

## **EMC filters**

3-line filters

Sine-wave output filters

230/400 V AC, 6 A ... 249 A, 40 °C


**Series/Type:**            **B84143V\*R/S231**

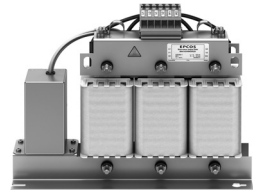
**Date:**                    January 2024

**Sine-wave output filters for 3-phase systems**
**Rated voltage  $V_R$ : 230/400 V AC**
**Rated current  $I_R$ : 6 A to 249 A**
**Construction**

- 3-line filters

**Features**

- Reduction of motor noise and eddy current losses
- Generation of sinusoidal phase-to-phase voltage with low ripple
- dv/dt reduction
- Easy to install
- Degree of protection: IP00<sup>1)</sup>
- Optimized for long motor cables and operation under full load<sup>2)</sup>
- Natural cooling
- Wiring between inverter and filter must be shorter than 10 meters!
- Designed with reference to IEC 60939 und UL1283
- UL approved insulation system  
(system designation: T-EIS-CF1) 


**Typical applications**

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

**Terminals**

- Up to 145 A: Finger-safe terminal blocks
- 209 A, 249 A: Copper busbars

**Marking**

Marking on component:

Manufacturer's logo, ordering code, rated voltage, rated current, rated motor frequency, rated switch frequency, rated temperature, climatic category, date code

Minimum data on packaging:

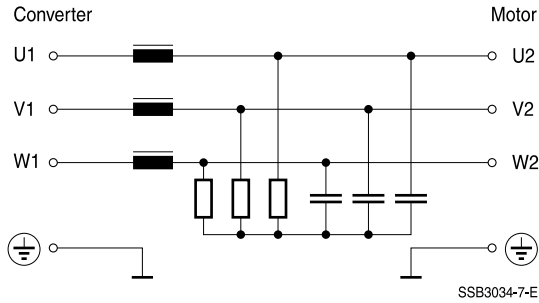
Manufacturer's logo, ordering code, quantity, date code

1) According to IEC 60529

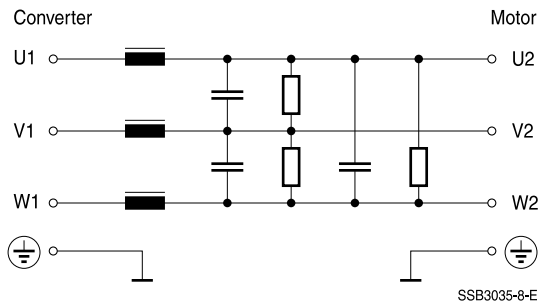
2) The maximum permissible motor cable length depends on the application and must be checked.

Typical circuit diagrams

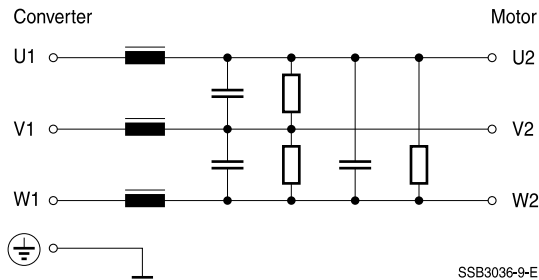
Filters 6 A ... 43 A



Filters 64 A ... 145 A



Filters 209 A, 249 A

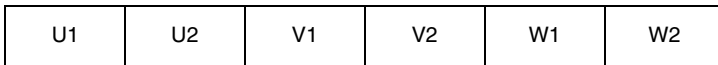


Sine-wave output filters for 3-phase systems

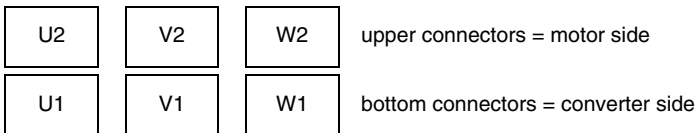
Connection

|            |    |        |    |
|------------|----|--------|----|
| Converter: | U1 | Motor: | U2 |
|            | V1 |        | V2 |
|            | W1 |        | W2 |

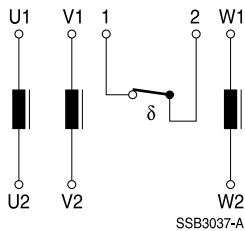
Connection order in case of terminal connection:



Connection order in case of busbar connection:



Types 209 A and 249 A contain a thermo switch



**Technical data and measuring conditions**

|                                  |   |
|----------------------------------|---|
| Rated voltage $V_R$ [L-PE / L-L] | 230/400 V AC (50/60 Hz)   |
| Rated current $I_R$              | Referred to 40 °C rated temperature   |
| Test voltage $V_{test}$          | 1500 V AC, 2 s (line/line)<br>2500 V AC, 2 s (lines/case)   |
| Frequency                        | Motor $f_M$ 0 Hz ... 100 Hz<br>Pulse (Switching) $f_P$ see table "Characteristics and ordering codes" |
| Overload capability (thermal)    | $1.5 \cdot I_R$ for 1 min per hour  |
| Max. dv/dt on filter input       | 5 kV/ $\mu$ s (request for higher values)   |
| Climatic category (IEC 60068-1)  | 25/085/21 (-25 °C/+85 °C/21 days damp heat test)  |

|  |                 |                             |
|--|-----------------|-----------------------------|
|  | <b>WARNING!</b> | Hot surface! Risk of burns! |
|--|-----------------|-----------------------------|

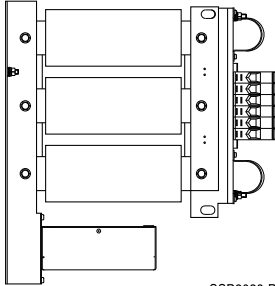
**Characteristics and ordering codes**

| $I_R$<br>A                             | Terminal<br>cross section<br>mm <sup>2</sup> | $R_{typ}$<br>m $\Omega$ | Min. pulse<br>frequency<br>kHz | Max. pulse<br>frequency<br>kHz | $P_L^{1)}$<br>W | Approx.<br>weight<br>kg | Ordering code   |
|--|--|-------------------------|--------------------------------|--------------------------------|-----------------|-------------------------|-----------------|
| <b><math>V_R = 230/400</math> V AC</b> |  |                         |                                |                                |                 |                         |                 |
| 6                                      | 6  | 390                     | 3                              | 10                             | 80              | 5                       | B84143V0006R231 |
| 7                                      | 6  | 290                     | 3                              | 10                             | 130             | 5                       | B84143V0007R231 |
| 12                                     | 6  | 67                      | 3                              | 10                             | 130             | 7                       | B84143V0012R231 |
| 38                                     | 10   | 25                      | 3                              | 10                             | 220             | 20                      | B84143V0038R231 |
| 43                                     | 10   | 16                      | 3                              | 10                             | 240             | 24                      | B84143V0043R231 |
| 64                                     | 35   | 8.9                     | 3                              | 10                             | 270             | 41                      | B84143V0064R231 |
| 77                                     | 35   | 5.5                     | 3                              | 8                              | 360             | 43                      | B84143V0077R231 |
| 91                                     | 35   | 5.5                     | 3                              | 8                              | 400             | 62                      | B84143V0091R231 |
| 145                                    | 35   | 4.5                     | 3                              | 8                              | 500             | 70                      | B84143V0145R231 |
| 209                                    | $40 \times 3^{2)}$                           | 1.5                     | 2.4                            | 6                              | 800             | 112                     | B84143V0209S231 |
| 249                                    | $40 \times 3^{2)}$                           | 1.7                     | 2.4                            | 6                              | 1060            | 120                     | B84143V0249S231 |

1) Estimated total losses at rated current and voltage in operation on converter at min. pulse frequency

2) With busbar

**Application note**

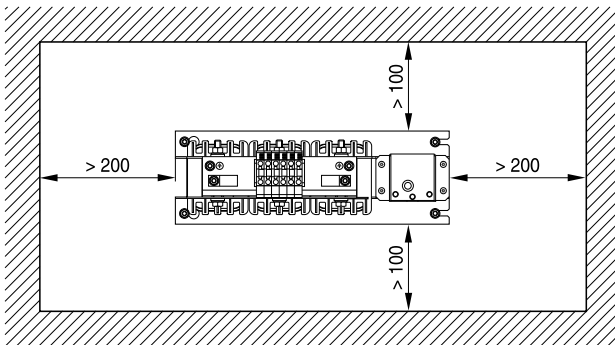
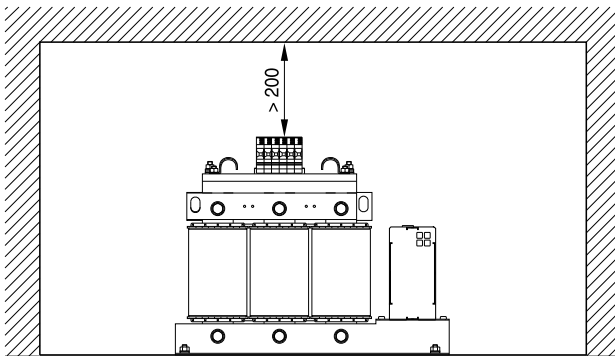


SSB3038-B

Wall mounting only possible for filters up to 145 A

Capacitors must be downside in case of wall mounting!

**Convection space \*\*\* Kopie: SSB3039-C**

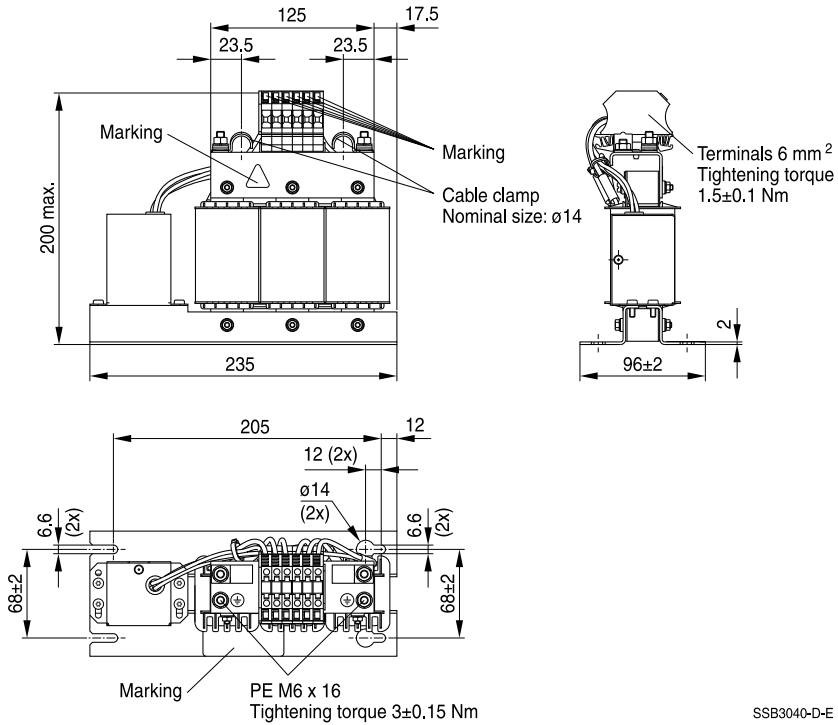


SSB3039-C

General tolerances according to ISO 2768-cL  
Dimensions in mm

Dimensional drawings

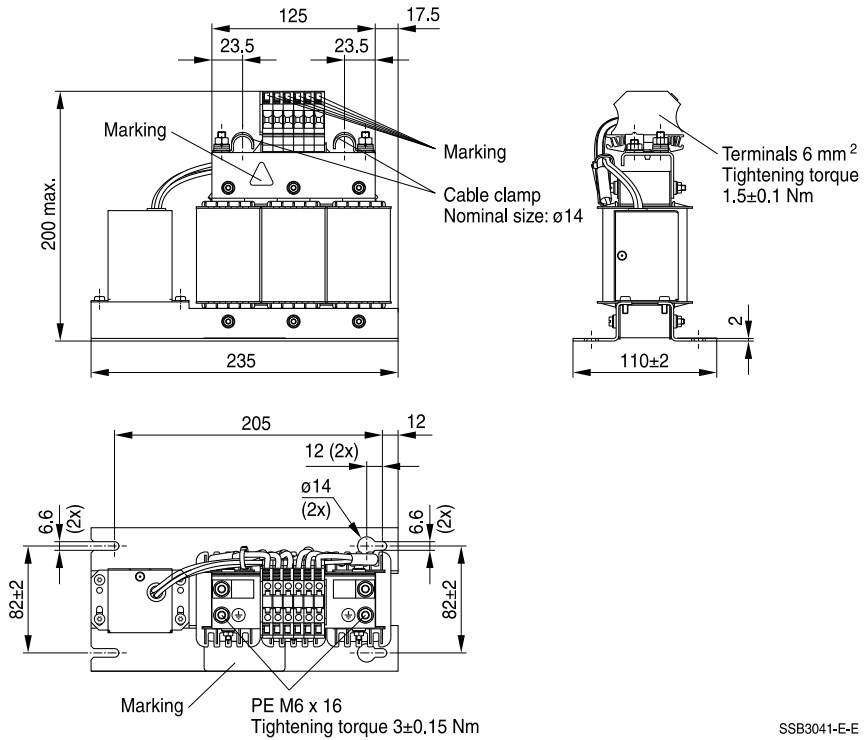
B84143V0006R231, B84143V0007R231 (6 A, 7 A)



SSB3040-D-E

General tolerances according to ISO 2768–cL  
Dimensions in mm

**B84143V0012R231 (12 A)**

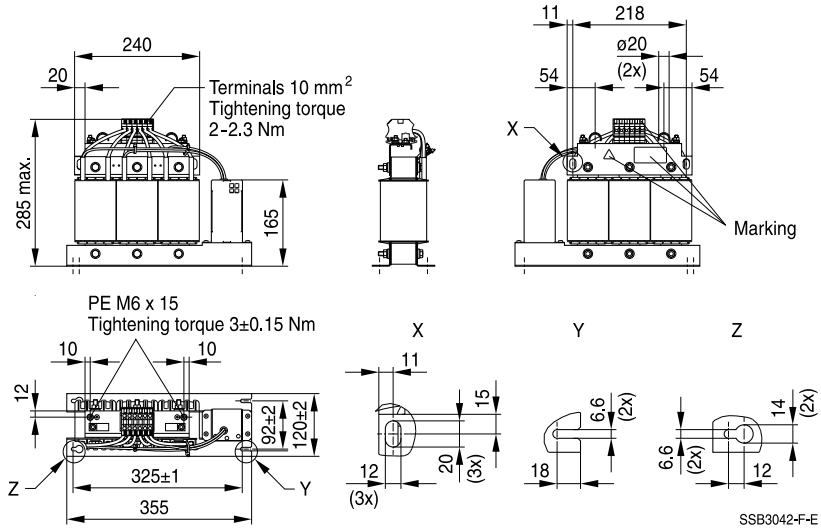


SSB3041-E-E

General tolerances according to ISO 2768–cL  
Dimensions in mm



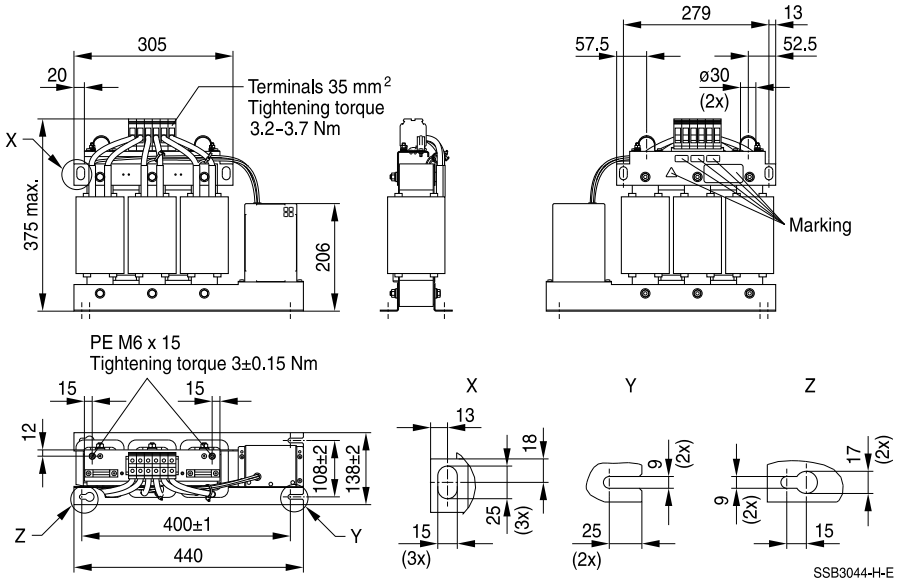
B84143V0038R231 (38 A)



General tolerances according to ISO 2768-cL  
Dimensions in mm

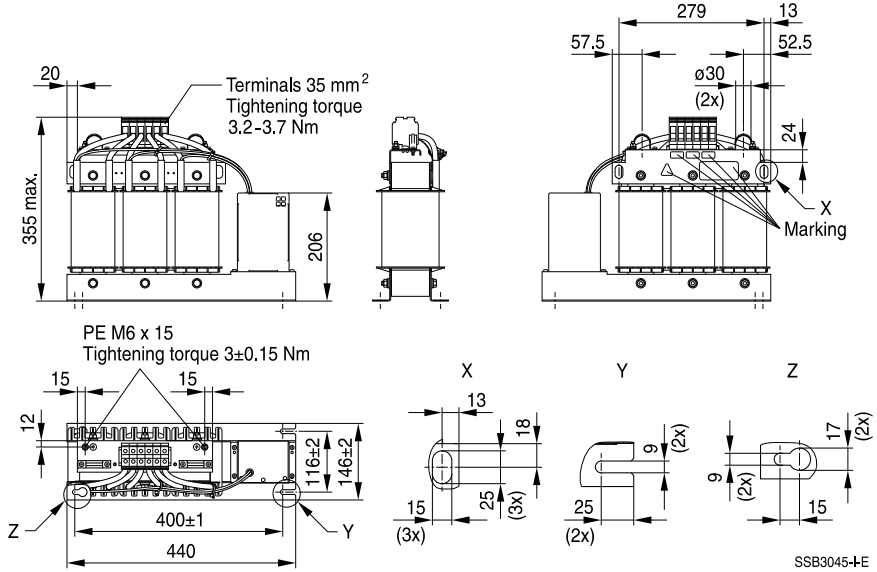


**B84143V0064R231 (64 A)**



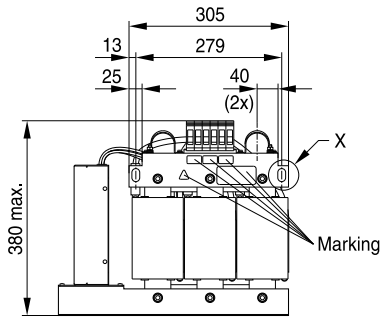
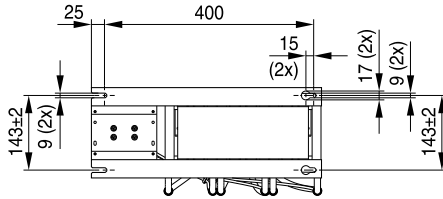
General tolerances according to ISO 2768-cL  
Dimensions in mm

B84143V0077R231 (77 A)

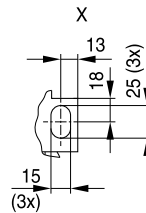
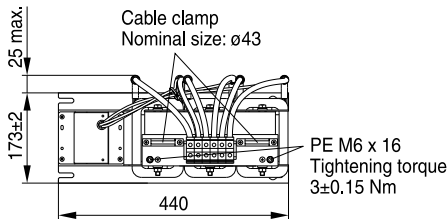
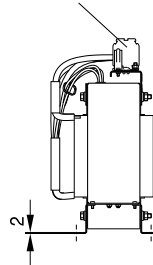


General tolerances according to ISO 2768–cL  
Dimensions in mm

B84143V0091R231 (91 A)



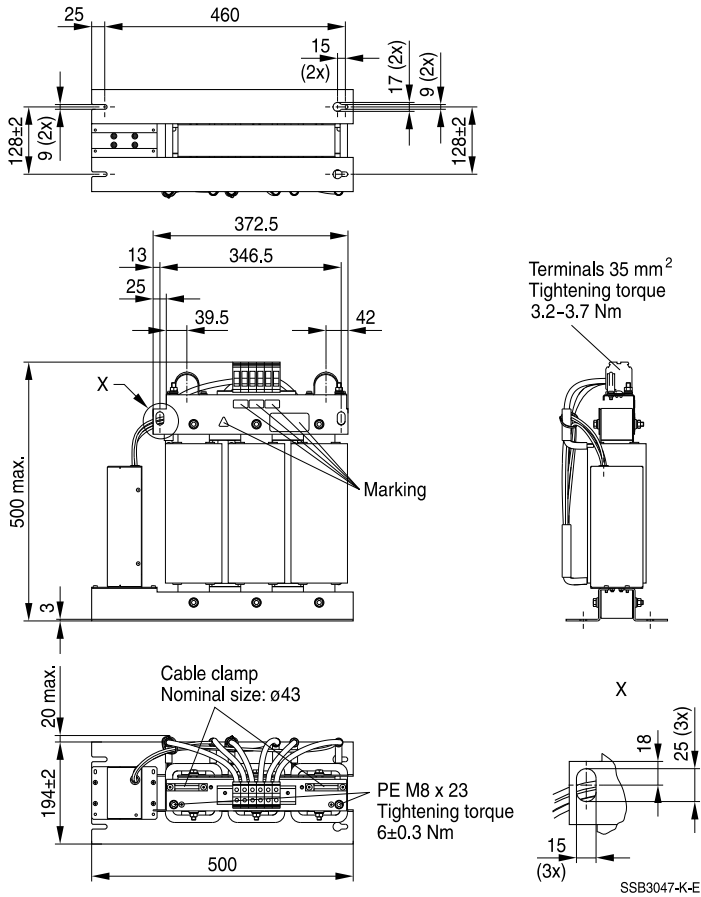
Terminals 35 mm<sup>2</sup>  
Tightening torque  
3.2-3.7 Nm



SSB3046-J-E

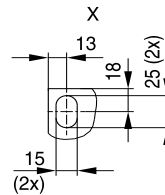
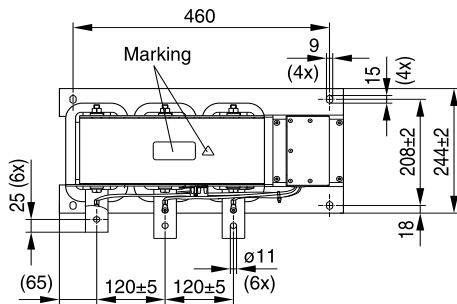
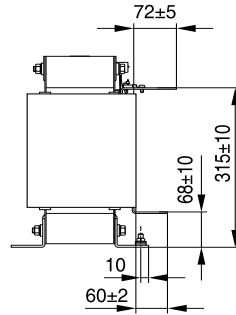
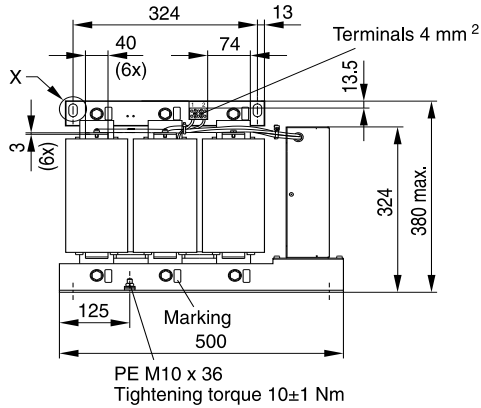
General tolerances according to ISO 2768-cL  
Dimensions in mm

**B84143V0145R231 (145 A)**



General tolerances according to ISO 2768-cL  
Dimensions in mm

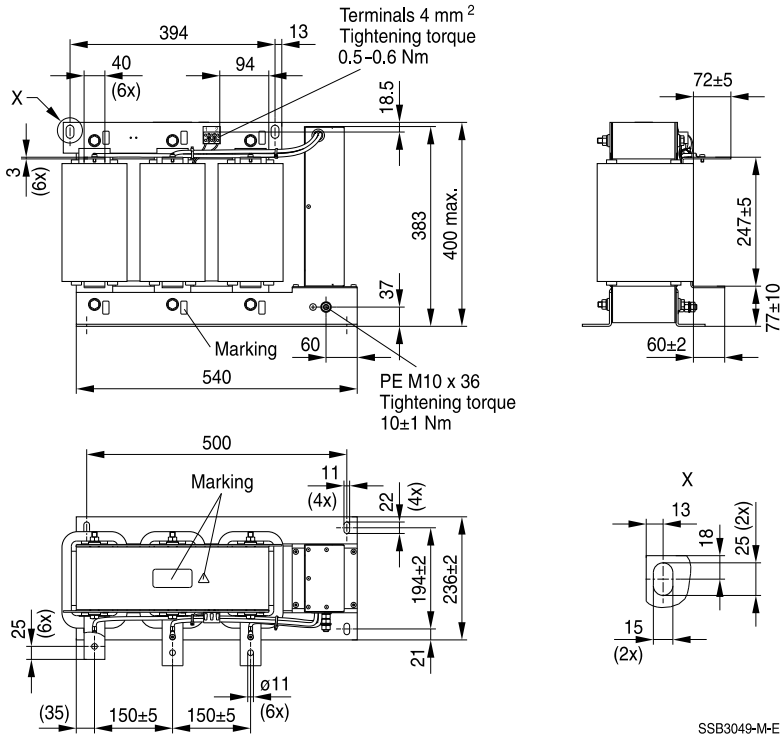
**B84143V0209S231 (209 A)**



SSB3048-L-E

General tolerances according to ISO 2768–cL  
Dimensions in mm

B84143V0249S231 (249 A)



SSB3049-M-E

General tolerances according to ISO 2768-cL  
Dimensions in mm



### Cautions and warnings

- Please note further advice in our website [www.tdk-electronics.tdk.com/pemc\\_filters\\_gti](http://www.tdk-electronics.tdk.com/pemc_filters_gti)
- 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: The products contain components that store an electric charge. Dangerous voltages can continue to exist at the product 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 product is installed and secured against loosening by defined tightening torque. Remove them at last, when uninstalling. Depending on the magnitude of the leakage currents, the particular specifications for making the protective-earth connection must be observed.
- Impermissible overloading of the product, 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 product housing).
- The products must be protected in the application against impermissible exceeding of the rated currents by overcurrent protective devices.
- For leakage currents  $>10$  mA, a fixed connection of the protective earth conductor to the public power grid is required. This means that connection via plug connectors is not permitted. The protective conductor must have a minimum cross-section of  $10$  mm<sup>2</sup> Cu or  $16$  mm<sup>2</sup> Al over its entire length. Alternatively, two separate protective conductors with the minimum cross-section specified in each case can also be connected.
- For leakage currents  $3.5$  mA  $< I_{LK}^a) \leq 10$  mA, the following solutions are possible:
  - Stationary device with fixed connection
  - Stationary device with type B plug-in connection (industrial plug-in connection according to IEC 60309) and cross-section  $\geq 2.5$  mm<sup>2</sup>
  - Stationary device with type A plug-in connection (non-industrial plug-in device) and additional second protective earth connection
  - Movable equipment with type A plug-in connection and additional second protective earth connection in premises with restricted access
- The products must be protected in the application against impermissible exceeding of the specification parameter.
- The converter output frequency must be within the specified range to avoid resonances and uncontrolled warming of the output chokes and output filters.
- The components can become very hot during operation, there is the risk of burns if touched. The product can remain hot for some time after the power is switched off!
- The products are only to be attached to the fixings or mounting holes provided for this purpose in accordance with the data sheet. It is not permitted for the product specified in the data sheet to assume a mechanical function in the final application, in particular any type of tension or pressure on the product must be prevented.

a)  $I_{LK}$  = Leakage current

### Display of ordering codes for TDK Electronics products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications, on the company website, or in order-related documents such as shipping notes, order confirmations and product labels. The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products.

Detailed information can be found on the Internet under [www.tdk-electronics.tdk.com/orderingcodes](http://www.tdk-electronics.tdk.com/orderingcodes).

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 is to check the suitability of the 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 $\mu\text{C}$ ). 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 filters<br>Installation       | When installing and removing our 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><br>Leakage current, 8.6       |

| Topic   | Instructions   | Reference chapter (data book), paragraph |
|---|--|--|
| 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                   |
| 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          |

**Symbols and terms**

| Symbol      | English                                       | German                               |
|-------------|---|--------------------------------------|
| $\alpha$    | Insertion loss                                | Einfügungsdämpfung                   |
| $C_R$       | 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 (Eingang zu Ausgang) |
| 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                  | Bemessungsstoßstromfestigkeit        |
| $I_q$       | 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 typisch        |
| $T_A$       | 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                         |

| Symbol | English                   | German                         |
|--------|---------------------------|--------------------------------|
| $V_X$  | 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) |

## Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, we are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether a product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet ([www.tdk-electronics.tdk.com/material](http://www.tdk-electronics.tdk.com/material)). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply**.

## Important notes

7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard.**  
The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements (“CSR”) TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System.** For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.
8. The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, FilterCap, FormFit, InsuGate, LeaXield, MediPlas, MiniBlue, MiniCell, MKD, MKK, ModCap, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PiezoBrush, PlasmaBrush, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap, XieldCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at [www.tdk-electronics.tdk.com/trademarks](http://www.tdk-electronics.tdk.com/trademarks).

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