



# Bulletin 1606 Switched Mode Power Supplies

Catalog Number: 1606-XLP50E

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## Terminology and Abbreviations

- **PE and  $\oplus$  symbol**—PE is the abbreviation for Protective Earth and has the same meaning as the symbol  $\oplus$ .
- **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  $\pm 15\%$ ) 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, AC100V and AC230V parameters are valid at 50Hz and AC120V parameters are valid at 60Hz 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

LISTEN.  
THINK.  
SOLVE.



## Power Supply

- AC 100-240V Wide Range Input
- NEC Class 2 Compliant
- Adjustable Output Voltage
- Efficiency up to 89%
- Compact Design, Width only 45mm
- Full Output Power Between -10°C and +60°C
- DC-OK Signal Included
- Large International Approval Package
- DIN Rail Bracket for Wall or Panel Mount Included
- 3 Year Warranty

## 1. Description

A compact size, light weight, simple mounting on the DIN rail and the quick connect spring-clamp terminals are what makes the 1606-XLP power supplies so easy to use and install in 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 connected to the public mains network or exposed to a critical industrial environment.

The 1606-XLP series offers output voltages from 5 to 56Vdc and a power rating of up to 100W. A DC-OK signal allows remote diagnostics.

The supplementary decoupling diode module 1606-XLPRED helps you build redundant systems or protect against back-feed voltages.

## 2. Specification Quick Reference

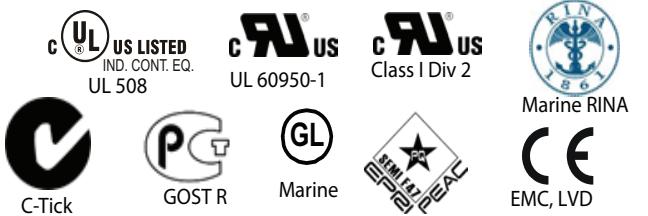
Output voltage	DC 24V	
Adjustment range	24-28V	
Output current	2.1-1.8A	24-28V
Output power	50W	
Output ripple	< 50mVpp	20Hz to 20MHz
Input voltage	AC 100-240V	Wide Range Input
Mains frequency	50-60Hz	±6%
AC Input current	typ. 0.77 / 0.44A	at 120 / 230Vac
Power factor	typ. 0.56 / 0.52	at 120 / 230Vac
AC Inrush current	17 / 35A	typ. peak value at 120 / 230Vac 40°C and cold start
DC Input	85-375Vdc	
Efficiency	typ. 88.4 / 89.0%	at 120 / 230Vac
Losses	typ. 6.6 / 6.2W	at 120 / 230Vac
Temperature range	-10°C to +70°C	operational
Derating	1.3W/°C	+60 to +70°C
Hold-up time	typ. 35 / 190ms	at 120 / 230Vac
Dimensions	45x75x91mm	WxHxD

## 3. Catalog Numbers

Power Supply 1606-XLP50E Standard unit

Accessory 1606-XLPRED Decoupling / Redundancy module

## 4. Certification Marks



All parameters are specified at 24V, 2.1A, 230Vac input, 25°C ambient and after a 5 minutes run-in time unless noted otherwise.

Rockwell Automation Publication 1606-RM034A-EN-P — March 2014

## Intended Use

- This device is designed for installation in an enclosure and is intended for the general professional use such as in industrial control, office, communication, and instrumentation equipment.
- Do not use this power supply in aircraft, trains, nuclear equipment or similar systems where malfunction may cause severe personal injury or threaten human life.

## Installation Requirements

- 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.
- Mount the unit on a DIN rail so that the terminals are located on the bottom of the unit. For other mounting orientations, refer to derating requirements in this document.
- This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 15%!
- Keep the following installation clearances: 40mm on top, 20mm on the bottom, 5mm on the left and right sides are recommended when the device is loaded permanently with more than 50% of the rated power. Increase this clearance to 15mm in case the adjacent device is a heat source (e.g. another power supply).

**SHOCK HAZARD:** Do not use the power supply without proper grounding (Protective Earth). Use the terminal on the input block for earth connection and not one of the screws on the housing.



- 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.

**WARNING: EXPLOSION HAZARDS!**



Substitution of components may impair suitability for this environment. Do not disconnect the unit or operate the voltage adjustment or S/P jumper unless power has been switched off or the area is known to be non-hazardous.

## 5. AC-Input

AC input	nom.	AC 100-240V	Wide-range input, TN-, TT-, IT-Mains, see Fig. 5-1
AC input range		85-264Vac	Continuous operation
		60-85Vac	Full power for 200ms, no damage between 0 and 85Vac
		264-300Vac	< 0.5s
Input frequency	nom.	50 – 60Hz	±6%
Turn-on voltage	typ.	65Vac	Steady-state value, see Fig. 5-1
Shut-down voltage	typ.	55Vac	Steady-state value, see Fig. 5-1

		AC 100V	AC 120V	AC 230V	
Input current	typ.	0.91A	0.77A	0.47A	at 24V, 2.1A see Fig. 5-3.
Power factor *)	typ.	0.58	0.56	0.52	at 24V, 2.1A see Fig. 5-1.
Crest factor **)	typ.	3.05	3.26	3.91	at 24V, 2.1A
Start-up delay	typ.	32ms	32ms	32ms	See Fig. 5-2.
Rise time	typ.	33ms	33ms	48ms	0mF, 24V, 2.1A, see Fig. 5-2.
	typ.	45ms	45ms	60ms	2mF, 24V, 2.1A, see Fig. 5-2.
Turn-on overshoot	max.	400mV	400mV	400mV	See Fig. 5-2.

\*) 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. 5-1 Input voltage range

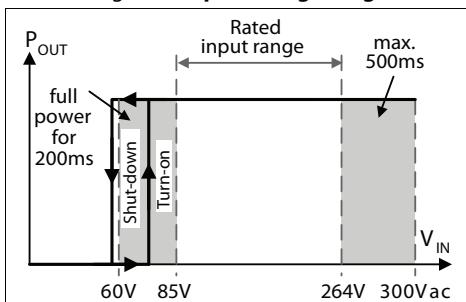


Fig. 5-2 Turn-on behavior, definitions

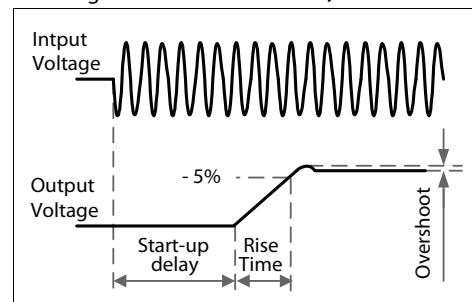


Fig. 5-3 Input current vs. output load

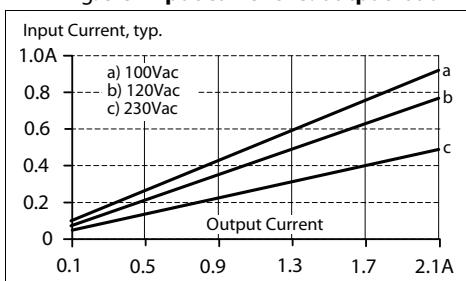
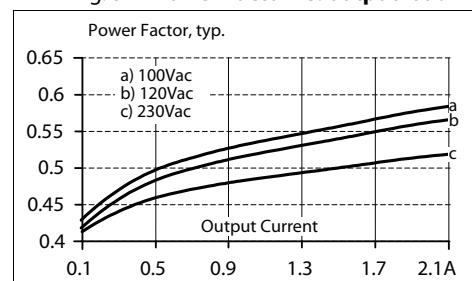


Fig. 5-4 Power Factor vs. output load

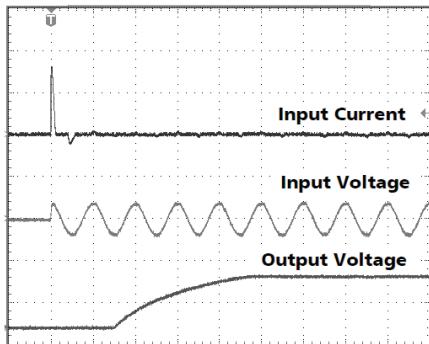


## 6. Input Inrush Current Surge

A NTC limits the input inrush current after turn-on of the input voltage. The inrush current is input voltage- and ambient temperature-dependent.

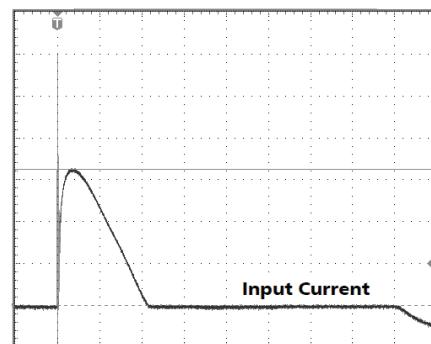
		AC 100V	AC 120V	AC 230V	
Inrush current	max.	18A <sub>peak</sub>	23A <sub>peak</sub>	48A <sub>peak</sub>	40°C ambient, cold start
	typ.	14A <sub>peak</sub>	17A <sub>peak</sub>	35A <sub>peak</sub>	40°C ambient, cold start
Inrush energy	typ.	0.3A <sup>2</sup> s	0.4A <sup>2</sup> s	1.5A <sup>2</sup> s	40°C ambient, cold start

Fig. 6-1 Input inrush current, typical behavior



Input: 230Vac  
Output: 24V, 2.1A  
Ambient: 40°C  
Upper curve: Input current 20A / DIV  
Middle curve: Input voltage 1000V / DIV  
Lower curve: Output voltage 20V / DIV  
Time scale: 20ms / DIV

Fig. 6-2 Input inrush current, zoom into the first peak

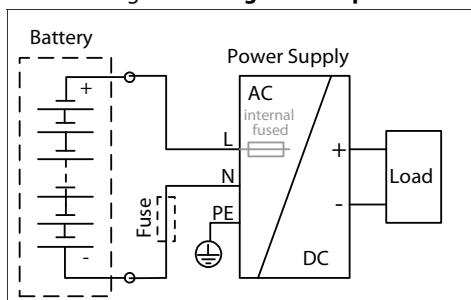


Input: 30Vac  
Output: 24V, 2.1A  
Ambient: 40°C  
Input current curve: 10A / DIV, 1ms / DIV  
**Ipeak 32.4A**  
The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

## 7. DC-Input

DC input	nom.	DC 110-290V	-25%/+30%
DC input range	min.	85-375Vdc	Continuous operation
DC input current	typ.	0.50A / 0.19A	110Vdc / 300Vdc at 24V and 2.1A
Turn-on voltage	typ.	81Vdc	Steady state value
Shut-down voltage	typ.	58Vdc	Steady state value

Fig. 7-1 Wiring for DC Input



### Instructions for DC use:

- Use a battery or similar DC source.
- Connect +pole to L and – pole to N.
- Connect the PE terminal to a earth wire or to the machine ground.
- In case the – pole of the battery is not connected to earth, use an appropriate fuse to protect the N terminal.

## 8. Hold-up Time

		<b>AC 100V</b>	<b>AC 120V</b>	<b>AC 230V</b>
Hold-up Time	typ. typ.	54ms 26ms	82ms 40ms	360ms 180ms

1.05A, 24V, see Fig. 8-1  
2.1A, 24V, see Fig. 8-1

Fig. 8-1 Hold-up time vs. input voltage

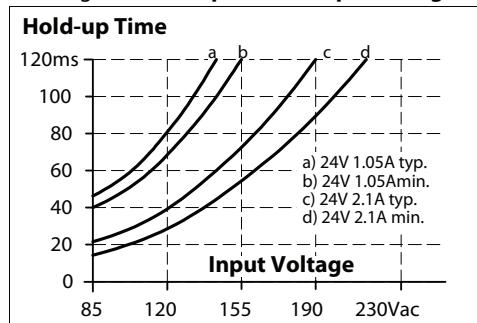
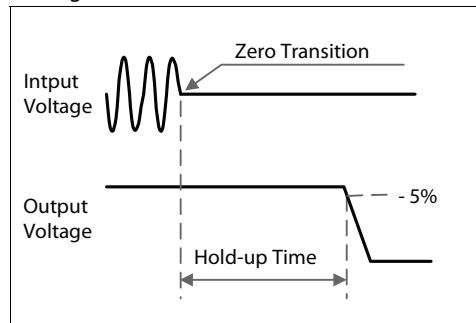


Fig. 8-2 Shut-down behavior, definitions



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

## 9. DC-OK Output

This feature monitors the output voltage, which is present on the output terminals.

The signal is a source output which can feed loads up to 30mA. Loads can be a 24V relay ( $R_{coil} < 700\Omega$ ), a LED or the input of a PLC system. The relay operates or the LED is on if output voltage exceeds the threshold level. A wheeling diode (necessary when the load is a relay) is already included in the power supply.

Threshold value	20V +/-4%	
Output current	min.	30mA
Output voltage	min	Vout - 1V at 30mA

For typical values see Fig. 9-2  
The open collector is internally linked to the positive output pole. The DC-OK voltage is approximately the output voltage if the output voltage is higher than the threshold level.

Fig. 9-1 DC-ok wiring diagram

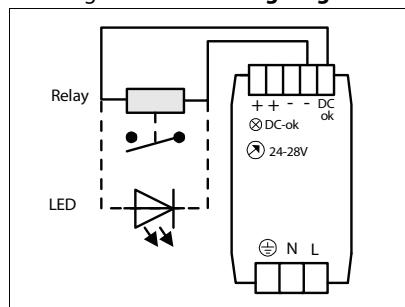
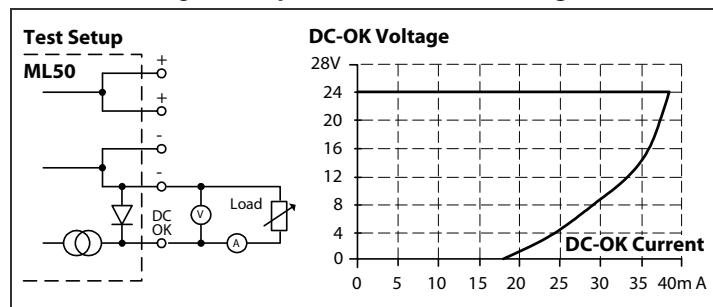


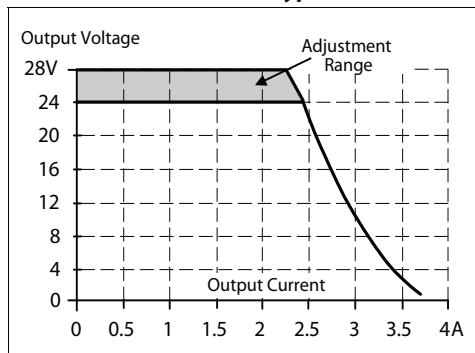
Fig. 9-2 Output characteristic DC-OK signal



## 10. Output

Output voltage	nom.	24V	
Adjustment range	min.	24-28V	Guaranteed
	max.	30V	At clockwise end position of potentiometer
Factory setting		24.5V	$\pm 0.2\%$ , at full load, cold unit
Line regulation	max.	10mV	85 to 264Vac
Load regulation	max.	100mV	Static value, 0A $\rightarrow$ 2.1A $\rightarrow$ 0A
Ripple and noise voltage	max.	50mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	1600 $\mu$ F	
Output current	nom.	2.1A	At 24V, see Fig. 10-1
	nom.	1.8A	At 28V, see Fig. 10-1
Output power	nom.	50W	
Short-circuit current	min.	3.1A	Load impedance 400mOhm, see Fig. 10-1
	max.	5A	Load impedance 400mOhm, see Fig. 10-1

Fig. 10-1 **Output voltage vs. output current,**  
230Vac, typ.



### Peak current capability (up to several ms)

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 cause a voltage dip on the output. Detailed curves can be found in section 27.1.

Peak current voltage dips	typ.	from 24V to 16V	at 4.2A for 50ms, resistive load
	typ.	from 24V to 15V	at 10.5A for 2ms, resistive load
	typ.	from 24V to 10.5V	at 10.5A for 5ms, resistive load

## 11. Efficiency and Power Losses

	AC 100V	AC 120V	AC 230V	
Efficiency	typ.	87.5%	88.4%	89.0% 2.1A, 24V
Power losses	typ.	0.6W	0.7W	1.3W 0A
	typ.	4.0W	4.1W	4.4W 1.05A, 24V
	typ.	7.2W	6.6W	6.2W 2.1A, 24V

Fig. 11-1 Efficiency vs. output current at 24V

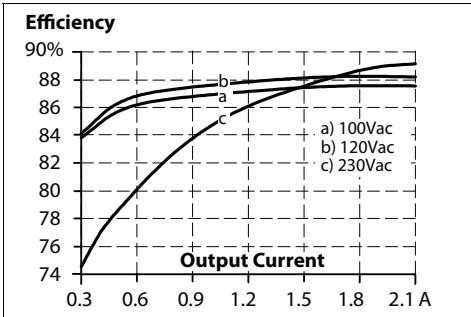


Fig. 11-2 Losses vs. output current at 24V

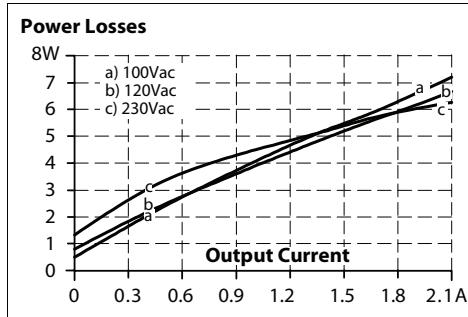


Fig. 11-3 Efficiency vs. input voltage, 24V, 2.1A

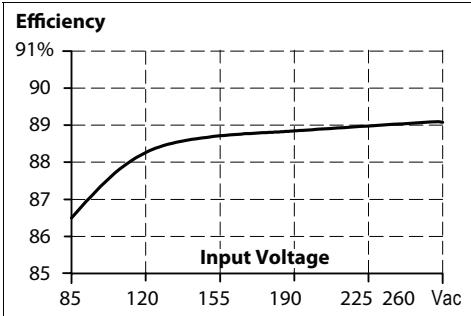
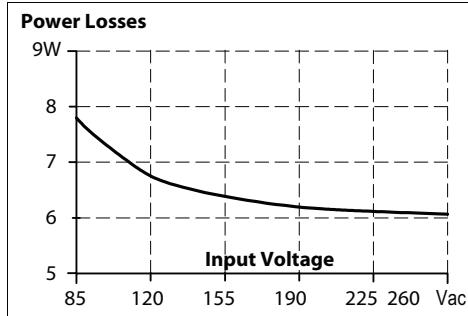
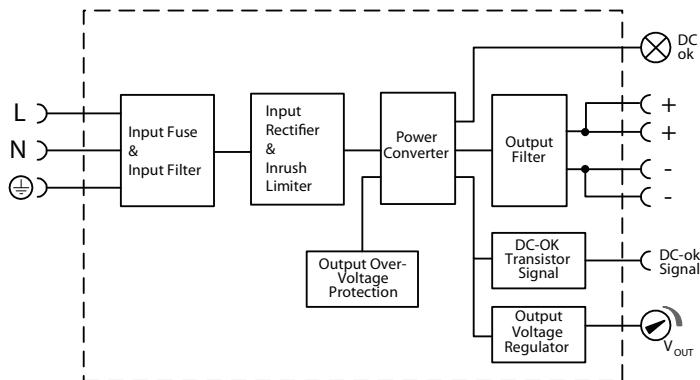


Fig. 11-4 Losses vs. input voltage, 24V, 2.1A



## 12. Functional Diagram

Fig. 12-1 Functional diagram



## 13. Reliability

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

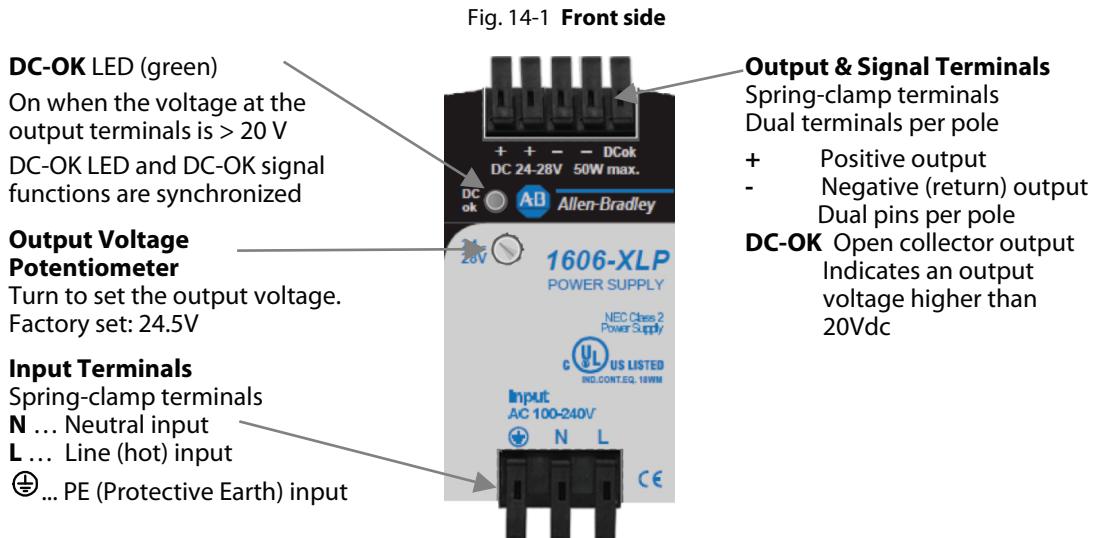
	<b>AC 100V</b>	<b>AC 120V</b>	<b>AC 230V</b>	
Lifetime expectancy	min. 34,000h min. 112,000h min. 96,000h	44,000h 117,000h 125,000h	54,000h 111,000h 152,000h	40°C, 24V 2.1A 40°C, 24V, 1.05A 25°C, 24V, 2.1A
MTBF SN 29500, IEC 61709	2,383,000h 3,977,000h	2,456,000h 4,100,000h	2,613,000h 4,362,000h	40°C, 24V, 2.1A 25°C, 24V, 2.1A
MTBF MIL HDBK 217F	1,021,000h 1,370,000h	1,053,000h 1,413,000h	1,120,000h 1,503,000h	40°C, 24V, 2.1A, Ground Benign GB40 25°C, 24V, 2.1A, Ground Benign GB25

The **Lifetime expectancy** shown in the table indicates the operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors.

Lifetime expectancy is specified in operational hours. Lifetime expectancy is calculated according to specifications from the manufacturer of the capacitor. The prediction model allows a calculation of up to 15 years from shipping date.

**MTBF** stands for **Mean Time Between Failures**; it is calculated according to statistical device failures and indicates reliability of a device. It is the statistical representation of the likelihood of failure of a unit and does not necessarily represent the life of a product.

## 14. Front Side and User Elements



## 15. 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. Mounting and wiring do not require a screwdriver.

Type	Quick-connect spring-clamp terminals
Solid wire	0.3-4mm <sup>2</sup>
Stranded wire	0.3-2.5mm <sup>2</sup>
American wire gauge	26-12 AWG
Ferrules	Allowed, but not required
Wire stripping length	6mm / 0.25inch
Pull-out force	12AWG:60N, 14AWG:50N, 16AWG:40N (according to UL486E)

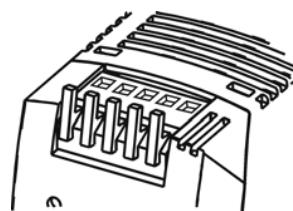
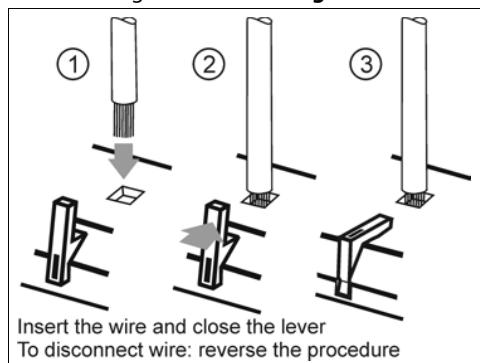


Fig. 15-1 Connecting a wire



### Instructions:

- Use appropriate copper cables
- Follow local and national installation codes and regulations!
- Ensure that all strands of a stranded wire enter the terminal connection!
- Do not use the unit without PE connection.

## 16. EMC

The CE mark indicates conformance with EMC guideline 89/336/EEC, 93/68/EEC and the low-voltage directive (LVD) 73/23/EWG.

<b>EMC Immunity</b>	EN 61000-6-2, EN 61000-6-1	Generic standards	
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8kV 8kV
Electromagnetic RF field	EN 61000-4-3	80MHz-1Ghz	10V/m
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines	4kV 2kV
Surge voltage on input	EN 61000-4-5	L → N N / L → PE	2kV 4kV
Surge voltage on output	EN 61000-4-5	+ → + / - → PE	500V 500V
Conducted disturbance	EN 61000-4-6	0,15-80MHz	10V
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
Voltage interruptions	EN 61000-4-11		0Vac, 5000ms
Input voltage swells	Rockwell Automation	internal standard	300Vac, 500ms
Powerful transients	VDE 0160	over entire load range	750V, 1.3ms

**Criteria:**

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

**C:** Temporary loss of function is possible. Power supply might shut-down and restarts by itself. The power supply will incur no damage or hazard.

<b>EMC Emission</b>	EN 61000-6-3, EN 61000-6-4	Generic standards	
Conducted emission	EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22 EN 55022	Class B, input lines Class B, output lines	
Radiated emission	EN 55011, EN 55022	Class B	
Harmonic input current	EN 61000-3-2	Fulfilled	
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled	

This device complies with FCC Part 15 rules.

Operation is subjected to the 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 undesirable operation.

<b>Switching frequency</b>	variable, typ. 100kHz, (60-275kHz)	Input voltage and output load dependent
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## 17. Environment

Operational temperature	-10°C to +70°C (14°F to 158°F)	Reduce output power according to Fig. 17-1
Output de-rating	1.3W/°C	60-70°C (140°F to 158°F), see Fig. 17-1
Storage temperature	-40 to +85°C (-40°F to 185°F)	Storage and transportation
Humidity	5 to 95% r.H.	IEC 60068-2-30 Do not energize while condensation is present
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	IEC 60068-2-6
Shock	20g 6ms, 10g 11ms 3 bumps / direction, 18 bumps in total	IEC 60068-2-27
Altitude	0 to 6000m (0 to 20000ft)	Reduce output power or ambient temperature above 2000m sea level.
Output de-rating (for altitude)	3W/1000m or 5°C/1000m	Above 2000m (6500ft), see Fig 17-2
Over-voltage category	III	EN 50178, IEC 62103 at Altitudes < 2000m
	II	Altitudes from 2000m to 6000m
Degree of pollution	2	EN 50178, IEC 62103, non conductive

Fig. 17-1 Output current vs. ambient temp.

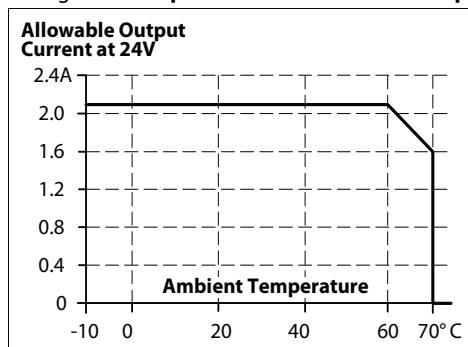
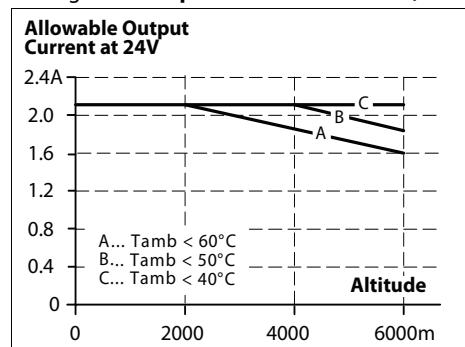


Fig. 17-2 Output current vs. altitude, 24V



The ambient temperature is defined 2cm below the unit.

## 18. Protection Features

Output protection	Electronically protected against overload, no-load and short-circuits.	
Output over-voltage protection	typ. 36V max. 39V	In case of an internal power supply fault, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
Output over-current protection	electronically limited	see Fig. 10-1
Degree of protection	IP 20	EN/IEC 60529
Penetration protection	> 2.5mm in diameter	E.g. screws, small parts
Over-temperature protection	not included	
Input transient protection	MOV	Metal Oxide Varistor
Internal input fuse	T3.15A H.B.C.	Not user replaceable

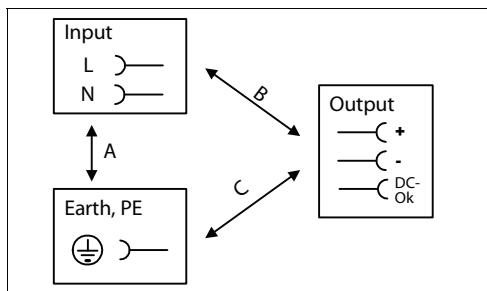
Note: In case of a over-voltage, overload, no-load or short-circuit event, an audible noise may be heard.

## 19. Safety

Input / output separation	SELV PELV double or reinforced insulation	IEC/EN 60950-1 EN 60204-1, EN 50178, IEC 62103, IEC 60364-4-41
Class of protection	I	PE (Protective Earth) connection required
Isolation resistance	> 5MΩ	input to output, 500Vdc
Touch current (leakage current)	typ. 0.12mA typ. 0.17mA typ. 0.29mA < 0.16mA < 0.23mA < 0.40mA	100Vac, 50Hz, TN mains 120Vac, 60Hz, TN mains 230Vac, 50Hz, TN mains 110Vac, 50Hz, TN mains 132Vac, 60Hz, TN mains 264Vac, 50Hz, TN mains

## 20. Dielectric Strength

Fig. 20-1 Dielectric strength



	A	B	C
Type test	60s	2500Vac	3000Vac
Factory test	5s	2500Vac	2500Vac
Field test	5s	2000Vac	2000Vac

**Type tests and factory tests:**

Conducted by the manufacturer. Do not repeat test in field!

**Rules for field test:**

Use appropriate test equipment which applies the voltage with a slow ramp! Connect L and N together as well as all output poles.

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

To fulfill the PELV requirements according to EN60204-1 § 6.4.1, it is recommended that either the + pole, the - pole or any other part of the output circuit be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or cannot be switched off in the occurrence of unnoticed earth faults.

## 21. Certifications

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EN 60950-1, EN 61204-3		Complies with CE EMC and CE Low Voltage Directives
UL 508		LISTED as Industrial Control Equipment E198865
UL 60950-1		RECOGNIZED E168663 recognized for use in the U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950). Information Technology Equipment, Level 3
NEC Class 2		Listed as Limited Power Source (LPS) in the UL 60950-1 UL report.
ISA 12.12.01, CSA C22.2 No. 213		RECOGNIZED UNDER FILE NUMBER E244404 for use in the U.S.A. (ISA 12.12.01) and Canada (C22.2 No. 213) Hazardous Location Class I, Div. 2, Groups A, B, C, D
Marine GL		GL (Germanischer Lloyd) classified for marine and offshore applications. Environmental category: C, EMC2. See below for link to Certificate.
Marine RINA		RINA (Registro Italiana Navale) certified. See below for link to Certificate.
SEMI F47		SEMI F47-0706 Voltage Sag Immunity Compliance. See below for link to Certificate.
GOST R		GOST R certification is applicable for products intended for sale and use within Russia. See below for link to Certificate.
C-TICK		C-tick compliance is for products intended for sale and use within the Australian market. See below for the link to the C-Tick Declarations of Conformity.

Product certification information (including Certificates and Declarations of Conformity) can be found at [www.ab.com/certifications](http://www.ab.com/certifications).

## 22. Environment Compliance

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Electrolytic capacitors included in this unit do not use electrolytes such as Quaternary Ammonium Salt Systems.

Plastic housings and other molded plastic materials are free of halogens, wires and cables are not PVC insulated.

The unit conforms to the RoHS directive 2002/96/EC

The materials used in our production process do not include the following toxic chemicals:

Polychlorinated Biphenyl (PCB), Pentachlorophenol (PCP), Polychlorinated naphthalene (PCN), Polybrominated Biphenyl (PBB), Polybrominated Biphenyl Oxide (PBO), Polybrominated Diphenyl Ether (PBDE), Polychlorinated Diphenyl Ether (PCDE), Polybrominated Diphenyl Oxide (PBDO), Cadmium, Asbestos, Mercury, Silica

## 23. Physical Dimensions and Weight

Weight	240g / 0.53lb
DIN Rail	Use 35mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm. The DIN rail height must be added to the depth (91mm) to calculate the total required installation depth.

Fig. 23-1 Front view

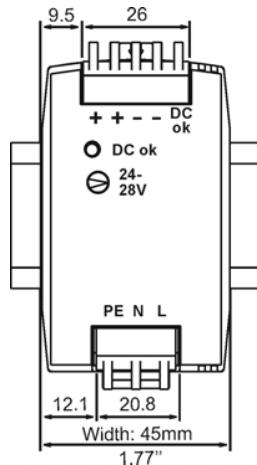
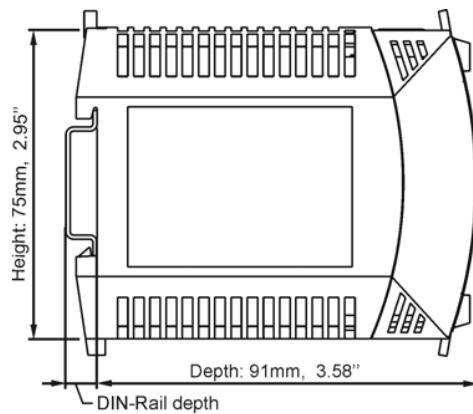


Fig. 23-2 Side view



## 24. Installation and Operation Instructions

### Mounting:

Output terminal must be located on top and input terminal on the bottom. For other orientations, see section 26-12. An appropriate electrical and fire end-product enclosure should be considered in the end use application.

### Cooling:

Convection cooled, no forced cooling required. Do not cover ventilation grille (e.g. cable conduits) by more than 30%!

### Installation clearances:

25mm on top and bottom.

### Risk of electrical shock, fire, personal injury or death!

Do not use the unit without proper ground connection (Protective Earth).

Turn power off before working on the power supply. Protect against inadvertent re-powering.

Make sure the wiring is correct by following all local and national codes.

Do not open, modify or repair the unit.

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 is likely to occur.

### Service parts:

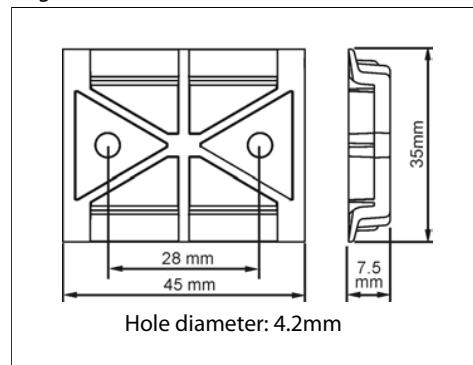
The unit does not contain any service parts. The tripping of an internal fuse is caused by an internal fault. Should damage or malfunction occur during operation, turn power off immediately and return the unit to the factory for inspection!

## 25. Accessory

### DIN Rail bracket for wall or panel mount

A DIN rail bracket is included in each shipping box.

Fig. 25-1 DIN Rail Bracket Dimensions

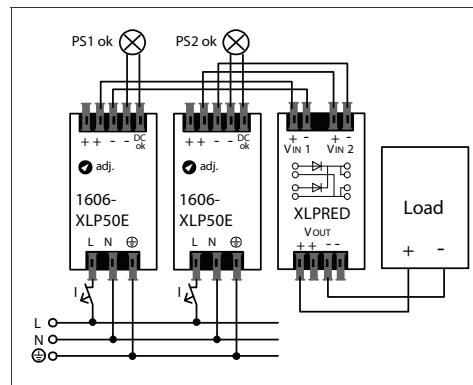


### 1606-XLPRED Dual decoupling module 2x5A

Fig. 25-2 1606-XLPRED Dual Decoupling Module



Fig. 25-3 Redundant System with two 1606-XLP50E and one 1606-XLPRED



## 26. Application Notes

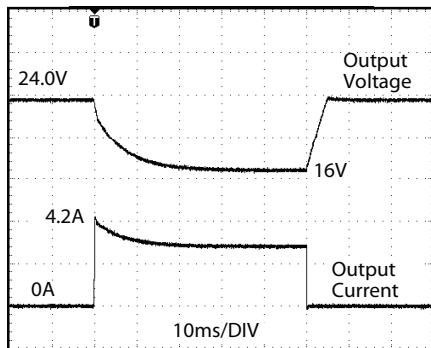
### 26.1. Peak Current Capability

Solenoids, contactors and pneumatic modules often have a steady state (sealed) 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.

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

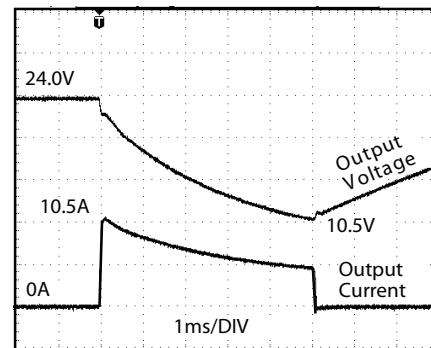
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following examples show typical voltage dips:

Fig. 26-1 Peak load 4.2A for 50ms, typ.



Peak load 4.2A (resistive) for 50ms  
Output voltage dips from 24V to 16V.

Fig. 26-2 Peak load 10.5A for 5ms, typ.



Peak load 10.5A (resistive) for 5ms  
Output voltage dips from 24V to 10.5V.

### 26.2. 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-EMF (Electro Magnetic Force).

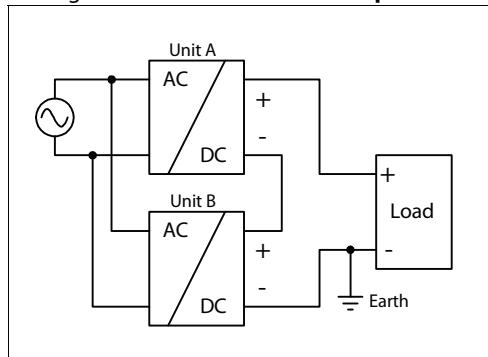
This power supply is resistant and does not show malfunction when a load feeds back voltage to the power supply. It does not matter, whether the power supply is on or off.

The maximum allowed feed back voltage is 35Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in section 10.

## 26.3. Series Operation

The power supply can be put in series to increase the output voltage.

Fig. 26-3 Schematic for series operation



### Instructions for use in series:

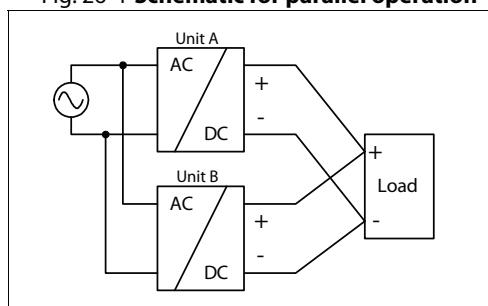
- It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc.
- Voltages with a potential above 60Vdc are no longer SELV and can be dangerous. Such voltages must be installed with a protection against touching.
- For serial operation use power supplies of the same type.
- Earthing of the output is required when the sum of the output voltage is above 60Vdc.

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

## 26.4. Parallel Use to Increase Output Power

Several power supplies can be paralleled to increase the output power. The 1606-XLP50E does not include a feature to balance 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 causes no harm to the power supply as long as the ambient temperature stays below 50°C.

Fig. 26-4 Schematic for parallel operation



### Instructions for parallel use:

- Use only power supplies from the same series.
- Adjust the output voltages of all power supplies to approximately the same value ( $\pm 200\text{mV}$ ).
- A fuse (or diode) on the output is only required if more than three units are connected in parallel.
- Do not load terminals with more than 13A. Follow wiring instructions according to section 27.6.
- Ensure that the ambient temperature of the power supply does not exceed 50°C.

## 26.5. Parallel Use for Redundancy

Power supplies can be paralleled for redundancy to gain a higher system reliability. Redundant systems require a certain amount of extra power to support the load in case one power unit fails. The simplest way is to put two power supplies in parallel. This is called a 1+1 redundancy. Should one power supply fail, the second 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 2.1A are paralleled to build a 8A redundant system. If one unit fails, the 8A can still be drawn.

**Please note:** This simple way to build a redundant system has two major disadvantages.

- The faulty power supply cannot be identified. The green LED will still be on since it is reverse-powered from the other power supply.
- It does not cover failures such as an internal short circuit in the secondary side of the power supply. In such a situation the defective unit becomes a load for the other power supplies and the output voltage can no longer be maintained.

The above conditions can be avoided by using decoupling diodes which are included in the 1606-XLPRED decoupling module.

Other recommendations for building redundant power systems:

- a) Use separate input fuses for each power supply.
- b) Monitor the individual power supply units. A DC-ok output is included in the 1606-XLP50E and 1606-XLP50EZ. In all other cases, use the 1606-XLERED redundancy module which includes a monitoring circuit for each input.
- c) When possible, connect each power supply to different phases of the mains network.

## 26.6. Daisy Chaining of Outputs

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the maximum current through one terminal pin does not exceed 13A. If the current is higher, use a separate distribution terminal block.

Fig. 26-5 Daisy chaining of outputs

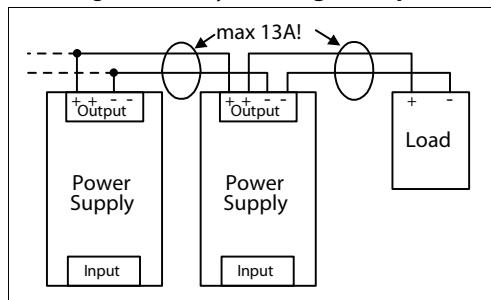
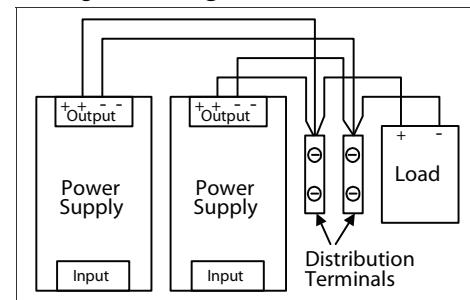


Fig. 26-6 Using distribution terminals



## 26.7. Charging Batteries

The power supply can be used for float-charging of lead-acid or maintenance-free 24V VRLA batteries.

### Instructions for charging batteries:

- a) Ensure that the ambient temperature of the power supply does not exceed 50°C.
  - b) Set the output voltage on a disconnected load, very precisely to the end-of-charge voltage according to the expected battery temperature.
- |                       |       |       |        |       |
|-----------------------|-------|-------|--------|-------|
| End-of-charge voltage | 27.8V | 27.5V | 27.15V | 26.8V |
| Battery temperature   | 10°C  | 20°C  | 30°C   | 40°C  |
- c) Use a 4A or 6A circuit breaker (or 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) Use only matched batteries when putting 12V types in series.
  - f) The return current to the power supply is typ. 10.7mA at 25Vdc when the power supply is switched off (except if using a blocking diode).

## 26.8. External Input Protection

The unit is tested and approved for branch circuits up to 15A (UL) or 16A (IEC). External protection is required only if the supplying branch has an ampacity greater than this. In some countries, local regulations may apply, so check local codes and requirements.

If using an external protective device, a minimum value is required to avoid undesired tripping of the fuse.

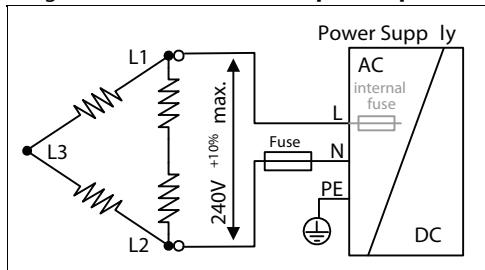
	B-Characteristic	C-Characteristic
Ampacity	max. 15A (UL), 16A (IEC)	15A (UL), 16A (IEC)
	min.	6A

## 26.9. Inductive and Capacitive Loads

The unit is designed to supply any type of load, including unlimited capacitive and inductive loads.

## 26.10. Operation on Two Phases

Fig. 26-7 Schematic for two phase operation



### Instructions for two phase operation:

- a) A phase to phase connection is allowed as long as the supplying voltage is below 240V+10%
- b) Use a fuse or a circuit breaker to protect the N input. The N input is not protected internally; in this case it is connected to a hot wire.

Appropriate fuses or circuit breakers are specified in section 27-6, "External Input Protection".

## 26.11. 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 the outside. The inside temperature defines the ambient temperature for the power supply.

Results from such an installation:

Power supply is placed in the middle of the box; no other heat producing equipment is inside the box.

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

Input: 230Vac

Load:

24V, 2.1A; load is placed outside the box.

Temperature inside the box:

40.8°C (in the middle of the right side of the power supply with a distance of 1cm)

Temperature outside the box:

21.9°C

Temperature rise:

18.9K

Load:

24V, 1.7A; load is placed outside the box.

Temperature inside the box:

38.7°C (in the middle of the right side of the power supply with a distance of 1cm)

Temperature outside the box:

21.7°C

Temperature rise:

17.0K

## 26.12. 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 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. 26-8  
**Mounting Orientation A**  
(Standard orientation)

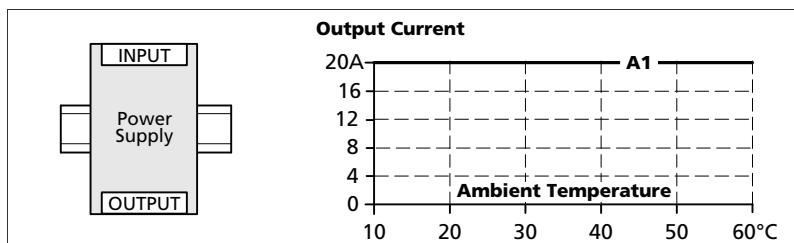


Fig. 26-9  
**Mounting Orientation B**  
(Upside down)

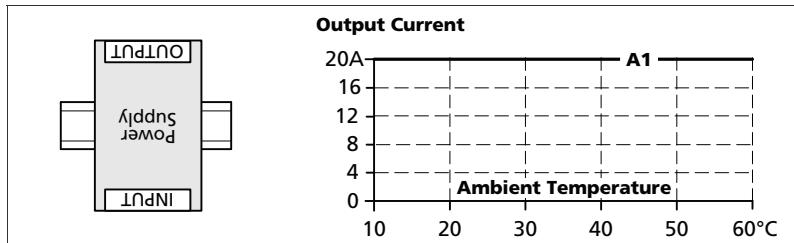


Fig. 26-10  
**Mounting Orientation C**  
(Table-top mounting)

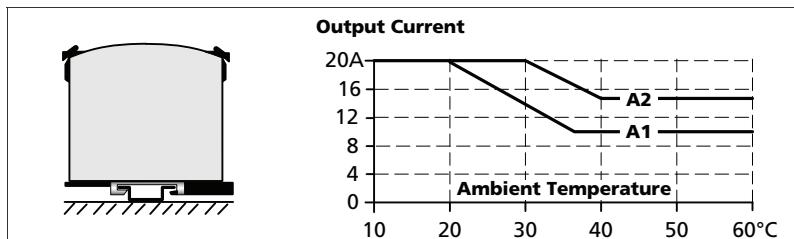


Fig. 26-11  
**Mounting Orientation D**  
(Horizontal cw)

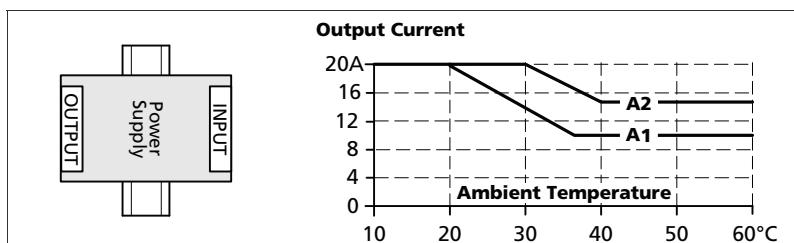
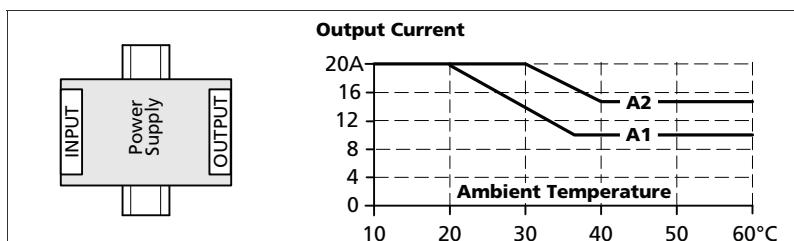


Fig. 26-12  
**Mounting Orientation E**  
(Horizontal ccw)



## **Rockwell Automation Support**

Rockwell Automation provides technical information on the Web to assist you in using its products. At <http://www.rockwellautomation.com/support>, you can find technical manuals, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools. You can also visit our Knowledgebase at <http://www.rockwellautomation.com/knowledgebase> for FAQs, technical information, support chat and forums, software updates, and to sign up for product notification updates.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect<sup>SM</sup> support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://www.rockwellautomation.com/support/>.

## **Installation Assistance**

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the <a href="#">Worldwide Locator</a> at <a href="http://www.rockwellautomation.com/rockwellautomation/support/overview.page">http://www.rockwellautomation.com/rockwellautomation/support/overview.page</a> , or contact your local Rockwell Automation representative.

## **New Product Satisfaction Return**

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication [RA-DU002](#), available at [http://literature.rockwellautomation.com/idc/groups/literature/documents/du/ra-du002\\_en-e.pdf](http://literature.rockwellautomation.com/idc/groups/literature/documents/du/ra-du002_en-e.pdf).

**[www.rockwellautomation.com](http://www.rockwellautomation.com)**

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### **Power, Control and Information Solutions Headquarters**

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444  
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleerlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640  
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846