Redundancy Power Supply - 24V, 10 A, 240 W, Single-phase Input

Catalog Numbers 1606-XLE240ERL, 1606-XLE240ERZ, 1606-XLE240CRZ, 1606-XLE240EDRZ

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.

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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).

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Notes

Product Overview

The Bulletin 1606-XLE line features cost optimized power supplies without compromising quality, reliability, and performance. The 1606-XLE240ERL and 1606-XLE240ERZ power supplies offer high efficiency, electronic inrush current limitation, active PFC, wide operational temperature range, and compact size. The units include a decoupling MOSFET for building 1+1 or n+1 redundant power supply systems.

These redundancy power supplies come with three connection terminal options; screw terminals, spring-clamp terminals, or plug connector terminals that allow replacement on an active application.

Catalog number 1606-XLE240EDRZ features an enhanced DC input voltage range and catalog number 1606-XLE240ECRZ is additionally equipped with conformal coated printed circuit boards.

These power supplies are suitable for a wide range of applications due to high immunity to transients and power surges, low electromagnetic emission, a DC OK signal contact for remote monitoring, and extensive international approvals.

- AC 100…240V Wide-range Input
- Width only 39 mm
- Built-in Decoupling Mosfet for 1+1 and n+1 Redundancy
- Efficiency up to 95.2%
- 20% Output Power Reserves
- Safe HiccupPLUS Overload Mode
- Easy Fuse Breaking – 3 times nominal current for 12 ms
- 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 Included

Specifications

Attribute	Value	Notes
Output current	24V DC	Nominal
Adjustment range	—	—
Output current	12 A	Below +45 °C (113 °F) ambient
	10 A	At +60 °C (140 °F) ambient
	7.5 A	At +70 °C (158 °F) ambient
	Derate linearly between +45...70 °C (+113...158 °F)	
AC Input voltage	100...240V AC	-15%/+10%
Mains frequency	50-60Hz	±6%
AC Input current	2.17/1.14 A	At 120/230V AC
Power factor	0.99/0.78	At 120/230V AC
Input voltage DC	DC 110-150V±20%	For 1606-XLE240ERxx
	DC 110-300V±20%	For 1606-XLE240EDxx
Input current DC	2.35 A/0.84 A	At 110 / 300V DC
AC Inrush current	6 / 9 Apk	At 120 / 230V AC
Efficiency	93.0 / 94.7%	At 120 / 230V AC
Losses	18.1 / 13.4 W	At 120 / 230V AC
Hold-up time	37 / 37ms	At 120 / 230V AC
Temperature range	-25...+70 °C (-13...+158 °F)	—
Size (w x h x d)	39x124x117mm	Without DIN rail and plug connectors
Weight	600 g (1.32 lb)	—

Catalog Numbers

Catalog Number	Description
1606-XLE240ERL	24V, 10 A 240 W Single-phase power supply with quick connect, spring-clamp terminals
1606-XLE240ERZ	24V, 10 A 240 W Single-phase power supply with hot swappable plug connectors
1606-XLE240ECRZ	24V, 10 A 240 W Single-phase power supply with conformal coated printed circuit boards
1606-XLE240EDRZ	24V, 10 A 240 W Single-phase power supply with enhanced DC-input
1606-XLA-W41	Wall Mount Bracket
1606-XLA-S44	Side Mount Bracket

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 8.

Attribute		Value	Notes
AC input	Nom	AC 100...240V	–
AC input range	Min	85...264V AC	Continuous operation
	Min	264...300V AC	For maximal 500 ms (occasional)
Allowed voltage L or N to earth	Max	300V AC	Continuous, according to IEC 62477-1
Input frequency	Nom	50...60Hz	±6%
Turn-on voltage	Typ	80V AC	Steady-state value, see Figure 1.
Shut-down voltage	Typ	72V AC	Steady-state value, see Figure 1.
	Typ	55V AC	Dynamic value (max 250 ms)
External input protection		The device is designed, tested, and approved for branch circuits up to 30 A (UL) or 32 A (IEC) without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 10 A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker.	

		AC 100V	AC 120V	AC 230V	Notes
Input current	Typ	2.63 A	2.17 A	1.14 A	At 10 A, see Figure 3.
Power factor	Typ	0.99	0.99	0.97	At 10 A, see Figure 4.
Crest factor	Typ	1.5	1.5	1.65	At 10 A, The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
Startup delay	Typ	300 ms	290 ms	240 ms	See Figure 2.
Rise time	Typ	30 ms	30 ms	30 ms	At 10 A constant current load, 0mF load capacitance, see Figure 2.
	Typ	75 ms	75 ms	75 ms	At 10 A constant current load, 20mF load capacitance, see Figure 2.
Turn-on overshoot	Max	200 mV	200 mV	200 mV	See Figure 2.

Figure 1 - Input Voltage Range

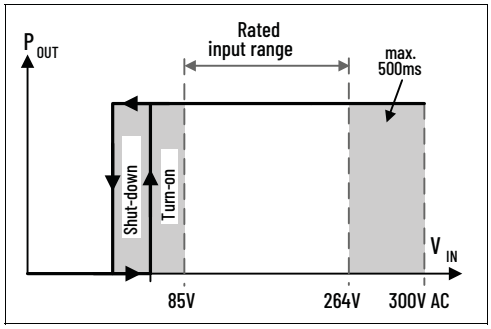


Figure 2 - Turn-on Behavior, definitions

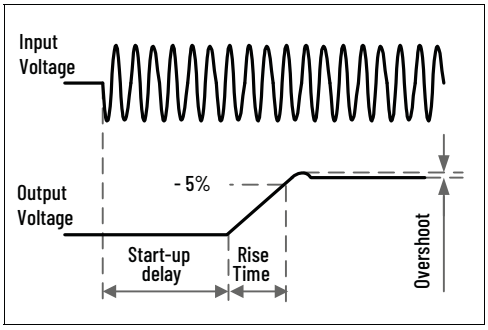


Figure 3 - Input Current versus Output Current

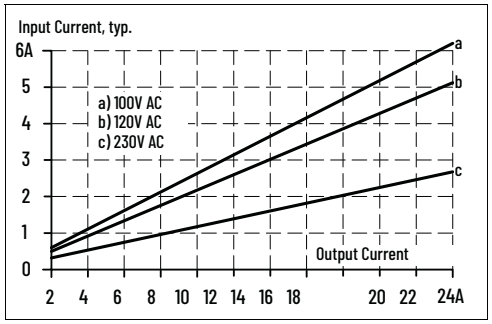
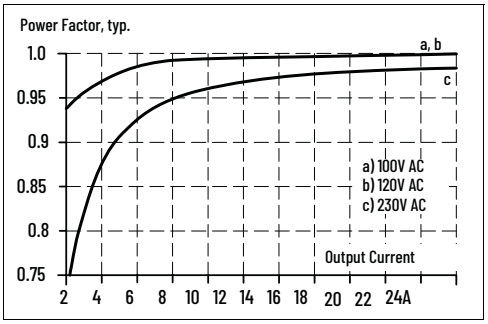


Figure 4 - Power Factor versus Output Current

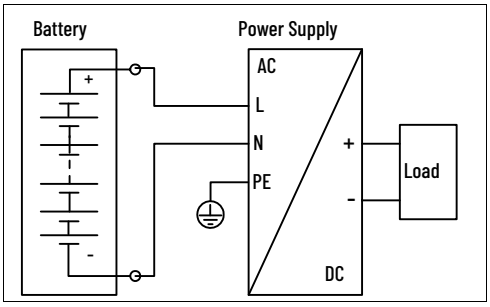


DC Input

The device is suitable to be supplied from a DC input voltage. Use a battery or a similar DC source. A supply from the intermediate DC-bus of a frequency converter is not recommended and can cause a malfunction or damage the unit. Connect +pole to L, –pole to N and the PE terminal to an earth wire or to the machine ground.

DC input	Nom	DC 110...150V	±20% for 1606-XLE240ER...
	Nom	DC 110...300V	±20% for 1606-XLE240EC...
DC input range	Min	88...180V DC	Continuous operation for 1606-XLE240ER...
		88...360V DC	Continuous operation for 1606-XLE240EC...
DC input current	Typ	2.35 A	At 110V DC and 10 A load current
	Typ	0.84 A	At 300V DC and 10 A load current
Allowed Voltage (+) or (-) input to Earth	Max	360V 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
		55V DC	Dynamic value (max 250 ms)

Figure 5 - 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.

Attribute		AC 100V	AC 120V	AC 230V	Temperature
Inrush current	Max	11 A peak	7 A peak	11 A peak	At 40 °C (104 °F), cold start
	Typ	9 A peak	6 A peak	6 A peak	At 25 °C (77 °F), cold start
	Typ	9 A peak	6 A peak	9 A peak	At 40 °C (104 °F), cold start
Inrush energy	Max	0.1 A^2s	0.1 A^2s	0.4 A^2s	At 40 °C (104 °F), cold start

Figure 6 - Typical Turn-on Behavior at Nominal Load, 120V AC Input, and 25 °C (77 °F) Ambient

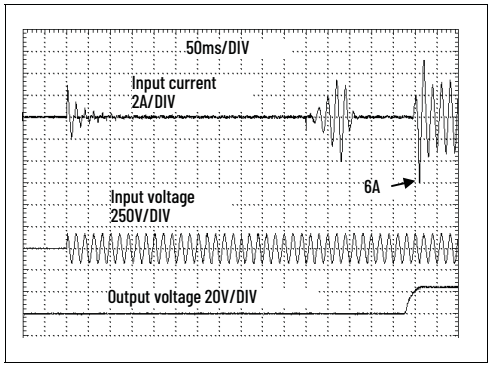
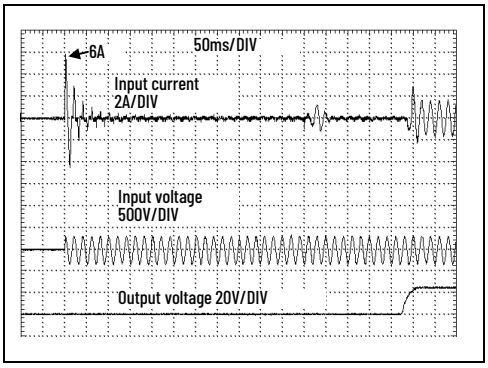


Figure 7 - Typical Turn-on Behavior at Nominal Load, 230V AC Input and 25 °C (77 °F) Ambient



Output

The output provides a SELV/PELV/ES1 rated voltage, which is galvanically isolated from the input voltage. The output of the devices includes a decoupling MOSFET for building 1+1 or n+1 redundant power supply systems.

The device is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or "UltraCaps") with a capacitance > 1F are connected to the output, the unit might charge the capacitor in the HiccupPLUS mode.

The device is featured with a "soft output regulation characteristic" to achieve current share between multiple devices when they are connected in parallel. The "soft output regulation characteristic" regulates the output voltage in such a manner that the voltage at no load is approximately 4% higher than at nominal load.

Output voltage	Nom	DC 24V	23.8...25.2V
Adjustment range		See Adjusting the Output Voltage on page 26	
Factory settings		24.1V	±0.2%, at 10 A, cold unit (results to Typ 23.9V±0.2% at 24 A and Typ 25.1V±0.2% at no load)
Line regulation	Max	10 mV	85...300V AC
Load regulation	Typ	1000 mV	Static value, 0 A --> 10 A; see Figure 8.
Ripple and noise	Max	50 mVpp	20 Hz to 20 MHz, 50 Ω
Output current	Nom	12 A(1)	Below 45 °C ambient temperature, see Figure 23.
	Nom	10 A	At 60 °C ambient temperature, see Figure 23.
	Nom	7.5 A	At 70 °C ambient temperature, see Figure 23.
Fuse breaking(2)	Typ	30 A	Up to 12 ms once every 5 seconds, see Figure 10.
Overload protection		Included	Electronically helps protected against overload, no-load, and short-circuits. In a protection event, audible noise can occur.
Overload behavior		Continuous current	Output voltage >13V DC, see Figure 8.
		Intermittent current(3)	Output voltage <13V DC, see Figure 8.
Overload/ short-circuit current	Max	15.5 A	Continuous current, see Figure 8.
	Typ	14 A	Intermittent current peak value for Typ 2 s Load impedance 10mΩ, see Figure 9. Discharge current of output capacitors is not included
	Max	5 A	Intermittent current average value (R.M.S.) Load impedance 10mΩ, see Figure 9.
Output capacitance	Typ	4400 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 with a duty cycle of 10% and/ or not longer than 1 minute every 10 minutes.

(2) The fuse braking current is an enhanced transient current which helps to start heavy loads or to trip fuses on faulty output branches. The output voltage stays above 20V. See Peak Current Capability on page 25 for additional measurements.

(3) At heavy overloads (when output voltage falls below 13V), the power supply delivers continuous output current for 2 s. After this, the output is switched off for approx. 18s before a new start attempt is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally. See Figure 8.

Figure 8 - Output Voltage Versus Output Current, Typ

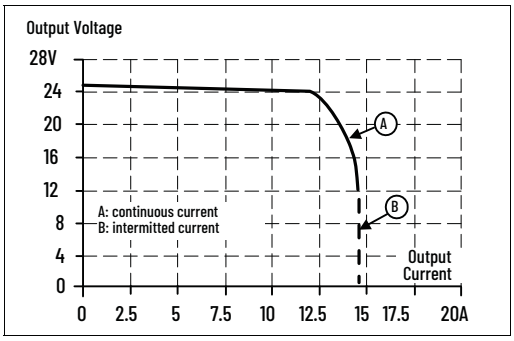


Figure 9 - Short-circuit on Output, Hiccup PLUS Mode, Typ

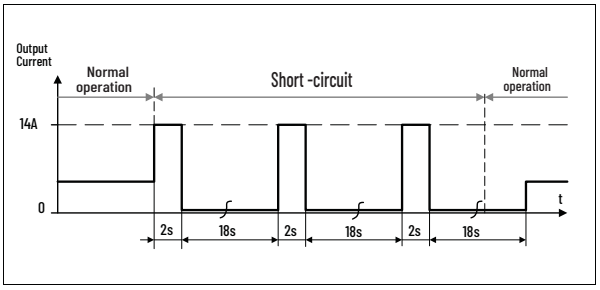
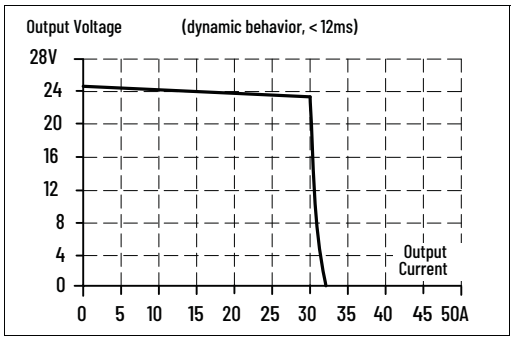


Figure 10 - Dynamic Overcurrent, Capability, Typ



Hold-up Time

		AC 100V	AC 120V	AC 230V	
Hold-up Time	Typ	73 ms	73 ms	73 ms	At 5 A, see Figure 11
	Min	55 ms	55 ms	55 ms	At 5 A, see Figure 11
	Typ	37 ms	37 ms	37 ms	At 10 A, see Figure 11
	Min	28 ms	28 ms	28 ms	At 10 A, see Figure 11

Figure 11 - Hold-up Time Versus Input Voltage

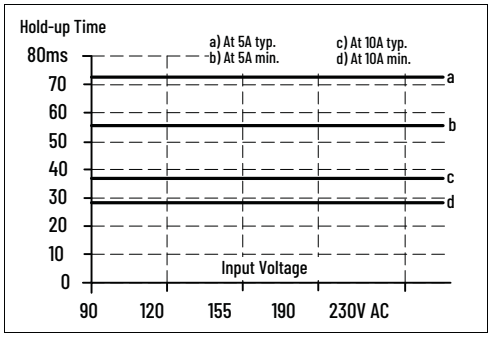
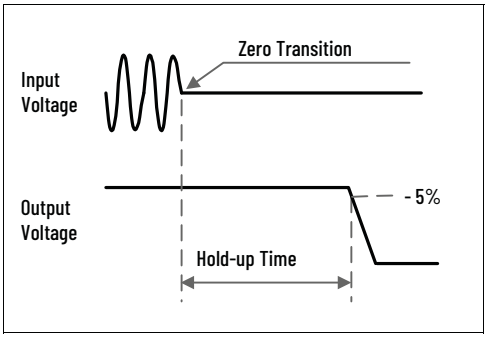


Figure 12 - Shut-down Behavior, Definitions

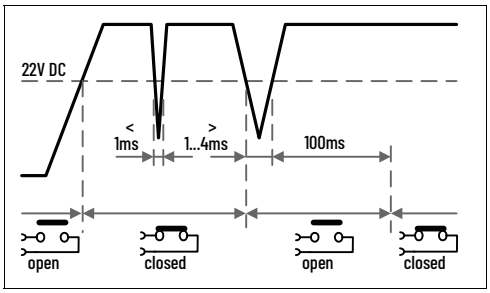


DC OK Relay Contact

This feature monitors the output voltage of the power supply in front of the decoupling device.

Contact closes	As soon as the output voltage reaches Typ 22V DC.
Contact opens	As soon as the output voltage dips below 22V DC. Short dips will be extended to a signal length of 100 ms. Dips shorter than 1 ms will be ignored.
Switching	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 13 - DC OK Relay Contact Behavior



Efficiency and Power Losses

		AC 100V	AC 120V	AC 230V	
Efficiency	Typ	92.2%	93.0%	94.7%	At 10 A
	Typ	91.9%	92.8%	94.6%	At 12 A (Power Boost)
Average efficiency[1]	Typ	91.8%	92.4%	93.9%	25% at 2.5 A, 25% at 5 A, 25% at 7.5 A. 25% at 10 A
Power losses	Typ	4 W	3.7 W	2.9 W	At 0 A
	Typ	11.3 W	10.7 W	8.6 W	At 5 A
	Typ	20.3 W	18.1 W	13.4 W	At 10 A
	Typ	25.4 W	22.3 W	16.4 W	At 12 A (Power Boost)

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

Figure 14 - Efficiency Versus Output Current, Typ

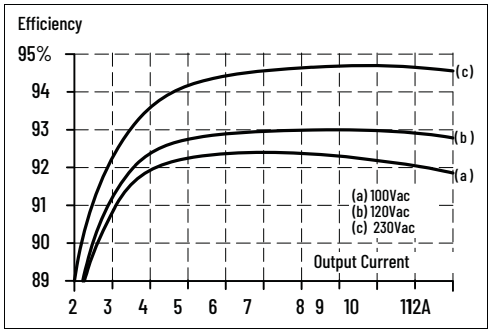


Figure 15 - Losses Versus Output Current, Typ

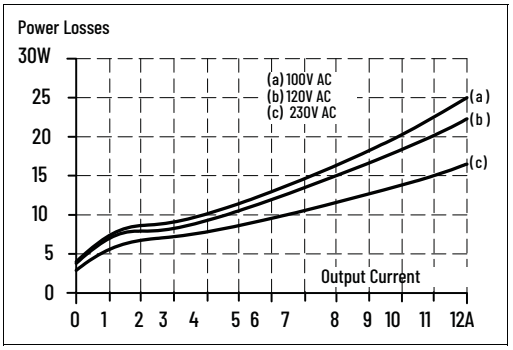


Figure 16 - Efficiency Versus Input Voltage at 10 A, Typ

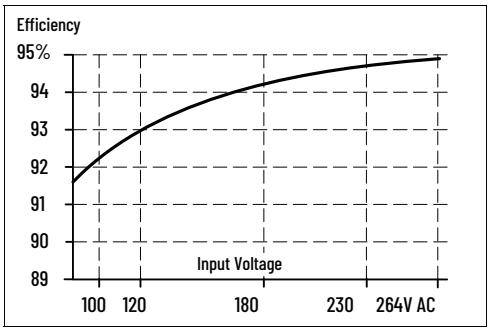
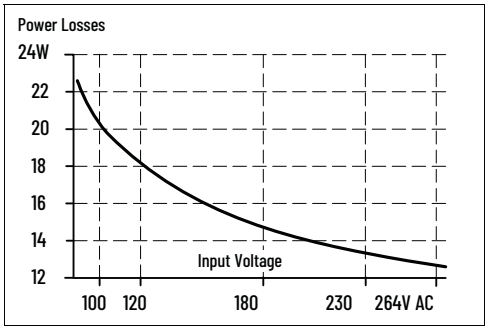


Figure 17 - Losses Versus Input Voltage at 10 A, Typ



Lifetime Expectancy

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

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy	143,000 h	152,000 h	188,000 h	At 5 A and 40 °C (104 °F)
	405,000 h	434,000 h	531,000 h	At 5 A and 25 °C (77 °F)
	66,000 h	78,000 h	109,000 h	At 10 A and 40 °C (104 °F)
	188,000 h	220,000 h	307,000 h	At 10 A and 25 °C (77 °F)
	37,000 h	47,000 h	71,000 h	At 12 A and 40 °C (104 °F)
	105,000 h	132,000 h	200,000 h	At 12 A and 25 °C (77 °F)

Mean Time Between Failure

Mean Time Between Failure (MTBF), which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

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

For these types of units the MTTF (Mean Time To Failure) value is the same value as the MTBF value.

	AC 100V	AC 120V	AC 230V	
MTBF SN 29500, IEC 61709	535,000 h	556,000 h	641,000 h	At 10 A and 40 °C (104 °F)
	972,000 h	1,006,000 h	1,138,000 h	At 10 A and 25 °C (77 °F)
MTBF MIL HDBK 217F	205,000 h	208,000 h	232,000 h	At 10 A and 40 °C (104 °F); Ground Benign GB40
	279,000 h	283,000 h	318,000 h	At 10 A and 25 °C (77 °F); Ground Benign GB25
	45,000 h	46,000 h	53,000 h	At 10 A and 40 °C (104 °F); Ground Fixed GF40
	58,000 h	59,000 h	63,000 h	At 10 A and 25 °C (77 °F); Ground Fixed GF25

Functional Diagram

Figure 18 - Functional diagram 1606-XLE240ERL

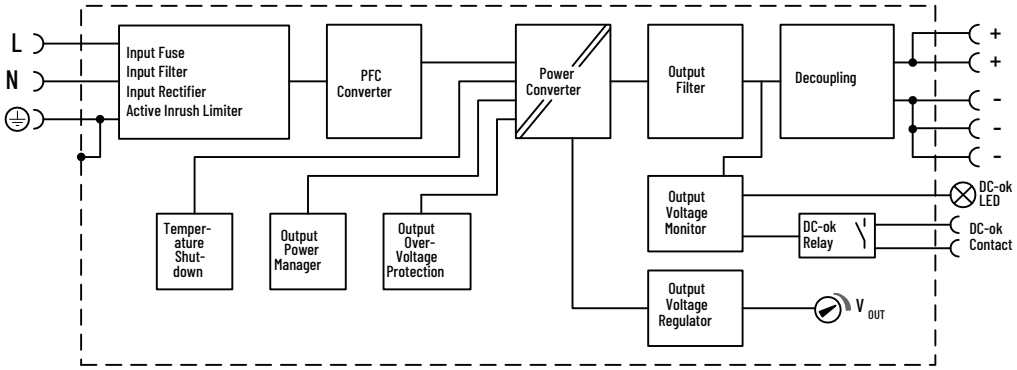
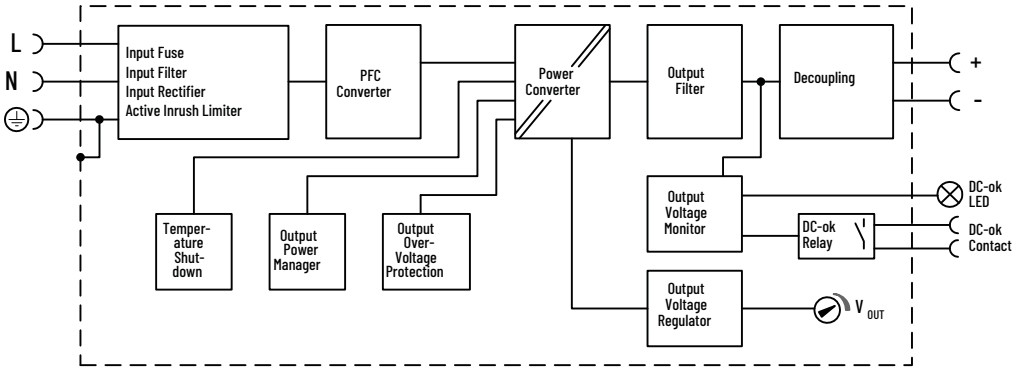


Figure 19 - Functional diagram 1606-XLE240ERZ, -XLE240CRZ, -XLE240EDRZ



Terminals and Wiring

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

1606-XLE240ERL	Input	Output	DC OK-Signal
Type	Quick-connect spring-clamp termination		Push-in termination
Solid wire max	6 mm^2		1.5 mm^2
Stranded wire max	4 mm^2		1.5 mm^2
American Wire Gauge	AWG 20-10		AWG 24-16
Max wire diameter (including ferrules)	2.8 mm		1.6 mm
Wire stripping length	10 mm (0.4 in.)		7 mm (0.28 in.)
Screwdriver	–		3 mm slotted to open the spring
1606-XLE240ERZ, -XLE240EDRZ, -XLE240ECRZ	**Input**	**Output**	**DC OK-Signal**
Type	Plug connector with screw termination(1)		
Solid wire max	4 mm^2	6 mm^2	1.5 mm^2
Stranded wire max	2.5 mm^2	4 mm^2	1.5 mm^2
American Wire Gauge	AWG 20-12	AWG 20-10	AWG 24-16
Wire diameter max (including ferrules)	2.4 mm	2.4 mm	1.8 mm
Recommended tightening torque, Max	0.5 Nm, 4.5 lb-in	0.5 Nm, 4.5 lb-in	0.8 Nm, 7 lb-in
Wire stripping length	7 mm (0.28 in.)	7 mm (0.28 in.)	6 mm (0.24 in.)
Screwdriver	3 mm slotted or cross-head No 2		3 mm slotted

(1) Do not unplug the connectors more than 20 times in total.

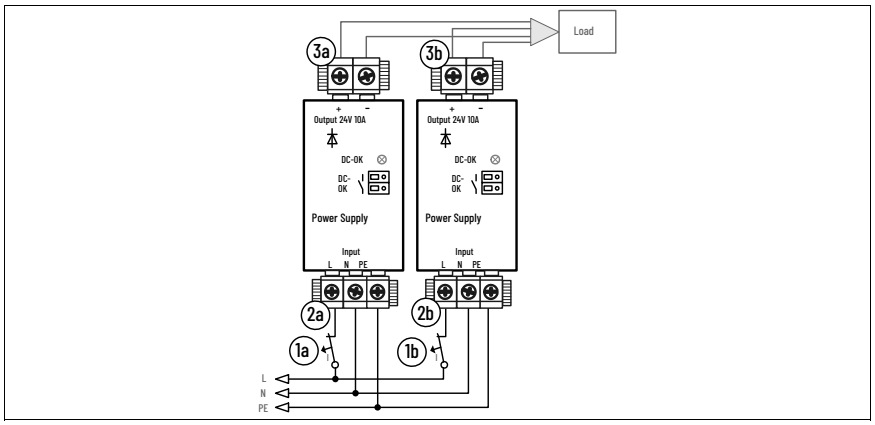
Instructions for Wiring

- Use appropriate copper cables that are designed for minimum operating temperatures of: 60 °C for ambient up to 45 °C, 75 °C for ambient up to 60 °C and 90 °C for ambient up to 70 °C minimum.
- Follow national installation codes and installation regulations!
- Confirm that all strands of a stranded wire enter the terminal connection!
- Verify unused terminal compartments are securely tightened.
- Ferrules are allowed and recommended.

Replacing Units While the System is Running

This feature is available only for the 1606-XLE240ERZ, -XLE240CRZ, and -XLE240EDRZ units, which are equipped with hot-swappable plug connectors.

Figure 20 - Replacing the power supply or redundancy module while the system is running



Replacement Instructions (Example for left power supply):

1. Switch-off circuit breaker (1a).
2. Remove plug (2a).
3. Remove plug (3a). The plug helps prevent the cables from shorting.
4. Change power supply.
5. Put the plug (3a) back in.
6. Put the plug (2a) back in.
7. Turn-on the circuit breaker (1a).
8. The circuit is redundant again.

To replace the right power supply, repeat the process using (1b), (2b) and (3b).

Front Side and User Elements

Figure 21 - 1606-XLE240ERL

Figure 22 - 1606-XLE240ERZ, -XLE240CRZ, -XLE240EDRZ

User Elements		
1	**Input Terminals**	
	N, L	N, L Line Input
	⏚	PE (Protective Earth) Input
2	**Output Terminals** Two identical + poles and two identical - poles	
	+	Positive Output
	-	Negative (return) Output
3	**Output Voltage Potentiometer**	
4	**DC OK light-emitting diode (LED) (green)** On, when the output voltage is above 22V.	
5	**DC OK Relay Contact** The DC OK relay contact is synchronized with the DC OK light-emitting diode (LED). See DC OK Relay Contact on page 12.	

Electromagnetic Compatibility

The electromagnetic compatibility (EMC) behavior of the device is designed for applications in industrial environment and in residential, commercial, and light industry environments.

EMC Immunity	**According to the generic standards EN 61000-6-1 and EN 61000-6-2.**			
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8 kV 15 kV	Criterion A [1] Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-2.7GHz	20V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines DC OK signal (coupling clamp)	4 kV 2 kV 2 kV	Criterion A Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N L → PE, N → PE	2 kV 4 kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + / - → PE	1 kV 2 kV	Criterion A Criterion A
Surge voltage on Signals	EN 61000-4-5	DC OK signal → PE	1 kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	20V	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 100V AC 40% of 100V AC 70% of 100V AC 0% of 200V AC 40% of 200V AC 70% of 200V AC	0V AC, 20 ms 40V AC, 200 ms 70V AC, 500 ms 0V AC, 20 ms 80V AC, 200 ms 140V AC, 500 ms	Criterion A Criterion C Criterion C Criterion A Criterion A Criterion A
Voltage interruptions	EN 61000-4-11	0% of 200V AC (=0V)	5000 ms	Criterion C
Voltage sags	SEMI F47 0706	80% of 120V AC (96V AC) 70% of 120V AC (84V AC) 50% of 120V AC (60V AC)	1000 ms 500 ms 200 ms	Criterion A Criterion A Criterion A
Powerful transients	VDE 0160	Over entire load range	750V, 0.3 ms	Criterion A

(1) Criterion:

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

C: Temporary loss of function is possible. Device can shut-down and restart by itself. No damage or hazards for the power supply will occur.

EMC Emission	**According to the generic standards EN 61000-6-3 and EN 61000-6-4.**	
Conducted emission input lines	EN 55011, EN 55015, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	5dB higher than average limits for DC power port according EN 61000-6-3[1]
Radiated emission	EN 55011, EN 55022	Class B
Harmonic input current	EN 61000-3-2	Class A equipment: fulfilled Class C equipment: fulfilled in the load range from 8 to 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.

(1) Restrictions apply for applications in residential, commercial and light-industrial environments, where local DC power networks according to EN 61000-6-3 are involved. No restrictions for all kinds of industrial applications.

Switching Frequencies		
PFC converter	100 kHz	Fixed frequency
Main converter	80...140kHz	Output load dependent
Auxiliary converter	60 kHz	Fixed frequency

Environment

Attribute	Value	Notes
Operational temperature	-25...+70 °C (-13...+158 °F)	Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2 cm below the unit.
Storage temperature	-40...+85 °C (-40...+185 °F)	For storage and transportation
Output derating[1]	0.13 A/°C 0.25 A/°C 0.63 A/1000m or 5°C/1000m 0.38 A/-5kPa or 3°C/-5kPa	Between +45 ...60 °C (113...140°F) Between +60... +70 °C (140...158°F) For altitudes >2000 m (6560 ft), see Figure 24. For atmospheric pressures <80 kPa, see Figure 24
The derating is not hardware that is controlled. The customer has to take this into consideration to stay below the derated current limits in order not to overload the unit.		
Humidity	5...95% r.h.	According to IEC 60068-2-30 Do not energize while condensation is present.
Atmospheric pressure	110-4780 kPa	See Figure 24 for details
Altitude	Up to 6000 m (20,000 6560 ft)	See Figure 24 for details
Overvoltage category	III	According to IEC 60664-1 for altitudes up to 2000 m
	II	According to IEC 60664-1, for altitudes between 2000 and 6000 m and atmospheric pressures from 80-47kPa.
Degree of pollution	2	According to IEC 62477-1, not conductive
Vibration sinusoidal	2...17.8Hz: ±1.6 mm; 17.8...500Hz: 2 g 2 hours / axis	According to IEC 60068-2-6
Shock [2]	30 g 6 ms, 20 g 11 ms 3 bumps per direction, 18 bumps in total	According to IEC 60068-2-27
	Shock and vibration are tested in combination with DIN rails according to EN 60715 with a height of 15 mm and a thickness of 1.3 mm and standard orientation.	
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 minimum 10years in these environments.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit.	

(1) The derating is not hardware controlled. The customer has to take this into consideration to stay below the derated current limits in order not to overload the unit.
(2) Shock and vibration are tested in combination with DIN rails according to EN 60715 with a height of 15 mm and a thickness of 1.3 mm and standard orientation.

Figure 23 - Output Current Versus Ambient Temperature

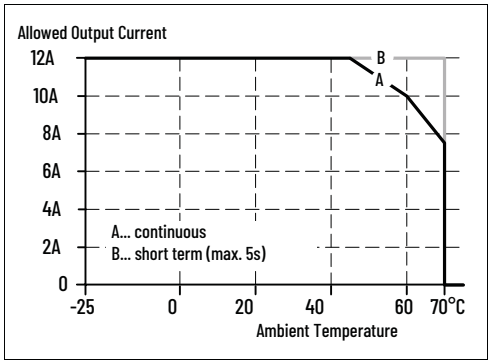
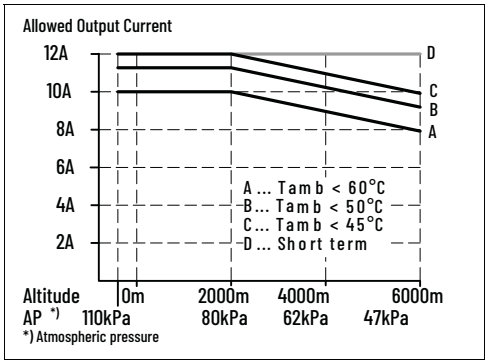


Figure 24 - Output Current Versus Altitude



Safety and Protection Features

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	0.10 Ω	Resistance between PE terminal and the housing in the area of the DIN rail mounting bracket.
Output overvoltage protection(1)	Typ	30.5V DC	In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
	Max	32V DC	
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(2)		Included	Output shut-down with automatic restart. Temperature sensors are installed on critical components inside the unit and turn the unit off in safety critical situations, which can happen e.g. 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 since this is dependent on input voltage, load and installation methods.
Input transient protection		MOV (Metal Oxide Varistor)	For protection values see EMC on page 19
Internal input fuse		Included	Not user replaceable slow-blow high-braking capacity fuse
Touch current (leakage current)	Typ	0.14 mA / 0.36 mA	At 100V AC, 50Hz, TN-,TT-mains / IT-mains
	Typ	0.20 mA / 0.50 mA	At 120V AC, 60Hz, TN-,TT-mains / IT-mains
	Typ	0.33 mA / 0.86 mA	At 230V AC, 50Hz, TN-,TT-mains / IT-mains
	Max	0.18 mA / 0.43 mA	At 110V AC, 50Hz, TN-,TT-mains / IT-mains
	Max	0.26 mA / 0.61 mA	At 132V AC, 60Hz, TN-,TT-mains / IT-mains
	Max	0.44 mA / 1.05 mA	At 264V AC, 50Hz, TN-,TT-mains / IT-mains

(1) In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
(2) Temperature sensors are installed on critical components inside the unit and turn the unit off in safety critical situations, which can happen for example, when ambient temperature is too high, ventilation is obstructed or the derating requirements are not followed. There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.

Dielectric Strength

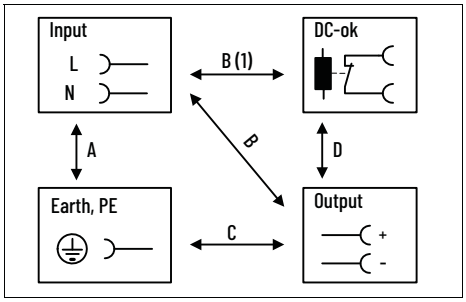
The output voltage is floating and has no ohmic connection to the ground. Type and routine tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (2 s up and 2 s down). Connect all input-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.

		A	B	C	D(1)
Type test	60s	2,500V AC	4,000V AC	1,000V AC	500V AC
Routine test	5s	2,500V AC	2,500V AC	500V AC	500V AC
Field test	5s	2,000V AC	2,000V AC	500V AC	500V AC
Cut-off current setting for field test		> 10 mA	> 10 mA	> 20 mA	> 1 mA

It is recommend that either the + pole, the – pole or any other part of the output circuit shall be connected to the earth/ground system. This helps to avoid situations in which a load starts unexpectedly or can not be switched off when unnoticed earth faults occur.

(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.

Figure 25 - Dielectric Strength



Certifications and Standards Compliance

EC Declaration of Conformity	CE	The CE mark indicates conformance with the EMC directive (available), Low-voltage directive (available) and the ATEX directive (planned)
IEC 60950-1 2nd Edition	IECEE CB SCHEME	CB Scheme for I.T.E. Information Technology Equipment
IEC 62368-1 2nd Edition	IECEE CB SCHEME	CB Scheme for I.C.T. Information and Communication Technology
IEC 61010-2-201 2nd Edition	IECEE CB SCHEME	CB Scheme for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment
ANSI/UL 61010-2-201 (former UL 508)	c UL US LISTED IND. CONT. EQ.	Listed as Open Type Device for use in Control Equipment UL Category NMTR, NMTR7 E-File: E56639
ANSI/ISA 12.12.01 Class I Div 2	c UL US LISTED PROCESS CONT. EQ. CLASS I DIVISION 2	Listed for use in Hazardous Location Class I Div 2
EN 60079-0, EN 60079-7 ATEX	Ex II 3G Ex ec nC II T4 Gc	Approval for use in hazardous locations Zone 2 Category 3G.
IEC 60079-0, IEC 60079-7	**IECEx**	Suitable for use in Class 1 Zone 2 Groups IIa, IIb and IIc locations.
EAC TR Registration (only for 1606-XLE480ERL and 1606-XLE480ERZ)	EAC	Registration for the Eurasian Customs Union market (Russia, Kazakhstan, Belarus)
RoHS Directive	RoHS ✓	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
REACH Directive	REACH ✓	Directive 1907/2006/EU of the European Parliament and the Council of June 1st, 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

Approximate Dimensions

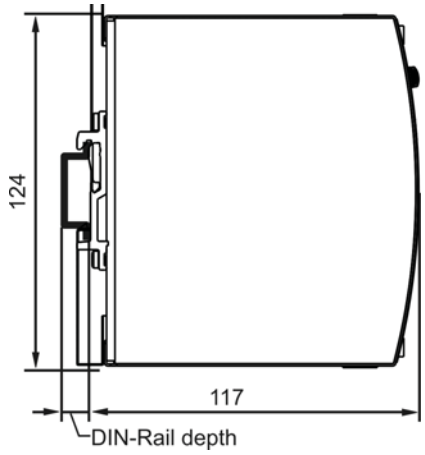
Width	39 mm (1.54 in.)
Height[1]	124 mm (4.88 in.)
Depth[1]	117 mm (4.61 in.) The DIN rail height must be added to the unit depth to calculate the total required installation depth.
Weight	600 g /1.32 lb
DIN-Rail	Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15 mm.
Housing material	Body: Aluminum alloy Cover: zinc-plated steel
Installation clearances	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 15 mm in case the adjacent device is a heat source (Example: another power supply).
Penetration protection	Small parts like screw with a diameter larger than 4 mm

(1) Without plug connectors.

Figure 26 - Front View 1606-XLE240ERL

All dimensions in mm

Figure 27 - Side View 1606-XLE240ERL



All dimensions in mm

Figure 28 - Front View 1606-XLE240ERZ, -XLE240EDRZ -XLE240ECRZ

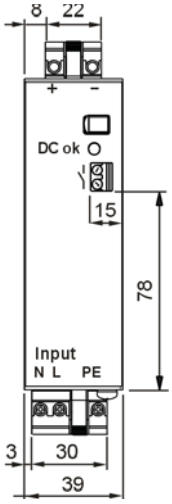
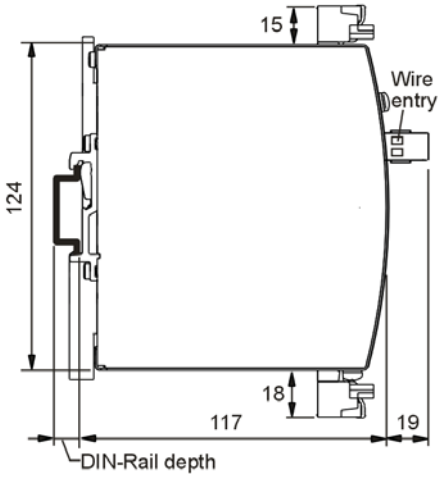


Figure 29 - Side View 1606-XLE240ERZ,-XLE240EDRZ -XLE240ECRZ



All dimensions in mm

Applications Notes

Peak Current Capability

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

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

The peak current capability also ensures the safe operation of subsequent circuit breakers of load circuits. The load branches are often individually protected with circuit breakers or fuses. In case of a short or an overload in one branch circuit, the fuse or circuit breaker need a certain amount of 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 30 - 20 A Peak Current for 50 ms, Typ (2x the Nominal Current)

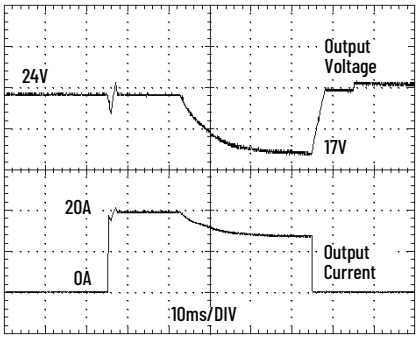


Figure 31 - 50 A Peak Current for 5 ms, Typ (5x the Nominal Current)

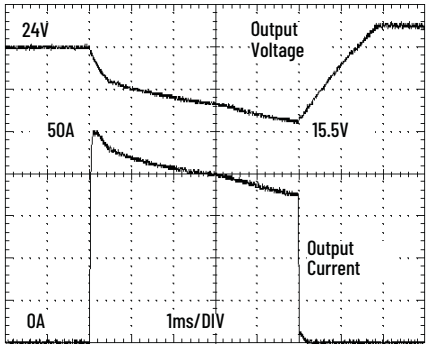
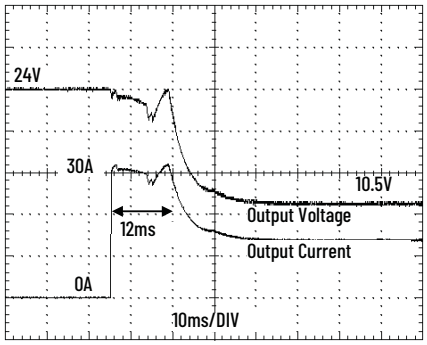


Figure 32 - 30 A Peak Current for 12 ms, Typ (3x the Nominal Current)



Peak Current Voltage Dips(1)

Typ	from 24V to 17V	At 20 A for 50 ms, resistive load
Typ	from 24V to 19V	At 50 A for 2 ms, resistive load
Typ	from 24V to 15.5V	At 50 A for 5 ms, resistive load

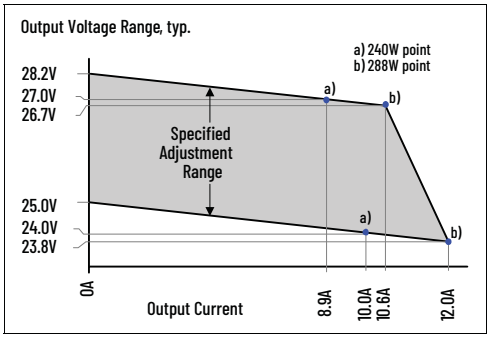
(1) The DC OK relay triggers when the voltage dips more than 10% for longer than 1 ms.

Adjusting the Output Voltage

A voltage adjustment potentiometer can be found behind the flap on the front of the unit. However, it is not recommended to change the output voltage since load sharing between power supplies connected in parallel can only be achieved by a precise setting of the output voltages. The factory settings allow precise load sharing and only qualified personnel should change the adjustment potentiometer.

Lower end of the specified adjustment range			
Output voltage	Nom	24.0V	Due to the soft output voltage regulation characteristic (parallel mode feature) a setting to 24.0V results to an output voltage of 23.8V±0.2% at 24 A and 25.0V±0.2% at no load. See Figure 33.
Output current	Min	12 A	At 45 °C (113 °F)
	Min	10 A	At 60 °C (140 °F)
	Min	7.55 A	At 70 °C (158 °F)
Reduce output current linearly between +45 °C and +70 °C.			
Upper end of the specified adjustment range			
Output voltage	Nom	27.0V	Due to the soft output voltage regulation characteristic (parallel mode feature) a setting to 28.0V results to an output voltage of 27.7V±0.2% at 20.6A and 29.2V±0.2% at no load. See Figure 33.
Output current	Min	10.6 A	At 45 °C (113 °F)
		8.9 A	At 60 °C (140 °F)
		6.7 A	At 70 °C (158 °F)
Reduce output current linearly between +45 ...70 °C (+113 ...158 °F)			
The maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances is 30V. It is not a guaranteed value which can be achieved. Current values between 24 and 27V can be interpolated.			

Figure 33 - Adjustment Range of the Output Voltage



The output voltage shall only be changed when absolutely necessary. For example, battery charging, described next.

Charging of Batteries

This redundancy power supply is ideal for charging batteries due to the decoupling circuit built in to the output stage which does not require a fuse or diode between the power supply and the battery.

It can be used to charge sealed lead acid (SLA) or valve regulated lead acid (VRLA) lead batteries when following these instructions:

Set output voltage (measured at disconnected battery) very precisely to the end-of-charge voltage. Use the potentiometer, which is hidden behind the flap on the front of the unit. See See Adjusting the Output Voltage on page 26.

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

- Ensure that the ambient temperature of the power supply stays below 40 °C (104 °F).
- Use only matched batteries when connecting 12V types in series.
- The return current to the power supply (battery discharge current) is typically 11mA when the power supply is switched off.

Output Circuit Breakers

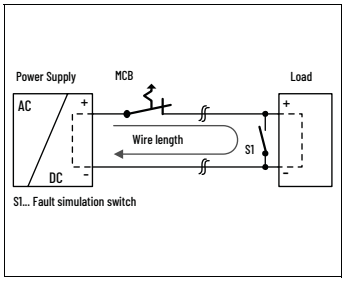
Standard miniature circuit breakers (MCBs or UL 1077 circuit breakers) are commonly used for AC-supply systems and may also be used on 24V branches.

MCB's 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 as thermally safe regardless of whether the MCB opens or not.

To avoid voltage dips and under-voltage situations in adjacent 24V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10ms 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 actually 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.

Figure 34 - Test Circuit



Maximal Wire Length (1) for a Fast (Magnetic) Tripping

	0.75 mm²	1.0 mm²	1.5 mm²	2.5 mm²
C-2A	30 m	37 m	54 m	84 m
C-3A	25 m	30 m	46 m	69 m
C-4A	9 m	15 m	25 m	34 m
C-6A	3 m	3 m	4 m	7 m
C-8A	–	–	–	–
B-6A	12 m	15 m	21 m	34 m
B-10A	3 m	3 m	4 m	9 m
B-13A	2 m	2 m	3 m	6 m

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

Series Operation

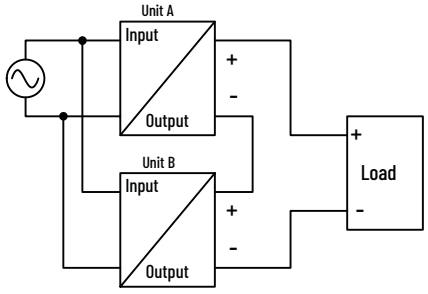
Power supplies of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150V DC. Voltages with a potential above 60V DC must be installed with a protection against touching.

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 (left / right) between two power supplies and avoid installing the power supplies on top of each other. Do not use power supplies in series in mounting orientations other than the standard mounting orientation (input terminals on bottom of the unit).

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

Figure 35 - Series Operation



Parallel Use to Increase Output Power

Power supplies can be paralleled to increase the output power. For redundancy applications one extra power supply is always needed for sufficient output current in case one unit fails.

The unit is permanently set to “parallel use” mode in order to achieve load sharing between power supplies connected in parallel. The “Parallel use” mode regulates the output voltage in such a manner that the voltage at no load is approx. 4% higher than at nominal load. See Output on page 10.

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

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

Do not use power supplies in parallel in mounting orientations other than the standard mounting orientation (input terminals on bottom of the unit) or in any other condition where a derating of the output current is required (for example, altitude).

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

Do not load paralleled power supplies with higher currents as shown in the following diagrams:

Figure 36 - Output Current Versus Ambient Temperature for Two Paralleled Units

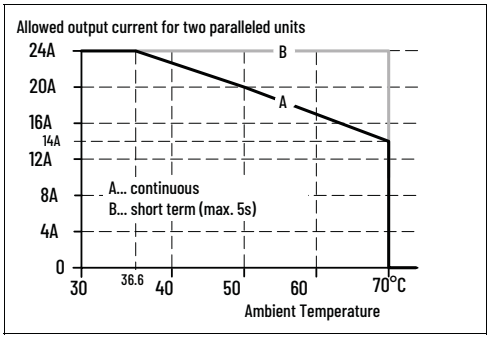
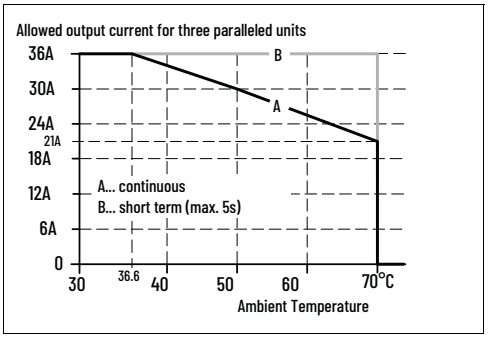


Figure 37 - Output Current Versus Ambient Temperature for Three Paralleled Units



Parallel Use For Redundancy

Power supplies can be paralleled for redundancy to gain higher system availability. The unit is already equipped with a MOSFET as decoupling device on the output to avoid, that a faulty unit becomes a load for the other power supplies and the output voltage cannot be maintained any more.

Recommendations for building redundant power systems:

a. Use separate input fuses for each power supply.
b. Monitor the individual power supply units by utilizing the built-in DC OK relay contacts on each power supply.

Figure 38 - Wiring Diagram, 1+1 Redundancy for 10 A Output Current

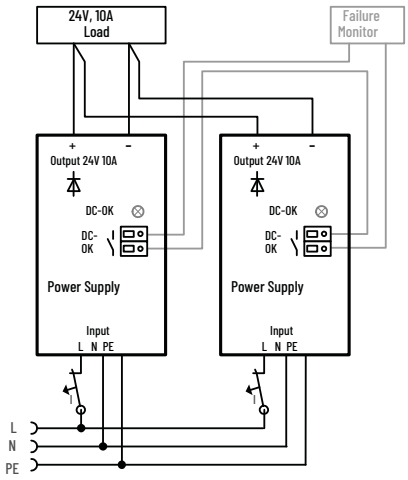
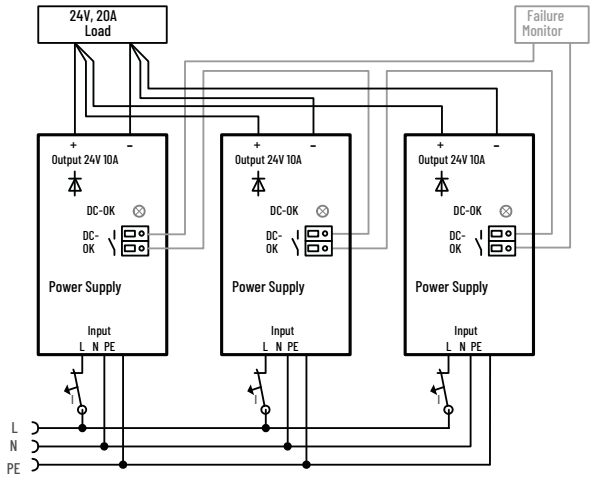


Figure 39 - Wiring Diagram, N+1 Redundancy for 20A Output Current[(a)]



IMPORTANT Use separate mains systems for each power supply whenever it is possible.

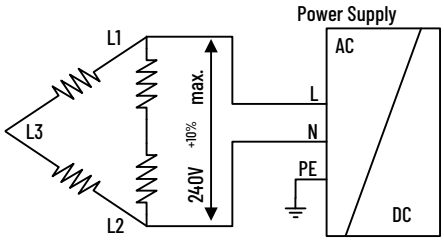
(a) Observe the temperature derating requirements of Figure 36 and Figure 37 for n+1 redundancy applications.

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%.

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

Figure 40 - Operation on Two Phases



Use in a Tightly Sealed Enclosure

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

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

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

	Case A	**Case B**	**Case C**	**Case D**
Enclosure Size	Rittal Typ IP66 Box PK 9519 100, plastic **110** x1 80 x 165 mm		Rittal Typ IP66 Box PK 9519 100, plastic, **180** x 180 x 165 mm	
Input Voltage	230V AC			
Load	24V, 8 A; (=80%)	24V, 10 A; (=100%)	24V, 8 A; (=80%)	24V, 10 A; (=100%)
Temperature inside enclosure	45.4 °C (113.72 °F)	49.0 °C (120.2 °F)	42.0 °C (107.6 °F)	44.4 °C (111.92 °F)
Temperature outside enclosure	25.0 °C (77 °F)	25.0 °C (77 °F)	25.0 °C (77 °F)	25.0 °C (77 °F)
Temperature rise	20.4 K	24.0 K	17.0 K	19.4 K

Mounting Orientations

Mounting orientations other than all terminals on the bottom 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).

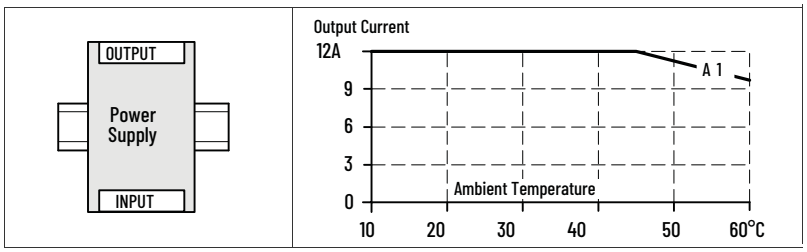


Figure 41 - Mounting Orientation A (Standard Orientation)

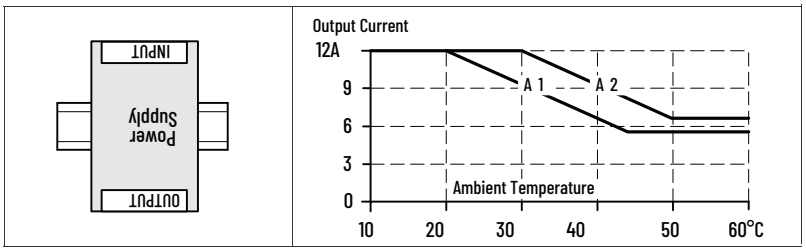


Figure 42 - Mounting Orientation B (Upside Down)

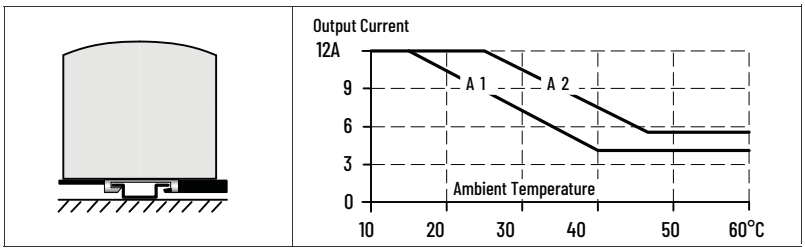


Figure 43 - Mounting Orientation C (Table-top Mounting))

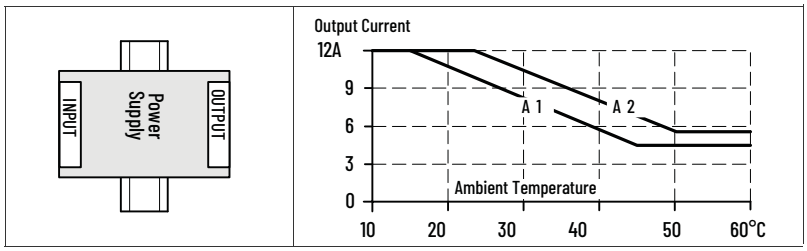


Figure 44 - Mounting Orientation D (Horizontal Input on the Left)

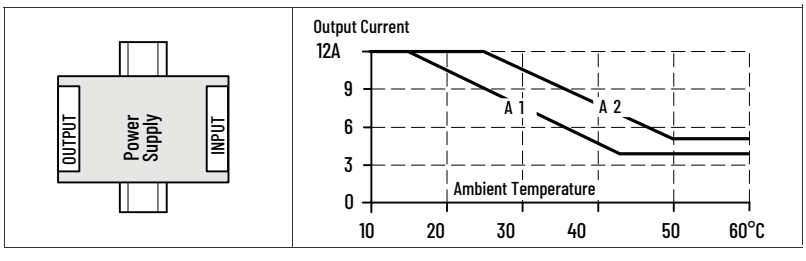


Figure 45 - Mounting Orientation E (Horizontal Input on the Right)

Notes:

Additional Resources

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

Resource	Description
Power Supply Technical Data, publication 1606-TD002.	Provides product selection, specifications, and dimensions information.
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)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

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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