

Power Supply - 24V, 20 A, 480 W, Single-phase Input

Catalog Numbers 1606-XLE480EP, 1606-XLE480EPC, 1606-XLE480EL, 1606-XLE480EH, 1606-XLE480EM, 1606-XLE480EP-D

Allen-Bradley
by ROCKWELL AUTOMATION

Reference Manual

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Table of Contents

Notes:

Terminology and Abbreviations

Term, Abbreviation, or Symbol	Definition
PE	PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol in the following row.
	The symbol for Protective Earth. This symbol has the same meaning as PE.
Earth, Ground	This document uses the term 'earth' which is the same as the U.S. term 'ground.'
PELV	Protection by extra-low voltage.
SELV	Safety by extra-low voltage.
AC 230V	A value that is displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included. For example: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
230V AC	A figure with the unit (V AC) at the end is a momentary figure without any additional tolerances included.
50 Hz versus 60 Hz	As long as not otherwise stated, AC 230V parameters are valid at 50 Hz mains frequency.
typ	A typical value.
nom	A nominal value.
– (alone in a table cell)	A single dash alone in a table cell indicates that there is no information to be included in that cell.

All parameters that are listed in this document are typical values that are specified under the following conditions unless otherwise noted: 230V AC, 50 Hz input voltage, 24V, 20 A output load, 25 °C (77 °F) ambient temperature, after a 5 minutes run-in time.

Product Overview

Bulletin 1606-XLE power supplies are cost optimized without compromising quality, reliability, and performance. Bulletin XLE power supplies offer high efficiency, electronic inrush current limitation, active power factor correction (PFC), wide operational temperature range, and compact size.

The 1606-XLE480EPC is equipped with conformal coated printed circuit boards that are preferred for applications in harsh areas.

The 1606-XLE480EP-D is equipped with quick-connect spring-clamp terminals that are preferred for applications that are exposed to mechanical vibration. The 1606-XLE480EH has push-in terminals that are optimized for easy cabinet wiring.

The 1606-XLE480EM is equipped with a remote ON/OFF feature and the 1606-XLE480EP-D features an enhanced DC input voltage range.

The devices have a power reserve of 20% included, which may even be used continuously up to +45 °C (113 °F).

Bulletin 1606-XLE480 power supplies have the features and approval ratings to meet the needs of a wide range of applications. Features include a high resistance to transients and power surges, low electromagnetic emission, and DC OK relay contact.

Figure 1 - 1606-XLE480EP

Figure 2 - 1606-XLE480EPC

Figure 3 - 1606-XLE480EL

Figure 4 - 1606-XLE480EH

Figure 5 - 1606-XLE480EM

Figure 6 - 1606-XLE480EP-D

Power supply features:

- AC 100…240V wide-range input
- Width only 48 mm (1.89 in.)
- Efficiency up to 95.6%
- Excellent partial load efficiency
- 20% output power reserves
- Easy fuse breaking – 3 times nominal current for 12 ms
- Safe Hiccup^{PLUS} overload mode
- Active power factor correction (PFC)
- Minimal inrush current surge
- Full power between -25…+60 °C (-13…140 °F)
- DC OK relay contact
- Current-sharing feature for parallel use

Specifications

Attributes	Values	Notes
Output voltage	DC 24V	Nominal
Adjustment range	24...28V	Factory setting 24.1V
Output current	24.0...20.6 A	Below +45 °C (113 °F) ambient
	20.0...17.1 A	At +60 °C (140 °F) ambient
	15.0...13.0 A	At +70 °C (158 °F) ambient
	Derate linearly between 45...70 °C (113...158 °F)	
Input voltage AC	AC 100...240V	-15%/+10%
Mains frequency	50...60 Hz	±6%
Input current AC	4.26 / 2.23 A	At 120 / 230V AC
Power factor	0.99 / 0.98	At 120 / 230V AC
Input voltage DC	DC 110...150V$^{\pm 20\%}$	For 1606-XLE480EP (-xx)
	DC 110...300V$^{\pm 20\%}$	For 1606-XLE480EP-D
Input current DC	4.64 A / 1.66 A	At 110 / 300V DC
AC Inrush current	10.0 / 4.5 A pk	At 120 / 230V AC
Efficiency	94.2 / 95.6%	At 120 / 230V AC
Losses	29.6 / 22.1 W	At 120 / 230V AC
Hold-up time	32 / 32 ms	At 120 / 230V AC
Temperature range	-25...+70 °C (-13...158 °F)	–
Size (W x H x D)	48 x 124 x 127 mm (1.89 x 4.88 x 5.00 in.)	Without DIN rail
Weight	830 g (1.83 lb)	–

Catalog Numbers

Component Types	Catalog Numbers	Descriptions
Power supplies	1606-XLE480EP	Standard version of power supply
	1606-XLE480EPC	With conformal coated PC-boards
	1606-XLE480EP-D	With quick-connect spring-clamp terminals
	1606-XLE480EH	With push-in terminals
	1606-XLE480EM	With remote ON/OFF feature
	1606-XLE480EP-D	Enhanced DC input
	1606-XLE480ERL	With built-in redundancy
	1606-XLE480ERZ	With built-in redundancy
Mount bracket	1606-XLA-XLE	Wall/Panel mount bracket
Buffer module	1606-XLSBUFFER24	Buffer module
Redundancy modules	1606-XLSRED40	Dual redundancy module
	1606-XLSRED4HE	Dual redundancy module
	1606-XLSREDS40HE	Single channel redundancy module

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 DC Input on page 9.

Attribute		Value	Notes
AC input	Nom	AC 100...240V	–
AC input range	Min	85...264V AC	Continuous operation
	Min	264...300V AC	Occasionally for maximal 500 ms
Allowed voltage L or N to earth	Max	300V AC	Continuous, according to IEC 60664-1
Input frequency	Nom	50...60 Hz	±6%
Turn-on voltage	Typ	82V AC	Steady-state value, see Figure 7 on page 8
Shut-down voltage	Typ	72V AC	Steady-state value, see Figure 7 on page 8

Attribute		Values			Notes
		AC 100V	AC 120V	AC 230V	
Input current	Typ	5.15 A	4.26 A	2.23 A	At 24V, 20 A, see Figure 9 on page 8
Power factor	Typ	0.996	0.996	0.980	At 24V, 20 A, see Figure 10 on page 8
Crest factor	Typ	1.65	1.63	1.63	At 24V, 20 A, The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
Start-up delay	Typ	450 ms	450 ms	450 ms	See Figure 8 on page 8
Rise time	Typ	145 ms	145 ms	145 ms	At 24V, 20 A constant current load, 0 mF load capacitance, see Figure 8 on page 8
	Typ	160 ms	160 ms	160 ms	At 24V, 20 A constant current load, 20 mF load capacitance, see Figure 8 on page 8
Turn-on overshoot	Max	200 mV	200 mV	200 mV	In single use mode, see Figure 8 on page 8

Figure 7 - Input voltage range

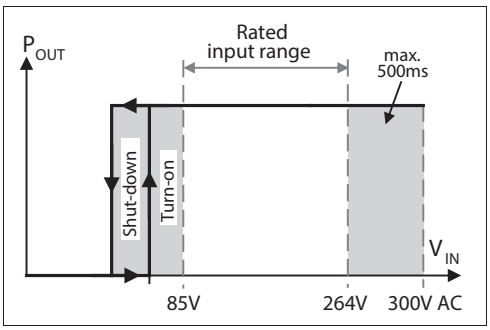


Figure 8 - Turn-on behavior, definitions

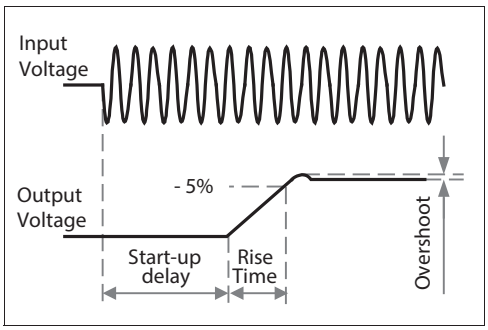


Figure 9 - Input current versus output current at 24V output voltage

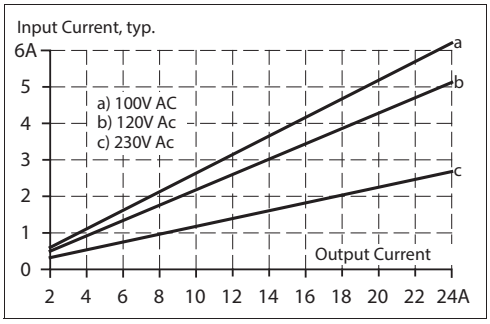
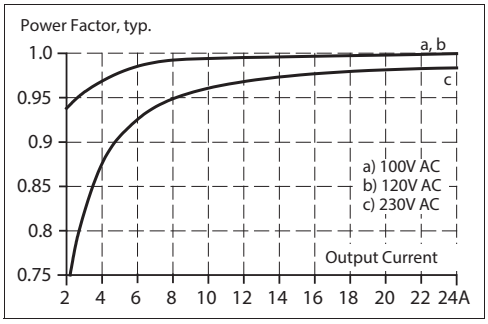


Figure 10 - Power factor versus output current at 24V output voltage



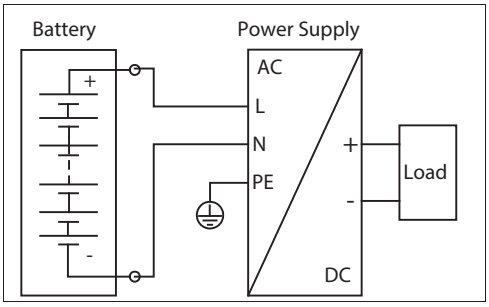
DC Input

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

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

Attribute		Value	Notes
DC input	Nom	DC 110...150V	±20% For 1606-XLE480EP, 1606-XLE480EPC, 1606-XLE480EP-D, 1606-XLE480EH, 1606-XLE480EM
		DC 110...300V	±20% For 1606-XLE480EP-D
DC input range	Min	88...180V DC	Continuous operation for 1606-XLE480EP, 1606-XLE480EPC, 1606-XLE480EP-D, 1606-XLE480EH, 1606-XLE480EM
		88...360V DC	Continuous operation for 1606-XLE480EP-D
DC input current	Typ	4.64 A	At 110V DC, at 24V, 20 A
		1.66 A	At 300V DC, at 24V, 20 A
Allowed Voltage (+) or (-) input to Earth	Max	375V DC	Continuous according to IEC 60664-1
Turn-on voltage	Typ	80V DC	Steady state value
Shut-down voltage	Typ	70V DC	Steady state value

Figure 11 - Wiring for DC Input



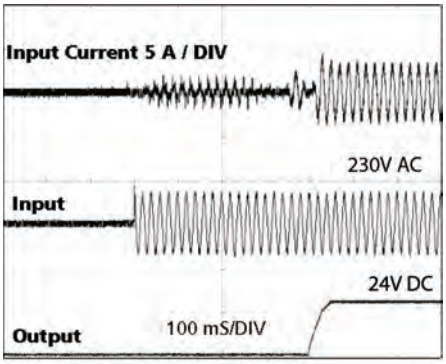
Input Inrush Current

An active inrush limitation circuit limits the input inrush current after turn-on of the input voltage.

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

Attributes		Values			Notes
		AC 100V	AC 120V	AC 230V	
Inrush current	Max	15 A pk	12 A pk	5.5 A pk	Temperature independent
	Typ	12 A pk	10 A pk	4.5 A pk	Temperature independent
Inrush energy	Max	1 A^2s	1 A^2s	1 A^2s	Temperature independent

Figure 12 - Typical turn-on behavior at nominal load and 25 °C (77 °F) ambient



Output

The output provides a SELV/PELV/ES1 rated voltage, which is galvanically isolated from the input voltage.

The device is designed to supply any kind of load, including capacitive and inductive loads. If extremely large capacitors are connected to the output, the unit might charge the capacitor in an intermittent mode. An example of an extremely large capacitor for use with this power supply is an electric double layer capacitor (EDLC or "UltraCap") with a capacitance > 1 F.

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

Attributes		Values	Notes
Output voltage	Nom	24V	–
Adjustment range	Min	24...28V	Guaranteed value
	Max	30V	The max output voltage that can occur at the clockwise end position of the potentiometer due to tolerances. It is not guaranteed that this value can be achieved.
Factory setting output voltage	Typ	24.1V	±0.2% in "single use" mode at full load, cold unit
	Typ	24.1V	±0.2% in "parallel use" mode at 20 A, cold unit (results to 23.9V ±0.2% at 24 A and 25.1V ±0.2% at no load)
Line regulation	Max	10 mV	Between 85...300V AC input voltage change
Load regulation	Max	100 mV	Between 0...24 A in "single use" mode, static value
	Typ	1000 mV	Between 0...20 A in "parallel use" mode, static value, see Figure 14 on page 12.
Ripple and noise voltage	Max	50 mVpp	Bandwidth 20 Hz to 20 mHz, 50 Ω
Output current	Nom	24 A(1)	At 24V and an ambient temperature below 45 °C (113 °F)
	Nom	20 A	At 24V and 60 °C (140 °F) ambient temperature
	Nom	15 A	At 24V and 70 °C (158 °F) ambient temperature
	Nom	20.6 A(1)	At 28V and an ambient temperature below 45 °C (113 °F)
	Nom	17.1 A	At 28V and 60 °C (140 °F) ambient temperature
	Nom	13 A	At 28V and 70 °C (158 °F) ambient temperature
	–	Derate linearly between 45...70 °C (113...158 °F)	
Fuse-breaking current	Typ	60 A	Up to 12 ms once every 5 seconds, see Figure 16 on page 12. The fuse-breaking current is an enhanced transient current that helps to trip fuses on faulty output branches. The output voltage stays above 20V.
Overload behavior	–	Continuous current	For output voltage above 13V DC, see Figure 13 on page 12
	–	Intermittent current(2)	For output voltage below 13V DC, see Figure 13 on page 12
Overload/ short-circuit current	Max	29.8 A	Continuous current, see Figure 13 on page 12
	Typ	29 A	Intermitted current peak value for 2 s typ Load impedance 10 mΩ, see Figure 15 on page 12. Discharge current of output capacitors is not included.
	Max	9.8 A	Intermitted current average value (R.M.S.) Load impedance 10 mΩ, see Figure 15 on page 12.
Output capacitance	Typ	8 500 µF	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) This current is also available for temperatures up to +70 °C (158 °F) with a duty cycle of 10% and/or not longer than 1 minute every 10 minutes.

(2) At heavy overloads (when output voltage falls below 13V), the power supply delivers continuous output current for 2 s. Next, the output is switched off for approximately 18 s. Next, 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 operates normally. See Figure 15 on page 12.

Figure 13 - Output voltage versus output Current, typ

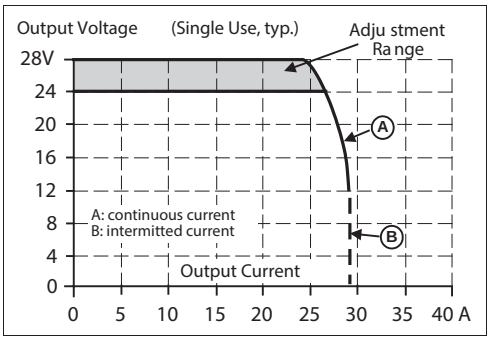


Figure 14 - Output voltage in parallel use mode, typ

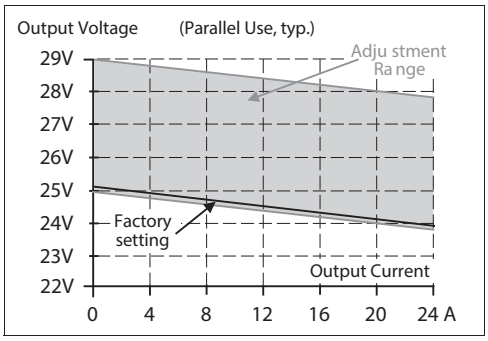


Figure 15 - Short-circuit on output, HiccupPLUS® mode, typ

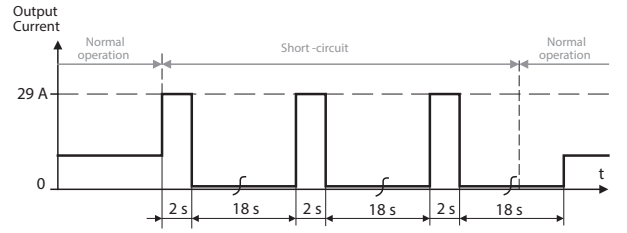
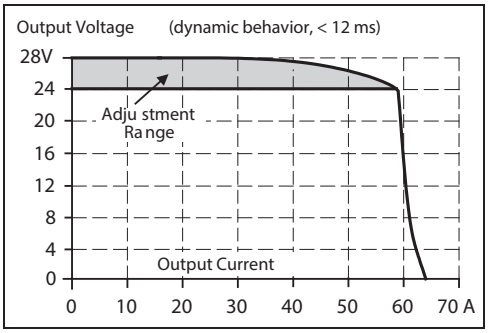


Figure 16 - Dynamic overcurrent capability, typ



Hold-up Time

The hold-up time is the time during which the output voltage of a power supply 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.

Type of Hold-up Time	AC 100V	AC 120V	AC 230V	Figure References
Typ	65 ms	65 ms	65 ms	At 24V, 10 A, see Figure 17
Minimum	54 ms	54 ms	54 ms	At 24V, 10 A, see Figure 17
Typ	32 ms	32 ms	32 ms	At 24V, 20 A, see Figure 17
Minimum	24 ms	24 ms	24 ms	At 24V, 20 A, see Figure 17

Figure 17 - Hold-up time versus input voltage

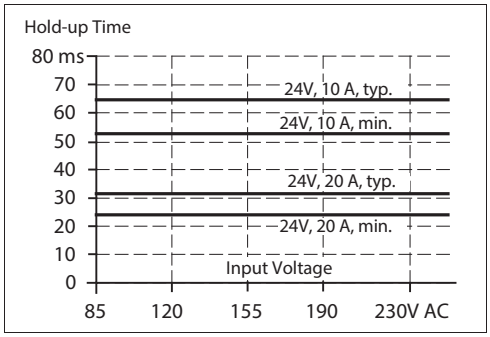
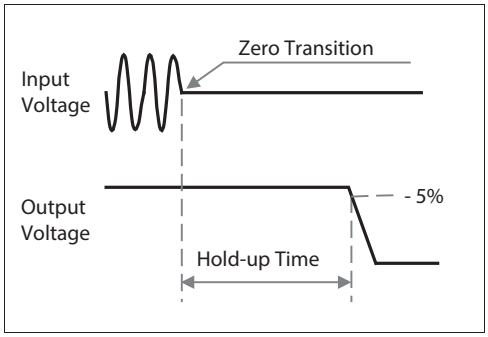


Figure 18 - Shut-down behavior, definitions

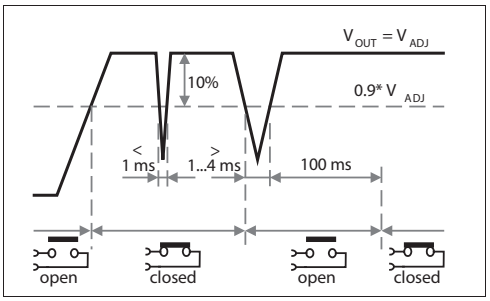


DC OK Relay Contact

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

Attributes	Descriptions
Contact closes	As soon as the output voltage reaches 90% typ of the adjusted output voltage level.
Contact opens	As soon as the output voltage dips more than 10% below the adjusted output voltage. Short dips are extended to a signal length of 100 ms. Dips shorter than 1 ms are ignored.
Switching hysteresis	1V
Contact ratings	Maximal 60V DC 0.3 A, 30V DC 1 A, 30V AC 0.5 A, resistive load Minimal permissible load: 1 mA at 5V DC
Isolation voltage	See Dielectric Strength on page 22.

Figure 19 - DC OK relay contact behavior



Remote ON/OFF Function

This feature is available only for the 1606-XLE480EM and allows to switch-off the power supply output with a signal switch or transistor. A link between pin 15 and 16 turns on the power supply. Pin 15 is referenced to the (-) output voltage.

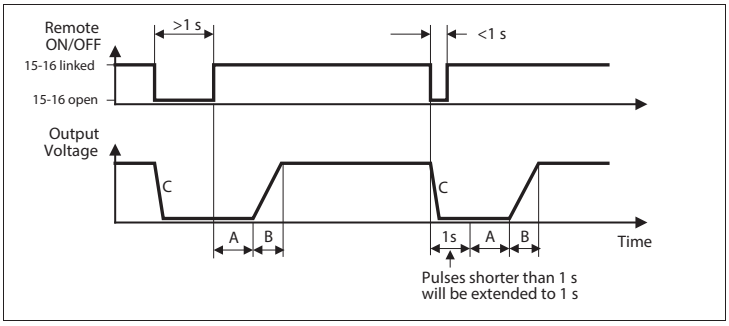
The open-loop voltage between pin 16 and pin 15 can be up to 18V. The maximum current, when in remote ON mode, can be up to 2.5 mA.

The threshold level to switch-off the output is typically 5V and the turn-on threshold is typically 9V.

When multiple power supplies are connected in parallel, pin 15 and pin 16 are also allowed to be paralleled to control all units with the same switch or transistor.

IMPORTANT The remote ON/OFF function has no safety feature included.

Figure 20 - The switch-off and the turn-on timing

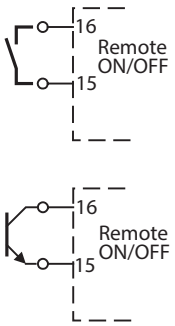


A: Turn-on delay according to Figure 8 on page 8

B: Rise time according to Figure 8 on page 8

C: No active discharge of the output after switch-off

Figure 21 - Remote ON/OFF switch



Efficiency and Power Losses

Attributes		Values			Notes
		AC 100V	AC 120V	AC 230V	
Efficiency	Typ	93.6%	94.2%	95.6%	At 24V, 20 A
	Typ	93.5%	94.1%	95.5%	At 24V, 24 A (Power Boost)
Average efficiency(1)	Typ	93.2%	93.8%	95.0%	25% at 5 A, 25% at 10 A, 25% at 15 A. 25% at 20 A
Power losses	Typ	0.4 W	0.5 W	0.9 W	1606-XLE480EM in "Remote OFF" mode
	Typ	2.5 W	2.2 W	2.2 W	At 24V, 0 A
	Typ	16.0 W	15.0 W	12.5 W	At 24V, 10 A
	Typ	32.8 W	29.6 W	22.1 W	At 24V, 20 A
	Typ	40.0 W	36.1 W	27.1 W	At 24V, 24 A (Power Boost)

(1) The average efficiency is an assumption for a typical application where the power supply has the following load:

25% of the nominal load for 25% of the time

50% of the nominal load for 25% of the time

75% of the nominal load for 25% of the time

100% of the nominal load for 25% of the time

Functional Diagram

Figure 22 - Functional diagram 1606-XLE480EP, 1606-XLE480EPC, 1606-XLE480EP-D, 1606-XLE480EP-D

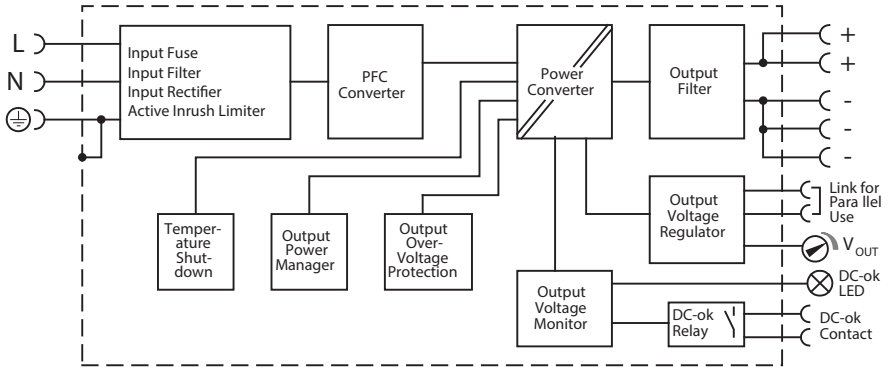


Figure 23 - Functional diagram 1606-XLE480EH

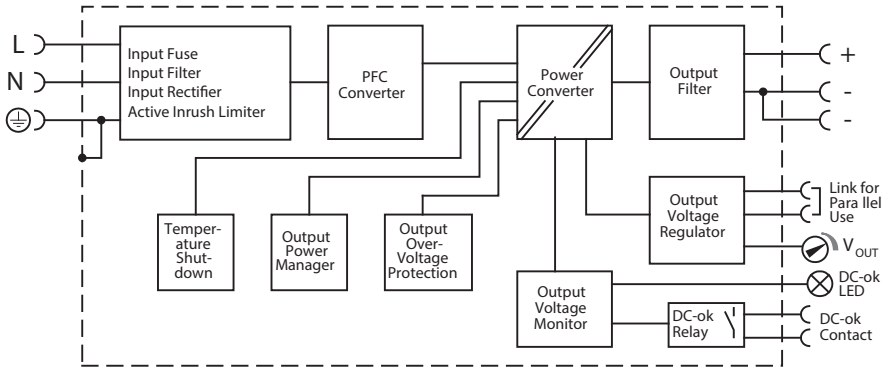
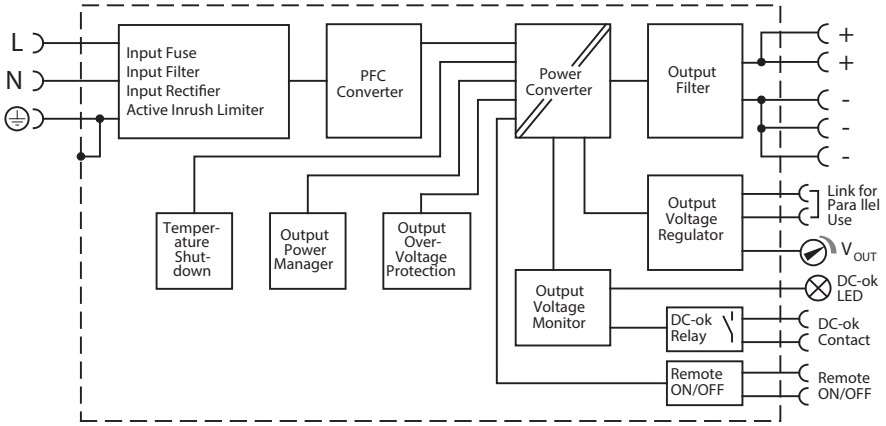


Figure 24 - Functional diagram 1606-XLE480EM

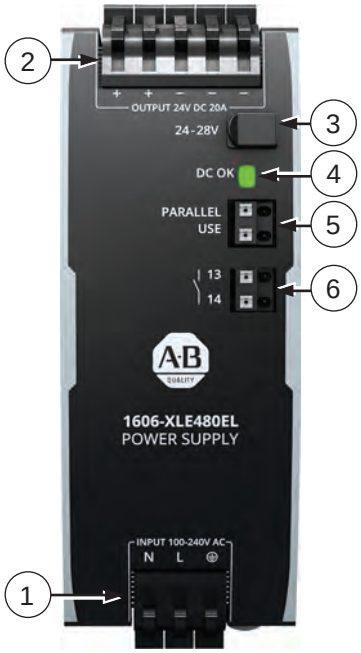


Front Side and User Elements

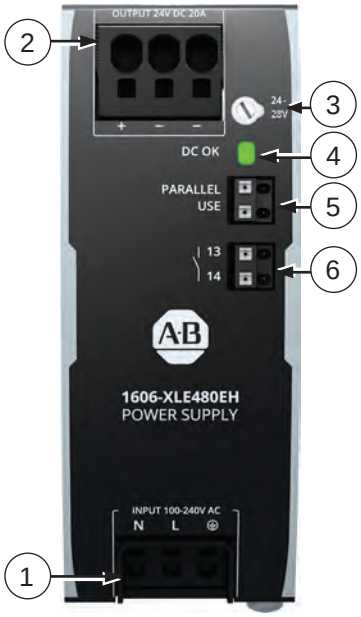
Figure 25 - Front Side and User Elements

1606-XLE480EP,
1606-XLE480EPC

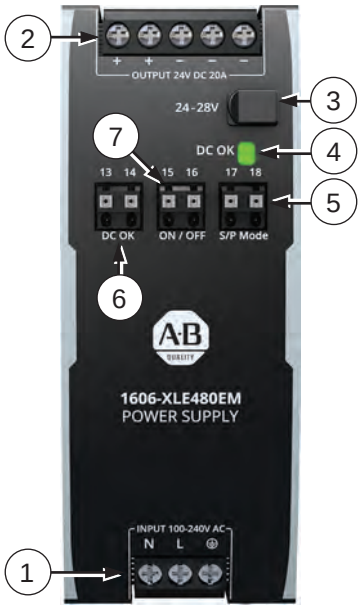
1606-XLE480EL



1606-XLE480EH



1606-XLE480EM



1606-XLE480EP-D

User Element	Description
1	**Input Terminals** N, L Line input, PE (Protective Earth) input
2	**Output Terminals** 1606-XLE480EH: one + pole and two identical - poles All other units: two identical + poles and three identical - poles **+** Positive output **–** Negative (return) output
3	**Output Voltage Potentiometer** Open the flap to adjust the output voltage. The factory setting is 24.1V.
4	**DC OK status indicator** (green) On, when the output voltage is >90% of the adjusted output voltage
5	**Parallel Use, Single Use Link** Link the two terminal poles when power supplies are connected in parallel. To achieve a sharing of the load current between the individual power supplies, Parallel Use regulates the output voltage in such a manner that the voltage at no load is approx 4% higher than at nom load. See also Parallel Use to Increase Output Power on page 31.
6	**DC OK Relay Contact** The DC OK relay contact is synchronized with the DC OK status indicator. See DC OK Relay Contact on page 13 for details.
7	**Remote ON/OFF Input** Pin 15 and 16 must be connected to turn off the power supply. See Remote ON/OFF Function on page 14 for details.

Connection Terminals

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

1606-XLE480EP, 1606-XLE480EPC, 1606-XLE480EM, 1606-XLE480EP-D	Input	Output	Signal Terminals
Type	Screw termination	Screw termination	Push-in termination
Solid wire	6.0 mm^2 max (0.0093 in^2 max)	6.0 mm^2 max (0.0093 in^2 max)	1.5 mm^2 max (0.0023 in^2 max)
Stranded wire	4.0 mm^2 max (0.0062 in^2 max)	4.0 mm^2 max (0.0062 in^2 max)	1.5 mm^2 max (0.0023 in^2 max)
American Wire Gauge	AWG 20...10	AWG 20...10	AWG 24...16
Wire diameter max (including ferrules)	2.8 mm (0.11 in.)	2.8 mm (0.11 in.)	1.6 mm (0.06 in.)
Recommended tightening torque	1 N•m max, 9 lb•in	1 N•m max, 9 lb•in	–
Wire stripping length	7.0 mm (0.28 in.)	7.0 mm (0.28 in.)	7.0 mm (0.28 in.)
Screwdriver	3.5 mm (0.14 in.) slotted or cross-head No 2	3.5 mm (0.14 in.) slotted or cross-head No 2	3.0 mm (0.12 in.) slotted to open the spring

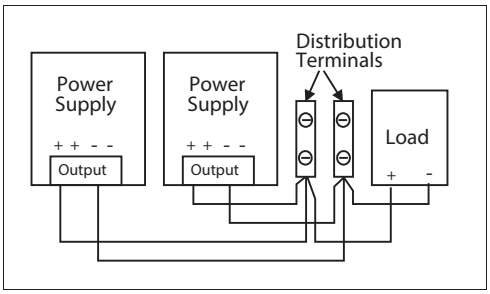
1606-XLE480EP-D	Input	Output	Signal Terminals
Type	Quick-connect spring-clamp termination	Quick-connect spring-clamp termination	Push-in termination
Solid wire	6.0 mm^2 max (0.0093 in^2 max)	6.0 mm^2 max (0.0093 in^2 max)	1.5 mm^2 max (0.0023 in^2 max)
Stranded wire	4.0 mm^2 max (0.0062 in^2 max)	4.0 mm^2 max (0.0062 in^2 max)	1.5 mm^2 max (0.0023 in^2 max)
American Wire Gauge	AWG 20...10	AWG 20...10	AWG 24...16
Wire diameter max (including ferrules)	2.8 mm (0.11 in.)	2.8 mm (0.11 in.)	1.6 mm (0.06 in.)
Wire stripping length	10.0 mm (0.4 in.)	10.0 mm (0.4 in.)	7.0 mm (0.28 in.)
Screwdriver	–	–	3.0 mm (0.12 in.) slotted to open the spring

1606-XLE480EH	Input	Output	Signal Terminals
Type	Push-in termination	Push-in termination	Push-in termination
Solid wire	2.5 mm^2 max (0.0039 in^2 max)	10.0 mm^2 max (0.0155 in^2 max)	1.5 mm^2 max (0.0023 in^2 max)
Stranded wire	2.5 mm^2 max (0.0039 in^2 max)	6.0 mm^2 max (0.0093 in^2 max)	1.5 mm^2 max (0.0023 in^2 max)
Stranded wire with ferrules	1.5 mm^2 max (0.0023 in^2 max)	4.0 mm^2 max (0.0062 in^2 max)	1.5 mm^2 max (0.0023 in^2 max)
American Wire Gauge	AWG 24...12	AWG 24...8	AWG 24...16
Wire diameter max (including ferrules)	2.3 mm (0.09 in.)	3.3 mm (0.13 in.)	1.6 mm (0.06 in.)
Wire stripping length	10.0 mm (0.40 in.)	15.0 mm (0.60 in.)	7.0 mm (0.28 in.)
Screwdriver	3.0 mm (0.12 in.) slotted to open the spring	3.0 mm (0.12 in.) slotted to open the spring	3.0 mm (0.12 in.) slotted to open the spring

Daisy chaining

Daisy chaining (jumping from one power supply output to the next) is not allowed. Use a separate distribution terminal block as shown in Figure 26.

Figure 26 - Using distribution terminals



Lifetime Expectancy

The power supply lifetime expectancies in the table indicate the minimum operating hours (service life). The lifetime expectancies of the built-in electrolytic capacitors determine the power supply lifetime expectancies. Lifetime expectancy is specified in operational hours and is calculated according to the manufacturer specification of the capacitor. The manufacturer of the electrolytic capacitors only guarantees a maximum life of up to 15 years (131,400 h). Any number that exceeds 131,400 h is a calculated theoretical lifetime, which can be used to compare devices.

Lifetime Expectancies			Conditions
AC 100V	AC 120V	AC 230V	
48,000 h	60,000 h	94,000 h	At 24V, 20 A and 40 °C (104 °F)
123,000 h	149,000 h	173,000 h	At 24V, 10 A and 40 °C (104 °F)
23,000 h	31,000 h	54,000 h	At 24V, 24 A and 40 °C (104 °F)
136,000 h	169,000 h	265,000 h	At 24V, 20 A and 25 °C (77 °F)
348,000 h	422,000 h	488,000 h	At 24V, 10 A and 25 °C (77 °F)
64,000 h	88,000 h	152,000 h	At 24V, 24 A and 25 °C (77 °F)

Mean Time Between Failure

Mean Time Between Failure (MTBF) 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. For example, an MTBF figure of 1,000,000 h means that statistically one unit fails every 100 hours if 10,000 units are installed in the field. However, it cannot be determined if the failed unit has been running for 50,000 h or only for 100 h.

The Mean Time To Failure (MTTF) of the power supply is the same value as the MTBF value of the power supply.

Type of MTBF	MTBF			Conditions
	AC 100V	AC 120V	AC 230V	
MTBF SN 29500, IEC 61709	422,000 h	445,000 h	590,000 h	At 24V, 20 A and 40 °C (104 °F)
	790,000 h	832,000 h	1,060,000 h	At 24V, 20 A and 25 °C (77 °F)
MTBF MIL HDBK 217F	186,000 h	191,000 h	226,000 h	At 24V, 20 A and 40 °C (104 °F); Ground Benign GB40
	256,000 h	263,000 h	313,000 h	At 24V, 20 A and 25 °C (77 °F); Ground Benign GB25
	40,000 h	42,000 h	50,000 h	At 24V, 20 A and 40 °C (104 °F); Ground Fixed GF40
	53,000 h	55,000 h	67,000 h	At 24V, 20 A and 25 °C (77 °F); Ground Fixed GF25

Electromagnetic Compatibility

The electromagnetic compatibility (EMC) behavior of the device is designed for applications in industrial, residential, commercial, and light industry environments. The output is allowed to be grounded or floating.

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

For the power supply to supply a local DC power network in residential, commercial, and light-industrial environments, it requires additional measures to reduce the conducted emissions on the output. An example additional measure is using a filter. No restrictions apply for local DC power networks in industrial environments.

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

(1) Criterion A: Device shows normal operation behavior within the defined limits.
Criterion C: Temporary loss of function is possible. The device may shut down. If it shuts down, it restarts by itself. No damage or hazards for the device occur.

EMC Emission Attributes	Standards	Notes
Conducted emission input lines	EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B
Radiated emission	EN 55011, EN 55022	Class B
Harmonic input current	EN 61000-3-2	Fulfilled for Class A equipment Fulfilled for Class C equipment in the load range from 8...24 A
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with constant current loads, non-pulsing
This device complies with FCC Part 15 rules. Operation is subjected to following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.		

Switching Frequency Attributes	Values	Notes
PFC converter	100 kHz	Fixed frequency
Main converter	80…140 kHz	Output load dependent
Auxiliary converter	60 kHz	Fixed frequency

Environment

Attribute	Values	Notes
Operational temperature	-25…+70 °C (-13…+158 °F)	The operational temperature is the ambient or surrounding temperature and is defined as the air temperature 2 cm (0.79 in.) below the device.
Storage temperature	-40…+85 °C (-40…+185 °F)	For storage and transportation
Output derating	6.4 W/1 °C (6.4 W/ 1.8 °F)	Between 45…60 °C (113…140 °F)
	12 W/1 °C (12 W/ 1.8 °F)	Between 60…70 °C (140…158 °F)
	1.33 A/1000 m (1.33 A/ 3281 ft) or 5 °C/1000 m (9 °F/ 3281 ft)	For altitudes >2000 m (6560 ft), see Figure 28 on page 20
	The derating is not hardware-controlled. You must pay attention to ensure that derating stays below the derated current limits in order not to overload the unit.	
Humidity	5…95% r.h.	According to IEC 60068-2-30
Atmospheric pressure	110…47 kPa	See Figure 28 on page 20 for details
Altitude	Up to 6000 m (19,685 ft)	See Figure 28 on page 20 for details
Overvoltage category	III	According to IEC 60664-1 for altitudes up to 2000 m (6560 ft)
	II	According to IEC 60664-1, for altitudes above 2000 m (6560 ft)
Degree of pollution	2	According to IEC 62477-1, not conductive
Vibration sinusoidal	2…17.8 Hz: ±1.6 mm 17.8…500 Hz: 2 g 2 hours / axis	According to IEC 60068-2-6
Shock	30 g 6 ms, 20 g 11 ms 3 bumps / direction 18 bumps in total	According to IEC 60068-2-27
	Shock and vibration are tested in combination with DIN rails according to EN 60715 with a height of 15 mm (0.59 in.), a thickness of 1.3 mm (0.05 in.), and a standard 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	Tested according to ISA-71.04-1985, Severity Level G3 and IEC 60068-2-60 Test Ke Method 4 for a service life of 10 yr min in these environments.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload, or short circuit.	

Figure 27 - Output current versus ambient temp.

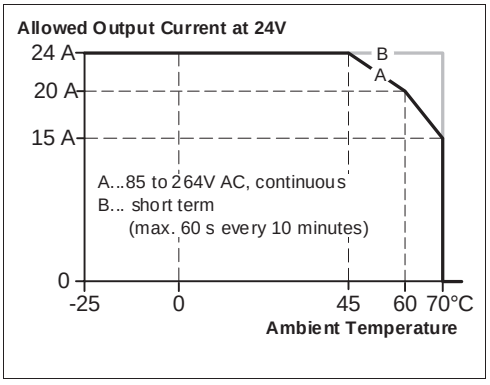
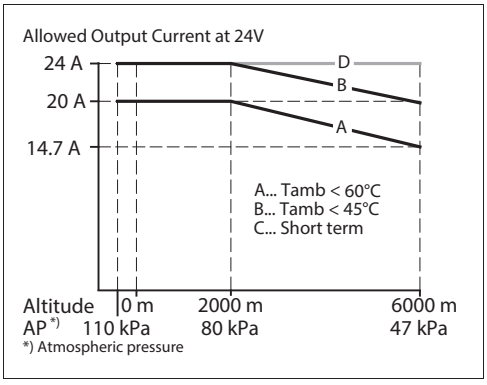


Figure 28 - Output current versus altitude



Safety and Protection Features

Attributes		Values	Notes
Isolation resistance	Min	500 MΩ	At delivered condition between input and output, measured with 500V DC
	Min	500 MΩ	At delivered condition between input and PE, measured with 500V DC
	Min	500 MΩ	At delivered condition between output and PE, measured with 500V DC
	Min	500 MΩ	At delivered condition between output and DC OK contacts, measured with 500V DC
PE resistance	Max	0.1 Ω	Resistance between PE terminal and the housing in the area of the DIN rail mounting bracket.
Output overvoltage protection	Typ	30.5V DC	–
	Max	32V DC	–
	If there is an internal anomaly, a redundant circuit limits the max output voltage. The output shuts down and automatically attempts to restart.		
Class of protection	–	I	According to IEC 61140 A PE (Protective Earth) connection is required
Degree of protection	–	IP 20	According to EN/IEC 60529
Over-temperature protection	–	Included	Output shuts down with automatic restart. Temperature sensors are installed on critical components inside the unit and turn off the unit in safety critical situations. These situations can include when ambient temperature is too high, ventilation is obstructed, or the derating requirements are not followed. There is no correlation between the operating temperature and turn-off temperature because this is dependent on input voltage, load, and installation methods.
Input transient protection	–	MOV (Metal Oxide Varistor)	For protection values, see Electromagnetic Compatibility on page 19.
Internal input fuse	–	Included	Cannot be replaced by the customer, slow-blow high-breaking capacity fuse
Touch current (leakage current)	Typ	0.12 mA / 0.31 mA	At 100V AC, 50 Hz, TN-,TT-mains / IT-mains
	Typ	0.18 mA / 0.45 mA	At 120V AC, 60 Hz, TN-,TT-mains / IT-mains
	Typ	0.30 mA / 0.76 mA	At 230V AC, 50 Hz, TN-,TT-mains / IT-mains
	Max	0.16 mA / 0.38 mA	At 110V AC, 50 Hz, TN-,TT-mains / IT-mains
	Max	0.23 mA / 0.55 mA	At 132V AC, 60 Hz, TN-,TT-mains / IT-mains
	Max	0.39 mA / 0.94 mA	At 264V AC, 50 Hz, TN-,TT-mains / IT-mains

Dielectric Strength

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

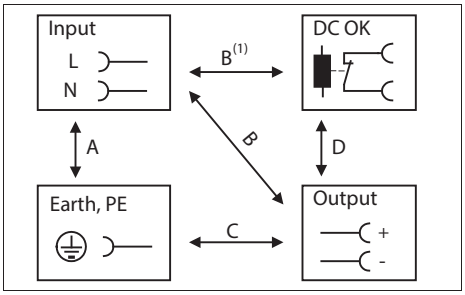
The output is insulated to the input by a double or reinforced insulation.

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

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

Test or Setting	Time	A	B	C	D
Type test	60 s	2500V AC	3000V AC	1000V AC	500V AC
Routine test	5 s	2500V AC	2500V AC	500V AC	500V AC
Field test	5 s	2000V AC	2000V AC	500V AC	500V AC
Cutoff current setting for field test	–	> 10 mA	> 10 mA	> 20 mA	> 1 mA

Figure 29 - Dielectric strength



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

Approvals

Approval Name	Approval Symbol	Notes
EC Declaration of Conformity	CE	The CE marking indicates conformance with the - RoHS directive - EMC Directive, - Low Voltage Directive and the - ATEX directive
IEC 60950-1 2nd Edition (except for 1606-XLE480EP-D)	IECEE CB SCHEME	CB Scheme, Information Technology Equipment
UL 508 (except for 1606-XLE480EP-D)	c UL US LISTED IND. CONT. EQ.	Listed for use as Industrial Control Equipment; U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01); E-File: NMTR(7).E56639
UL 60950-1 2nd Edition (except for 1606-XLE480EP-D)	c UL us	Recognized for use as Information Technology Equipment, Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1); E-File: QQGQ(2,8). E168663 Applicable for altitudes up to 2000 m (6560 ft).
EN 60079-0, EN 60079-7 ATEX (except for 1606-XLE480EP-D)	Ex II 3G Ex ec nC II T4 Gc	Approval for use in hazardous locations Zone 2 Category 3G. Number of ATEX certificate: EPS 17 ATEX 1 089 X
IEC 60079-0, IEC 60079-7 (except for 1606-XLE480EP-D)	IECEx	Suitable for use in Class 1 Zone 2 Groups IIa, IIb, and IIc locations. Number of IECEx certificate: EPS 17.0046X
EAC TR Registration (except for 1606-XLE480EM and 1606-XLE480EP-D)	EAC	Registration for the Eurasian Customs Union market (Russia, Kazakhstan, Belarus)

Fulfilled Standards

Standard Name	Standard Symbol	Notes
REACH Directive	REACH ✓	Directive 1907/2006/EU of the European Parliament and the Council of June 1, 2007 regarding the Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH)
IEC/EN 61558-2-16 (Annex BB)	Safety Isolating Transformer	Safety Isolating Transformers corresponding to Part 2...6 of the IEC/EN 61558

Physical Dimensions and Weight

Attribute	Description
Width	48 mm (1.89 in.)
Height	124 mm (4.88 in.)
Depth	127 mm (5.0 in.) The DIN rail height must be added to the unit depth to calculate the total required installation depth.
Weight	830 g (1.83 lb)
DIN rail	Use 35 mm(1.38 in.) DIN rails according to EN 60715 or EN 50022 with a height of 7.5 mm or 15 mm (0.30 in. or 0.59 in.)
Housing material	Body: Aluminum alloy Cover: Zinc-plated steel
Penetration protection	Small parts like screws and nuts with a diameter larger than 5 mm (0.20 in.)

Figure 30 - Dimensions from Front View

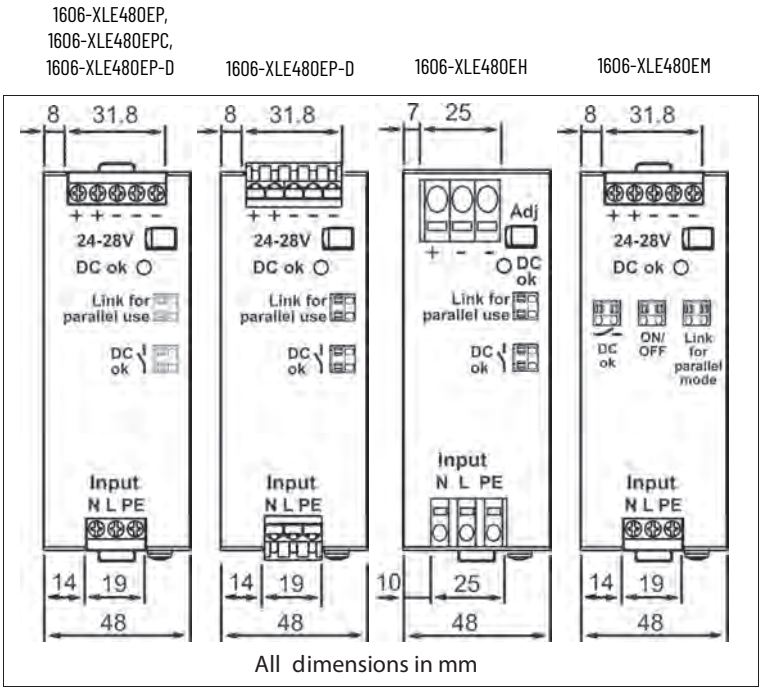
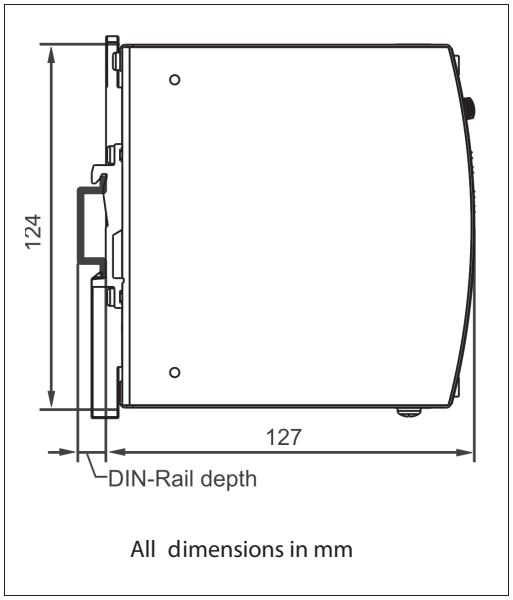


Figure 31 - Dimensions from Side view



Accessories

This section describes accessories that can be used with the power supplies.

Wall/Panel Mount Bracket

The wall/panel mount bracket (1606-XLA-XLE) is used to mount the devices on a wall/panel without using a DIN rail. The bracket can be mounted without detaching the DIN rail brackets of the power supply. Figure 32 through Figure 35 and Figure 37 show power supply 1606-XLE480EP mounted on the bracket.

Figure 32 - Power supply mounted on bracket, front left view

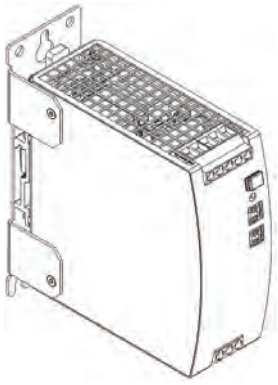


Figure 33 - Power supply mounted on bracket, front right view

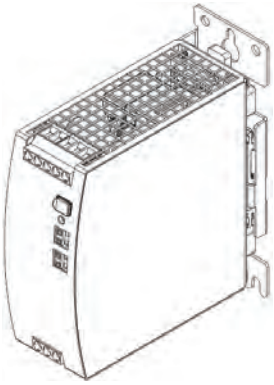


Figure 34 - Power supply mounted on bracket, back right view

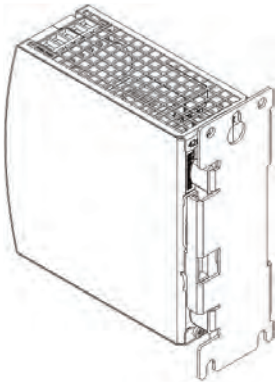
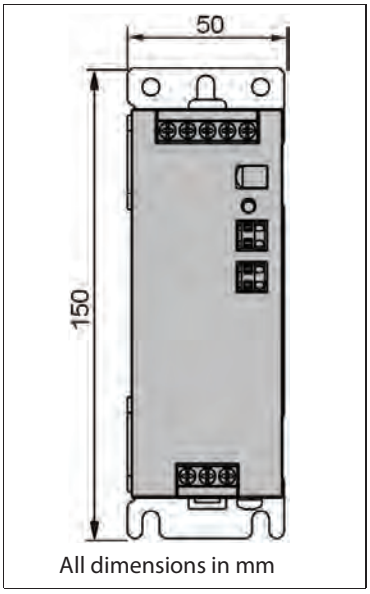
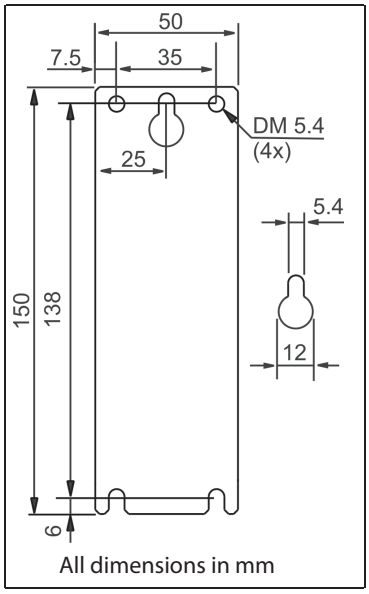


Figure 35 - Power supply mounted on bracket, front view



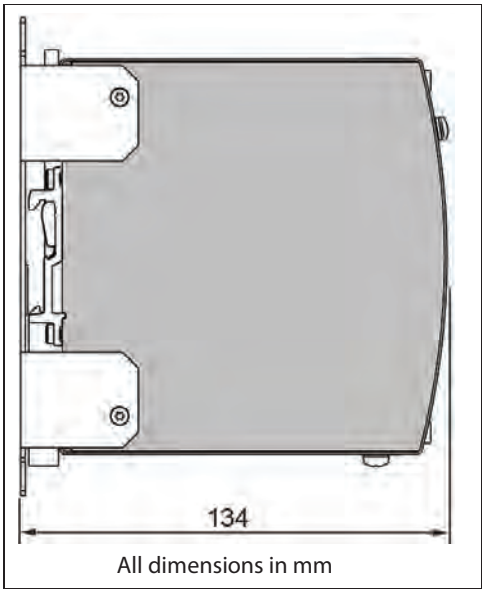
All dimensions in mm

Figure 36 - Hole pattern for wall mounting



All dimensions in mm

Figure 37 - Power supply mounted on bracket, left view



All dimensions in mm

1606-XLSBUFFER24 Buffer Module

The 1606-XLSBUFFER24 buffer module is a supplementary device for DC 24V power supplies. It delivers power to bridge typical mains failures or extends the hold-up time after the AC power is turned off.

When the power supply provides a sufficient voltage, the buffer module stores energy in the integrated electrolytic capacitors. When the mains voltage is lost, the stored energy is released to the DC bus in a regulated process.

The buffer module can be added in parallel to the load circuit at any given point and does not require any control wiring.

One buffer module can deliver 20 A additional current and can be added in parallel to increase the output ampacity or the hold-up time.

1606-XLSRED40 Redundancy Module

The 1606-XLSRED40 is a dual redundancy module, which can be used to build 1+1 or N+1 redundant systems.

The device is equipped with two 20 A nominal input channels, which are individually decoupled using metal–oxide–semiconductor field-effect transistor (MOSFET) technology. The output can be loaded with a nominal 40 A continuous current.

Using MOSFETs instead of diodes reduces heat generation, losses and voltage drop between input and output. Due to these advantages, the unit is narrow and only requires 36 mm (1.42 in.) width on the DIN rail.

The device does not require an additional auxiliary voltage and is self-powered even if there is a short circuit across the output.

A feature of this redundancy module is a special circuit, which keeps the losses and temperature low, even at overload and short circuit conditions up to 65 A continuous current.

See Parallel Use for Redundancy on page 32 for wiring information.

1606-XLSRED4HE Redundancy Module

The 1606-XLSRED4HE is a dual redundancy module, which can be used to build 1+1 or N+1 redundant systems.

The device is equipped with two 20 A nominal input channels, which are individually decoupled by using MOSFET technology. The output can be loaded with a nominal 40 A continuous current.

Using MOSFETs instead of diodes reduces heat generation, losses and voltage drop between input and output. Due to these advantages, the unit is narrow and only requires 36 mm (1.42 in.) width on the DIN rail.

The device does not require an additional auxiliary voltage and is self-powered even if there is a short circuit across the output. It requires suitable power supplies on the input, where the sum of the continuous short circuit current stays below 26 A. This is typically achieved when the power supplies are featured with an intermittent overload behavior (Hiccup Mode).

See Parallel Use for Redundancy on page 32 for wiring information.

1606-XLSREDS40HE Redundancy Module

The 1606-XLSREDS40HE is a 40 A single-channel redundancy module, which is equipped with a plug connector on the output. The plug connector allows replacing the power supply or the redundancy module while the system is running. The plug connector helps prevent the output wires from touching and creating a short in the load circuit.

The input of the device is decoupled by using MOSFET technology.

Using MOSFETs instead of diodes reduces heat generation, losses and voltage drop between input and output. Due to these advantages, the unit is narrow and only requires 46 mm (1.81 in.) width on the DIN rail.

The device does not require an additional auxiliary voltage and is self-powered even if there is a short circuit across the output. It requires a suitable power supply on the input, where the continuous short circuit current stays below 22 A. This is typically achieved when the power supply is featured with an intermittent overload behavior (Hiccup Mode).

See Parallel Use for Redundancy on page 32 for wiring information.

Peak Current Capability

The unit can deliver peak currents (up to several milliseconds) which are higher than the specified short-term currents. This ability 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 helps to ensure the safe operation of subsequent circuit breakers of load circuits. The load branches are often individually protected with circuit breakers or fuses. If there is a short or an overload in one branch circuit, the fuse or circuit breaker need a certain amount of overcurrent to open in a timely manner. This avoids voltage loss in adjacent circuits.

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

Figure 38 - 40 A peak current for 50 ms, typ (2x the nominal current)

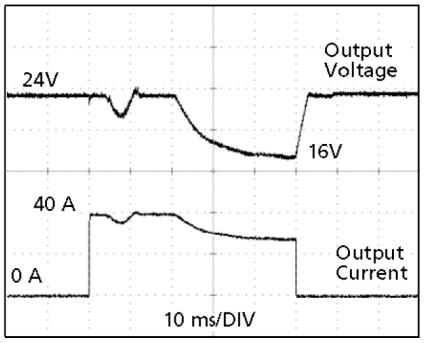


Figure 39 - 60 A peak current for 12 ms, typ (3x the nominal current)

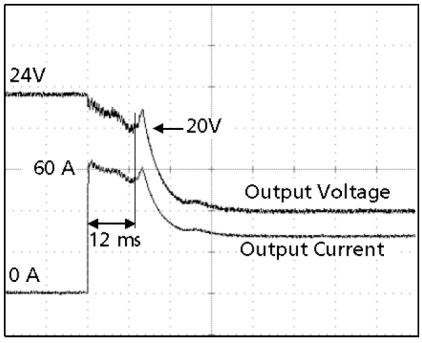
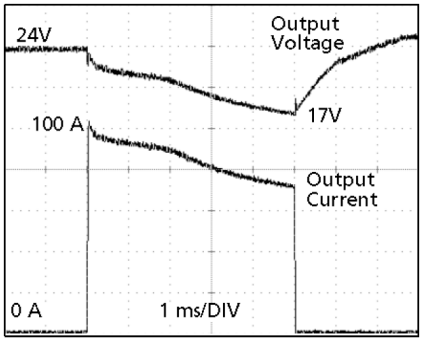


Figure 40 - 100 A peak current for 5 ms, typ (5x the nominal current)



IMPORTANT The DC OK relay might trigger when the voltage dips more than 10% for longer than 1 ms.

Attribute		Values	Notes
Peak current voltage dips	Typ	from 24V to 16V	At 40 A for 50 ms, resistive load
	Typ	from 24V to 21V	At 100 A for 2 ms, resistive load
	Typ	from 24V to 17V	At 100 A for 5 ms, resistive load

Output Circuit Breakers

Standard miniature circuit breakers (MCBs or UL 1077 circuit breakers) are commonly used for AC supply systems and may also be used on 24V branches.

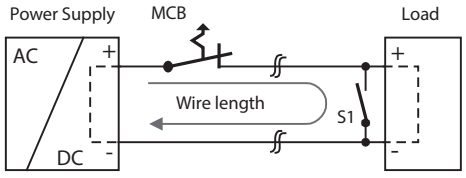
MCBs are designed to protect wires and circuits. If the ampere value and the characteristics of the MCB are adapted to the wire size that is used, the wiring is considered thermally safe regardless of whether the MCB opens or not.

To avoid voltage dips and undervoltage situations in adjacent 24V branches that are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10 ms is necessary corresponding roughly to the ride-through time of PLCs. This requires power supplies with high current reserves and large output capacitors. Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to flow. The best current reserve in the power supply does not help if Ohm's law does not permit current flow. The following table has typical test results showing which B- and C-Characteristic MCBs magnetically trip depending on the wire cross section and wire length.

Type of Wire	Maximal Wire Length(1) for a Fast (Magnetic) Tripping			
	0.75 mm^2 cross section	1.0 mm^2 cross section	1.5 mm^2 cross section	2.5 mm^2 cross section
C-2A	31 m (150.9 ft)	37 m (121.3 ft)	63 m (206.6 ft)	98 m (321.5 ft)
C-3A	28 m (91.8 ft)	34 m (111.5 ft)	51 m (167.3 ft)	78 m (255.9 ft)
C-4A	18 m (59.0 ft)	25 m (82.0 ft)	38 m (124.6 ft)	58 m (190.2 ft)
C-6A	9 m (29.5 ft)	11 m (36.0 ft)	18 m (59.0 ft)	26 m (85.3 ft)
C-8A	6 m (19.6 ft)	7 m (22.9 ft)	12 m (39.3 ft)	14 m (45.9 ft)
C-10A	4 m (13.1 ft)	6 m (19.6 ft)	11 m (36.0 ft)	13 m (42.6 ft)
C-13A	2 m (6.5 ft)	2 m (6.5 ft)	4 m (13.1 ft)	7 m (22.9 ft)
B-6A	23 m (75.4 ft)	28 m (91.8 ft)	46 m (150.9 ft)	66 m (216.5 ft)
B-10A	11 m (36.0 ft)	14 m (45.9 ft)	19 m (62.3 ft)	32 m (104.9 ft)
B-13A	7 m (22.9 ft)	11 m (36.0 ft)	16 m (52.4 ft)	29 m (95.1 ft)
B-16A	5 m (16.4 ft)	6 m (19.6 ft)	8 m (26.2 ft)	15 m (49.2 ft)
B-20A	1 m (3.2 ft)	1 m (3.2 ft)	2 m (6.5 ft)	4 m (13.1 ft)
B-25A	not applicable	not applicable	not applicable	1 m (3.2 ft)

(1) Remember to consider twice the distance to the load (or cable length) when calculating the total wire length (+ and – wire).

Figure 41 - Test circuit



S1... Fault simulation switch

Use the Power Supply to Charge Batteries

The power supply can be used to charge lead-acid batteries or maintenance-free batteries. Two 12V SLA or VRLA batteries are needed in series connection. Be aware of the following when you use the power supply to charge batteries:

- Use only matched batteries when putting 12V types in series.
- Ensure that the ambient temperature of the power supply stays below 40 °C (104 °F).
- Use a 30 A or 32 A circuit breaker or a blocking diode between the power supply and the battery.
- Ensure that the output current of the power supply is below the allowed charging current of the battery.
- The return current to the power supply is typically 3.5 mA. This return current can discharge the battery when the power supply is switched off except if a blocking diode is used.
- Set the device into "Parallel Use" mode and adjust the output voltage. The output voltage is measured at no load and at the battery end of the cable, precisely to the end-of-charge voltage.

End-of-charge voltage	27.8V	27.5V	27.15V	26.8V
Battery temperature	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)

Series Operation

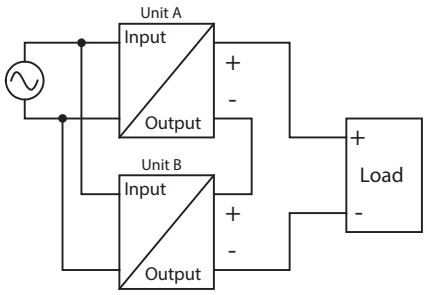
Devices of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150V DC. Voltages with a potential above 60V DC must be installed with a protection against touching.

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

Keep an installation clearance of 15 mm (0.59 in.) (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.

Leakage current, EMI, inrush current, and harmonics increase when using multiple devices.

Figure 42 - Series operation



Parallel Use to Increase Output Power

Devices can be paralleled to increase the output power. For the power supplies to be used in parallel, either option A or option B below must be used:

- Option A: Adjust the output voltage of all power supplies to the same value (±100 mV) in “Single Use” mode with the same load conditions on all units.
- Option B: If the power supplies still have their factory settings, leave the power supplies with the factory settings.

After the power supplies are adjusted as described in Option A or Option B, set the unit to “Parallel Use” mode, in order to achieve load sharing. The “Parallel Use” mode regulates the output voltage in such a manner that the voltage at no load is approximately 4% higher than at nominal load. See also Output on page 11.

The ambient temperature is not allowed to exceed +60 °C (140 °F).

If more than three units are connected in parallel, a fuse or circuit breaker with a rating of 30 A or 32 A is required on each output. Alternatively, a diode or redundancy module can also be used.

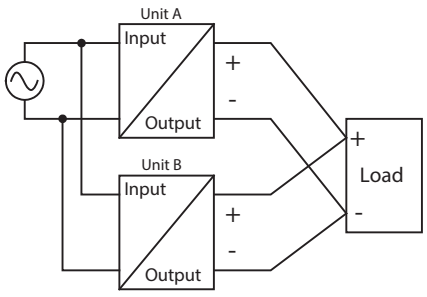
Energize all units simultaneously. If the output was in overload or short circuits and the required output current is higher than the current of one unit, then it also might be necessary to cycle the input power (turn off for at least 5 seconds).

Keep an installation clearance of 15 mm (0.59 in.) (left/right) between two devices and avoid installing devices on top of each other. Do not use power supplies in parallel if they are in a condition where a reduction of the output current is required. These conditions include:

- a mounting orientation other than the standard mounting orientation
- altitude
- any other condition where a reduction of the output current is required

Leakage current, EMI, and inrush current increase when using multiple devices.

Figure 43 - Parallel use to increase output power



Parallel Use for Redundancy

There are variants in the 1606-XLE480 series with built-in redundancy available, including the 1606-XLE480ERL and 1606-XLE480ERZ power supplies.

1+1 Redundancy

Devices can be paralleled for redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one device fails. The simplest way is to put two devices in parallel. This is called a 1+1 redundancy. In case one device fails, the other one is automatically able to support the load current without any interruption. It is essential to use a redundancy module to decouple devices from each other. This helps prevent the defective unit from becoming a load for the other device, and thereby helps ensure that the output voltage is maintained.

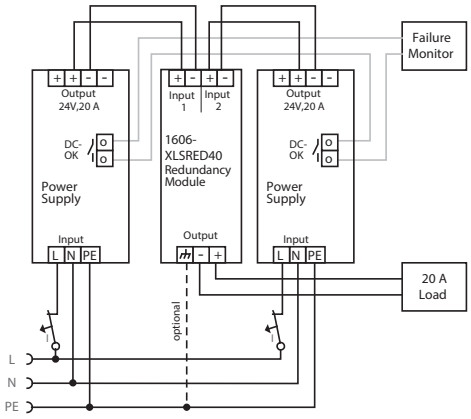
1+1 redundancy allows ambient temperatures up to +70 °C (158 °F).

Leakage current, EMI, inrush current, and harmonics increase when using multiple devices.

Recommendations for building redundant power systems:

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

Figure 44 - Example 1+1 redundancy configuration for 20 A load current with a dual redundancy module



Alternatively, the 1606-XLSRED4HE redundancy module can be used, but has the input and output terminals reversed.

N+1 Redundancy

Redundant systems for a higher power demand are usually built in an N+1 method. For example four power supplies, each rated for 20 A are paralleled to build a 60 A redundant system.

Leakage current, EMI, inrush current, and harmonics increase when using multiple power supplies.

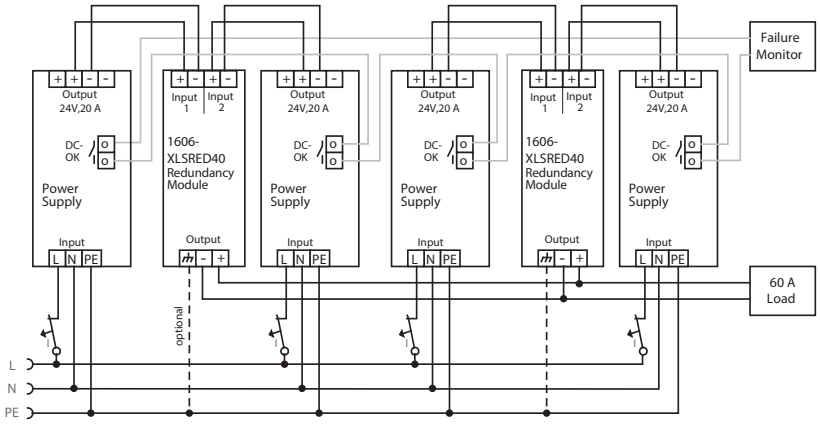
Keep an installation clearance of 15 mm (0.59 in.) (left/right) between two power supplies and avoid installing the power supplies on top of each other.

Do not use power supplies in parallel if they are in a condition where a reduction of the output current is required. These conditions include:

- a mounting orientation other than the standard mounting orientation
- altitude
- any other condition where a reduction of the output current is required

For N+1 redundancy, the ambient temperature is not allowed to exceed +60 °C (140 °F).

Figure 45 - Example N+1 redundancy configuration for 60 A load current with multiple power supplies and redundancy modules



Alternatively, the 1606-XLSRED4HE redundancy module can be used, but has the input and output terminals reversed.

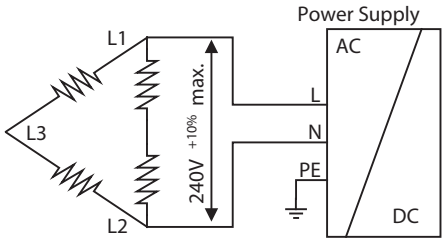
Operation on Two Phases

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.

The maximum allowed voltage between a Phase and the PE must be below 300V AC.

Figure 46 - Operation on two phases



Use in a Tightly Sealed Enclosure

When the device is installed in a tightly sealed enclosure, the temperature inside the enclosure is 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 1 cm (0.39 in.). The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure.

Attributes	Case A	Case B
Enclosure size	180 x 180 x 165 mm (7.09 x 7.09 x 6.5 in.) Rittal Typ IP66 Box PK 9519 100, plastic	180 x 180 x 165 mm (7.09 x 7.09 x 6.5 in.) Rittal Typ IP66 Box PK 9519 100, plastic
Input voltage	230V AC	230V AC
Load	24V, 16 A; (=80%)	24V, 20 A; (=100%)
Temperature inside the box	51.7 °C (125.06 °F)	55.8 °C (132.44 °F)
Temperature outside the box	25.9 °C (78.62 °F)	25.6 °C (78.08 °F)
Temperature rise	25.8 K	30.2 K

Mounting Orientations

Mounting orientations other than input terminals on the bottom and output on the top require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature. The listed lifetime and MTBF values in this publication apply only for the standard mounting orientation. Figure 47 through Figure 47 indicate allowed output currents for altitudes up to 2000 m (6560 ft).

Figure 47 - Mounting orientation A (standard orientation)

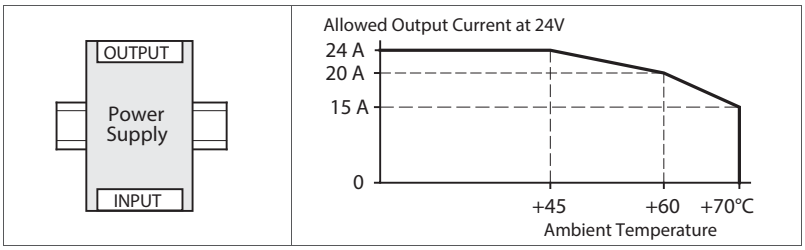


Figure 48 - Mounting orientation B (upside down)

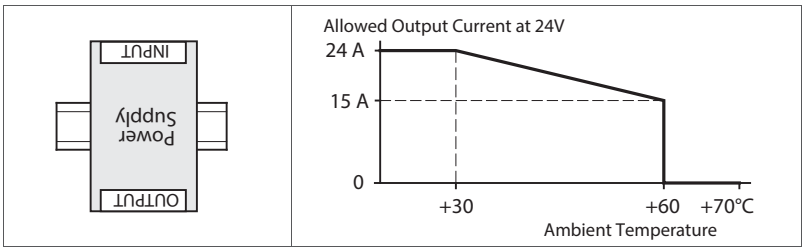


Figure 49 - Mounting orientation C (table-top mounting)

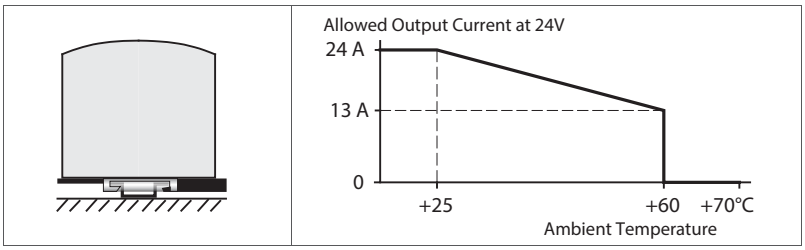
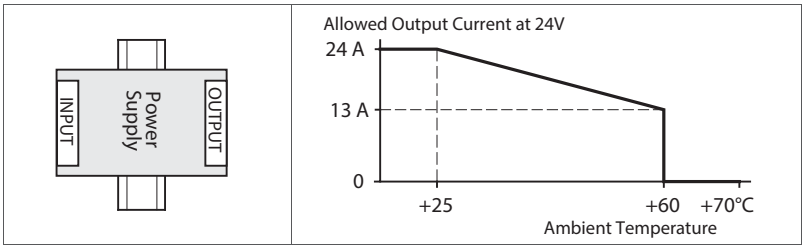
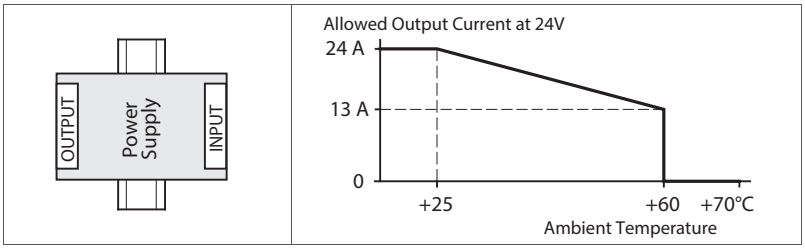


Figure 50 - Mounting orientation D (horizontal cw)



Mounting orientation E (horizontal ccw)



Notes:

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Switched Mode Power Supply Specifications Technical Data, publication 1606-TD002	Provides specifications for Bulletin 1606-XL, -XLE, -XLP, and -XLS products and applications.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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