

## 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 2<sup>nd</sup> 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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## 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.

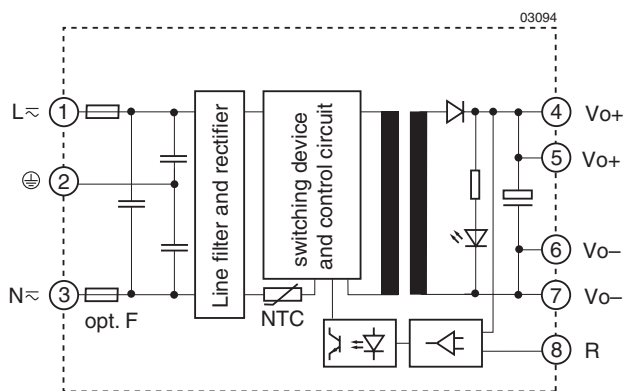


Fig. 1  
Block diagram LOK4301, LOK4601 and 4801 (rectifier versions), all LOR and all LOS.

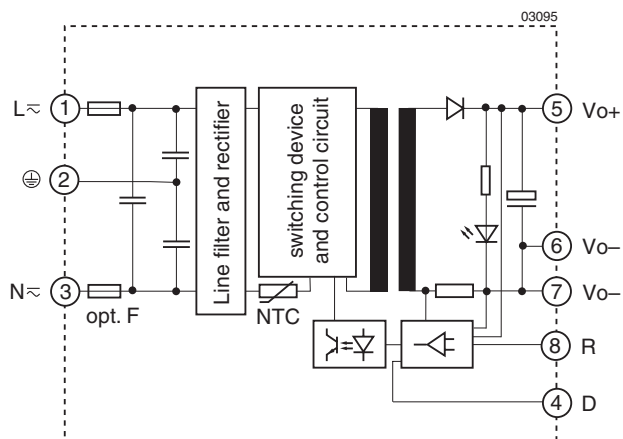


Fig. 2  
Block diagram LOK4140, LOK4240 and LOK4740 (battery charger versions) and LOK4001- 2RLD.

## Electrical Input Data

General Condition:  $T_A = 25\text{ }^{\circ}\text{C}$  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  | 85 - 264  | 85 - 264  |      |
|                        |                                                          | 90 - 250  | 90 - 250  | 90 - 250  | VDC  |
| $f_i$                  | Nominal line frequency                                   | 50 - 60   | 50 - 60   | 50 - 60   | Hz   |
| $I_i$                  | Input current at 115 / 230 VAC <sup>1</sup>              | 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     |      |
| $I_{i \text{ nr max}}$ | Peak inrush current at $V_i = 230\text{ V}$ <sup>2</sup> | 18        | 18        | 19        |      |

<sup>1</sup> At  $I_{o \text{ nom}}$ .

<sup>2</sup> Inrush current limitation by a 16  $\Omega$  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<br>4301-2(R) |     |     | LOS/LOR/LOK<br>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                                                          | $\pm 1.5$    |     |     | $\pm 1.5$                |     |     | $\pm 1.5$                |     |     | $\pm 1.5$   |     |     | %                |
| $V_{o\text{ adj}}$ | 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                | $V_{i\text{ min}} - V_{i\text{ max}}$<br>LOS<br>LOR<br>LOK                    | -            |     |     | 1.25<br>2.5<br>4.0       |     |     | 0.65<br>1.25<br>2.0      |     |     | -           |     |     | A                |
| $V_o$              | Output voltage noise<br>(BW = 20 MHz) | $V_{i\text{ nom}}, I_{o\text{ nom}}$ ,<br>IEC 61200                           | 50           |     |     | 100 150                  |     |     | 100 150                  |     |     | 200         |     |     | mV <sub>pp</sub> |
|                    | Static line/load regulation           | $V_{i\text{ min}} - V_{i\text{ max}}$ ,<br>$I_o = (0.1 - 1) I_{o\text{ nom}}$ | $\pm 1$      |     |     | $\pm 1$                  |     |     | $\pm 1$                  |     |     | $\pm 1$     |     |     | %                |
| $V_{o\text{ l}}$   | Dynamic load regulation               | $V_{i\text{ nom}}, (0.1 \times 0.9) I_{o\text{ nom}}$                         | $\pm 5$      |     |     | $\pm 2$                  |     |     | $\pm 1.5$                |     |     | $\pm 1$     |     |     |                  |
| $t_r$              | 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       |     |     |                  |
| $\alpha_{Uo}$      | Temper. coefficient of $V_o$          | $V_{i\text{ nom}}, I_{o\text{ nom}}$                                          | $\pm 0.05$   |     |     | $\pm 0.05$               |     |     | $\pm 0.05$               |     |     | $\pm 0.05$  |     |     | %/K              |
| $f_s$              | Switching frequency                   |                                                                               | 100          |     |     | 100 <sup>1</sup>         |     |     | 100 <sup>1</sup>         |     |     | 100         |     |     | kHz              |

<sup>1</sup> 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                        | $V_{i\text{ nom}}, 0.5 I_{o\text{ nom}}$<br>R-input open-circuit              | 12.84 <sup>1</sup>      |     |     | 25.68 <sup>1</sup>      |     |     | 51.36 <sup>1</sup>      |     |     | 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<br>(BW = 20 MHz) | $V_{i\text{ nom}}, I_{o\text{ nom}}$<br>IEC 61204                             | 100 150                 |     |     | 100 150                 |     |     | 200                     |     |     | mV <sub>pp</sub> |
|                    | Static line/load regulation           | $V_{i\text{ min}} - V_{i\text{ max}}$ ,<br>$I_o = (0.1 - 1) I_{o\text{ nom}}$ | $\pm 2$ <sup>1</sup>    |     |     | $\pm 1$ <sup>1</sup>    |     |     | $\pm 1$ <sup>1</sup>    |     |     | %                |
| $V_{o\text{ l}}$   | Dynamic load regulation               | $V_{i\text{ nom}}, (0.1 \times 0.9) I_{o\text{ nom}}$                         | $\pm 2$ <sup>1</sup>    |     |     | $\pm 1.5$ <sup>1</sup>  |     |     | $\pm 1$ <sup>1</sup>    |     |     |                  |
| $t_r$              | 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                   |     |     |                  |
| $\alpha_{Uo}$      | Temper. coefficient of $V_o$          | $V_{i\text{ nom}}, I_{o\text{ nom}}$                                          | $\pm 0.05$ <sup>1</sup> |     |     | $\pm 0.05$ <sup>1</sup> |     |     | $\pm 0.05$ <sup>1</sup> |     |     | %/K              |
| $f_s$              | Switching frequency                   |                                                                               | 100                     |     |     | 100                     |     |     | 100                     |     |     | kHz              |

<sup>1</sup> 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*.

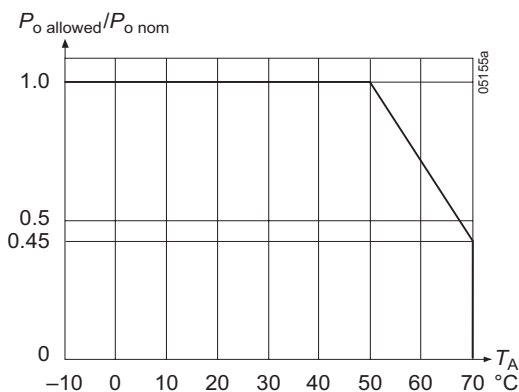


Fig. 4  
Maximum allowed output power versus ambient temperature at  $V_i > 105$  VAC for LOK models, operated in vertical position

### Output Power at Low Input Voltage

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

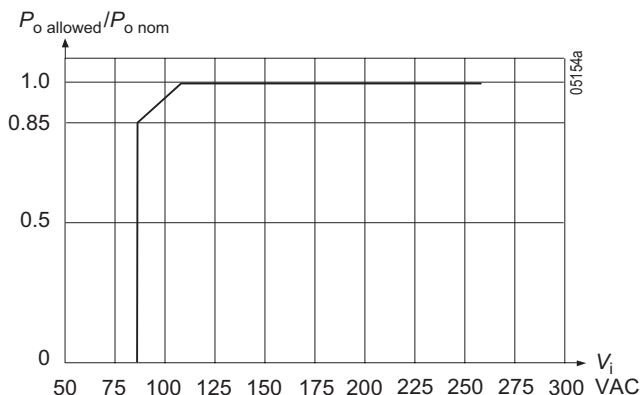


Fig. 3  
Maximum allowed output power versus input voltage at  $T_A = 50$  °C for LOK models operated in vertical position

### 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.

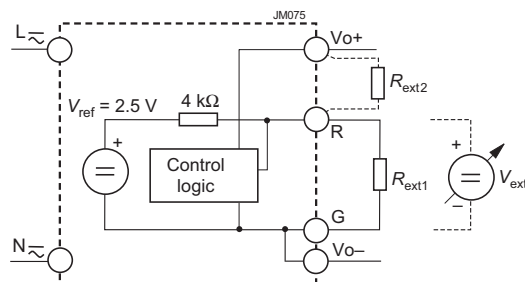


Fig. 5  
Output voltage control by means of the R-input

### 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  |      |
|            | $V_o > V_{o\ t\ max}$ |              | 0.6 |              | 0.6  |              | 0.6 |              | 0.6 |      |
|            | $I_D < 50\ mA$        |              |     |              |      |              |     |              |     |      |

### 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.

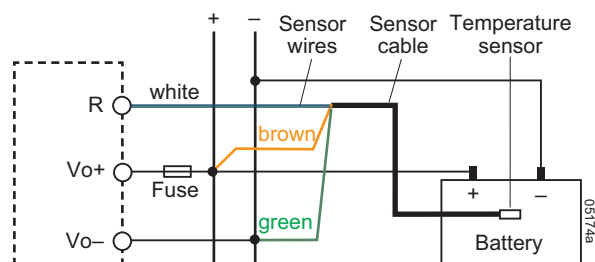


Fig. 6  
Voltage setting by a temperature sensor, wiring diagram

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*).

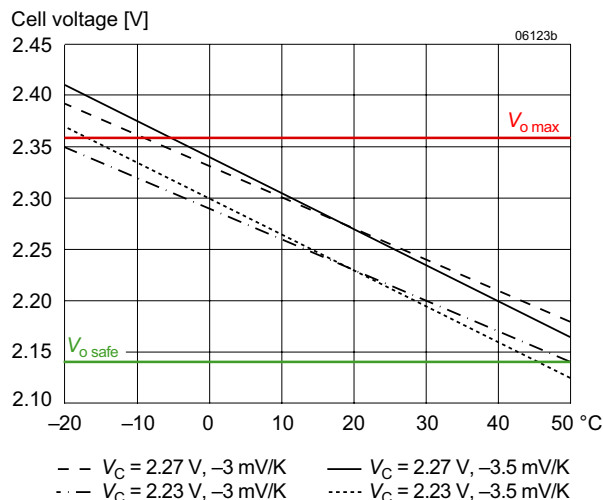


Fig. 7  
Float charge voltage for defined temperature coefficients.

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

<sup>1</sup> Related and previous standards are referenced in: *Technical Information: Standards*

<sup>2</sup> i = input, o = output, ⊕ = PE case.

<sup>3</sup> 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.

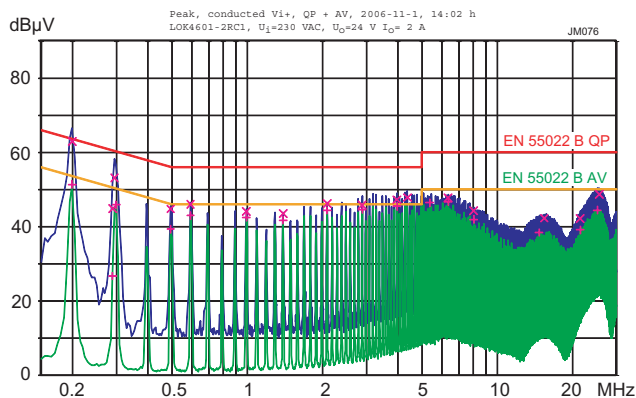


Fig. 8

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)

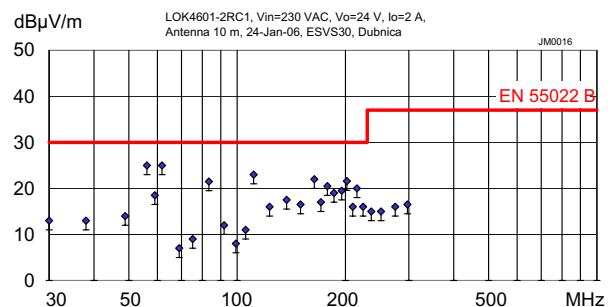


Fig. 9

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

Table 7: Temperature specifications

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

<sup>1</sup> 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

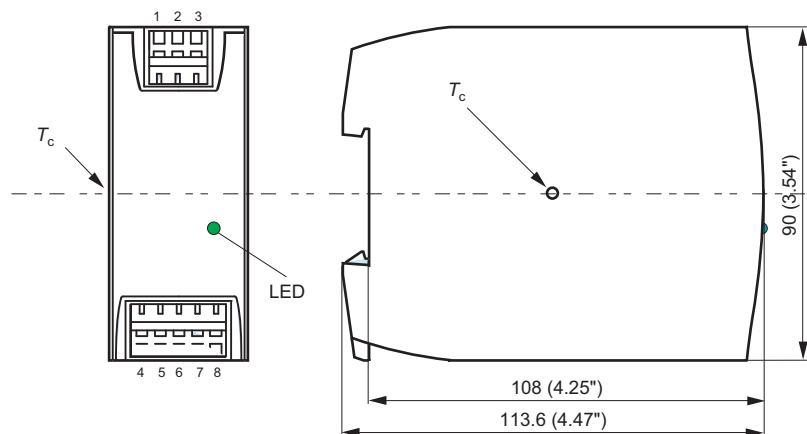
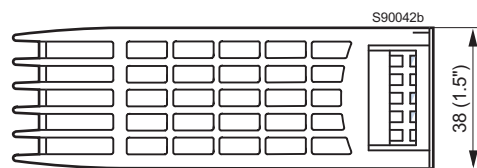


Fig. 10  
Case

## 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 2<sup>nd</sup> 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 $\geq 1$ s                    | 2.1                       | 2.1 <sup>1</sup> | 1.4                        | kVDC |
|                                  | AC test voltage equivalent to actual factory test | 1.5                       | 1.5 <sup>1</sup> | 1.0                        | kVAC |
| Insulation resistance at 500 VDC |                                                   | >300                      | >300             | >100                       | MΩ   |

<sup>1</sup> 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.

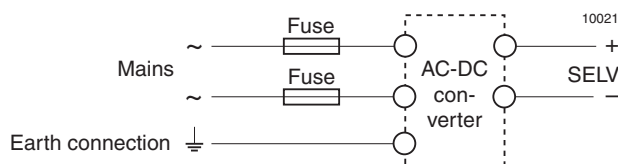


Fig. 11  
Schematic safety concept

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 $\leq 250$ VAC   | Double or reinforced                                                          | Earth connection <sup>1</sup> and installation according to the applicable standards | SELV circuit                                        |

<sup>1</sup> 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 mm<sup>2</sup> (AWG14), stranded wires 1 mm<sup>2</sup> (AWG16).

#### G: RoHS

RoHS-compliant for all six substances.

**NUCLEAR AND MEDICAL APPLICATIONS** - Power-One products are not designed, intended for use in, or authorized for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems without the express written consent of the respective divisional president of Power-One, Inc.

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