

## EMC filters

3-phase line reactors for converters  
4 A ... 390 A, 40 °C, 50/60 Hz

**Series/Type:** B86305L  
**Date:** May 2014


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**3-phase line reactors for converters**
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**Rated voltage  $V_R$ : 520 V AC**
**Rated current  $I_R$ : 4 A to 390 A**
**Construction**

- 3-phase line reactor
- Natural cooling

**Features**

- Easy to install
- Low weight
- Compact design
- Design complies with IEC 60076-6
- Degree of protection<sup>1)</sup>:
  - IP20 (4 A ... 16 A)
  - IP10 (30 A ... 60 A)
  - IP00 (100 A ... 390 A)
- Inductance constant up to  $1.5 \times I_R$
- Inductance higher than 60% rated value at  $3 \times I_R$
- UL approved insulation system  
T-EIS-CF1 


**Typical applications**

- Frequency converters for motor drives, e.g.
  - elevators
  - pumps
  - traction systems
  - conveyor systems
  - HVAC systems (heating, ventilation and air conditioning)
- Power supplies

**Terminals**

- Finger-safe terminal blocks (< 100 A)
- Busbars from 100 A, cross section  $20 \times 3$  mm

**Marking**

Marking on component:

Manufacturer's logo, ordering code, rated current, rated frequency, inductance, approximate weight, date code

Minimum data on packaging:

Manufacturer's logo, ordering code, quantity, date code

1) According to IEC 60529

**3-phase line reactors for converters**
**Technical data and measuring conditions**

|                                  |   |
|----------------------------------|---|
| Rated voltage $V_R$              | 520 V AC (50/60 Hz)                                       |
| Rated current $I_R$              | Referred to 40 °C rated temperature                       |
| Test voltage $V_{test}$          | 1100 V AC, 2 s (line/line)<br>2500 V AC, 2 s (lines/case) |
| Relative voltage drop $u_k$ in % | At $I_R$ ; 50 Hz and 400 V AC                             |
| Insulation class                 | F (155 °C)  |
| Overload capability (thermal)    | $3 \cdot I_R$ , $t < 3$ s in 300 s                        |
| Climatic category (IEC 60068-1)  | 25/100/21 (–25 °C/+100 °C/21 days damp heat test)         |
| Approvals                        | Insulation system class 155 (F); T-EIS-CF1 UL 1446        |

**Characteristics and ordering codes**

| $I_R^*$<br>A                       | $u_k$<br>% | $R_{typ}^{(1)}$<br>mΩ | $L_R^{(2)}$<br>mH | $P_L^{(3)}$<br>W | Approx. weight<br>kg | Ordering code   |
|------------------------------------|------------|-----------------------|-------------------|------------------|----------------------|-----------------|
| <b><math>V_R = 520</math> V AC</b> |            |                       |                   |                  |                      |                 |
| 4                                  | 5.4        | 335.0                 | 10.0              | 25               | 1.3                  | B86305L0004R000 |
| 10                                 | 5.4        | 78.0                  | 4.0               | 43               | 2.7                  | B86305L0010R000 |
| 16                                 | 4.4        | 42.2                  | 2.0               | 65               | 3.1                  | B86305L0016R000 |
| 30                                 | 4.1        | 12.4                  | 1.0               | 50               | 5.5                  | B86305L0030R000 |
| 60                                 | 4.1        | 6.2                   | 0.5               | 100              | 8.5                  | B86305L0060R000 |
| 100                                | 4.1        | 3.2                   | 0.3               | 160              | 15.0                 | B86305L0100S000 |
| 230                                | 4.7        | 0.9                   | 0.15              | 340              | 32.0                 | B86305L0230S000 |
| 390                                | 4.0        | 0.6                   | 0.075             | 480              | 44.0                 | B86305L0390S000 |

\* Higher current values upon request

1) Typical value at 20 °C, tolerance ±10%

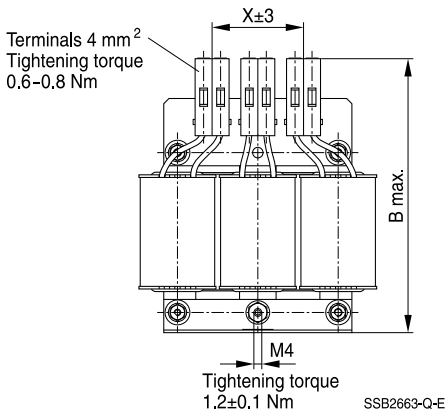
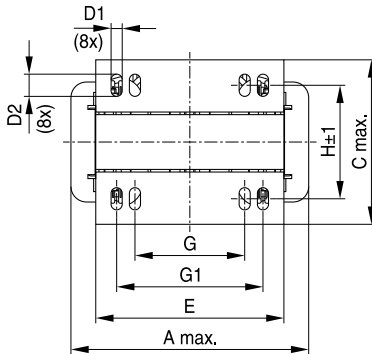
2) Tolerance –0%/+20%,

3) At  $I_R$ , 50 Hz, 20 °C

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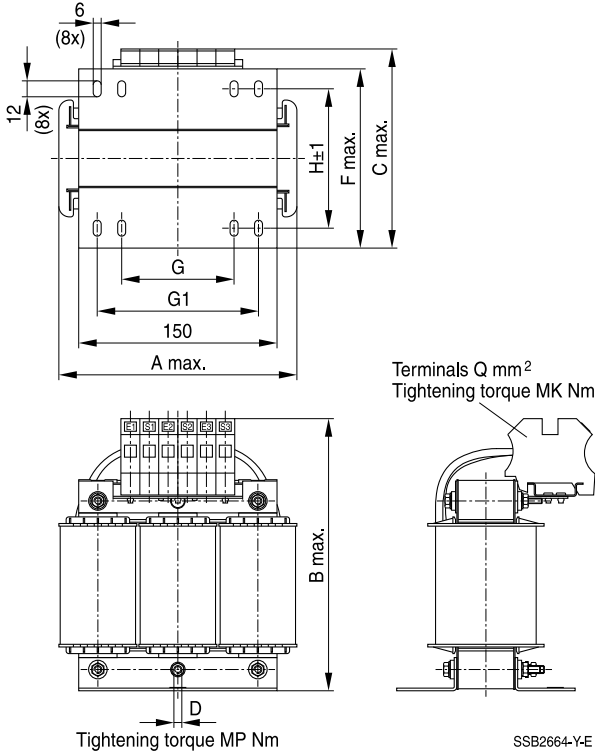
Dimensional drawings

B86305L0004R000 ... B86305L0016R000 (4 A ... 16 A)



| Ordering code   | A   | B   | C  | D1 × D2 | E   | G  | G1   | H  | X  |
|-----------------|-----|-----|----|---------|-----|----|------|----|----|
| B86305L0004R000 | 100 | 135 | 60 | 6 × 9   | 80  | 40 | 60   | 42 | 40 |
| B86305L0010R000 | 130 | 150 | 90 | 6 × 12  | 100 | 60 | 80.5 | 62 | 50 |
| B86305L0016R000 | 130 | 150 | 90 | 6 × 12  | 100 | 60 | 80.5 | 62 | 50 |

General tolerances according to ISO 2768-cL  
Dimensions in mm

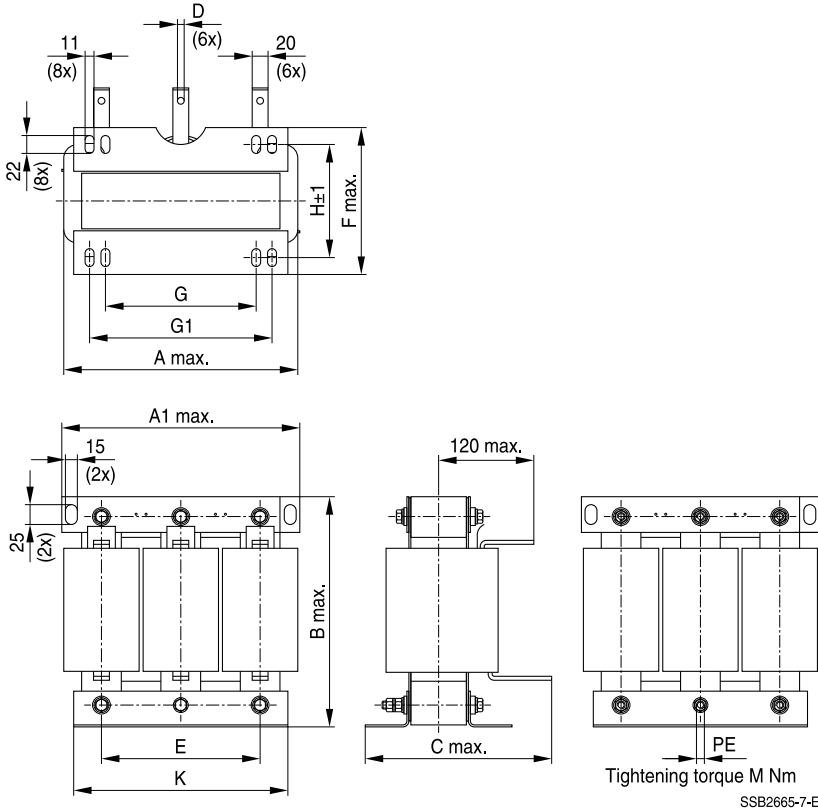
**B86305L0030R000, B86305L0060R000 (30 A, 60 A)**


| Ordering code   | A   | B   | C   | E   | F   | G  | G1  | H   | Q<br>(mm <sup>2</sup> ) | MK<br>(Nm) | PE D | PE MP<br>(Nm) |
|-----------------|-----|-----|-----|-----|-----|----|-----|-----|-------------------------|------------|------|---------------|
| B86305L0030R000 | 155 | 170 | 135 | 125 | 120 | 75 | 107 | 90  | 16                      | 2.0-2.3    | M4   | 1.2±0.1       |
| B86305L0060R000 | 180 | 205 | 150 | 150 | 135 | 85 | 122 | 105 | 35                      | 3.2-3.7    | M6   | 3.0±0.15      |

General tolerances according to ISO 2768–cL  
Dimensions in mm

3-phase line reactors for converters

B86305L0100S000 ... B86305L0390S000 (100 A ... 390 A)




| Ordering code                 | A   | A1  | B   | C   | ∅D  | E   | F   | G   | G1  | H     | K   | PE  | M     |
|-------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-------|
| B86305L0100S000               | 270 | 270 | 210 | 180 | 6.5 | 180 | 145 | 105 | 181 | 100   | 240 | M8  | 6±0.3 |
| B86305L0230S000               | 320 | 300 | 290 | 235 | 8.5 | 200 | 185 | 190 | 230 | 142   | 270 | M10 | 10±1  |
| B86305L0390S000 <sup>1)</sup> | 320 | 300 | 290 | 265 | 8.5 | 200 | 215 | 190 | 230 | 168.5 | 270 | M10 | 10±1  |

General tolerances according to ISO 2768–cL  
Dimensions in mm

1) Preliminary data: Size of Cu connectors 30 × 3 mm

## Cautions and warnings

Please read all safety and warning notes carefully before installing the EMC filter and putting it into operation (see ). The same applies to the warning signs on the filter. Please ensure that the signs are not removed nor their legibility impaired by external influences.

Death, serious bodily injury and substantial material damage to equipment may occur if the appropriate safety measures are not carried out or the warnings in the text are not observed.

## Using according to the terms

The EMC filters may be used only for their intended application within the specified values in low-voltage networks in compliance with the instructions given in the data sheets and the data book. The conditions at the place of application must comply with all specifications for the filter used.

### Warning

- It shall be ensured that only qualified persons (electricity specialists) are engaged on work such as planning, assembly, installation, operation, repair and maintenance. They must be provided with the corresponding documentation.
- Danger of electric shock. EMC filters contain components that store an electric charge. Dangerous voltages can continue to exist at the filter terminals for longer than five minutes even after the power has been switched off.
- The protective earth connections shall be the first to be made when the EMC filter is installed and the last to be disconnected. Depending on the magnitude of the leakage currents, the particular specifications for making the protective-earth connection must be observed.
- Impermissible overloading of the EMC filter or filter, such as with circuits able to cause resonances, impermissible voltages at higher frequencies etc. can lead to bodily injury and death as well as cause substantial material damages (e.g. destruction of the filter housing).
- EMC filters and filters must be protected in the application against impermissible exceeding of the rated currents by overcurrent protective circuitry.
- In case of leakage currents  $>3.5$  mA you shall mount the PE conductor stationary with the required cross section before beginning of operation and save it against disconnecting. For leakage currents  $I_L^{(1)} < 10$  mA the PE conductor must have a KU value<sup>2)</sup> of  $4.5 A^{3)}$ ; for leakage currents  $I_L \geq 10$  mA the PE conductor must have a KU value of 6.<sup>4)</sup>
- Output chokes and output filters must be protected in the application against impermissible exceeding of the component temperature.
- The converter output frequency must be within the specified range to avoid resonances and uncontrolled warming of the output chokes and output filters.

1)  $I_L$  = leakage current let-go

2) The KU value (symbol KU) is a classification parameter of safety-referred failure types designed to ensure protection against hazardous body currents and excessive heating.

3) A value of KU = 4.5 with respect to interruptions is attained with: a) a permanently connected protective earth circuit  $\geq 2.5$  mm<sup>2</sup> connected via shroud connectors (IEC 60309–2) and b) a protective earth circuit.

4) KU = 6 with respect to interruptions is achieved for fixed–connection lines  $\geq 10$  mm<sup>2</sup> where the type of connection and line layout correspond to the requirements for PEN conductors as specified in relevant standards.

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The table below summarizes the safety instructions that must be observed without fail. A detailed description can be found in the relevant chapters of the databook.

| Topic   | Instructions  | Reference chapter (data book), paragraph               |
|---|---|--|
| Selecting a filter  | When selecting a filter, it is mandatory to observe the rated data of the equipment (such as its rated input current, rated voltage, harmonic content etc.) as well as the derating instructions in Chapters 9 and 10.  | Selection guide for converter filters                  |
| Rated voltage   | When power distribution systems deviating from the symmetric TN-S system it is to check the suitability of the EMC filters and the allowed voltages including the fault cases.  | Power distribution systems, 7                          |
| Protection from residual voltages<br>Discharge resistors      | Active parts must be discharged within 5 s to a voltage of less than 60 V (or 50 $\mu$ C). If this limit cannot be observed due to the operating mode, the hazardous point must be permanently marked in a clearly visible way.<br><br>Filters which are not permanently connected (e.g. when the test voltage is applied to the filter at the incoming goods inspection) must be discharged after the voltage has been switched off. | Safety regulations, 6.1<br><br>Safety regulations, 6.2 |
| Installing and removing of EMC filters<br>Installation        | When installing and removing our EMC filters, a voltage-free state must be set up and secured with observance of the five safety rules described in EN 50110-1.   | Safety regulations, 6.4                                |
| Use in IT systems   | The special features of the IT system ("first fault case" and other fault cases) shall be observed.   | Power distribution system (network types), 7.6         |
| Safety notes on leakage currents                              | The filter leakage currents specified in the data book are intended for user information only. The maximum leakage current of the entire electrical equipment or appliance has to be limited for safety reasons. Please obtain the applicable limits for your application from the relevant regulations, provisions and standards.  | Leakage current, 8.4<br>Leakage current, 8.6           |
| Voltage derating<br>Hazards caused by overloading the filters | If the permissible limits for the higher-frequency voltages at the filter are exceeded, the filter may be damaged or destroyed.   | Voltage derating, 9.8                                  |
| Current derating at elevated ambient temperatures             | Non-observance of the current derating may lead to overheating and consequently represents a fire hazard.   | Current derating, 10.1                                 |



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| Topic  | Instructions   | Reference chapter (data book), paragraph |
|--|--|--|
| Protective earth connection at operating currents >250 A | For operating currents greater than 250 A, we recommend the PE connection to be set up between the feed (filter: line) and output (filter: load) not via the PE terminal bolt in the filter housing.   | Mounting instructions, point 2           |
| Mounting position  | Note the mounting position of the filters! It must always be ensured that natural convection is not impaired.  | Mounting instructions, point 13          |
| Long motor cables  | Long motor cables cause parasitic currents in the installation. The cable lengths indicated for the output chokes and output filters serve for orientation. The user must check the technical parameters and especially the choke temperatures for the respective application. | Mounting instructions, point 15          |

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**3-phase line reactors for converters**
**Symbols and terms**

| Symbol      | English                                       | German                           |
|-------------|---|----------------------------------|
| $\alpha$    | Insertion loss                                | Einfügungsämpfung                |
| $C_R$       | Rated capacitance                             | Bemessungskapazität              |
| $C_X$       | Capacitance X capacitor                       | Kapazität X-Kondensator          |
| $C_Y$       | Capacitance Y capacitor                       | Kapazität Y-Kondensator          |
| $\Delta V$  | Voltage drop (input to output)                | Spannungsabfall im Filter        |
| $dv/dt$     | Rate of voltage rise                          | Spannungsanstiegsgeschwindigkeit |
| $f$         | Frequency                                     | Frequenz                         |
| $f_M$       | Converter output frequency                    | Motorfrequenz                    |
| $f_P$       | Pulse frequency                               | Pulsfrequenz                     |
| $f_R$       | Rated frequency                               | Bemessungsfrequenz               |
| $f_{res}$   | Resonant frequency                            | Resonanzfrequenz                 |
| $I_C$       | Current through capacitor                     | Strom durch Kondensator          |
| $I_{LK}$    | Filter leakage current                        | Filter-Ableitstrom               |
| $I_{max}$   | Maximum current                               | Maximalstrom                     |
| $I_N$       | Nominal current                               | Nennstrom                        |
| $I_{op}$    | Operating current (design current)            | Betriebsstrom                    |
| $I_{pk}$    | Rated peak withstand current                  | Bemessungs-Stoßstromfestigkeit   |
| $I_q$       | Capacitive reactive current                   | Kapazitiver Blindstrom           |
| $I_R$       | Rated current                                 | Bemessungsstrom                  |
| $I_S$       | Interference current                          | Störstrom                        |
| $L$         | Inductance                                    | Induktivität                     |
| $L_R$       | Rated inductance                              | Bemessungsinduktivität           |
| $L_{stray}$ | Stray inductance                              | Streuinduktivität                |
| $P_L$       | Power loss                                    | Verlustleistung                  |
| $R$         | Resistance                                    | Widerstand                       |
| $R_{is}$    | Insulation resistance                         | Isolationswiderstand             |
| $R_{typ}$   | DC resistance, typical value                  | Gleichstromwiderstand, Richtwert |
| $T_A$       | Ambient temperature                           | Umgebungstemperatur              |
| $T_{max}$   | Upper category temperature                    | Obere Kategorietemperatur        |
| $T_{min}$   | Lower category temperature                    | Untere Kategorietemperatur       |
| $T_R$       | Rated temperature                             | Bemessungstemperatur             |
| $u_k$       | Referred voltage drop in %                    | Bezogener Spannungsabfall in %   |
| $V_{eff}$   | RMS voltage                                   | Effektivspannung                 |
| $V_K$       | Voltage drop                                  | Spannungsabfall                  |
| $V_{LE}$    | Voltage line to earth; voltage line to ground | Spannung Phase zu Erdpotential   |
| $V_N$       | Nominal voltage                               | Nennspannung                     |
| $V_R$       | Rated voltage                                 | Bemessungsspannung               |
| $V_{peak}$  | Peak voltage                                  | Spitzenspannung                  |
| $V_{test}$  | Test voltage                                  | Prüfspannung                     |
| $V_X$       | Voltage over X capacitor                      | Spannung über X-Kondensator      |
| $V_Y$       | Voltage over Y capacitor                      | Spannung über Y-Kondensator      |
| $X_L$       | Inductive reactance                           | Induktiver Blindwiderstand       |
| $Z$         | Impedance                                     | Scheinwiderstand                 |
| $ Z $       | Impedance, absolute value                     | Scheinwiderstand (Betragswert)   |

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