MELCHER™
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# RCM500/1000 Series

## 500/1000 W DC-DC Converters





5 YEAR warranty

RoHS Compliant

The RCM500 and RCM1000 Series converters are reliable power supplies for railway and transportation systems. They are optimized for 72 or 110 V railway batteries. The output delivers 24 V with 500 or 1000 W. The converters are designed for chassis mounting and exhibit a closed housing with cooling openings.

Many options are available, such as an output ORing FET for redundant operation, output voltage adjustment, interruption time of 10 ms, shutdown input, and a monitoring relay (change-over contact).

### Features

- Optimized for 72 V or 110 V railway batteries
- Output voltage 24 V
- Closed housing for chassis mounting
- Extremely high efficiency and high power density
- Low inrush current
- 3 connectors: Input, output, auxiliary (option)
- Overtemperature, overvoltage, overcurrent, and short-circuit protection
- Many options available
- Compliant to EN 50155, EN 50121-3-2, AREMA
- RoHS-compatible for all 6 substances
- Fire and smoke: compliant to EN 45545 and NFPA 130
- 5 year warranty

Safety-approved to the latest edition of IEC/EN 60950-1 and UL/CSA 60950-1

[1] pending

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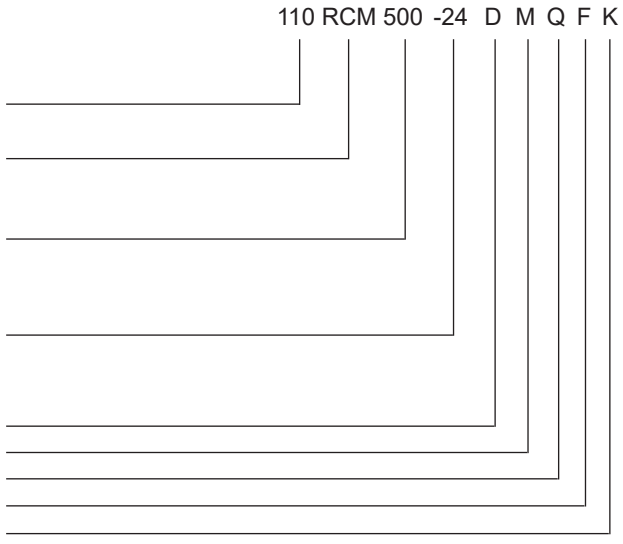
## Model Selection

*Table 1: Standard models*

| Input voltage | | | | | Output | | Power | Efficiency [2] | | Model | Options |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $V_{i\,min}$ [1] [V] | $V_{i\,cont}$ [V] | | | $V_{i\,max}$ [1] [V] | $V_{o\,nom}$ [V] | $I_{o\,nom}$ [A] | $P_{o\,nom}$ [W] | $\eta_{min}$ [%] | $\eta_{typ}$ [%] | | |
| 43.2 | 50.4 | (72) | 90 | 110 | 24 | 21 | 500 | 95.5 | 96 | 72RCM500-24 | D, M, Q, F, K |
| | | | | | 24 | 42 | 1000 | 95.5 | 96 | 72RCM1000-24 | |
| 66 | 77 | (110) | 137.5 | 154 | 24 | 21 | 500 | 96 | 96.4 | 110RCM500-24 | |
| | | | | | 24 | 42 | 1000 | 96 | 96.4 | 110RCM1000-24 | |

[1] Short time; see table 2 for details.
[2] Efficiency at $T_A$ = 25 °C, $V_{i\,nom}$, $I_{o\,nom}$, $V_{o\,nom}$, only option D fitted.

### Part Number Description




Operating input voltage $V_{i\,cont}$ (continuously):
- 50.4 – 90 VDC ..... 72
- 77 – 137.5 VDC ..... 110

Series ..... RCM

Output power:
- 500 W ..... 500
- 1000 W ..... 1000

Nominal output voltage:
- 24 V ..... -24

Auxiliary functions and options:
- Out OK, output voltage adjust, shutdown [1] ..... D
- Interruption time ..... M
- ORing FET ..... Q
- Fuse built-in ..... F
- Pluggable Connectors ..... K

[1] Opt. D requires the auxiliary connector.

**Note:** The sequence of options must follow the order above.

**Note:** All models are RoHS-compliant for all six substances.

Available combinations of options:

72/110RCMxxx-24 (K)
72/110RCMxxx-24D (K)
72/110RCMxxx-24DF (K)
72/110RCMxxx-24DMQ (K)
72/110RCMxxx-24DMQF (K)

Example: 110RCM500-24DMQ: DC-DC converter, input voltage range 77 to 137.5 V continuously, output providing 24 V /21 A, monitoring relay, output voltage adjust, shutdown input, active current sharing, interruption time 10 ms, integrated ORing FET, RoHS-compliant for all six substances.

### Product Marking

Type designation, applicable safety approval and recognition marks, CE mark, pin allocation, and product logo.

Input voltage range and input current, nominal output voltage and current, degree of protection, batch no., serial no., and data code including production site, version (modification status) and date of production.



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## Functional Description

The input voltage is fed via an efficient input filter and a step-up converter (switching with 2 × 110 kHz) to the high-efficient DC-DC converter operating at a switching frequency of approximately 90 kHz. The built-in overvoltage limiter protects against input voltage surges.

The inrush current is limited by an electronic circuitry. A VDR resistor protects against external surges.

If there is no external circuit breaker, the converter can be ordered with built-in fuse (opt. F). This fuse is not accessible.

The circuitry to provide the interruption time (opt. M) is located after the input filter together with the reverse polarity protection formed by a FET.

The rectification on the secondary side is provided by synchronous rectifiers, in order to keep the losses as low as possible. The output voltage control logic is located on the secondary side and controls the FETs of the DC-DC converter via insulated drivers.

An auxiliary converter supplies all circuits with a stable bias voltage.

An output ORing FET is available (opt. Q) and allows for a redundant power supply system.

Opt. D encompasses an additional signal connector to allow for output voltage adjustment, active current sharing, primary shutdown, and an output voltage monitor activating a relay with change-over contact.

The converter is mounted onto a base plate which acts as cooling plate. An additional heatsink for natural convection cooling is available as accessory. A thermal protection on the input and output side prevents from overheating.

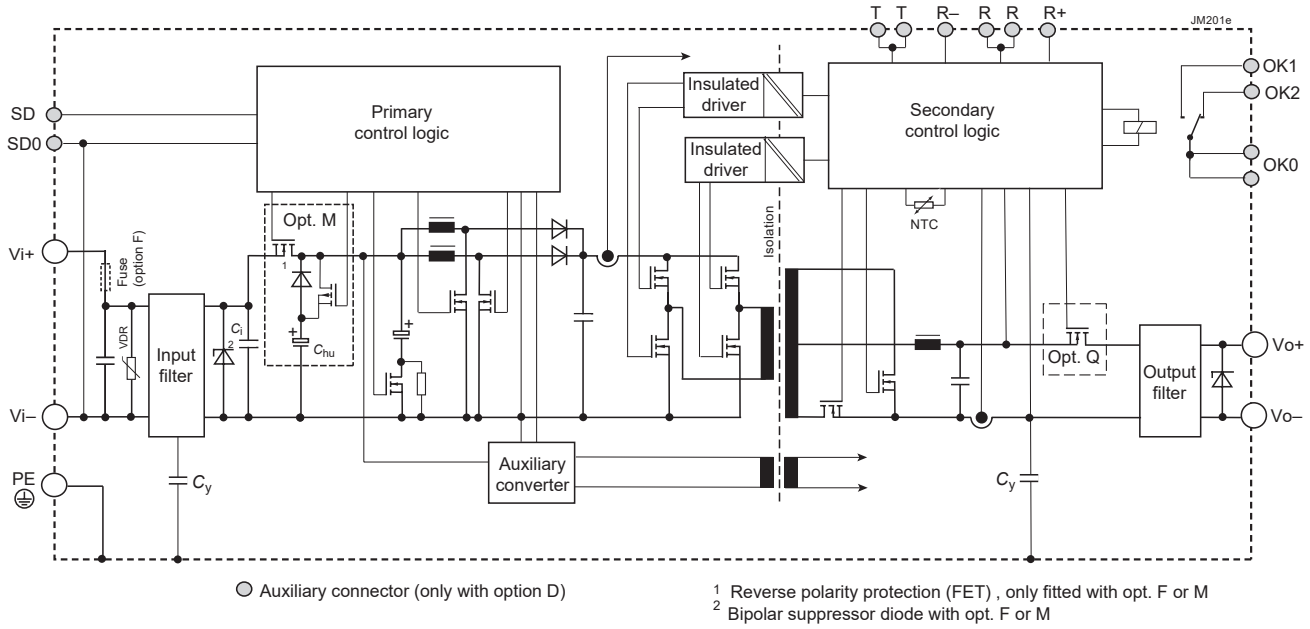



*Fig. 1*
*Block diagram*


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## Electrical Input Data

General conditions:
- $T_A$ = 25 °C, unless specified.

*Table 2a: Input data of RCM500 models*

| Model | | | 72RCM500-24 | | | 110RCM500-24 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Characteristics | | Conditions | min | typ | max | min | typ | max | |
| $V_i$ | Operating input voltage | $I_o$ = 0 – $I_{o\,max}$<br>$T_{A\,min}$ – $T_{A\,max}$ | 50.4 | (72) | 90 | 77 | (110) | 137.5 | V |
| $V_{i\,2s}$ | for ≤ 2 s | without shutdown | 43.2 | | 100.8 | 66 | | 154 | |
| $V_{i\,nom}$ | Nominal input voltage | | | 72 | | | 110 | | |
| $V_{i\,abs}$ | Input voltage limits | 3 s without damage | 0 | | 108 | 0 | | 165 | |
| $I_i$ | Typical input current | $V_{i\,nom}$, $I_{o\,nom}$ | | 7.3 | | | 4.8 | | A |
| $P_{i\,0}$ | No-load input power | $V_{i\,min}$ – $V_{i\,max}$, $I_o$ = 0 | | 2.5 | 4 | | 2.5 | 4 | W |
| $P_{i\,SD}$ | Idle input power | $V_{i\,min}$ – $V_{i\,max}$, $V_{SD}$ = 0 V | | 2 | 3 | | 2 | 3 | |
| $C_i$ | Input capacitance [1] | | | 7 | | | 7 | | µF |
| $R_i$ | Input resistance | | | 14 | | | 14 | | mΩ |
| $I_{inr\,p}$ | Peak inrush current | $V_i$ = $V_{i\,max}$, $P_{o\,nom}$ | | | 20 | | | 20 | A |
| $t_{inr\,d}$ | Duration of inrush current | | | | 0.5 | | | 0.5 | ms |
| $t_{on}$ | Duration of inrush current | 0 → $V_{i\,min}$, $P_{o\,nom}$ | | 300 | 500 | | 300 | 500 | |
| | Start-up time after removal of shutdown | $V_{i\,min}$, $P_{o\,nom}$<br>$V_{SD}$ = 0 → 5 V | | 300 | 500 | | 300 | 500 | |

*Table 2b: Input data of RCM1000 models*

| Model | | | 72RCM1000-24 | | | 110RCM1000-24 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Characteristics | | Conditions | min | typ | max | min | typ | max | |
| $V_i$ | Operating input voltage | $I_o$ = 0 – $I_{o\,max}$<br>$T_{A\,min}$ – $T_{A\,max}$ | 50.4 | (72) | 90 | 77 | (110) | 137.5 | V |
| $V_{i\,2s}$ | for ≤ 2 s | without shutdown | 43.2 | | 100.8 | 66 | | 154 | |
| $V_{i\,nom}$ | Nominal input voltage | | | 72 | | | 110 | | |
| $V_{i\,abs}$ | Input voltage limits | 3 s without damage | 0 | | 108 | 0 | | 165 | |
| $I_i$ | Typical input current | $V_{i\,nom}$, $I_{o\,nom}$ | | 15 | | | 9.5 | | A |
| $P_{i\,0}$ | No-load input power | $V_{i\,min}$ – $V_{i\,max}$, $I_o$ = 0 | | 3 | 4 | | 3 | 4 | W |
| $P_{i\,SD}$ | Idle input power | $V_{i\,min}$ – $V_{i\,max}$, $V_{SD}$ = 0 V | | 2.5 | 3 | | 2.5 | 3 | |
| $C_i$ | Input capacitance [1] | | | 7 | | | 7 | | µF |
| $R_i$ | Input resistance | | | 14 | | | 14 | | mΩ |
| $I_{inr\,p}$ | Peak inrush current | $V_i$ = $V_{i\,max}$, $P_{o\,nom}$ | | | 40 | | | 40 | A |
| $t_{inr\,d}$ | Duration of inrush current | | | | 0.5 | | | 0.5 | ms |
| $t_{on}$ | Duration of inrush current | 0 → $V_{i\,min}$, $P_{o\,nom}$ | | 300 | 500 | | 300 | 500 | |
| | Start-up time after removal of shutdown | $V_{i\,min}$, $P_{o\,nom}$<br>$V_{SD}$ = 0 → 5 V | | 300 | 500 | | 300 | 500 | |

[1] Not smoothed by the inrush current limiter at start-up (for inrush current calculation)



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### Input Transient and Reverse Polarity Protection

A VDR resistor and a symmetrical input filter form an effective protection against input transients, which typically occur in many installations, but especially in battery-driven mobile applications.

If the input voltage has the wrong polarity, the incorporated reverse diode will cause the external input circuit breaker or fuse to trip. With option M or F (incorporated fuse), an active reverse-polarity protection circuit prevents from any damage.

### Input Under-/Overvoltage Lockout

If the input voltage is out of range, an internally generated signal disables the converter to avoid any damage.

### Efficiency

See fig. 2 for efficiency curves of selected models.

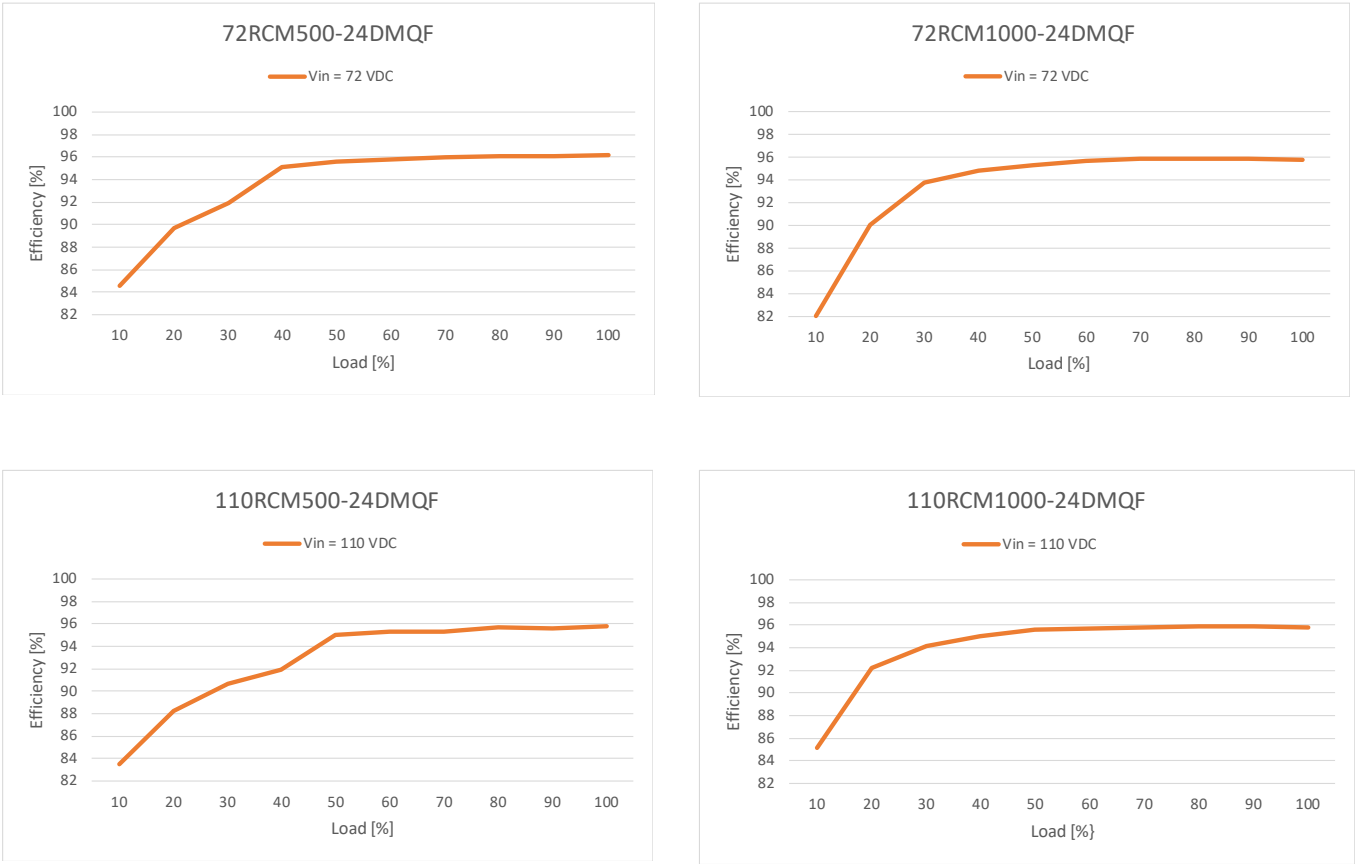



*Fig. 2*
*Typical efficiency versus output load*



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## Electrical Output Data

General conditions:

- $T_A$ = 25 °C, unless $T_C$ is specified
- R input not connected

*Table 3: Output data*

| Model | | | | 72/110RCM500-24 | | | 72/110RCM1000-24 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| Characteristics | | | Conditions | min | typ | max | min | typ | max | |
| $V_o$ | Output voltage [1] | | $V_{i\,nom}$, 0.5 $I_{o\,nom}$ | 23.76 | 24 | 24.24 | 23.76 | 24 | 24.24 | V |
| $V_{ow}$ | Worst case output voltage | | $V_{i\,min} - V_{i\,max}$ $T_{C\,min} - T_{C\,max}$, 0 - $I_{o\,nom}$ | 23.28 | | 24.72 | 23.28 | | 24.72 | V |
| $V_{o\,droop}$ | Output voltage droop | | | | - 10 | | | - 5 | | mV/A |
| $V_{o\,L}$ | Overvoltage shutdown [6] | | | | 28 | | | 28 | | V |
| $V_{o\,P}$ | Overvoltage protection [2] | | | 28.5 | 30 | 31.5 | 28.5 | 30 | 31.5 | V |
| $I_{o\,nom}$ | Nominal output current | | $T_{C\,min} - T_{C\,max}$ | | 21 | | | 42 | | A |
| $I_{o\,L}$ | Output current limit | | | | | 23 | | | 45 | A |
| $v_o$ | Output noise [3] | Switching frequency | $V_{i\,nom}$, $I_{o\,nom}$ BW = 20 MHz | | | 240 | | | 240 | $mV_{pp}$ |
| | | Total incl. spikes | | | | 480 | | | 480 | $mV_{pp}$ |
| $v_{od}$ | Dynamic load regulation | Voltage deviation [5] | $V_{i\,nom}$, 0.1↔0.9 $I_{o\,nom}$ | | | 1000 | | | 1000 | $mV_{pp}$ |
| $t_d$ [4] | | Recovery time | | | | 5 | | | 5 | ms |
| $\alpha_{vo}$ | Temperature coefficient of $v_o$ (NTC) | | 0 - $I_{o\,nom}$, $T_{C\,min} - T_{C\,max}$ | - 0.02 | | 0 | - 0.02 | | 0 | %/K |

[1] If the output voltage is increased above $V_{o\,nom}$ through R-input control, the output power should be reduced accordingly, so that $P_{o\,max}$ and $T_{C\,max}$ are not exceeded.
[2] Breakdown voltage of the incorporated suppressor diode at 1 mA . Exceeding this value might damage the suppressor diode.
[3] Measured according to IEC/EN 61204 with a probe described in annex A
[4] Recovery time until $V_o$ returns to ±1% of $V_o$; see fig. 3.
[5] No overshoot at switch on.
[6] Output overvoltage shutdown by an electronic circuitry, with automatic recovery.

### Output Voltage Regulation

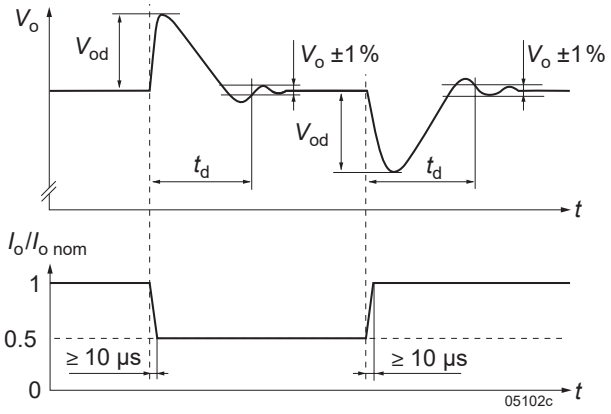



*Fig. 3*
*Typical dynamic load regulation of output voltage*



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### Output Current Limitation

The output is continuously protected against open-circuit (no load) and short-circuit by an electronic current limitation with rectangular characteristic; see fig. 4.

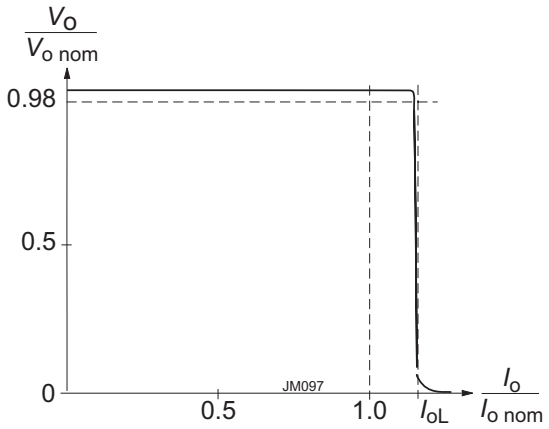



*Fig. 4*
*Rectangular current limitation*

### Series, Parallel Connection, Redundancy

The outputs of several RCM Series converters may be connected in series.

**Note**: If the sum of the output voltages is greater than 60 V, it cannot be considered being SELV (Safety Extra Low Voltage) according to the safety standards. but the voltage may exceed the SELV level.

The outputs RCM Series converters may be connected in parallel. In order to ensures proper current sharing, the load lines should have equal length and section. The output voltage exhibits a slight droop characteristic, which facilitates current sharing. In addition, the output voltage tends to be lowered with increasing temperature.

Converters with option D exhibit an additional pin T to provide active current sharing by simply interconnecting all T- pins. For redundant systems, we recommend option Q, which exhibits ORing diodes built by FETs, in order to keep the losses to a minimum. Figure 5 shows a system with 3 parallel-connected converters forming a redundant system. The output voltage is increased by the resistor $R_{ext2}$ (as an example). The OK signals, connected in series, allow for monitoring all 3 converters.

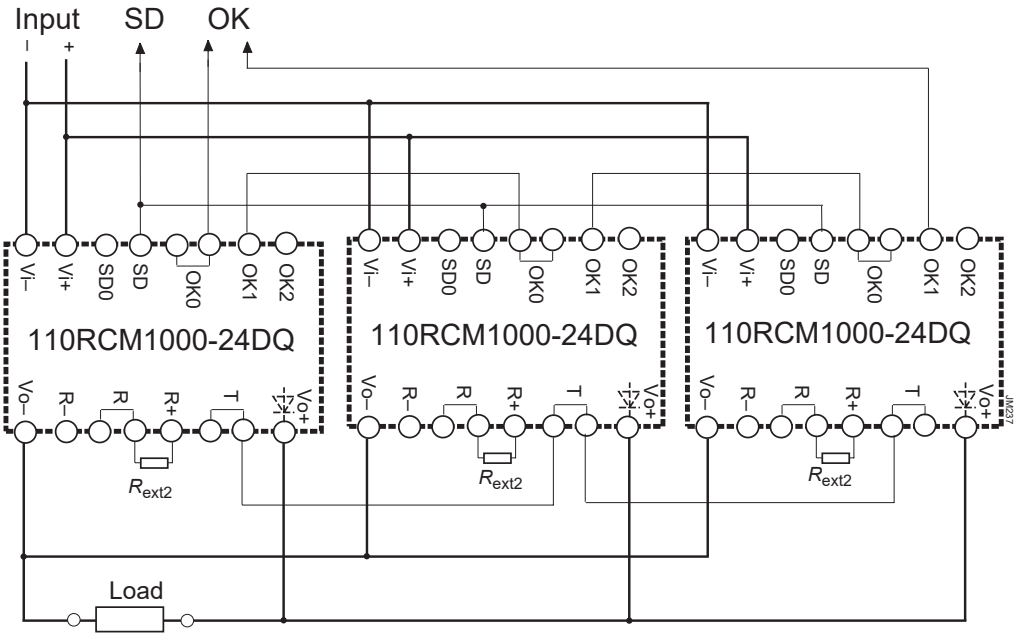



*Fig. 5*
*Parallel connection of 3 converters*



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### Thermal Considerations and Protection

A temperature protection is incorporated in the primary and secondary control logic each. It generates an internal inhibit signal, which disables the converter in case of overtemperature. The converter automatically recovers, when the temperature drops below the limit; see fig. 6. The relationship between $T_A$ and $T_C$ depends heavily upon the conditions of operation and the integration into a system.

**Caution:** The installer must ensure that under all operating conditions $T_C$ remains within the limits stated in table 7.

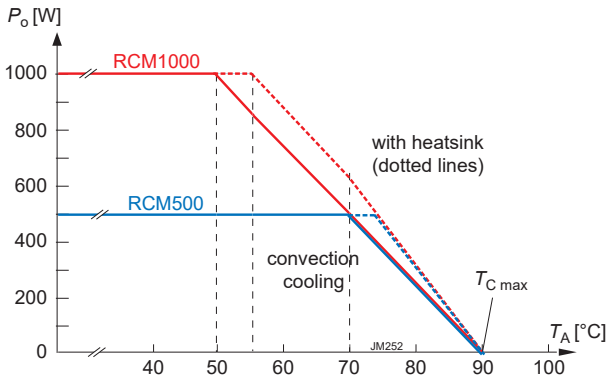



*Fig. 6*
*Typical output power derating versus temperature; vertical mounting position, free convection cooling.*

### LED Indicator

Each converter exhibits a green LED “Out OK”, signaling that the output voltage is inside the specified range.



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## Description of Options

### Option D: Output Monitor, Output Adjust, Shutdown

Option D consists of several auxiliary functions (R, OK, SD, T) and encompasses an additional auxiliary connector.

### Output Voltage Adjust (R)

**Note:** With open R-input, $V_o = V_{o\,nom}$.

The converter allows for adjusting the output voltage in the range of 80 to 105% of $V_{o\,nom}$. The adjust is accomplished by an external resistor $R_{ext1}$ or $R_{ext2}$, connected to input R; see fig. 7.

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

**either:** Between the pins R and R– to adjust the output voltage to a value below $V_{o\,nom}$:

$$R_{ext1} \approx 4\ k\Omega \bullet \frac{V_o}{V_{o\,nom} - V_o} - 15.8\ k\Omega$$

**Note:** $R_{ext1} = 0\ \Omega$ reduces $V_o$ to 80%.

**or:** Between the pins R and R+ to adjust the output voltage to a value greater than $V_{o\,nom}$:

$$R_{ext2} \approx 4\ k\Omega \bullet \frac{(V_o - 2.5\ V)}{2.5\ V \bullet (V_o/V_{o\,nom} - 1)} - 682\ k\Omega$$

**Note:** $R_{ext2} = 0\ \Omega$ increases $V_o$ to 105%.

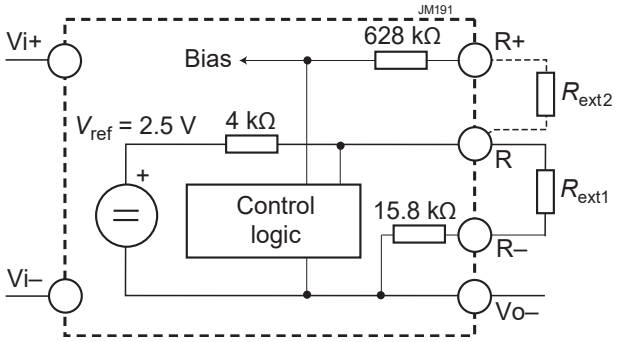



*Fig. 7*
*Output voltage control via R-input*

### Output Voltage Monitor (OK)

The output voltage $V_o$ is monitored. When $V_o$ is in range, a relay with a changeover contact connected to the auxiliary connector is activated, and OK0 is connected with OK1.

**Note:** The trigger levels are typ. ±5 % of $V_{onom}$ (with open R-input).

Data of relay contacts: 0.4 A / 150 VDC.

### Primary Shutdown (SD)

The output of the converter may be enabled or disabled by a logic signal (e.g. CMOS) applied between the shutdown pin SD and SD0 (= Vi–). If the shutdown function is not required, pin SD can be left open-circuit. Voltage on pin SD:

| | |
|---|---|
| Converter operating: | 12 V to $V_{i\,max}$ or open-circuit |
| Converter disabled: | –2 to +2 V |

The output response is shown in fig.8

**Note**: In systems consisting of several converters, this feature may be used to control the activation sequence by logic signals or to enable the power source to start up, before full load is applied.



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### Current Share Function in Parallel Operation (T)

Just interconnect the T-pins of all converters to balance their output currents. Only a single-wire connection is needed.

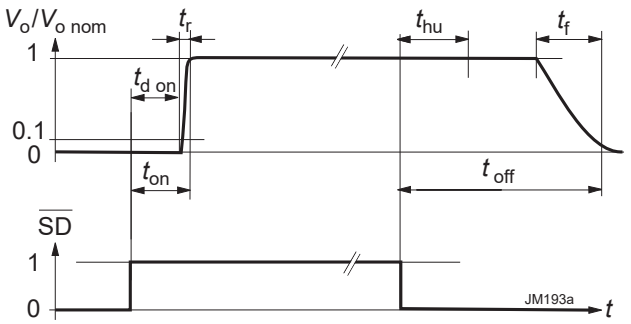



*Fig. 8*
*Typical output response to the SD-signal. If option M is not fitted, $t_{hu}$ = 0 ms.*

### Option Q: ORing FET for Redundant Systems

Two parallel connected converters are separated with ORing diodes (built by FETs). If one converter fails, the remaining one still delivers the full power to the loads. If more power is needed, the system may be extended to more parallel converters (n+1 redundancy).

Current sharing must be ensured by load lines of equal section and length. In addition, a slight droop characteristic of the outputs and a negative temperature coefficient are helpful as well.

To keep the losses as small as possible, the ORing diode is replaced by a FET.

**Note:** In the case of a failing converter, the output voltage is maintained by the redundant converters. However, the failing item should be identified and replaced. We recommend the Out OK function (option D).

### Option M: Interruption Time

The interruption time $t_{hu}$ is specified in the railway standard EN 50155:2017 clause 5.1.1.4: Class S2 is 10 ms. It is measured at $V_{B\ nom}$ (nominal battery voltage) for interruption and short-circuit of the input. After such an event, the system is ready for the next event after 10 s. Fig. 6 shows the output voltage $V_o$, if option M is fitted. Option M encompasses a backrush protection formed by a FET device.

For less critical applications, option M is not required (class S1). Such units have a slightly better efficiency.

### Option F: Incorporated Fuse

The railway standard EN 50155 does not recommend fuses in converters. Consequently, the installer should preview an external fuse or circuit breaker.

However, when this is not possible, we offer an incorporated fuse (option F) with active reverse polarity protection formed by a FET device. The fuse is not accessible and will not trip, unless the converter is really defect. The type of the incorporated fuses is specified in table 4. Such fuses are also recommended for external fuses.

*Table 4: Recommended external fuses (same as with option F)*

| Converter | Specification | Ordering number |
|---|---|---|
| 72RCM500-24 | 15 A fast acting | Littlefuse 0505015.MX52 LEP |
| 110RCM500-24 | 15 A fast acting | Littlefuse 0505015.MX52 LEP |
| 72RCM1000-24 | 2x 25 A fast acting | Littlefuse 0505025.MX52 LEP |
| 110RCM1000-24 | 25 A fast acting | Littlefuse 0505025.MX52 LEP |

### Option K: Pluggable Connectors

This option allows the use of preassembled pluggabale connectors; for details see *Accessories*.

**Note:** Female connectors must be ordered separately.



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## Electromagnetic Compatibility (EMC)

### Electromagnetic Immunity

*Table 5: Electromagnetic immunity (type tests). Corresponds or Exceeds EN50121-3-2:2016 and AREMA.*

| Phenomenon | Standard | Level | Coupling mode [1] | Value applied | Waveform | Source imped. | Test procedure | In oper. | Perf. crit. [2] |
|---|---|---|---|---|---|---|---|---|---|
| Electrostatic discharge (to case) | IEC/EN 61000-4-2 | 4 | contact discharge | 6000 $V_p$ | 1/50 ns | 330 Ω 150 pF | 10 pos. & 10 neg. discharges | yes | A |
| | | | air discharge | 8000 $V_p$ | | | | | |
| Electromagnetic field | IEC/EN 61000-4-3 | x | antenna | 20 V/m | AM 80% / 1 kHz | N/A | 80 – 800 MHz | yes | A |
| | | | antenna | 20 V/m | AM 80% / 1 kHz | N/A | 800 – 1000 MHz | yes | A |
| | | | | 20 V/m | | | 1400 – 2000 MHz | | |
| | | | | 5 V/m | | | 2000 – 2700 MHz | | |
| | | | | 3 V/m | | | 5100 – 6000 MHz | | |
| Electrical fast transients/burst | IEC/EN 61000-4-4 | 3 | capacitive, o/c | ±2000 $V_p$ | 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 | yes | A |
| | | 3 | i/c, +i/–i direct | | | | | | |
| Surges | IEC/EN 61000-4-5 | 3 | i/c | ±2000 $V_p$ | 1.2 / 50 µs | 42 Ω 0.5 µF | 5 pos. & 5 neg. surges per coupling mode | yes | A |
| | | | +i/–i | ±1000 $V_p$ | | | | | |
| | | | i/c, +i/–i | ±2000 $V_p$ | | 12 Ω 9 µF | | | B |
| Conducted disturbances | IEC/EN 61000-4-6 | 3 | i, o, signal wires | 10 VAC (140 dBµV) | AM 80% / 1 kHz | 150 Ω | 0.15 – 80 MHz | yes | A |
| Power frequency magnetic field | IEC/EN 61000-4-8 | 3 | | 300 A/m | | | 60 s in all 3 axis | yes | A |

[1] i = input, o = output, c = case
[2] A = normal operation, no deviation from specs.; B = normal operation, temporary loss of function or deviation from specs possible



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## Electromagnetic Emissions

The conducted emissions (fig. 9) have been tested according to EN 55011, group 1, class A (similar to EN 55032), much better values than requested by EN 50121-3-2:2016, table 2.1. The limits in fig. 9 apply to quasipeak values, which are always lower then peak values.

Radiated emissions have been tested as per EN 55011, group 1, class A, similar to EN 61000-6-4+A1:2011, table 1. The test was executed with horizontal and vertical polarization; the worse result is shown in fig. 10.

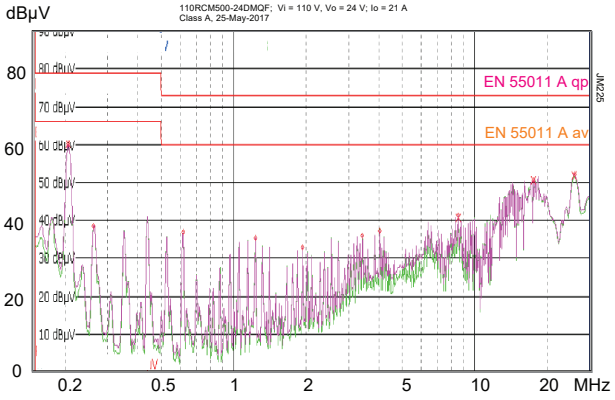



*Fig. 9a*
*110RCM500-24: Typ. conducted disturbances at the input ($V_i$=110 V, $I_{i\,nom}$, resistive load, quasi peak and average).*

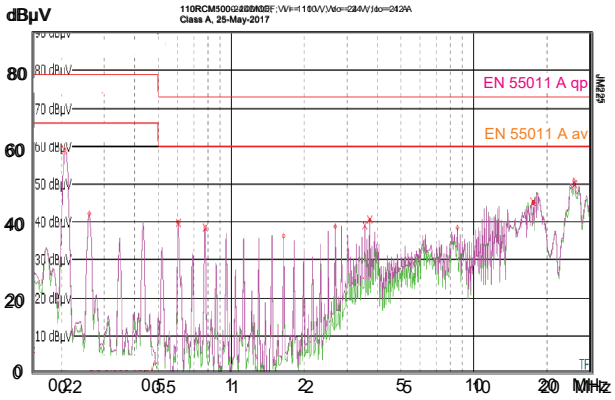



*Fig. 9b*
*110RCM1000-24: Typ. conducted disturbances at the input ($V_i$=110 V, $I_{i\,nom}$, resistive load, quasi peak and average).*

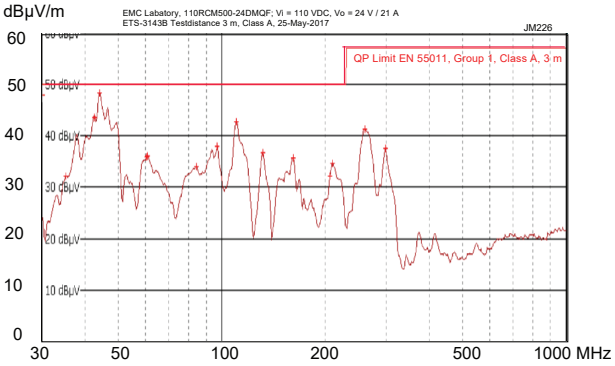



*Fig. 10a*
*110RCM500-24: Typ. radiated disturbances in 3 m distance ($V_i$ = 110 V, $I_{i\,nom}$, resistive load, quasi peak).*

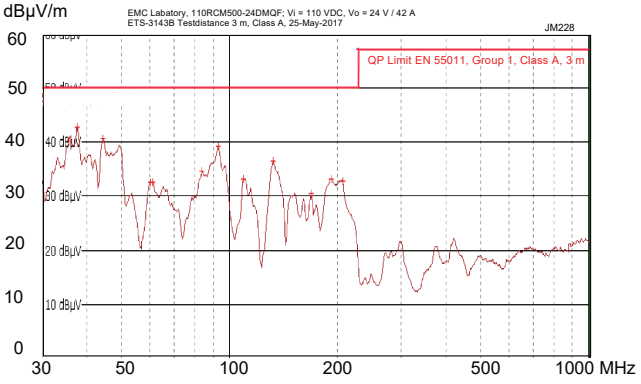



*Fig. 10b*
*110RCM1000-24: Typ. radiated disturbances in 3 m distance ($V_i$ = 110 V, $I_{i\,nom}$, resistive load, quasi peak).*


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## Immunity to Environmental Conditions

*Table 6: Mechanical and climatic stress. Air pressure 800 – 1200 hPa*

| Test method | | Standard | Test Conditions | | Status |
|---|---|---|---|---|---|
| Ad | Low temperature start-up test | EN 50155:2017, clause 13.4.4<br>IEC/EN 60068-2-1 | Temperature, duration:<br>Performance test: | - 40 °C, 2 h<br>+25 °C | Not operating |
| Be | Dry heat test, cycle A | EN 50155:2017, clause 13.4.5<br>IEC/EN 60068-2-2 | Temperature:<br>Duration: | 70 °C<br>6 h | Operating perf. crit. A |
| Db 2 | Cyclic damp heat test | EN 50155:2017, clause 13.4.7<br>IEC/EN 60068-2-30 | Temperature:<br>Cycles (respiration effect):<br>Duration: | 55 °C and 25 °C<br>2<br>2x 24 h | Not operating |
| Ka | Salt mist test sodium chloride (NaCl) solution | EN 50155:2017, clause 13.4.10<br>IEC/EN 60068-2-11 | Temperature:<br>Duration: | 35 $^{\pm 2}$ °C<br>48 h | Converter not operating |
| | Functional random vibration test | EN 50155:2017 clause 13.4.11.4<br>EN 61373:2010 clause 8,<br>class B, body mounted [1] | Acceleration amplitude:<br>Frequency band:<br>Test duration: | 0.1 $g_n$ = 1.01 m/s$^2$<br>5 – 150 Hz<br>30 min (10 min in each axis) | Operating perf. crit. A |
| | Simulated long life testing | EN 50155:2017 clause 13.4.11.2<br>EN 61373:2010 clause 9,<br>class B, body mounted [1] | Acceleration amplitude:<br>Frequency band:<br>Test duration: | 0.58 $g_n$ = 5.72 m/s$^2$<br>5 – 150 Hz<br>15 h (5 h in each axis) | Not operating |
| | Shock test | EN 50155:2017 clause 13.4.11.3<br>EN 61373:2010 clause 10,<br>class B, body mounted [1] | Acceleration amplitude:<br>Bump duration:<br>Number of bumps: | 5.1 $g_n$<br>30 ms<br>18 (3 in each direction) | Operating perf. crit. A |
| | Vibration sinusoidal | AREMA Part. 11.5.1<br>class C, D, E, I, J | Displacement amplitude:<br><br>Acceleration amplitude:<br>Frequency:<br>Test duration: | 0.3" (5 – 10 Hz)<br>0.07" (5 – 20 Hz)<br>1.5 $g_n$ = 14.7 m/s$^2$ (10 – 200 Hz)<br>5 – 200 Hz<br>12 h (4 h in each axis) | Operating perf. crit. A |
| | Mechanical shock | AREMA Part. 11.5.1<br>class C, D, E, I, J | Acceleration amplitude:<br>Bump duration:<br>Number of bumps: | 10 $g_n$ = 98 m/s$^2$<br>11 ms<br>18 (3 in each direction) | Operating perf. crit. A |

[1] Body mounted = chassis of a railway coach

### Temperatures

*Table 7: Temperature specifications, valid for an air pressure of 800 – 1200 hPa (800 – 1200 mbar)*

| Model | | | RCM500 | | | RCM1000 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | EN 50155:2017 Class OT4 | | | EN 50155:2017 Class OT2 | | | |
| Characteristics | | Conditions | min | max | 10 min | min | max | 10 min | |
| $T_A$ | Ambient temperature | Converter operating | - 40 | 70 | 85 | - 40 | 55 [2] | 70 | ° C |
| $T_C$ | Case temperature [1] | | - 40 | 90 | | | 90 | | |
| $T_S$ | Storage temperature | Not operational | - 55 | 85 | | - 55 | 85 | | |

[1] Measured at the measurement point $T_C$; see Mechanical Data.
[2] RCM1000 can be operated at higher temperature with reduced output power.

### Reliability

*Table 8: MTBF*

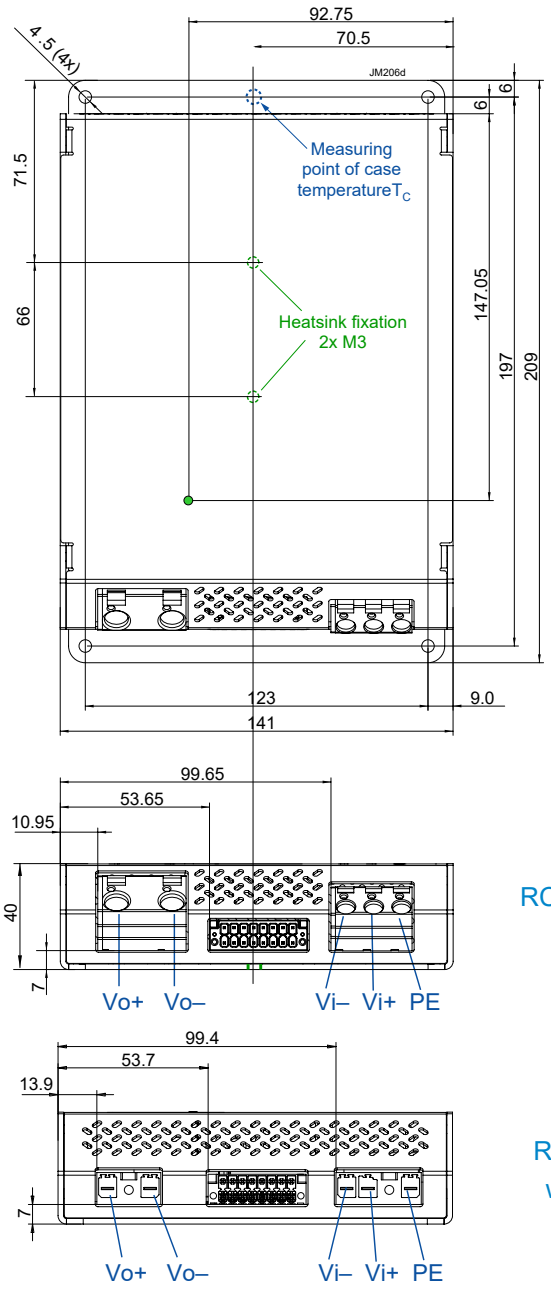
| Calculation method | Model | MTBF |
|---|---|---|
| According to IEC 61709 / SN-29500 | 110RCM500-24DMQF | 1 040 000 h |
| | 110RCM1000-24DMQF | 822 000 h |



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## Mechanical Data

Dimensions in mm.




RCM500/1000 standard

RCM500/1000 with option K

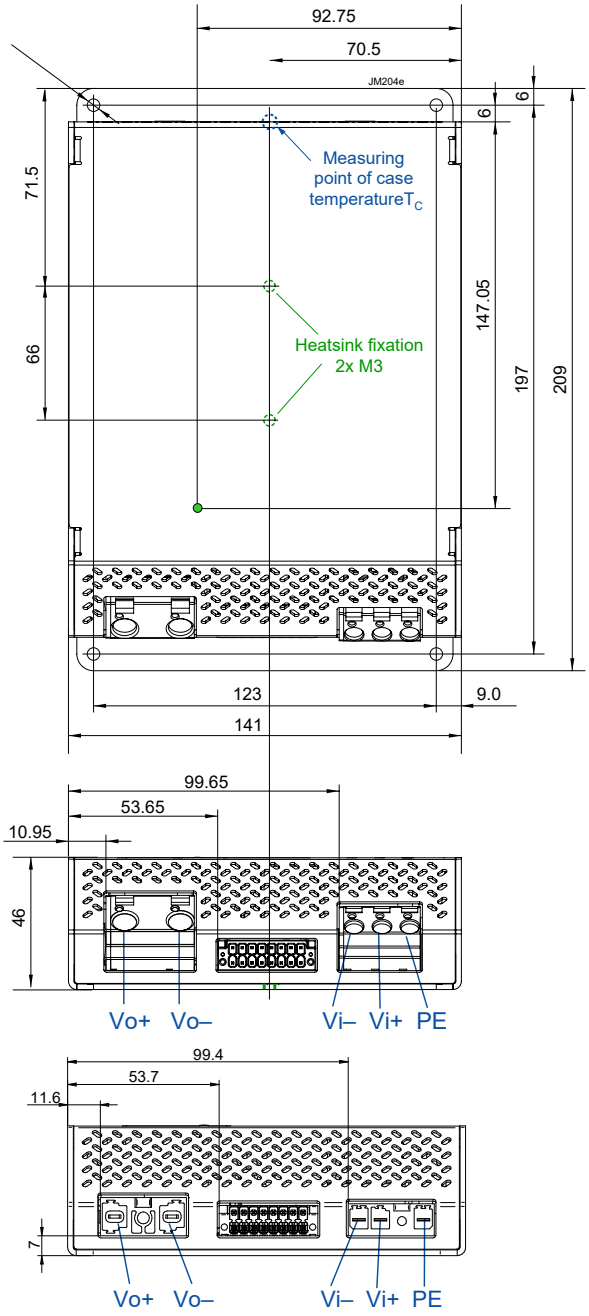



*Fig. 11*
*Case for RCM500 (RCM03),*
*Aluminum, EP powder-coated; 1160 g.*

*Fig. 12*
*Case for RCM1000 (RCM04),*
*Aluminum, EP powder-coated; 1250 g.*

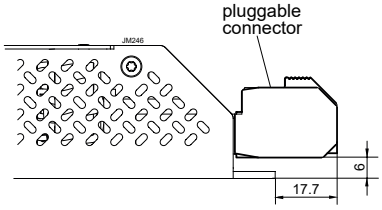



*Fig. 13*
*Case detail for RCM500/1000 with option K*

European Projection



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## Safety and Installation Instruction

### Connectors and Pin Allocation

- Input connector, 3 pins: Wago 745-353: Vi+, Vi–, PE;
  wire sections:
  RCM500/1000: 0.2 – 6 mm², 24 – 10 AWG;
  with option K: Weidmüller 1048500000
- Output connector, 2 pins: Wago 745-652/006-000: Vo+, Vo;
  wire sections:
  RCM500/1000: 0.2 – 16 mm², 24 – 06 AWG
  RCM500 with option K: Weidmüller 1048390000
  RCM1000 with option K: Weidmüller 1156650000
- Auxiliary connector: Phoenix Contact 1874043, pin allocation see fig. 14.

| R+ | R– | T | n.c. | OK1 | OK2 | n.c. | SD |
|---|---|---|---|---|---|---|---|
| R | R | T | n.c. | OK0 | OK0 | n.c. | SD0 |

*Fig. 14*
*Auxiliary connector pin allocation*

### Installation Instruction

These converters are components, intended exclusively for inclusion by an industrial assembly process or by a professionally competent person. Installation must strictly follow the national safety regulations in respect of the enclosure, mounting, creepage distances, clearances, markings and segregation requirements of the end-use application.

Connection to the system shall only be effected with cables with suitable section (primary and secondary connector in cage clamp technique).

The auxiliary connector shall be connected via the suitable female connector; see *Accessories*.

Other installation methods may not meet the safety requirements. Check that PE is safely connected to protective earth.

No fuse is incorporated in the converter (except for option F). An external circuit breaker or a fuse in the wiring to one or both input pins.

Do not open the converters, or the warranty will be invalidated. Make sure that there is sufficient airflow available for convection cooling and that the temperature of the bottom plate is within the specified range. This should be verified by measuring the case temperature at the specified measuring point, when the converter is operated in the end-use application. $T_{C\,max}$ should not be exceeded. Ensure that a failure of the converter does not result in a hazardous condition.

### Standards and Approvals

The RCM Series converters are approved according to the last edition of IEC/EN 60950-1 and UL/CSA 60950-1.

They have been evaluated for:

- Class I equipment
- Building in
- Double or reinforced insulation based on 250 VAC or 240 VDC between input and output, and between input and OK signals (relay contacts)
- Pollution degree 2 environment

The converters are subject to manufacturing surveillance in accordance with the above mentioned UL standards and with ISO 9001:2015.

### Cleaning Liquids and Protection Degree

The converters are not hermetically sealed. In order to avoid possible damage, any penetration of liquids shall be avoided.

The converters correspond to protection degree IP 30.



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## Railway Applications

The RCM Series converters have been designed observing the railway standards EN 50155:2017, EN 50121-3-2:2016, and AREMA. All boards are coated with a protective lacquer. The converters comply with the fire & smoke standard EN 45545-2, HL1 to HL3.

## Insulation Test

The electric strength test is performed in the factory as routine test in accordance with EN 50514 and IEC/EN 60950 and AREMA. It should not be repeated in the field. The Company will not honor warranty claims resulting from incorrectly executed electric strength tests.

*Table 9: Isolation*

| Characteristics | | Input to | | Output to Case | OK contacts to | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | Output [1] | Case + Output | | Input | Case | Outputs | |
| Electric strength test | Factory test 10 s | 4.2 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | kVDC |
| | AC test voltage equivalent to factory test | 3.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | kVAC |
| Insulation resistance | | >300 [2] | >300 [2] | >300 | >300 | >300 | >300 | MΩ |
| Creepage distances | | 5.0 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | mm |

[1] Pretest of subassemblies in accordance with IEC/EN 60950
[2] Tested at 500 VDC



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## Accessories

### Female Connector

A suitable 16 pin female connector is available; see fig. 15.

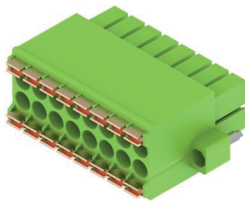


*Fig. 15*
*Female connector 16 pins, HZZ00146-G (Phoenix Contact 1790357)*

For converters RCM500/1000 with option K, use (see fig. 16):

- HZZ00303-G (3 poles, Weidmüller 1060580000) for RCM500/1000
- HZZ00302-G (2 poles, Weidmüller 1060550000) for RCM500
- HZZ00304-G (2 poles, Weidmüller 1156600000) for RCM1000

Wire section: 0.5 – 10 mm², 24 – 8 AWG



*Fig. 16*
*Female connectors for RCM500/1000 with option K*

### Additional Heatsink

A suitable heat sink (HZZ00149-G) for free air cooling is available, if cooling by wall or a chassis mounting is not possible; see fig. 17.

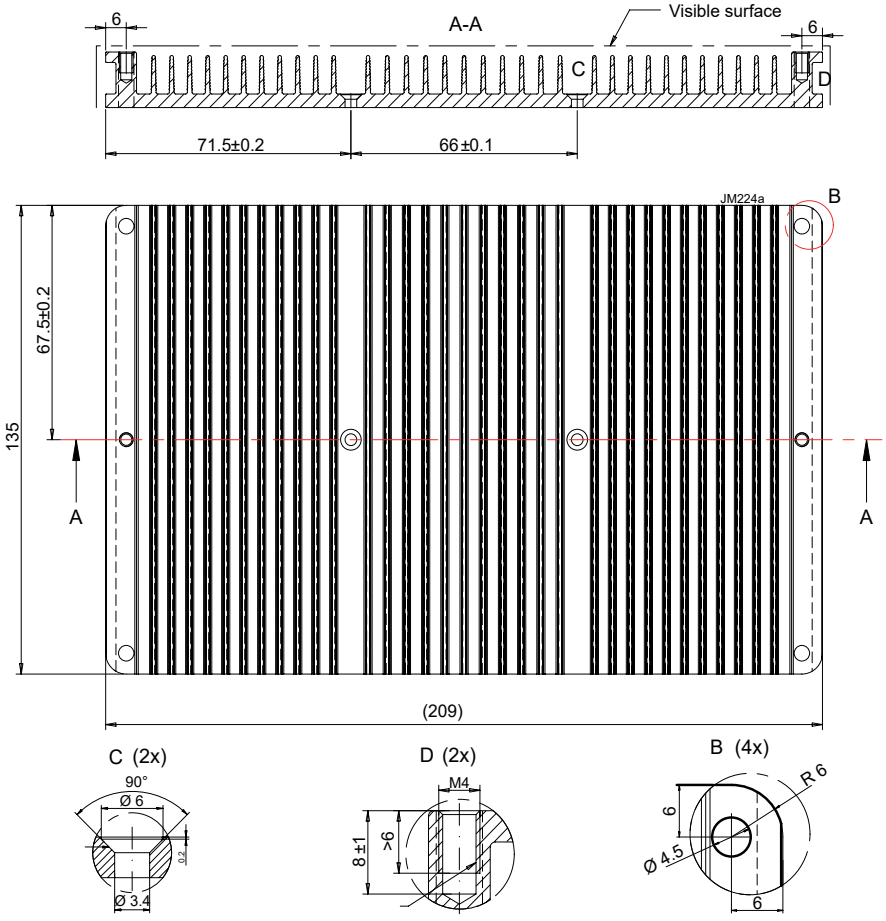



*Fig. 17*
*Additional heatsink for RCM500 and RCM1000 (HZZ00149-G)*
Weight 530 g

*Content: Heatsink + 2 screws (M3 x 6 mm)*

**NUCLEAR AND MEDICAL APPLICATIONS** - These products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

**TECHNICAL REVISIONS** - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.



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