Description
The RCM500 and RCM1000 Series converters are reliable power supplies for railway and transportation systems. They are optimized for 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 slots.

Many options are available, such as an output ORing FET for redundant operation, output voltage adjustment, interruption time of 10 ms (class ST2), shutdown input, and a monitoring relay (change-over contact).

Features
- RoHS lead-free-solder product
- Optimized for 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 overload protection
- Many options available
- Compliant to EN 50155, EN 50121-3-2
- Protected against fire and smoke according to EN 45545

Safety-approved to EN 60950-1/A12:2011 and UL/CSA 60950-1 2nd Ed +A2

1 pending
### Model Selection

**Table 1: Model Selection**

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>Output voltage</th>
<th>Power</th>
<th>Efficiency</th>
<th>Model</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_i$ min</td>
<td>$V_i$ cont</td>
<td>$V_i$ max</td>
<td>$V_o$ nom</td>
<td>$I_o$ nom</td>
<td>$P_o$ nom</td>
</tr>
<tr>
<td>66</td>
<td>77 (110)</td>
<td>137.5</td>
<td>24</td>
<td>21</td>
<td>504</td>
</tr>
<tr>
<td>154</td>
<td>24</td>
<td>42</td>
<td>1008</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Short time; see table 2 for details
2. Efficiency at $T_A = 25 \, ^\circ C$, $V_i$ nom, $I_o$ nom, $V_o$ nom, no option fitted.

### Part Number Description

Operating input voltage $V_{i\, cont}$ (continuously):

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 ........................................................................ F

\(^1\) Opt. D requires an additional signal connector.

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

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

**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.
Functional Description

The input voltage is fed via a high-efficient input filter and a step-up converter to the high efficient DC-DC converter with a switching frequency of approximately 135 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, it is possible to order the converter with built-in fuse (opt. F). Because this fuse is not accessible, a reverse polarity protection is incorporated (only with options F and M).

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 switches the FETs of the DC-DC converter via isolated 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 adjust, active current sharing, primary shut-down, and an output voltage monitor activating a relay with a change-over contact.

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

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Fig. 1
Block diagram
Electrical Input Data

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

Table 2: Input data

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>110RCM500-24</th>
<th>110RCM1000-24</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_i$</td>
<td>Operating input voltage</td>
<td>$I_o = 0 - I_{o,\text{max}}$</td>
<td>77 (110)</td>
<td>137.5</td>
</tr>
<tr>
<td>$V_{1,2s}$</td>
<td>for $\leq 2$ s without shutdown</td>
<td></td>
<td>66</td>
<td>154</td>
</tr>
<tr>
<td>$V_{i,\text{nom}}$</td>
<td>Nominal input voltage</td>
<td></td>
<td></td>
<td>110</td>
</tr>
<tr>
<td>$V_{i,\text{abs}}$</td>
<td>Input voltage limits</td>
<td>$3$ s without damage</td>
<td>0</td>
<td>165</td>
</tr>
<tr>
<td>$I_i$</td>
<td>Typical input current</td>
<td>$V_{i,\text{nom}}, I_{o,\text{nom}}$</td>
<td>4.8</td>
<td>9.5</td>
</tr>
<tr>
<td>$P_{i,0}$</td>
<td>No-load input power</td>
<td>$V_{i,\text{min}} - V_{i,\text{max}}, I_o = 0$</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>$P_{i,\text{SD}}$</td>
<td>Idle input power</td>
<td>$V_{i,\text{min}} - V_{i,\text{max}}, V_{\text{SD}} = 0,\text{V}$</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>$C_{i}$</td>
<td>Input capacitance$^1$</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>$R_{i}$</td>
<td>Input resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{\text{irp}}$</td>
<td>Peak inrush current</td>
<td>$V_i = 137.5,\text{V}, I_o,\text{nom}$</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>$t_{\text{inr, d}}$</td>
<td>Duration of inrush current</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t_{\text{on}}$</td>
<td>Start-up time at switch on</td>
<td>$0 \rightarrow V_{i,\text{min}}, I_{o,\text{nom}}$</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Start-up time after removal of shutdown</td>
<td>$V_{i,\text{min}} \geq 77,\text{V}, I_{o,\text{nom}}$</td>
<td></td>
<td>300</td>
</tr>
</tbody>
</table>

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

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 external input circuit breaker or fuse will trip. If the fuse is incorporated (options F and M), 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.
Electrical Output Data

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

### Table 4: Output data

<table>
<thead>
<tr>
<th>Output Characteristics</th>
<th>Conditions</th>
<th>110RCM500-24</th>
<th>110RCM1000-24</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_o$ Output voltage $^1$</td>
<td>$V_{i\text{ nom}}, 0.5, l_{o\text{ nom}}$</td>
<td>23.76</td>
<td>24</td>
<td>24.24</td>
</tr>
<tr>
<td>$V_{\text{dmax}}$ Worst case output voltage</td>
<td>$V_{i\text{ min}} - V_{i\text{ max}}$</td>
<td>23.28</td>
<td>24.72</td>
<td>23.28</td>
</tr>
<tr>
<td>$V_{\text{drop}}$ Voltage droop</td>
<td>–10</td>
<td>–5</td>
<td>mV/A</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{op}}$ Overvoltage protection $^2$</td>
<td>28.5</td>
<td>30</td>
<td>31.5</td>
<td>V</td>
</tr>
<tr>
<td>$V_{\text{ol}}$ Overvoltage shutdown $^5$</td>
<td>28</td>
<td>28</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$l_{o\text{ nom}}$ Nominal output current</td>
<td>21</td>
<td>42</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>$l_{o\text{ L}}$ Output current limit</td>
<td>$T_{C\text{ min}} - T_{C\text{ max}}$</td>
<td>23</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>$V_o$ Output noise $^3$</td>
<td>Switch. frequ.</td>
<td>240</td>
<td>240</td>
<td>mVpp</td>
</tr>
<tr>
<td></td>
<td>Total incl. spikes</td>
<td>480</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{od}}$ Dynamic load regulation</td>
<td>Voltage deviation $^5$</td>
<td>$V_{\text{ nom}}$, $l_{o\text{ nom}}$</td>
<td>0.1 $\leftrightarrow$ 0.9 $l_{o\text{ nom}}$</td>
<td></td>
</tr>
<tr>
<td>$t_d$ Recovery time</td>
<td></td>
<td></td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>$\alpha_{V_{o\text{to}}}$ Temp. coefficient of $V_o$ (NTC)</td>
<td>$0 - l_{o\text{ nom}}, T_{C\text{ min}} - T_{C\text{ max}}$</td>
<td>–0.02</td>
<td>0</td>
<td>–0.02</td>
</tr>
</tbody>
</table>

1. If the output voltage is increased above $V_{o\text{ nom}}$ through $R$-input control, the output power should be reduced accordingly, so that $P_{o\text{ max}}$ and $T_{C\text{ max}}$ 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 $V_{o\text{ nom}}$; see fig. 4.

5. No overshoot at switch on.


<Fig. 2>
**Typical dynamic load regulation of output voltage**

**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. 3.

**Parallel and Series Connection and Redundancy**

The outputs of max. 5 RCM Series converters may be connected in series without restrictions.

<Fig. 3>
**Rectangular current limitation of single-output models**

Converters with option D exhibit an additional pin T to provide active current sharing by simply interconnecting these pins. To ensure proper current sharing, the load lines should have equal length and section. For redundant systems, we recommend option Q.

The output voltage tends to be lowered with increasing temperature.

**LED Indicator**

The converters exhibit a green LED “Out OK”, signaling that the output voltage is within the specified range.
Description of Options

Option D: Output Monitor, Output Adjust, Shutdown

Option D consists of several auxiliary functions and encompasses an additional auxiliary connector.

Output Voltage Adjust (R)

Note: With open R-input, \( V_o = V_{o \text{nom}} \).

The converter allows for adjusting the output voltage in the range of 80 to 105\% of \( V_{o \text{nom}} \). The adjust is accomplished by an external resistor \( R_{\text{ext1}} \) or \( R_{\text{ext2}} \), connected to the R-input; see fig. 6.

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

either: Between the R-pin and R– to adjust the output voltage to a value below \( V_{o \text{nom}} \):

\[
R_{\text{ext1}} = 4 \, \text{k}\Omega \times \frac{V_o}{V_{o \text{nom}}} - 15.8 \, \text{k}\Omega
\]

Note: \( R_{\text{ext1}} = 0 \, \Omega \) reduces \( V_o \) to 80\%.

or: Between the R-pin and R+ to adjust the output voltage to a value greater than \( V_{o \text{nom}} \):

\[
R_{\text{ext2}} = 4 \, \text{k}\Omega \times \frac{(V_o - 2.5 \, \text{V})}{2.5 \, \text{V} \times (V_o/V_{o \text{nom}} - 1)} - 682 \, \text{k}\Omega
\]

Note: \( R_{\text{ext2}} = 0 \, \Omega \) increases \( V_o \) to 105\%.

Fig. 6
Output voltage control via R-input

Output Voltage Monitor (D)

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.

Note: The trigger levels are typ. \( \pm 5 \% \) of \( V_{o \text{nom}} \) (with open R-input).

Data of relay contacts: 0.4 A /150 VDC or 10 A /250 VAC.

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 (\( \sim V_i \)). If the shutdown function is not required, pin SD can be left open-circuit. Voltage on pin SD:

Converter operating: \( 10 \) to \( 154 \) V or open-circuit
Converter disabled: \( -2 \) to \( +2 \) V

The output response is shown in fig. 7.

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.

 Interruption Time (M)

The interruption time \( t_{\text{hu}} \) is specified in the railway standard EN 50155 clause 5.1.1.3: Class S2 is 10 ms. It is measured at \( V_{o \text{nom}} \) (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. 7 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.

Fig. 7
Typical output response to the SD-signal. If option M is not fitted, \( t_{\text{hu}} = 0 \).

ORing FET (Q) 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. The voltage drop is approx. 22 mV (not dependent of \( I_o \)).

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).
Incorporated Fuse (F)
The railway standard EN 50155 ban fuses in the converters. Consequently, the installer must preview an external fuse or circuit breaker. However, when this is not possible, we offer an incorporated fuse together with a 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 fuses are specified in table 5.

### Electromagnetic Compatibility (EMC)

#### Electromagnetic Immunity

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Standard</th>
<th>Level</th>
<th>Coupling mode</th>
<th>Value applied</th>
<th>Waveform</th>
<th>Source imped.</th>
<th>Test procedure</th>
<th>In oper.</th>
<th>Perf. crit.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrostatic discharge</strong></td>
<td>IEC / EN 61000-4-2</td>
<td>4 ³</td>
<td>contact direct</td>
<td>±2000 V&lt;sub&gt;p&lt;/sub&gt;</td>
<td>1/50 ns</td>
<td>330 Ω</td>
<td>10 positive and 10 negative discharges</td>
<td>yes</td>
<td>A</td>
</tr>
<tr>
<td>(to case)</td>
<td></td>
<td></td>
<td></td>
<td>6000 V&lt;sub&gt;p&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>air discharge</td>
<td>8000 V&lt;sub&gt;p&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electromagnetic field</strong></td>
<td>IEC / EN 61000-4-3</td>
<td>x⁴</td>
<td>antenna</td>
<td>20 V/m</td>
<td>AM 80% /1 kHz</td>
<td>n.a.</td>
<td>80 – 800 MHz</td>
<td>yes</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 V/m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 V/m</td>
<td>AM 80% /1 kHz</td>
<td>n.a.</td>
<td>800 – 1000 MHz</td>
<td>yes</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 V/m</td>
<td></td>
<td></td>
<td>1400 – 2000 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 V/m</td>
<td></td>
<td></td>
<td>2000 – 2700 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5100 – 6000 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electrical fast transients/burst</strong></td>
<td>IEC / EN 61000-4-4</td>
<td>3 ⁶</td>
<td>capacitive, o/c</td>
<td>±2000 V&lt;sub&gt;p&lt;/sub&gt;</td>
<td>bursts of 5/50 ns</td>
<td>50 Ω</td>
<td>60 s positive 60 s negative transients per coupling mode</td>
<td>yes</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>i/c, +i/-i direct</td>
<td>2.5/5 kHz over 15 ms; burst period: 300 ms</td>
<td>42 Ω 0.5 µF</td>
<td>5 pos. and 5 neg. surges per coupling mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surges</strong></td>
<td>IEC / EN 61000-4-5</td>
<td>3 ⁹</td>
<td>i/c</td>
<td>±2000 V&lt;sub&gt;p&lt;/sub&gt;</td>
<td>1.2/50 µs</td>
<td>150 Ω</td>
<td>0.15 – 80 MHz</td>
<td>yes</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+i/−i</td>
<td>±1000 V&lt;sub&gt;p&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conducted disturbances</strong></td>
<td>IEC / EN 61000-4-6</td>
<td>3 ¹⁰</td>
<td>i, o, signal wires</td>
<td>10 VAC (140 dBuV)</td>
<td>AM 80% 1 kHz</td>
<td>150 Ω</td>
<td>0.15 – 80 MHz</td>
<td>yes</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Converter</th>
<th>Fuse specification</th>
<th>Ordering number</th>
</tr>
</thead>
<tbody>
<tr>
<td>110RCM500-24</td>
<td>12 A, fast acting</td>
<td>Littlefuse 0505012.MX52 LEP</td>
</tr>
<tr>
<td>110RCM1000-24</td>
<td>25 A, fast acting</td>
<td>Littlefuse 0505025.MX52 LEP</td>
</tr>
</tbody>
</table>

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
3 Exceeds EN 50121-3-2:2015 table 6.3
4 Corresponds to EN 50121-3-2:2015 table 6.1
5 Corresponds to EN 50121-3-2:2015 table 6.2 (compliance with digital mobile phones).
6 Corresponds to EN 50121-3-2:2015 table 5.2
7 Covers or exceeds EN 50121-3-2:2015 table 4.3
8 Corresponds to EN 50121-3-2:2015 table 5.1 (radio frequency common mode).
Electromagnetic Emissions

The conducted emissions (fig. 9) have been tested according to EN 55011 (similar to EN 55022, much better values than requested by EN 50121-3-2:2015, table 1.1). The limits in fig. 8 and 9 apply to quasipeak values, which are always lower than peak values.

Radiated emissions have been tested according to EN 55011 (similar to EN 55022), class A, as requested in EN 50121-3-2:2015, table 3.1. The test is executed with horizontal and vertical polarization. The worse result is shown in fig. 10.

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

Fig. 8a
110RCM500-24: Typ. conducted disturbances at the input ($V_i=110$ V, $I_{inom}$, resistive load, quasi peak and average).

Fig. 9b
110RCM1000-24: Typ. radiated disturbances in 10 m distance ($V_i = 110$ V, $I_{inom}$, resistive load, quasi peak).

Fig. 8b
110RCM500-24: Typ. radiated disturbances in 10 m distance ($V_i = 110$ V, $I_{inom}$, resistive load, quasi peak).
Immunity to Environmental Conditions

Table 7: Mechanical and climatic stress. Air pressure 800 – 1200 hPa

<table>
<thead>
<tr>
<th>Test method</th>
<th>Standard</th>
<th>Test conditions</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bd Dry heat test steady state</td>
<td>EN 50155:2007, clause 12.2.4 IEC/EN 60668-2-2</td>
<td>Temperature: 70 °C, Duration: 6 h</td>
<td>Converter operating</td>
</tr>
<tr>
<td>Ad Cooling test steady state</td>
<td>EN 50155:2007, clause 12.2.3 IEC/EN 60668-2-1</td>
<td>Temperature, duration: −40 °C, 2 h, Performance test: +25 °C</td>
<td>Converter not operating</td>
</tr>
<tr>
<td>-- Low temperature storage test</td>
<td>EN 50155:2007, clause 12.2.14 IEC/EN 60668-2-1</td>
<td>Temperature, duration: −40 °C, 16 h</td>
<td>Converter not operating</td>
</tr>
<tr>
<td>Ka 1 Salt mist test</td>
<td>EN 50155:2007, clause 12.2.10 IEC/EN 60668-2-11</td>
<td>Temperature: 35 ±2 °C, Duration: 16 h</td>
<td>Converter not operating</td>
</tr>
<tr>
<td>-- Shock</td>
<td>EN 61373 sect. 10, class B, body mounted 1</td>
<td>Acceleration amplitude: 5.1 g_n, Bump duration: 30 ms, Number of bumps: 18 (3 in each direction)</td>
<td>Converter operating</td>
</tr>
<tr>
<td>-- Simulated long life testing at increased random vibration levels</td>
<td>EN 50155:2007 clause 12.2.11 IEC/EN 60668-2-11</td>
<td>Acceleration spectral density: 0.02 g_n²/Hz, Frequency band: 5 – 150 Hz, Acceleration magnitude: 0.8 g_n rms, Test duration: 15 h (5 h in each axis)</td>
<td>Converter operating</td>
</tr>
</tbody>
</table>

1 This test is not mandatory in EN 50155. It was not yet executed.
2 Body mounted = chassis of a railway coach

Temperatures

Table 8: Temperature specifications, valid for an air pressure of 800 – 1200 hPa (800 – 1200 mbar)

<table>
<thead>
<tr>
<th>Temperature</th>
<th>EN 50155 Class T2</th>
<th>EN 50155 Class TX 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>T_A Ambient temperature</td>
<td>−40</td>
<td>55</td>
</tr>
<tr>
<td>T_C Case temperature 2 3</td>
<td>-40</td>
<td></td>
</tr>
<tr>
<td>T_S Storage temperature</td>
<td>−55</td>
<td>85</td>
</tr>
</tbody>
</table>

1 Output power reduced.
2 Over temperature shutdown
3 Measured at the measurement point T_C; see Mechanical Data.

Reliability

Table 9: MTBF and device hours

<table>
<thead>
<tr>
<th>Ratings at specified case temperature between failures 1</th>
<th>Model</th>
<th>MTBF</th>
<th>Demonstrated hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accord. to IEC 62380 110RCM1000-24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Statistical values, based upon an average of 4300 working hours per year and in general field use over 5 years; upgrades and customer-induced errors are excluded.
Safety and Installation Instructions

Connectors and Pin Allocation

- Input connector, 3 pins: Wago 745-353: Vi+, Vi−, PE;
  recommended wire sections:
  RCM500: 2 – 6 mm², 14 – 10 AWG;
  RCM1000: 3.3 – 6 mm², 12 – 10 AWG;

- Output connector, 2 pins: Wago 745-652/006-000: Vo+, Vo−;
  recommended wire sections:
  RCM500: 3.3 – 13 mm², 12 – 06 AWG;
  RCM1000: 5 – 13 mm², 10 – 06 AWG;

- Auxiliary connector: Phoenix Contact 1874043;
  recommended wire section: 0.2 – 1.5 mm², 24 – 16 AWG;
  pin allocation see fig. 10.

Installation Instructions

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. \( T_{C_{\text{max}}} \) 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 safety standards IEC/EN 60950-1 and UL/CSA 60950-1 2nd Ed.

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 9001:2008.

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 20.

Railway Applications

The RCM Series converters have been designed observing the railway standards EN 50155:2007 and EN 50121:2015. All boards are coated with a protective lacquer. The converters comply with the fire & smoke standard EN 45545, HL1 to HL3.

Isolation

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

Table 11: Isolation

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Input to case + output</th>
<th>Output to case</th>
<th>Relay contacts to case</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric strength test</td>
<td>4.2</td>
<td>2.86</td>
<td>1.0</td>
<td>2.86</td>
</tr>
<tr>
<td>AC test voltage equivalent to actual factory test</td>
<td>3.0</td>
<td>2.0</td>
<td>0.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>&gt;300 ²</td>
<td>&gt;300 ²</td>
<td>&gt;100</td>
<td>&gt;300 &gt;300 &gt;300</td>
</tr>
<tr>
<td>Creepage distances</td>
<td>5.0</td>
<td>3.5</td>
<td>1.5</td>
<td>3.5 3.5 3.5</td>
</tr>
</tbody>
</table>

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

Dimensions in mm.

![Mechanical Data Diagram]

Fig. 11
Case for RCM500.
RCM03,
Aluminum,
EP powder-coated.

Fig. 12
Case for RCM1000.
RCM04,
Aluminum,
EP powder-coated.

Accessories

Female Connector
A suitable 16 pin female connector (HZZ00146-G) is available.

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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