned off and on again.
Output overcurrent protection	electronically limited	see Fig. 6-2
Degree of protection	IP20	EN/IEC 60529
Penetration protection	> 2.5mm in diameter	e.g. screws, small parts
Overtemperature protection	Not included	
Input transient protection	MOV	Metal Oxide Varistor
Internal input fuse	T3.15A H.B.C.	not user replaceable

*) In case of a protection event, audible noise may occur.

16. SAFETY FEATURES

Input / output separation *)	SELV	IEC/UL 60950-1
	PELV	IEC/EN 61010-2-201
Class of protection	I	PE (Protective Earth) connection required
	II (with restrictions)	for use without PE connection contact PULS
Insulation resistance	> 100MOhm	Input to output, 500Vdc
Touch current (leakage current)	typ. 0.17mA / 0.38mA	100Vac, 50Hz, TN-, TT-mains / IT-mains
	typ. 0.24mA / 0.55mA	120Vac, 60Hz, TN-, TT-mains / IT-mains
	typ. 0.40mA / 0.86mA	230Vac, 50Hz, TN-, TT-mains / IT-mains
	< 0.21mA / 0.44mA	110Vac, 50Hz, TN-, TT-mains / IT-mains
	< 0.30mA / 0.66mA	132Vac, 60Hz, TN-, TT-mains / IT-mains
	< 0.54mA / 1.08mA	264Vac, 50Hz, TN-, TT-mains / IT-mains

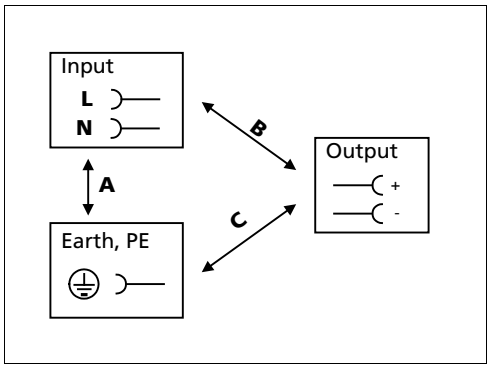
*) Double or reinforced insulation

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17. DIELECTRIC STRENGTH

The output voltage is floating and has no ohmic connection to the ground. Type and factory 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	500Vac
Factory test	5s	2500Vac	2500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac
Cut-off current setting		> 6mA	> 6mA	> 1mA

To fulfill the PELV requirements according to EN60204-1 § 6.4.1, we recommend that either the + pole, the – pole or any other part of the output circuit 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.

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18. APPROVED, FULFILLED OR TESTED STANDARDS

UL 508	c UL us LISTED	UL Certificate Listed equipment for category NMTR - Industrial Control Equipment and Fulfilled Standard Applicable for US and Canada E-File: E198865
IEC 61010-2-201	Safety ✓	Manufacturer's Declaration Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment
IEC 60950-1	CB Report	CB Scheme Certificate General safety requirements for Information Technology Equipment (ITE)
UL 60950-1	c UL us	UL Certificate Recognized component for category QQGQ - Information Technology Equipment (ITE) Applicable for US and Canada E-File: E137006
Class I Div 2	c SA us	CSA Certificate Power Supplies for Hazardous Location Applicable for Canada and US CSA Class: 5318-01 (Canada), 5318-81 (USA) Temperature Code: T4 Groups: A, B, C and D
Marine (DNV)	DNV DNV.COM/AF	DNV Certificate DNV Type approved product Certificate: TAA00001ST
Marine (ABS)	ABS	ABS Design Assessment Certificate ABS (American Bureau of Shipment) assessed product Certificate: 22-2231447-PDA
NEC Class 2	NEC CLASS 2	Manufacturer's Declaration NEC CLASS 2 – Limited Power Source Listed device according to NEC Handbook chapter 725-121
IEC 60068-2-60	Corrosion IEC 60068-2-60 Method 4 ✓	Manufacturer's Declaration (Online Document) Environmental Tests, Flowing Mixed Gas Corrosion Test Test Ke - Method 4 H2S: 10ppb NO2: 200ppb Cl2: 10ppb SO2: 200ppb Test Duration: 3 weeks, which simulates a service life of 10 years.
ISA-71.04-1985	Corrosion G3-ISA-71.04 ✓	Manufacturer's Declaration (Online Document) Airborne Contaminants Corrosion Test Severity Level: G3 Harsh H2S: 100ppb NOx: 1250ppb Cl2: 20ppb SO2: 300ppb Test Duration: 3 weeks, which simulates a service life of 10 years.
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

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19. REGULATORY PRODUCT COMPLIANCE

EU Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive - Low-voltage directive (LVD) - RoHS directive
REACH Regulation (EU)	REACH COMPLIANT	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
KC	KC	KC Korean Certification Korean - Registration of Broadcasting and Communication Equipment Registered under Clause3, Article 58-2 of Radio Waves Act. Registration No. R-R-PUG-ML15_051.

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20. PHYSICAL DIMENSIONS AND WEIGHT

Weight	130g
DIN rail	Use 35mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm. The DIN rail depth must be added to the unit depth (91mm) to calculate the total required installation depth.
Installation Clearances	See chapter 2

Fig. 20-1 **Front view**

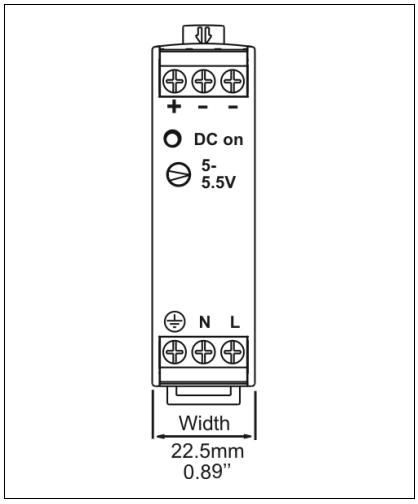
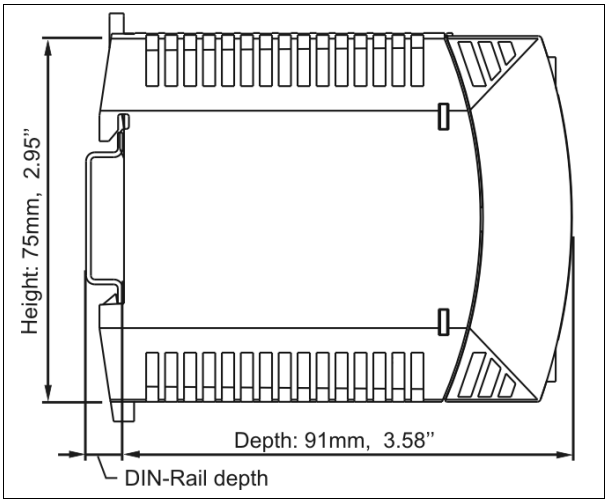


Fig. 20-2 **Side view**



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21. APPLICATION NOTES

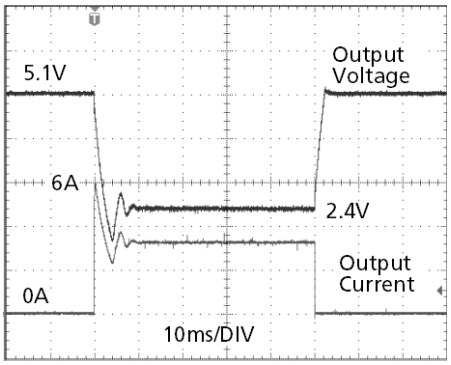
21.1. PEAK CURRENT CAPABILITY

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 (including the PowerBoost) The same situation applies, when starting a capacitive load.

Branch circuits are often protected with circuit breakers or fuses. In case of a short or an overload in the branch circuit, the fuse needs a certain amount of overcurrent to trip or to blow. The peak current capability ensures the safe operation of subsequent circuit breakers.

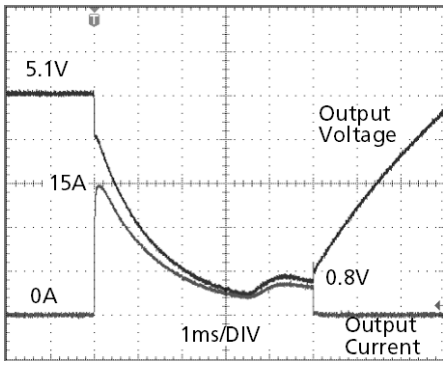
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 21-1 **Peak loading with 2x the nominal current for 50ms, typ.**



Peak load 6A (resistive load) for 50ms
Output voltage dips from 5.1V to 2.4V.

Fig. 21-2 **Peak loading with 5x the nominal current for 5ms, typ.**



Peak load 15A (resistive load) for 5ms
Output voltage dips from 5.1V to 0.8V.

21.2. BACK-FEEDING LOADS

Loads such as decelerating motors and inductors can feed voltage back to the power supply. This feature is also called return voltage immunity or resistance against Back- E.M.F. (Electro Magnetic Force).

The maximum allowed feed back voltage is 6.3Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in chapter 6.

This power supply 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. However, please note that the output voltage can dip to zero for approximately 200ms if the back-feed voltage is removed.

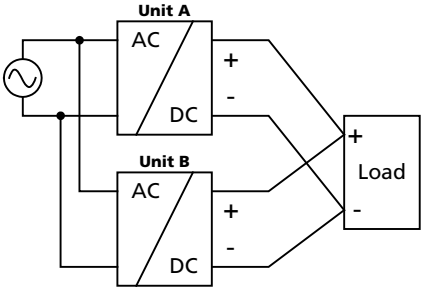
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21.3. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 20A. An external protection is only required, if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

If an external fuse is necessary or utilized, minimum requirements need to be considered to avoid nuisance tripping of the circuit breaker. A minimum value of 6A B- or 3A C-Characteristic breaker should be used.

21.4. PARALLEL USE TO INCREASE OUTPUT POWER



ML15.051 power supplies can be paralleled to increase the output power. This power supply has no feature included which balances the load current between the power supplies. Usually the power supply with the higher adjusted output voltage draws current until it goes into current limitation. This means no harm to this power supply as long as the ambient temperature stays below 45°C. The ML15.051 can also be paralleled with power supplies from MiniLine series with 5V output voltage. The output voltages of all power supplies shall be adjusted to the same value (±100mV). A fuse or diode on the output of each unit is only required if more than three units are connected in parallel. If a fuse (or circuit breaker) is used, choose one with approximately 150% of the rated output current of one power supply. 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 parallel in mounting orientations other than the standard mounting orientation (input terminals on the bottom and output terminals on top of the unit). Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

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21.5. PARALLEL USE FOR REDUNDANCY

Power supplies 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 power supply unit fails. The simplest way is to put two power supplies in parallel. This is called a 1+1 redundancy. In case one power supply unit fails, the other one is automatically able to support the load current without any interruption. Redundant systems for a higher power demand are usually built in a N+1 method. E.g. five power supplies, each rated for 3A are paralleled to build a 12A redundant system.

Please note: This simple way to build a redundant system does not cover failures such as an internal short circuit in the secondary side of the power supply. In such a case, the defect unit becomes a load for the other power supplies and the output voltage can not be maintained any more. This can only be avoided by utilizing decoupling diodes which are included in the decoupling module MLY02.100.

Recommendations for building redundant power systems:

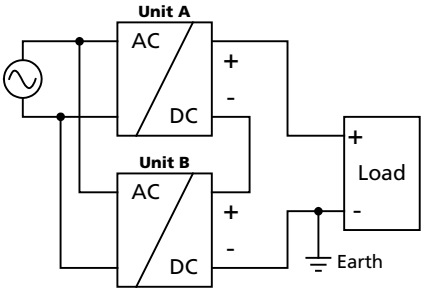
a) Use separate input fuses for each power supply.

b) Monitor the individual power supply units.

c) 1+1 Redundancy is allowed up to an ambient temperature of 60°C
N+1 Redundancy is allowed up to an ambient temperature of 45°C

d) It is desirable to set the output voltages of all units to the same value (± 100mV) or leave it at the factory setting.

21.6. SERIES OPERATION



Power supplies of the exact 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 are not SELV anymore and can be dangerous. Such voltages must be installed with a protection against touching. Earthing of the output is required when the sum of the output voltage is above 60Vdc. 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 (input terminals on the bottom and output terminals on top of the unit). Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

21.7. INDUCTIVE AND CAPACITIVE LOADS

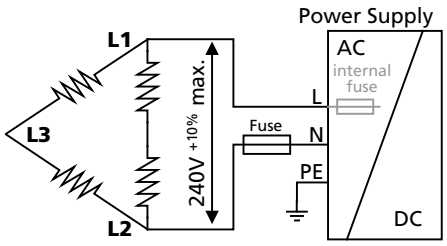
The unit is designed to supply unlimited inductive loads.

The max. capacitive load depends on the steady state output current. At 3A output current, the output capacity should not be larger than 10 000µF and at 0.3A output current not larger than 25 000µF. In case of larger capacitors, the unit can show start-up attempts or start-up problems.

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21.8. 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$^{+10\%}$. Use a fuse or a circuit breaker to protect the N input. The N input is internally not protected and is in this case connected to a hot wire. Appropriate fuses or circuit breakers are specified in chapter 21.3 “External Input Protection”.



21.9. USE WITHOUT PE ON THE INPUT

From a safety standpoint, the unit is internally designed according to the requirements for Protection Class 1 and 2. Please contact PULS if you do not plan to use the PE terminal. A different marking of the front foil is then required.

Grounding of the input is beneficial for a high EMI immunity: Symmetrical spikes or fast transients on the input side can be conducted directly to earth by the built-in filter capacitors. The magnitude of such spikes or fast transients on the output side caused by the input is much smaller compared to not connecting this terminal to ground.

Fig. 21-3 **Earthed input**

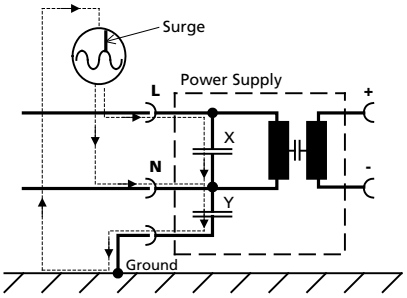
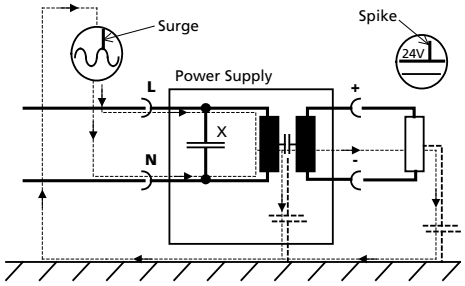


Fig. 21-4 **Not earthed input**



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21.10. 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, no other heat producing items are inside the box

Enclosure:	Rittal Type IP66 Box PK 9510 100, plastic, 130x130x75mm
Input:	230Vac

Case A:

Load:	5V, 3A; load is placed outside the box
Temperature inside the box:	38.2°C (in the middle of the right side of the power supply with a distance of 1cm)
Temperature outside the box:	26.0°C
Temperature rise:	12.2K

Case B:

Load:	5V, 2.4A; (=80%) load is placed outside the box
Temperature inside the box:	35.3°C (in the middle of the right side of the power supply with a distance of 1cm)
Temperature outside the box:	25.6°C
Temperature rise:	9.7K

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21.11. 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 max. allowed ambient temperature. The amount of reduction influences the lifetime expectancy of the power supply. Therefore, two different derating curves for continuous operation can be found below:

Curve A1 Recommended output current.
Curve A2 Max allowed output current (results in approximately half the lifetime expectancy of A1).

Fig. 21-5
Mounting Orientation A
(Standard orientation)

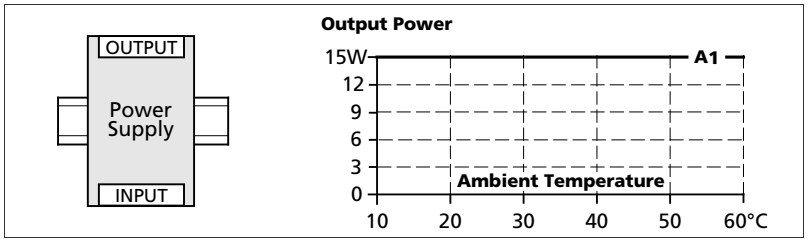


Fig. 21-6
Mounting Orientation B
(Upside down)

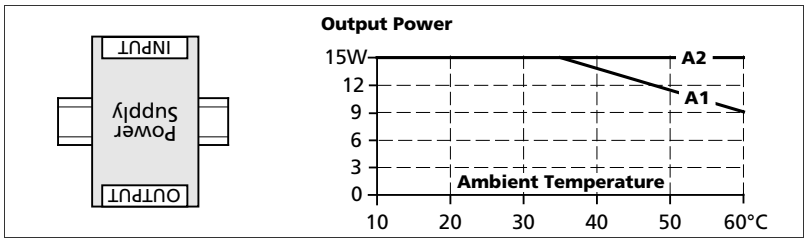


Fig. 21-7
Mounting Orientation C
(Table-top mounting)

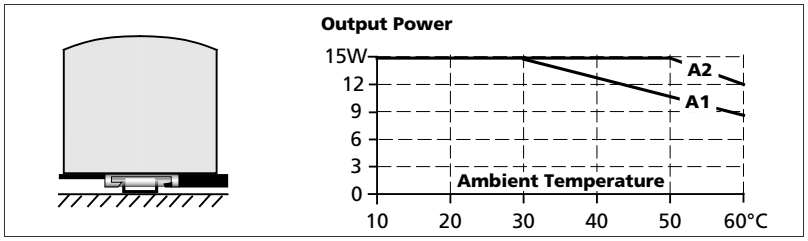


Fig. 21-8
Mounting Orientation D
(Horizontal cw)

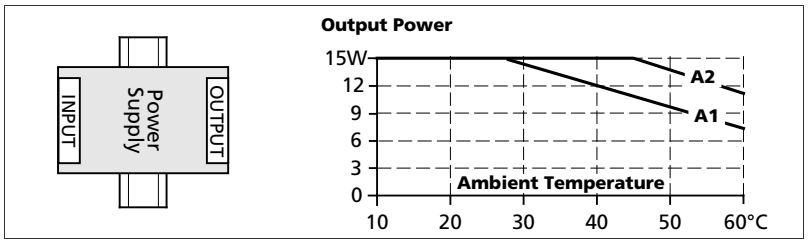
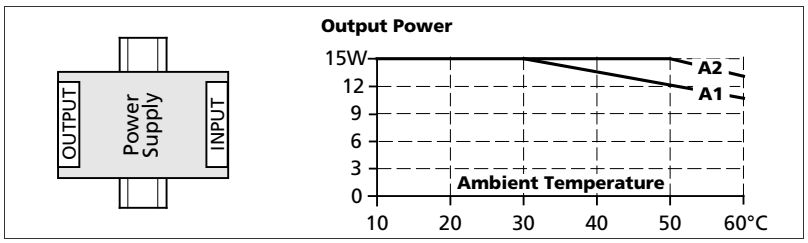


Fig. 21-9
Mounting Orientation E
(Horizontal ccw)



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