

15, 30, 50 Watt AC-DC (DC-DC) Converters Convert Simply



Features

- RoHS lead-free-solder and lead-solder-exempted products available
- Universal input range 100 – 240 VAC nominal
- Additional DC input 90 – 250 VDC
- Class I equipment
- Single output 5.1, 12, 24, or 48 VDC
- Extremely compact design
- Battery charger versions
- Operating ambient temperature range –10 to 50 °C with convection cooling
- Short-circuit and no-load proof

Safety-approved to IEC/EN 60950-1, UL/CSA 60950-1 2nd Ed. and UL-listed to UL 508.



Description

The Convert Simply front-end converters represent a family of 15, 30, and 50 watt DIN-rail mountable AC-DC converters for use as rectifiers or battery chargers. Plastic casing, compact size, and high reliability make the LOS, LOR, LOK4000 Series an excellent choice for space-critical applications, where a DIN-Rail mountable AC-DC converter is required. The universal input range and a built-in input filter allow flexible operation in a wide variety of electronic equipment and enables worldwide connection to the mains.

The converters are available as rectifiers with 12 V, 24 V or 48 V single output and special models suitable as battery

chargers for 12 V, 24 V, or 48 V batteries. The output voltage of LOK converters can be adjusted via the R input.

Safety approvals fully comply with worldwide requirements.

Applications

Typical applications are: powering building controls, factory automation, industrial controls, instrumentation, electromagnetic drives, fans, and other DC loads.

Note: For new designs, we recommend the LOK Series, which can completely replace LOR and LOS (same connections, same case).

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Model Selection

Table 1: Type survey

Output $V_{o\ nom}$ [VDC]	$I_{o\ nom}$ [A]	Operating input voltage ¹	Rated power ¹ $T_A = 50\ ^\circ\text{C}$ $P_{o\ tot}$ [W]	Efficiency ⁵ η_{typ} [%]	Model	Options ⁴
5.1	5.2	85 - 264 VAC 47 - 63 Hz 90 - 250 VDC	26	70	LOK4001-2RLD	F ² , K, G
12	1.25		15	74	LOS4301-2	
12	2.5		30	80	LOR4301-2	
12	4		48	82	LOK4301-2R	
12 - 12.84 ³ - 15	3.6		49	82	LOK4140-2RLD	
24	0.65		15	76	LOS4601-2	
24	1.25		30	82	LOR4601-2	
24	2		48	82	LOK4601-2R	
24 - 25.7 ³ - 30	1.8		49	82	LOK4240-2RLD	
48	1		48	82	LOK4801-2R	
48 - 51.4 ³ - 60	0.9		49	81	LOK4740-2RLD	

¹ Linear derating to 85% of $P_{o\ nom}$ below $V_i = 105\ \text{VAC}$, 110 VDC

² LOK types only

³ Setting voltage $V_{o\ set}$ for battery chargers with R-input left open-circuit.

⁴ For minimum order quantities and lead times contact Power-One.

⁵ Efficiency at $V_{i\ rated}$ and $I_{o\ nom}$

NFND Models in yellow are not recommended for new designs. They should be replaced by LOK models.

Part Number Description

Series	15 W LOS4	LOK4	3	0	1	-2	R	L	D	F	K	G
	30 W LOR4											
	50 W LOK4											
Output	5.1 V rectifier version 001											
	12 V rectifier version 301											
	24 V rectifier version 601											
	48 V rectifier version 801											
	12 – 15 V battery charger 140											
	24 – 30 V battery charger 240											
	48 – 60 V battery charger 740											
	other voltages or specs. 02 – 99											
Ambient temperature range T_A :	–10 to 50 °C -2 ³											
Features and options:												
	Output voltage control input R ²											
	Rectangular output characteristic L ¹											
	Output voltage OK signal D ¹											
	Built-in second fuse (option) F ²											
	K system connector (option) K											
	RoHS compliant for all 6 substances G ⁴											

¹ Battery chargers and LOK4001-2RLD

² LOK models only

³ Up to 70 °C with derating

⁴ G is always placed at the end of the part number.

Examples: LOK4140-2RLD: AC-DC converter, battery charger version, providing 12 - 15 V/3.6 A at the output
LOK4601-2R: AC-DC converter, rectifier version, providing 24 V/2 A, 48 W at the output

Functional Description

The Convert Simply 15, 30, and 50 watt front-end modules are flyback converters with a fixed frequency of 100 kHz (LOK) or 130 kHz (LOR, LOS). The battery charger modules and the

LOK4001-2RLD have a rectangular V/I output characteristic. The rectifier modules have overload protection working in a hiccup mode.

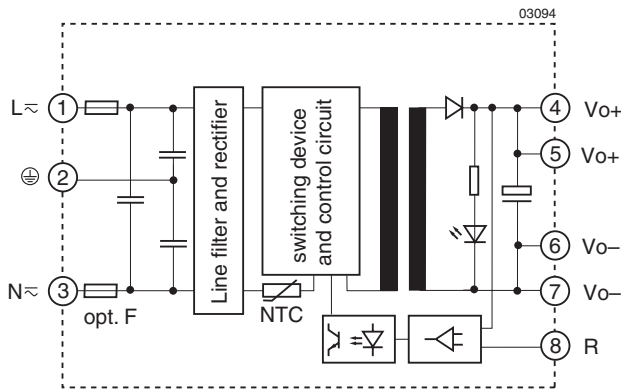


Fig. 1
Block diagram LOK4301, LOK4601 and 4801 (rectifier versions), all LOR and all LOS.

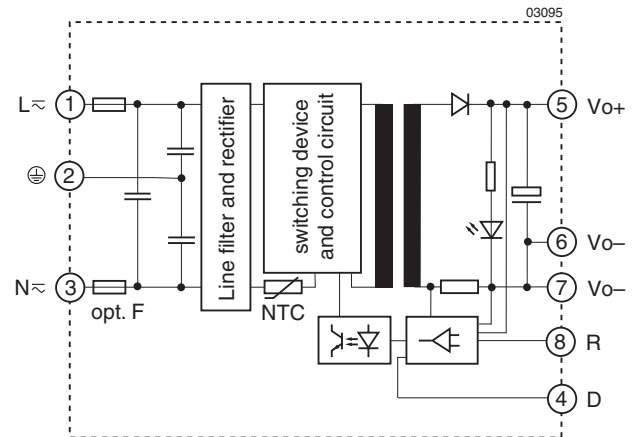


Fig. 2
Block diagram LOK4140, LOK4240 and LOK4740 (battery charger versions) and LOK4001- 2RLD.

Electrical Input Data

General Condition: $T_A = 25^\circ\text{C}$ unless otherwise specified

Table 2: Input data

Characteristics	LOS	LOR	LOK	Unit
$V_{i \text{ rated}}$ Rated input voltage range	100 - 240	100 - 240	100 - 240	VAC
$V_{i \text{ nom}}$ Nominal input voltage	230	230	230	
V_i Operating input voltage range	85 - 264 90 - 250	85 - 264 90 - 250	85 - 264 90 - 250	
f_i Nominal line frequency	50 - 60	50 - 60	50 - 60	Hz
I_i Input current at 115 / 230 VAC ¹	0.3/0.15	0.52/0.26	0.8/0.4	A
$I_{i \text{ nl}}$ Input current at 230 VAC and no load			0.035	
$I_{\text{inr max}}$ Peak inrush current at $V_i = 230 \text{ V}$ ²	18	18	19	

¹ At $I_{o \text{ nom}}$.

² Inrush current limitation by a 16 Ω NTC resistor.

Electrical Output Data

General Conditions: $T_A = 25\text{ }^{\circ}\text{C}$ unless otherwise specified. R input not connected.

Table 3a: Output data

Output			LOK4001-2RLD			LOS/LOR/LOK 4301-2(R)			LOS/LOR/LOK 4601-2(R)			LOK4801-2R			Unit
Characteristics		Conditions	min	typ	max	min	typ	max	min	typ	max	min	typ	max	
V_o	Output voltage $V_{o\text{ nom}}$	$V_{i\text{ nom}}, 0.5 I_{o\text{ nom}}$	5.1			12			24			48			V
	V_o setting tolerance	R-input open-circuit	± 1.5			± 1.5			± 1.5			± 1.5			%
$V_{o\text{ adj}}$	Adjustable voltage range	Units with feature R	4.5 - 5.5			10.8 - 13.2			21.6 - 26.4			43.2 - 52.8			V
$I_{o\text{ nom}}$	Nominal output current	$V_{i\text{ min}} - V_{i\text{ max}}$ LOS LOR LOK	-			1.25			0.65			-			A
			-			2.5			1.25			-			
			5.2			4.0			2.0			1.0			
V_o	Output voltage noise (BW = 20 MHz)	$V_{i\text{ nom}}, I_{o\text{ nom}}$, IEC 61200	50			100 150			100 150			200			mV _{pp}
	Static line/load regulation	$V_{i\text{ min}} - V_{i\text{ max}}$, $I_o = (0.1 - 1) I_{o\text{ nom}}$	± 1			± 1			± 1			± 1			%
$V_{o\text{ l}}$	Dynamic load regulation	$V_{i\text{ nom}}, (0.1 \times 0.9) I_{o\text{ nom}}$	± 5			± 2			± 1.5			± 1			
t_r	Transient recovery time	$I_o = (0.1 \times 0.9) I_{o\text{ nom}}$	4			4			4			4			ms
t_h	Hold-up time	115/230 VAC	14/90			14/90			14/90			14/90			
α_{Uo}	Temper. coefficient of V_o	$V_{i\text{ nom}}, I_{o\text{ nom}}$	± 0.05			± 0.05			± 0.05			± 0.05			%/K
f_s	Switching frequency		100			100 ¹			100 ¹			100			kHz

¹ LOR and LOS have 130 kHz.

Table 3b: Output data (battery charger models)

Output			LOK4140-2RLD			LOK4240-2RLD			LOK4740-2RLD			Unit
Characteristics		Conditions	min	typ	max	min	typ	max	min	typ	max	
V_o	Output voltage	$V_{i\text{ nom}}, 0.5 I_{o\text{ nom}}$ R-input open-circuit	12.84 ¹			25.68 ¹			51.36 ¹			V
$V_{o\text{ adj}}$	Adjustable voltage range		12.0 - 15.0			24.0 - 30.0			48.0 - 60.0			
$I_{o\text{ nom}}$	Nominal output current	$V_{i\text{ min}} - V_{i\text{ max}}$	3.6			1.8			0.9			A
V_o	Output voltage noise (BW = 20 MHz)	$V_{i\text{ nom}}, I_{o\text{ nom}}$, IEC 61204	100 150			100 150			200			mV _{pp}
	Static line/load regulation	$V_{i\text{ min}} - V_{i\text{ max}}$, $I_o = (0.1 - 1) I_{o\text{ nom}}$	± 2 ¹			± 1 ¹			± 1 ¹			%
$V_{o\text{ l}}$	Dynamic load regulation	$V_{i\text{ nom}}, (0.1 \times 0.9) I_{o\text{ nom}}$	± 2 ¹			± 1.5 ¹			± 1 ¹			
t_r	Transient recovery time	$I_o = (0.1 \times 0.9) I_{o\text{ nom}}$	4			4			4			ms
t_h	Hold-up time	115/230 VAC	14/90			14/90			14/90			
α_{Uo}	Temper. coefficient of V_o	$V_{i\text{ nom}}, I_{o\text{ nom}}$	± 0.05 ¹			± 0.05 ¹			± 0.05 ¹			%/K
f_s	Switching frequency		100			100			100			kHz

¹ R input left open-circuit.

Thermal Considerations

If an AC-DC converter is located in free, quasi-stationary air (convection cooling) at the indicated maximum ambient temperature $T_{A \max}$ (see table: *Temperature specifications*) and is operated at its nominal input voltage and output power, the temperature measured at the *Measuring point of case temperature* T_C (see *Mechanical Data*) will approach the indicated value $T_{C \max}$ after the warm-up phase. However, the relationship between T_A and T_C depends heavily on the conditions of operation and integration into a system. The thermal conditions are influenced by input voltage, output current, airflow, temperature of surrounding components and surfaces. $T_{A \max}$ is therefore, contrary to $T_{C \max}$, an indicative value only.

The relation between the maximum allowed output power $P_{O \text{ allowed}}$ and the temperature T_A of the surrounding air is given in the figure below. The rates apply if the AC-DC converter is located in free, quasi-stationary air (convection cooling).

Note: Sufficient forced cooling allows T_A to be higher than the value given in the table if $T_{C \max}$ according to the table is not exceeded.

Caution: The installer must ensure that under all operating conditions T_C remains within the limits that are stated in the table *Temperature specifications*.

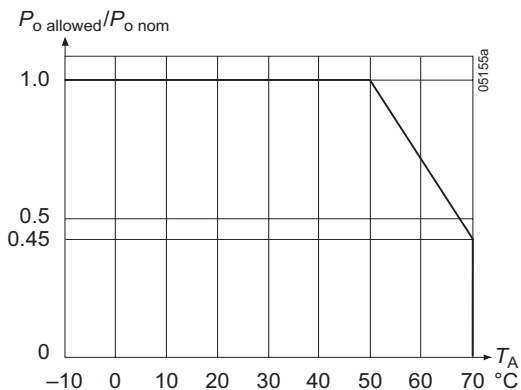


Fig. 4
Maximum allowed output power versus ambient temperature at $V_i > 105 \text{ VAC}$ for LOK models, operated in vertical position

Output Power at Low Input Voltage

The output power of LOK models must be derated at low input voltage, see figure below.

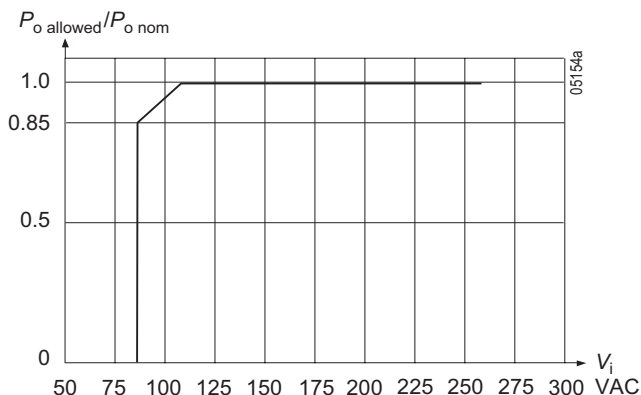


Fig. 3
Maximum allowed output power versus input voltage at $T_A = 50^\circ\text{C}$ for LOK models operated in vertical position

Output Protection

Battery charger versions LOK4140-, 4240-, LOK4740-2RLD, and the LOK4001-2RLD have a rectangular current limitation characteristic, which limits the output current to within 100 and 150% of $I_{O \text{ nom}}$. The other models are protected against overload by a current limiting circuit, which shuts down the converter in overload condition. It automatically restarts after removal of the overload condition (hiccup mode).

All models are short-circuit and no-load proof.

Outputs Connected in Series

Two or more converters supplying the same or different output voltages may be connected in series. The value of the maximum output current to be taken is defined by that unit providing the lowest current limiting value. It should be assured that the outputs do not feed backwards into each other caused by their different rise/fall times at switch-on/off cycles by adding reverse polarity diodes across each output.

Parallel Operation

Only possible with battery charger versions. The outputs of several battery charger models with equal output voltage (e.g. several LOK4240-2RLD) may be connected in parallel.

Auxiliary Functions

Adjustable Output Voltage (R input)

As a standard feature, the LOK units offer adjustable output voltage by using the control input R. If the R pin is left open-circuit, the output voltage is set to $V_{o\ nom}$. (see: *Output data*)

The R input is referenced to the secondary side of the converter. Adjustment of the output voltage is possible by means of either an external resistor or a voltage source.

a) Adjustment by means of an external resistor R_{ext1} :

Depending upon the value of the required output voltage, the resistor shall be connected

either: Between the R terminal and V_{o-} to achieve an output voltage adjustment range of approximately $V_o = 90 - 100\% V_{o\ nom}$. (LOK4301, 4601 and 4801 types)

$$R_{ext1} \approx 4\ k\Omega \cdot \frac{V_o}{V_{o\ nom} - V_o}$$

or: Between the R terminal and V_{o+} to achieve an output voltage range of approximately $V_o = 100 - 110\% V_{o\ nom}$ for rectifier versions and $100 - 125\% V_{o\ nom}$ for battery chargers.

$$R_{ext2} \approx 4\ k\Omega \cdot \frac{(V_o - 2.5\ V)}{2.5\ V \cdot (V_o/V_{o\ nom} - 1)}$$

b) Adjustment by means of an external voltage V_{ext} between V_{o-} and R terminal to achieve an output voltage adjustment range of approx. $90 - 110\% V_{o\ nom}$ (LOK 4301, 4601 and 4801 types), $93 - 117\% V_{o\ nom}$ for battery chargers.

$$V_{ext} \approx \frac{V_o \cdot 2.5\ V}{V_{o\ nom}}$$

Attempting to adjust the output below this range will cause the converter to shut down (hiccup mode).

Note: Applying an external control voltage $>3\ V$ may damage the converter.

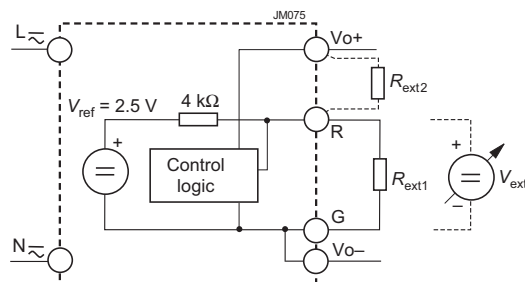


Fig. 5
Output voltage control by means of the R-input

Output Voltage OK (D Output)

The D-output is referenced to V_{o-} and monitors the output voltage V_o . If V_o drops below $V_{o\ t}$, the D-output will be disabled (open-collector circuit). The circuitry works independently of the input voltage and can therefore be used as battery-low indicator.

Table 4: Output Voltage OK signal

Conditions		LOK4001-2RLD		LOK4140-2RLD		LOK4240-2RLD		LOK4740-2RLD		Unit
		min	max	min	max	min	max	min	max	
$V_{o\ t}$	setting	4.4	4.8	10.5	11.5	21	23	42	46	V
V_D	$V_o - V_{o\ t\ min}$		60		60		60		60	
	$V_o > V_{o\ t\ max}$ $I_D < 50\ mA$		0.6		0.6		0.6		0.6	

Battery Charging/Temperature Sensor

The LOK 4140/4240/4740 are designed to charge lead-acid batteries. For optimum battery charging and extended life time of the battery an external temperature sensor may be connected to the R-input. The sensor should be mounted as close as possible to one of the poles of the battery.

Depending upon the cell voltage and the temperature coefficient of the battery, different temperature sensors are available. For more information please see: *Temperature Sensors* (Accessory Products on the Web Site) or contact Power-One.

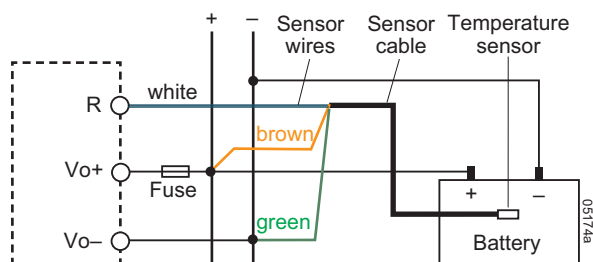


Fig. 6
Voltage setting by a temperature sensor, wiring diagram

If no sensor is used, the float charge voltage should be adjusted with a suitable resistor connected to the R input (see: *Adjustable Output Voltage*).

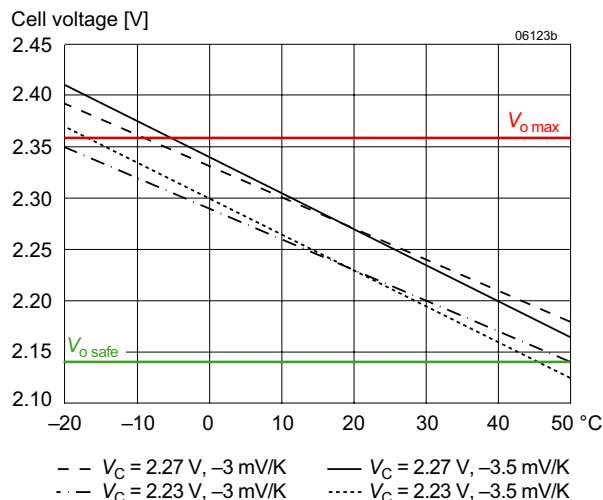


Fig. 7
Float charge voltage for defined temperature coefficients.

Electromagnetic Compatibility (EMC)

Immunity

A metal-oxide VDR together with the input fuse and the input filter form an effective protection against high input transient

voltages, which typically occur in most installations. The LOS, LOR and LOK series have been successfully tested to the following specifications:

Table 5: Immunity type tests

Phenomenon	Standard ¹	Level	Coupling mode ²	Value applied	Waveform	Source imped.	Test procedure	Per-form. ³
Electrostatic discharge	IEC/EN 61000-4-2	2	air discharge	8000 V _p	1/50 ns	330 Ω	10 positive and 10 negative discharges	B
Electromagnetic field	IEC/EN 61000-4-3	2	antenna	3 V/m	AM 80% 1 kHz	n.a.	80...1000 MHz 900 MHz 1800 MHz	B
Electrical fast transients/burst	IEC/EN 61000-4-4	3	direct, i/⊕, +i/-i	2 kV _p	bursts of 5/50 ns 2.5/5 kHz over 15 ms; burst period: 300 ms	50 Ω	60 s positive 60 s negative transients per coupling mode	B
Surge	IEC/EN 61000-4-5	3	i/⊕	2 kV _p	1.2 / 50 μs	12 Ω	5 pos. and 5 neg. surges per	A
		2	+i/-i	1 kV _p		2 Ω		
Conducted disturbances	IEC / EN 61000-4-6	2	box	3 VAC	AM 80% 1 kHz	150 Ω	0.15 - 80 MHz	A

¹ Related and previous standards are referenced in: *Technical Information: Standards*

² i = input, o = output, ⊕ = PE case.

³ A = Normal operation, no deviation from specifications, B = Normal operation, temporary deviation from specs possible.

Emissions

Internal input filtering keeps the conducted noise of the converters within the frequency range of 150 kHz to 30 MHz below class B according to EN 55022 standards.

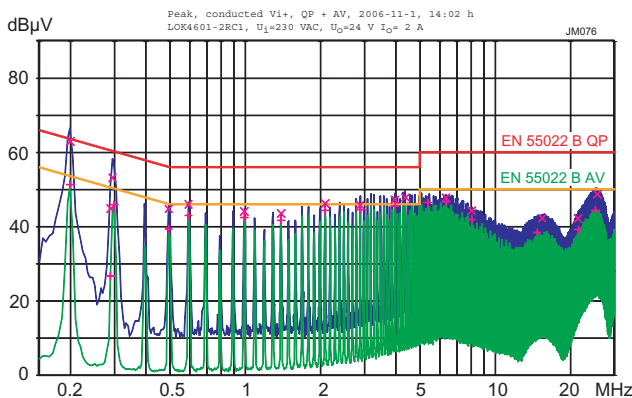


Fig. 8

Typical conducted disturbances (quasi-peak, average) at the input accord. to EN 55022 at $V_{i\text{ nom}}$ and $I_{o\text{ nom}}$ (LOK4601-2R)

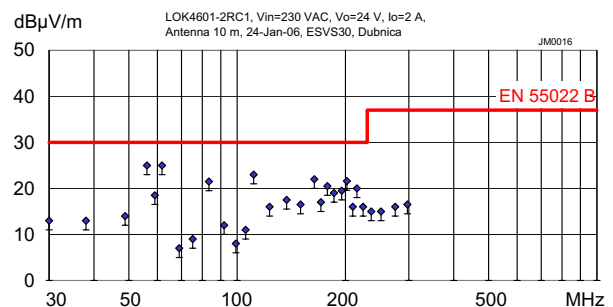


Fig. 9

Radiated disturbances measured according to EN 55011/55022 at $V_{i\text{ nom}}$ and $I_{o\text{ nom}}$. LOK4601-2R, $V_i = 230$ VAC.

Immunity to Environmental Conditions

Table 6: Mechanical stress

Test Method		Standard	Test Conditions		Status
Cab	Damp heat steady state	IEC/EN 60068-2-78 MIL-STD-810D section 507.2	Temperature: Relative humidity: Duration:	$40 \pm 2^{\circ}\text{C}$ $93 \pm 2/3\%$ 21 days	Converter not operating
Ea	Shock (half-sinusoidal)	IEC/EN 60068-2-27 MIL-STD-810D section 516.3	Acceleration amplitude: Bump duration: Number of bumps:	$15 g_n = 147 \text{ m/s}^2$ 11 ms 18 (3 each direction)	Converter operating
Eb	Bump (half-sinusoidal)	IEC/EN 60068-2-29 MIL-STD-810D section 516.3	Acceleration amplitude: Bump duration: Number of bumps:	$10 g_n = 98 \text{ m/s}^2$ 11 ms 6000 (1000 each direction)	Converter operating
Fc	Vibration (sinusoidal)	IEC/EN 60068-2-6 MIL-STD-810D section 514.3	Acceleration amplitude: Frequency (1 Oct/min): Test duration:	0.15 mm (10 - 60 Hz) $2 g_n = 20 \text{ m/s}^2$ (60 - 150 Hz) 10 - 150 Hz 3.75 h (1.25 h each axis)	Converter operating

Table 7: Temperature specifications

Characterisitcs		Conditions	min	max	Unit
T_A	Ambient temperature	Operational ¹	-10	50	$^{\circ}\text{C}$
T_C	Case temperature		-10	80	
T_S	Storage temperature	Non operational	-40	85	

¹ See: Thermal Consideration.

Table 8: MTBF Values

MTBF	Type	Ground benign	Ground fixed		Ground mobile	Unit
		$T_C = 40^{\circ}\text{C}$	$T_C = 40^{\circ}\text{C}$	$T_C = 70^{\circ}\text{C}$	$T_C = 50^{\circ}\text{C}$	
According to MIL-HDBK-217F, Notice 2	LOK	1 600 000	400 000	200 000	120 000	h

Mechanical Data

Dimensions in mm.

Weight:

LOS/LOR: approx. 0.25 kg

LOK: approx. 0.35 kg

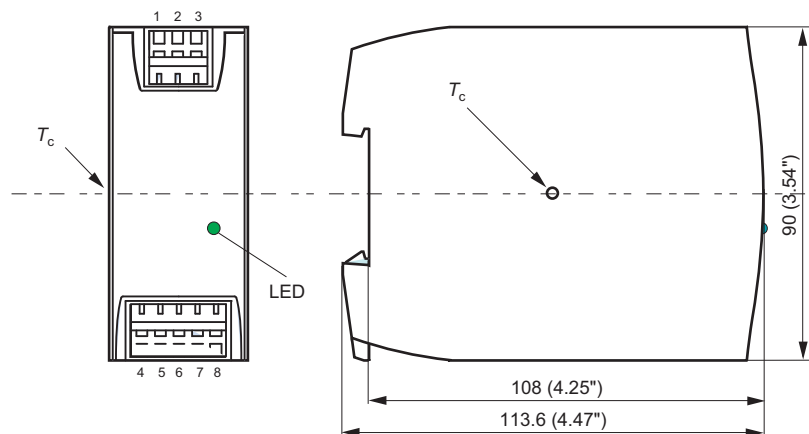
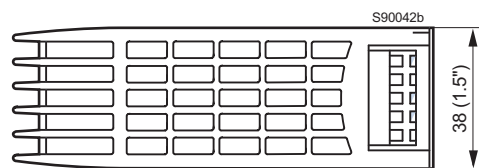


Fig. 10
Case

Safety and Installation Instructions

Terminal Allocation

The terminal allocation table defines the electrical potentials of the AC-DC converters. For mechanical positions of the terminals see *Mechanical Data*.

Table 9: Terminal allocation

Terminal	Electrical	LOK/LOR/LOS
1	Input (fused)	L~
2	Protective earth	⊕
3	Input	N~
4	D/Output (positive)	D/+
5	Output (positive)	+
6	Output (negative)	-
7	Output (negative)	-
8	R input or open	R/n.c.

Standards and Approvals

All models are safety-approved according to the standards IEC/EN 60950-1 and UL/CSA 60950-1 2nd Edition.

All models are UL 508-listed to UL 508.

These converters have been evaluated for:

- Class I equipment.
- Building in with vertical mounting on a DIN-rail.
- Double or reinforced insulation or an earthed part between input and output.
- Basic insulation between input and earth
- Functional insulation between output and earth
- Pollution degree 2 environment
- Connecting the input to a primary circuit with overvoltage category II.

The converters are subject to manufacturing surveillance in accordance with the above mentioned standards.

For details see the Declaration of Conformity (last 2 pages).

Protection Degree

IP 20: All models.

Installation Instructions

These converters are components, intended exclusively for inclusion within other equipment by an industrial assembly operation or by professional installers. Installation must strictly follow the national safety regulations in compliance with the enclosure, mounting, creepage, clearance, casualty, markings and segregation requirements of the end-use application.

Connection to the system shall be according to *Terminal allocation* and *Mechanical Data*. Check for hazardous voltages before altering any connection.

Ensure that a converter failure (e.g. by an internal short-circuit) does not result in a hazardous condition. See also *Safety of operator accessible output circuit*.

The phase input (L~) is internally fused by a 1.6 A slowblow type. It is not customer-accessible. This fuse is designed to protect the unit in case of overcurrent. Option F or external fuses in the wiring to one or both input lines (L~ and/or N~) may therefore be necessary to ensure compliance with local requirements.

A second fuse in the wiring to the terminal N~ is needed if:

- Local requirements demand an individual fuse in each source line
- Neutral and earth impedance is high or undefined
- Phase and neutral of the mains are not defined or cannot be assigned to the corresponding terminals (L~ to phase and N~ to neutral).

Note: Do not open the converters, or guarantee will be invalidated.

Make sure that there is sufficient air flow available for convection cooling. This should be verified by measuring the case temperature when the unit is installed and operated in the end-use application. The maximum specified case temperature $T_{C\max}$ shall not be exceeded.

Note: The converters are designed for vertical mounting on a DIN-rail. If a converter is operated as well in a horizontal position, the measuring point T_C should be located on the top.

Isolation

The electric strength test is performed in the factory as routine test in accordance with EN 50116 and IEC/EN 60950 and should not be repeated in the field. Power-One will not honor any warranty claims resulting from electric strength field tests.

Table 10: Isolation

Characteristic		Input to protective earth	Input to output	Output to protective earth	Unit
Electric strength test voltage	Actual factory test ≥ 1 s	2.1	2.1 ¹	1.4	kVDC
	AC test voltage equivalent to actual factory test	1.5	1.5 ¹	1.0	kVAC
Insulation resistance at 500 VDC		>300	>300	>100	MΩ

¹ In accordance with EN 50116 and IEC/EN 60950, subassemblies are pre-tested with 4.3 kVDC or 3.0 kVAC.

Leakage Current

A leakage currents flows due to internal leakage capacitance and Y-capacitors. This current is proportional to V_i and the input frequency, when neutral and protective earth are correctly connected as for class I equipment; see table 11.

Table 11: Leakage currents

Characteristic		LOK	Unit
Maximum earth leakage current	Permissible accord. to IEC 60950	3.5	mA
	Specified value at 264 V, 50 Hz	1.0	
Maximum output leakage current	Permissible accord. to IEC 60950	0.25	
	Specified value at 264 V, 50 Hz	0.035	

Safety of Operator-Accessible Output Circuits

The output circuit of the converter is an SELV circuit according to the IEC/EN 60950-1 related safety standards.

The following table shows a possible installation configuration, compliance with which causes the output circuit of an LOS, LOR or LOK4000 converter to be an SELV circuit up to a configured output voltage (sum of nominal voltages, if in series) of 36 V.

However, it is the sole responsibility of the installer to assure compliance with the applicable safety regulations.

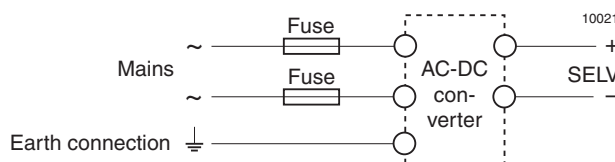


Fig. 11
Schematic safety concept

Table 12: Safety concept leading to a SELV output circuit

Conditions	AC-DC converter	Installation	Result
Nominal Supply voltage	Grade of insulation between input and output, provided by the AC-DC converter	Measures to achieve the resulting safety status of the output circuit	Safety status of the AC-DC converter output circuit
Mains ≤ 250 VAC	Double or reinforced	Earth connection ¹ and installation according to the applicable standards	SELV circuit

¹ The earth connection of terminal no. 2 has to be provided by the installer according to the relevant safety standards, e.g. IEC/EN 60950-1.

Description of Options

F: Built-in Second Fuse

A built-in second fuse in the neutral input line enables safe connection to the mains where phase and neutral are not defined or cannot be identified as e.g., in the case of plug and socket connection to the mains via Schuko-plugs; see also *Installation Instruction*.

K: System Connectors

For installation into systems using preassembled harnesses

the converters are available with connectors fitted with screw terminals. The system connectors are UL-listed and approved for currents up to 10 A. Wire cross-sections: Solid wires 1.5 mm² (AWG14), stranded wires 1 mm² (AWG16).

G: RoHS

RoHS-compliant for all six substances.

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