RCMB104
AC/DC sensitive residual current monitoring module for electric vehicle charging systems
**Intended use**

The residual current monitoring modules are used in combination with a measuring current transformer, e.g. the CTBC17, and a type A RCD which has to be provided in the installation for fault current monitoring of AC charging systems for electric vehicles in which AC or DC fault currents can occur.

The module is, depending on the variant, suitable for integration into a charging unit (Mode 2, IC-CPD,) according to IEC 62752 or UL 2231-2 (CCID5 or CCID20).

The monitoring module RCMB104 must be soldered or plugged directly on the customer’s own PCB via the provided connection pins, the length of the connection conductor paths should not exceed 100 mm!

The monitoring modules are only intended for purchase by the manufacturer of the charging system and not for end users!

**Function**

The residual current evaluation unit consists of an externally connected measuring current transformer for measuring and the monitoring module for evaluating the residual currents.

The module determines with its patented measuring method the RMS value of the DC component contained in the residual current and the AC component that is below the cutoff frequency.

The outputs Switch1 and Switch2 of the RCMB104 signal a limit value overrun. The limit values are variant-dependent and, in combination with RCD type A, comply with the respective normative trip requirements according to IEC 62752 or UL 2231-2 (CCID5 or CCID20).

**Residual current measurement:** AC/DC sensitive residual current measurement

**Charging process:** Before each charging process, the charge controller must check that the monitoring module functions correctly. The charging process must be disabled. Regular testing increases the safety of the charging process and prevents long-term drift of the residual current measurement by means of an internal offset measurement.

**Measuring current transformer:** The measuring current transformer is magnetically shielded, so that no external interference can affect the residual current measurement.

**Standards**

The monitoring modules comply, depending on the variant, with the following device standards:

**RCMB104-1:**
- IEC 62752 In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)

**RCMB104-2:**
- CCID20 acc. to UL 2231-2 (Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems)

**RCMB104-2:**
- CCID5 acc. to UL 2231-2 (Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems)

**Approvals**

- IEC 62752
- UL 2231-2 (CCID5 or CCID20)
- CCID20
- CCID5

* Only in case of use according to UL2231-2

**Patents**

EP 2 571 128 / US 9,397,494 / ZL 20120157968.6 / CN 103001175, EP 2 813 856
Wiring diagram

Ladeeinrichtung/Charging device

Mains 3AC

CTBC17

driver circuit

Vcc

L1

L2

L3

N

Residual current sensor

OUT IN

Switch1

Switch2

PWM

Test

PWM

n.c.

Error

Release

IN OUT

Laderegler/Charge controller

Vcc

10 nF*

100 nF*

100 nF*

100 nF*

* Optional capacities for EMC optimisation

Dimension diagram

Dimension in mm

Side view; Front view

Recommended drilling diameter: Ø 1,1mm

Tolerances dimensions

<table>
<thead>
<tr>
<th>x1</th>
<th>± 0,05</th>
</tr>
</thead>
<tbody>
<tr>
<td>x2</td>
<td>± 0,1</td>
</tr>
<tr>
<td>x3</td>
<td>± 0,2</td>
</tr>
<tr>
<td>x4</td>
<td>± 0,3</td>
</tr>
</tbody>
</table>
### Connection socket measuring current transformer

<table>
<thead>
<tr>
<th>Description</th>
<th>Pin assignment</th>
<th>Valuating board</th>
<th>Connection Socket CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test winding (start of winding)</td>
<td>3S1*</td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>Test winding</td>
<td>3S2</td>
<td>e</td>
<td></td>
</tr>
<tr>
<td>Measuring winding 2 (start of winding)</td>
<td>1S1*</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>Measuring winding 1 (start of winding)</td>
<td>2S1*</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>Measuring winding 2</td>
<td>1S2</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>Measuring winding 1</td>
<td>2S2</td>
<td>f</td>
<td></td>
</tr>
</tbody>
</table>

*Only valid for wired variants. For the soldered variant of the CTBC17, the corresponding manual must be observed. Further information see "Technical data".

### Inputs/outputs

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>Input test: activated by GND for 40 ms…1.2 s</td>
</tr>
<tr>
<td>Error</td>
<td>Fault output (active low)</td>
</tr>
<tr>
<td>LOW: no system fault</td>
<td></td>
</tr>
<tr>
<td>HIGH: system fault</td>
<td></td>
</tr>
<tr>
<td>Switch1</td>
<td>RCMB104-1 (active low):</td>
</tr>
<tr>
<td>LOW: $I_{\text{rms1}} &lt; \text{RMS 30 mA}$, no system fault</td>
<td></td>
</tr>
<tr>
<td>HIGH: $I_{\text{rms1}} \geq \text{RMS 30 mA}$ or system fault</td>
<td></td>
</tr>
<tr>
<td>RCMB104-2 CCID20 acc. to UL 2231-2 (active low):</td>
<td></td>
</tr>
<tr>
<td>LOW: $I_{\text{1}} &lt; \text{RMS 20 mA}$, no system fault</td>
<td></td>
</tr>
<tr>
<td>HIGH: $I_{\text{1}} \geq \text{RMS 20 mA}$ or system fault</td>
<td></td>
</tr>
<tr>
<td>Switch2</td>
<td>RCMB104-1 IEC 62752 (active low):</td>
</tr>
<tr>
<td>LOW: $I_{\text{rms2}} &lt; \text{RMS 5 mA}$, no system fault</td>
<td></td>
</tr>
<tr>
<td>HIGH: $I_{\text{rms2}} \geq \text{RMS 5 mA}$ or system fault</td>
<td></td>
</tr>
<tr>
<td>RCMB104-2 CCIDS acc. to UL 2231-2 (active low):</td>
<td></td>
</tr>
<tr>
<td>LOW: $I_{\text{2}} &lt; \text{RMS 5 mA}$, no system fault</td>
<td></td>
</tr>
<tr>
<td>HIGH: $I_{\text{2}} \geq \text{RMS 5 mA}$ or system fault</td>
<td></td>
</tr>
<tr>
<td>Vcc</td>
<td>$\pm \text{VCC}$: Voltage supply module +5 V</td>
</tr>
<tr>
<td>N. C.</td>
<td>Not connected</td>
</tr>
<tr>
<td>PWM</td>
<td>Output pulse width modulation (f = 8 kHz)</td>
</tr>
<tr>
<td>RCMB104-1: 0…100 % = DC 0…30 mA</td>
<td></td>
</tr>
<tr>
<td>RCMB104-2: 0…100 % = RMS 0…50 mA</td>
<td></td>
</tr>
</tbody>
</table>

### Recommended drilling diameter pins: Ø 0.9 mm

### Timing diagram „Test“ RCMB104-1 and -2

- M1-M3 = Measurement time point
- $t_1$ = typ. 270 ms (start up delay to drive outputs)
- $t_2$ = 30 ms…1.2 s
- $t_3$ = 700 ms
- $t_4$ = 700 ms
- $t_5$ = 600 ms

After starting the test, the charging system must ensure that the outputs are set correctly at the measurement time points M…:

- M1: Switch2 = HIGH
- M2: Switch1 = HIGH
- M3: Switch2 / Switch1 = LOW

*The offset measurement only takes place when, after the test, both outputs are LOW (M1, M2). If the outputs are not set correctly at the measuring times M…, the RCMB104 must be regarded as defective.
Technical data

Main circuit (current paths trough CT)
Rated operational voltage $U_e$ 230/400 V
Rated current $I_n$  single-phase: 32 A (80 A)
 three-phase: 32 A

Insulation coordination according to IEC 60664-1/IEC 60664-3
Definitions:
Main circuit IC1 (L1, L2, L3, N)
Control circuit IC2 (a…f, Test, Error, Switch1, Switch1, Vcc, GND, PWM)
Rated voltage 250 V
Overvoltage category (ÜK) III
Rated impulse voltage:
IC1/IC2  4 kV
Rated insulation voltage $U_I$:
IC1/IC2  250 V
Pollution degree 2
Protective separation (reinforced insulation) between:
IC1/IC2  ÜK III, 250 V

The data are valid from the main circuit to the control circuit.

Power supply
Nominal supply voltage $V_{cc}$ DC 5 V
Tolerance of the supply voltage $V_{cc}$ ±5%
Voltage ripple $V_{cc}$ < 100 mV
Absolute maximum supply voltage $V_{cc}$ DC 5.5 V
Supply current $I_{cc}$ 45 mA

Residual current measuring range
Rated frequency $f_{nom}$ 0…2000 Hz
Measuring range $I_{nom}$ ±300 mA
Resolution $I_{nom}$ < 0.2 mA

Response values

RCMB104-1 (Switch1)
Rated residual operating current $I_{nom1}$ RMS 30 mA
Response tolerance $I_{nom1}$
for $f = DC ... \leq 100$ Hz 0.7 ... 1 $I_{nom1}$
for $f = 100 ... < 400$ Hz 0.8 ... 2.5 $I_{nom1}$
for $f = 400 ... 2000$ Hz 1.5 ... 6 $I_{nom1}$
Restart value $I_{nom1}$ < 10 mA
Operating time $t_{res}$ (DC ... \leq 100 Hz)
1x $I_{nom1}$ < 270 ms
2x $I_{nom1}$ < 80 ms
5x $I_{nom1}$ < 20 ms

RCMB104-1 (Switch2, IEC 62752)
Rated residual operating current $I_{nom2}$ DC 6 mA
Response tolerance $I_{nom2}$
for $f = DC ... \leq 100$ Hz 0.7 ... 1 $I_{nom2}$
for $f = 100 ... < 400$ Hz 0.8 ... 2.5 $I_{nom2}$
for $f = 400 ... 2000$ Hz 1.5 ... 6 $I_{nom2}$
Restart value $I_{nom2}$ < 2.5 mA
Operating time $t_{res}$
DC 6 mA < 10 mA
DC 60 mA < 20 ms
DC 300 mA < 2.5 ms

Output Switch1, Switch2, Error

Type Open Collector (NPN)
Switching capacity DC 40 V/20 mA*
Signalling times in the event of module and hardware errors
Error ≤ 1.5 s
Switch1 ≤ 2.5 s
Switch2 ≤ 2.5 s

PMW output
Type PushPull
HIGH level 3.1...3.5 V*
LOW level 0...0.5 V*
PWM frequency 8000 Hz
Scaling
RCMB104-1 0...100 % = DC 0...30 mA
RCMB104-2 0...100 % = RMS 0...50 mA

Maximum current-carrying ability
10 mA
* The overvoltage protection must be ensured by the customer.

Control input (TEST)

Type LOW: activated state
HIGH: deactivated state
Switching thresholds
HIGH: 3.1...5.5 V
LOW: 0...0.6 V

EMV (IEC 62752, UL 2231-2)

ESD restrictions: The device must be mounted in an enclosure that complies with the mentioned standards.

Restrictions line-conducted interferences:
Maximum connection length: 100 mm
ESD immunity acc. to Human Body Model JESD22-A114 ±2 kV (air)
±2 kV (contact)
Operating temperature –30...80 °C
Storage temperature –40...85 °C
Climatic class
Stationary use (IEC 60721-3-3)  3K24 (except condensation, water and formation of ice)
Transport (IEC 60721-3-2)  2K11
Long-term storage (IEC 60721-3-1)  1K21

Classification of mechanical conditions
Stationary use (IEC 60721-3-3)  3M11
Transport (IEC 60721-3-2)  2M4
Long-term storage (IEC 60721-3-1)  1M12
Range of use  < 4000 m

Degree of protection
RCMB104  IP00
Measuring current transformer (without connector plug)  IP55

Connections
Measuring current transformer
Connection type  PCB plug-in connector 0.65 x 0.65 mm
Modular dimensions  single row 6 x 2.54 mm
Contact surface  tinned
Pin length  2.5 mm

Inputs/outputs
Connection type  PCB plug-in connector 0.5 x 0.5 mm
Arrangement of connections  double row 2 x 4 pins
Modular dimensions  2.00 mm
Contact surface  tinned
Pin length  2.5 mm

Soldering process for PCB  recommended: selective soldering

Ordering information

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Art. No.</th>
<th>Documentation number</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCMB104-1</td>
<td>0…2000 Hz IEC 6/30 mA</td>
<td>B94042480</td>
<td>D00294</td>
</tr>
<tr>
<td>RCMB104-2</td>
<td>0…2000 Hz UL 2231 5/20 mA</td>
<td>B94042481</td>
<td>D00294</td>
</tr>
<tr>
<td>CTBC17P-03</td>
<td>Measuring current transformer Ø = 17 mm</td>
<td>B98080070</td>
<td>D00421</td>
</tr>
<tr>
<td>CTBC17- Kabel180MM</td>
<td>Connection cable 180 ± 30 mm</td>
<td>B98080540</td>
<td></td>
</tr>
<tr>
<td>CTBC17- Kabel325MM</td>
<td>Connection cable 325 ± 25 mm</td>
<td>B98080541</td>
<td></td>
</tr>
<tr>
<td>CTBC17- Kabel600MM</td>
<td>Connection cable 600 ± 30 mm</td>
<td>B98080543</td>
<td></td>
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<tr>
<td>CTBC17- Kabel1470MM</td>
<td>Connection cable 1470 ± 30 mm</td>
<td>B98080542</td>
<td></td>
</tr>
</tbody>
</table>

Connection measuring current transformer CTBC17
Maximum distance to connector  100 mm
Connection type  PCB plug-in connector
Number of poles  6 (2x3 poles)
Modular dimensions  3.0 mm
Number of mating cycles  30
Manufacturer type designation  Molex MicroFit 3.0 Header
Article number  43045-0607

The connector is not included in the scope of delivery.
For further information, refer to the original data sheet created by Molex.