

## **EMC filters**

2-line filters

IEC inlet filters

**Series/Type:**        **B84771**

Date:                    November 2017

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**Power line filters for 1-phase systems**
**Rated voltage  $V_R$ : 250 V AC/DC**
**Rated current  $I_R$ : 1 A to 20 A**

**Construction**

- 2-line filters with IEC connector
- Appliance connector according to IEC 60320-1
- Metal case

**Versions**

- With discharge resistor (B84771A\*)
- Without discharge resistor (B84771C\*)
- Medical version with negligibly low leakage current (B84771M\*)

**Features**

- Easy to install
- Compact design
- Cost optimized construction
- Degree of protection front side with power plug: IP 40<sup>1)</sup>
- ENEC<sup>2)</sup>, UL and cUL approval   

**Typical applications**

- Switch-mode power supplies
- DC applications
- Measuring instruments
- Medical equipment

**Terminals**

Screw mounting, Snap-in version

- Line side: IEC connectors C14 according to IEC 60320-1 (1 A ... 15 A)  
IEC connectors C20 according to IEC 60320-1 (16 A ... 20 A)
- Load side: Tab connectors

Litz wire version

- Line side: IEC connectors C14 according to IEC 60320-1
- Load side: Litz wire, with cross section for  
1 A ... 8 A: approx. 0.823 mm<sup>2</sup> (18 AWG)  
10 A ... 15 A: approx. 1.31 mm<sup>2</sup> (16 AWG)

1) According to IEC 60529

2) ENEC approval for 12 A- and 15 A-type with 10 A, for 20 A-type with 16 A

**Marking**

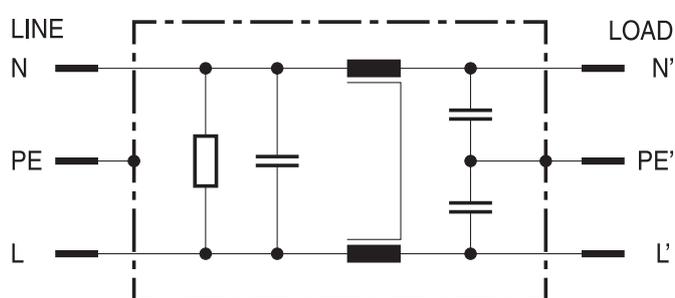
Marking on component:

Manufacturer's logo, ordering code, rated voltage, rated current, rated temperature, climatic category, date code, approvals

Minimum data on packaging:

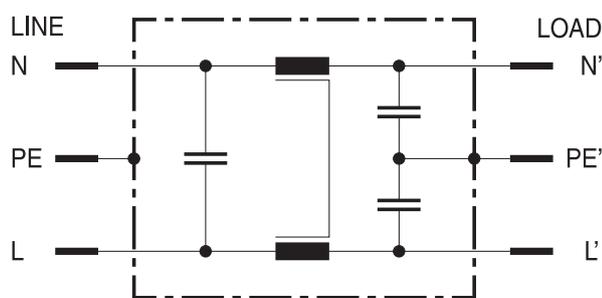
Manufacturer's logo, ordering code, quantity, date code

**Typical circuit diagram of B84771A\*  
(with discharge resistor)**



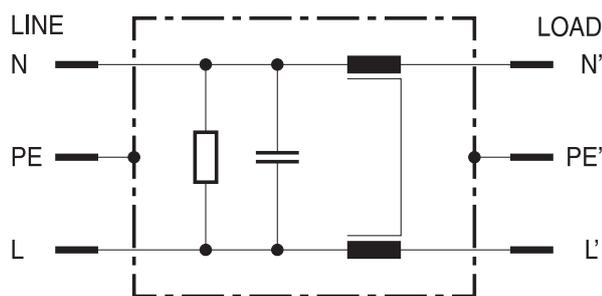
SSB2308-5

**Typical circuit diagram of B84771C\*  
(without discharge resistor)**



SSB2309-D

**Typical circuit diagram of B84771M\*  
(medical version)**



SSB2310-G

**Technical data and measuring conditions**

Rated voltage $V_R$	250 V AC (50/60 Hz) / 250 V DC
Rated current $I_R$	Referred to 50 °C rated temperature
Test voltage $V_{test}$	1 A ... 15 A types: 1000 V AC, 2 s (line/line) 16 A ... 20 A types: 1100 V DC, 2 s (line/line) B84771A/C*: 2000 V AC, 2 s (lines/case) B84771M*: 2500 V AC, 2 s (lines/case)
Leakage current $I_{LK}$	At $V_R$ and 50 Hz
Climatic category (IEC 60068-1)	25/085/21 (–25 °C/+85 °C/21 days damp heat test)
Approvals	EN 60939, UL 1283, CSA C22.2 No.8

**Screw mounting versions with tab connectors 6.3 × 0.8 mm<sup>2</sup>**
**Characteristics and ordering codes**

I <sub>R</sub>	C <sub>R</sub> X2	C <sub>R</sub> Y2	L <sub>R</sub>	I <sub>LK</sub> <sup>1)</sup>	R <sub>dis</sub>	Approx. weight	Ordering code	Approvals		
A	μF	pF	mH	mA	MΩ	g				
<b>V<sub>R</sub> = 250 V AC/DC</b>										
1	1 × 0.1	2 × 2200	2 × 12	0.173	1	40	B84771A0001A000	×	×	×
1	1 × 0.1	2 × 2200	2 × 12	0.173	—	40	B84771C0001A000	×	×	×
1	1 × 0.1	—	2 × 12	0	1	40	B84771M0001A000	×	×	×
3	1 × 0.1	2 × 2200	2 × 2.5	0.173	1	40	B84771A0003A000	×	×	×
3	1 × 0.1	2 × 2200	2 × 2.5	0.173	—	40	B84771C0003A000	×	×	×
3	1 × 0.1	—	2 × 2.5	0	1	40	B84771M0003A000	×	×	×
6	1 × 0.1	2 × 2200	2 × 0.84	0.173	1	40	B84771A0006A000	×	×	×
6	1 × 0.1	2 × 2200	2 × 0.84	0.173	—	40	B84771C0006A000	×	×	×
6	1 × 0.1	—	2 × 0.84	0	1	40	B84771M0006A000	×	×	×
8	1 × 0.1	2 × 2200	2 × 0.45	0.173	1	40	B84771A0008A000	×	×	×
8	1 × 0.1	2 × 2200	2 × 0.45	0.173	—	40	B84771C0008A000	×	×	×
8	1 × 0.1	—	2 × 0.45	0	1	40	B84771M0008A000	×	×	×
10	1 × 0.1	2 × 2200	2 × 0.24	0.173	1	40	B84771A0010A000	×	×	×
10	1 × 0.1	2 × 2200	2 × 0.24	0.173	—	40	B84771C0010A000	×	×	×
10	1 × 0.1	—	2 × 0.24	0	1	40	B84771M0010A000	×	×	×
12	1 × 0.1	2 × 2200	2 × 0.14	0.173	1	40	B84771A0012A000	×*	×	×
12	1 × 0.1	2 × 2200	2 × 0.14	0.173	—	40	B84771C0012A000	×*	×	×
12	1 × 0.1	—	2 × 0.14	0	1	40	B84771M0012A000	×*	×	×
15	1 × 0.1	2 × 2200	2 × 0.09	0.173	1	40	B84771A0015A000	×*	×	×
15	1 × 0.1	2 × 2200	2 × 0.09	0.173	—	40	B84771C0015A000	×*	×	×
15	1 × 0.1	—	2 × 0.09	0	1	40	B84771M0015A000	×*	×	×
16	1 × 0.33	2 × 2200	2 × 0.4	0.173	1	130	B84771A0016A000	×	×	×
16	1 × 0.33	—	2 × 0.4	0	1	130	B84771M0016A000	×	×	×
20	1 × 0.33	2 × 2200	2 × 0.3	0.173	1	130	B84771A0020A000	×*	×	×
20	1 × 0.33	—	2 × 0.3	0	1	130	B84771M0020A000	×*	×	×

× = Approval granted

\* = ENEC approval at 12 A and 15 A types with 10 A, at 20 A type with 16 A

1) Calculation according to IEC 60939-1, annex A, at rated voltage and 50 Hz. In practice are up to double values to be expected due to the insulation resistance values of the used ceramic capacitors. For the medical version results computationally the value 0. In practice are values 1 ... 2 mA to be expected due to the insulation resistance values of the used materials.

**Snap-in versions with tab connectors 6.3 × 0.8 mm<sup>2</sup>**
**Characteristics and ordering codes**

$I_R$	$C_R$ X2	$C_R$ Y2	$L_R$	$I_{LK}^{1)}$	$R_{dis}$	Approx. weight	Ordering code	Approvals		
A	$\mu F$	pF	mH	mA	M $\Omega$	g				
$V_R = 250 V AC/DC$										
1	1 × 0.1	2 × 2200	2 × 12	0.173	1	40	B84771A3001A000	×	×	×
1	1 × 0.1	—	2 × 12	0	1	40	B84771M3001A000	×	×	×
3	1 × 0.1	2 × 2200	2 × 2.5	0.173	1	40	B84771A3003A000	×	×	×
3	1 × 0.1	—	2 × 2.5	0	1	40	B84771M3003A000	×	×	×
6	1 × 0.1	2 × 2200	2 × 0.84	0.173	1	40	B84771A3006A000	×	×	×
6	1 × 0.1	—	2 × 0.84	0	1	40	B84771M3006A000	×	×	×
8	1 × 0.1	2 × 2200	2 × 0.45	0.173	1	40	B84771A3008A000	×	×	×
8	1 × 0.1	—	2 × 0.45	0	1	40	B84771M3008A000	×	×	×
10	1 × 0.1	2 × 2200	2 × 0.24	0.173	1	40	B84771A3010A000	×	×	×
10	1 × 0.1	—	2 × 0.24	0	1	40	B84771M3010A000	×	×	×
12	1 × 0.1	2 × 2200	2 × 0.14	0.173	1	40	B84771A3012A000	×*	×	×
12	1 × 0.1	—	2 × 0.14	0	1	40	B84771M3012A000	×*	×	×
15	1 × 0.1	2 × 2200	2 × 0.09	0.173	1	40	B84771A3015A000	×*	×	×
15	1 × 0.1	—	2 × 0.09	0	1	40	B84771M3015A000	×*	×	×

× = Approval granted

\* = ENEC approval at 12 A and 15 A types with 10 A

1) Calculation according to IEC 60939-1, annex A, at rated voltage and 50 Hz. In practice are up to double values to be expected due to the insulation resistance values of the used ceramic capacitors. For the medical version results computationally the value 0. In practice are values 1 ... 2  $\mu A$  to be expected due to the insulation resistance values of the used materials.

**Screw mounting versions with litz wires**
**Characteristics and ordering codes**

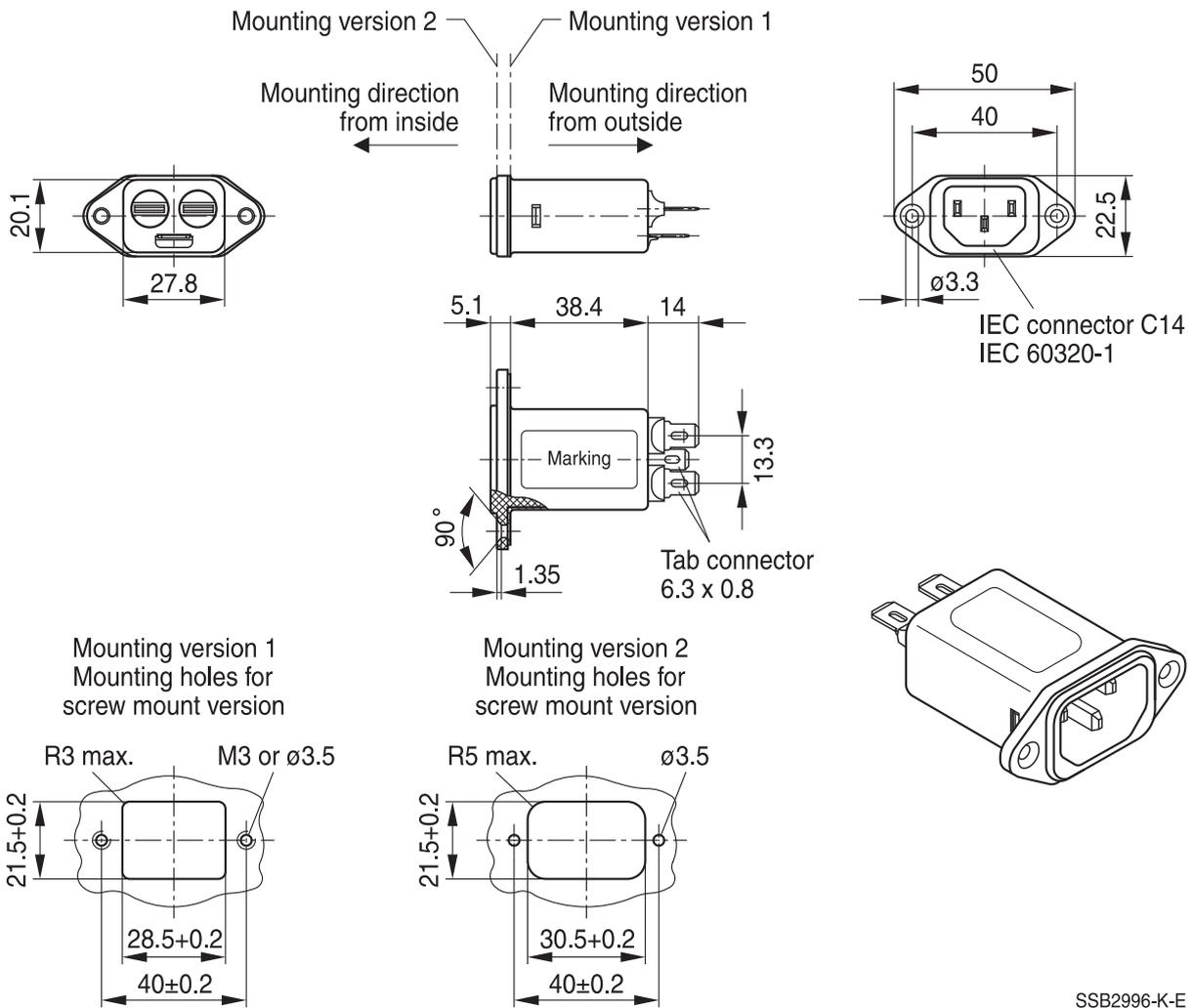
$I_R$	$C_R$ X2	$C_R$ Y2	$L_R$	$I_{LK}^{1)}$	$R_{dis}$	Approx. weight	Ordering code	Approvals		
A	$\mu F$	pF	mH	mA	$M\Omega$	g				
$V_R = 250 V AC/DC$										
1	1 × 0.1	2 × 2200	2 × 12	0.173	1	40	B84771A0001L000	×	×	×
1	1 × 0.1	—	2 × 12	0	1	40	B84771M0001L000	×	×	×
3	1 × 0.1	2 × 2200	2 × 2.5	0.173	1	40	B84771A0003L000	×	×	×
3	1 × 0.1	—	2 × 2.5	0	1	40	B84771M0003L000	×	×	×
6	1 × 0.1	2 × 2200	2 × 0.84	0.173	1	40	B84771A0006L000	×	×	×
6	1 × 0.1	—	2 × 0.84	0	1	40	B84771M0006L000	×	×	×
8	1 × 0.1	2 × 2200	2 × 0.45	0.173	1	40	B84771A0008L000	×	×	×
8	1 × 0.1	—	2 × 0.45	0	1	40	B84771M0008L000	×	×	×
10	1 × 0.1	2 × 2200	2 × 0.24	0.173	1	40	B84771A0010L000	×	×	×
10	1 × 0.1	—	2 × 0.24	0	1	40	B84771M0010L000	×	×	×
12	1 × 0.1	2 × 2200	2 × 0.14	0.173	1	40	B84771A0012L000	×*	×	×
12	1 × 0.1	—	2 × 0.14	0	1	40	B84771M0012L000	×*	×	×
15	1 × 0.1	2 × 2200	2 × 0.09	0.173	1	40	B84771A0015L000	×*	×	×
15	1 × 0.1	—	2 × 0.09	0	1	40	B84771M0015L000	×*	×	×

× = Approval granted

\* = ENEC approval at 12 A and 15 A types with 10 A

1) Calculation according to IEC 60939-1, annex A, at rated voltage and 50 Hz. In practice are up to double values to be expected due to the insulation resistance values of the used ceramic capacitors. For the medical version results computationally the value 0. In practice are values 1 ... 2  $\mu A$  to be expected due to the insulation resistance values of the used materials.

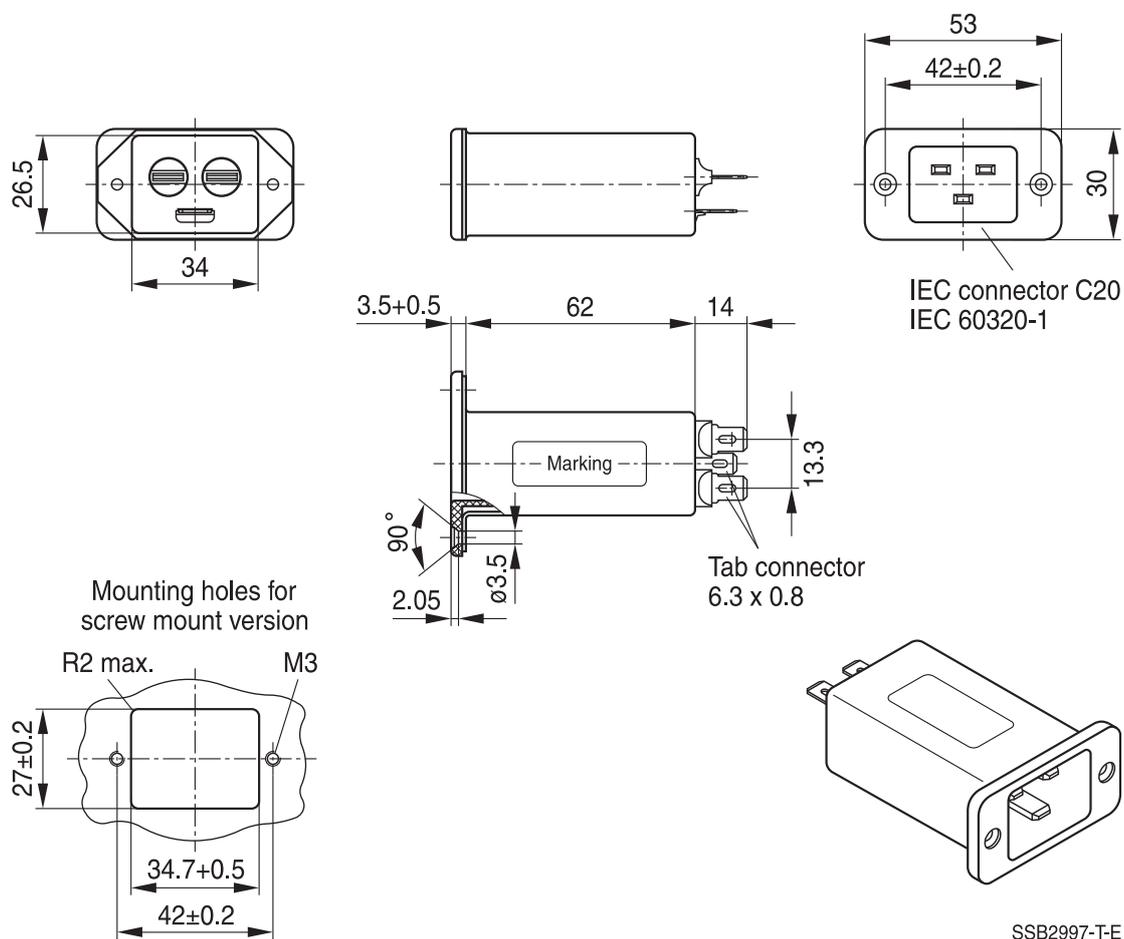
Dimensional drawings of screw mounting versions (1 A ... 15 A types)



SSB2996-K-E

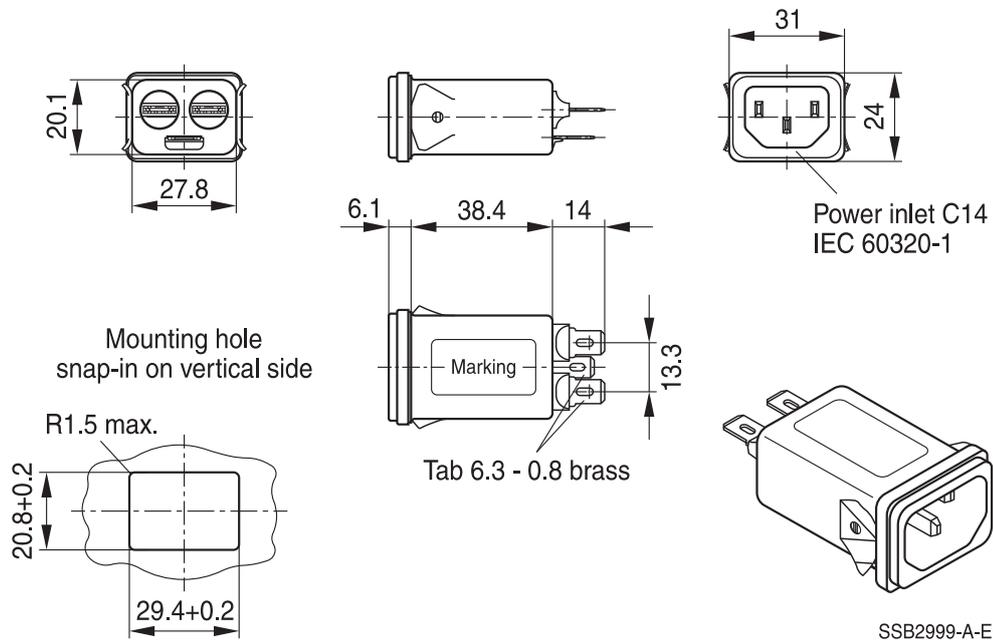
General tolerances according to ISO 2768-cL  
Dimensions in mm

Dimensional drawings of screw mounting versions (16 A ... 20 A types)



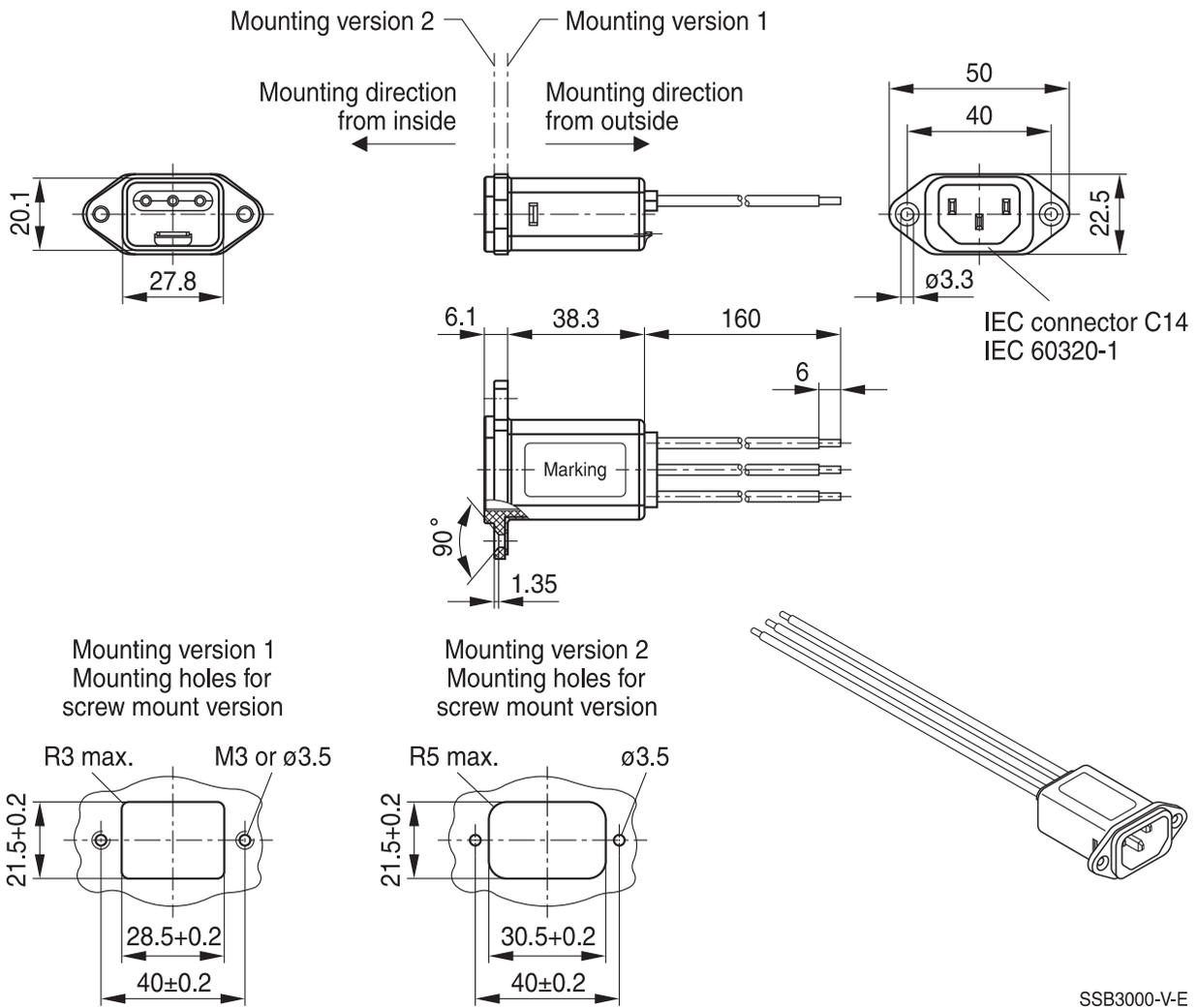
General tolerances according to ISO 2768-cL  
Dimensions in mm

Dimensional drawings of snap-in versions, snapper on vertical side (1 A ... 15 A types)



General tolerances according to ISO 2768-cL  
Dimensions in mm

**Dimensional drawings of versions with litz wire output**

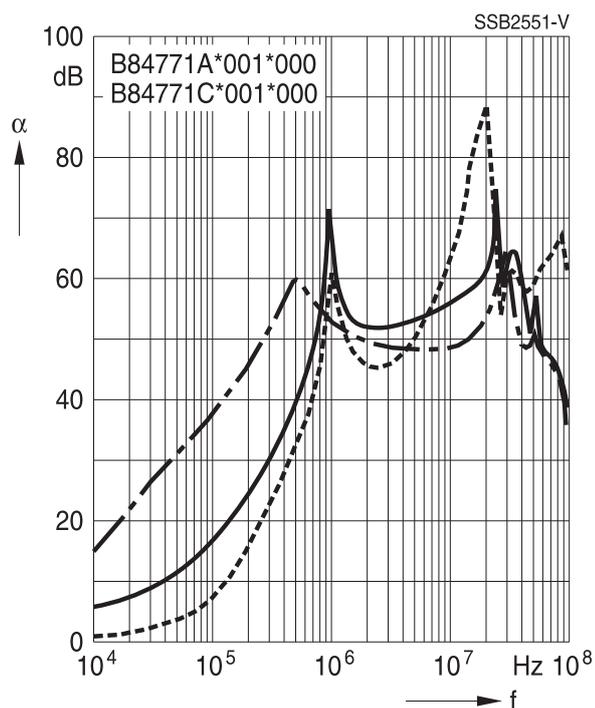


General tolerances according to ISO 2768-cL  
Dimensions in mm

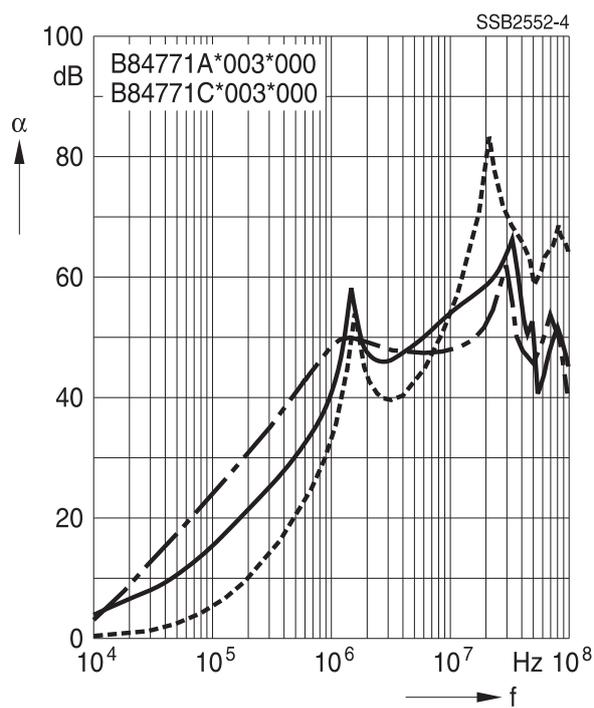
**Insertion loss** (typical values at  $Z = 50 \Omega$ )

- unsymmetrical, adjacent branches terminated
- - - - - common mode, all branches in parallel (asymmetrical)
- - - - - differential mode (symmetrical)

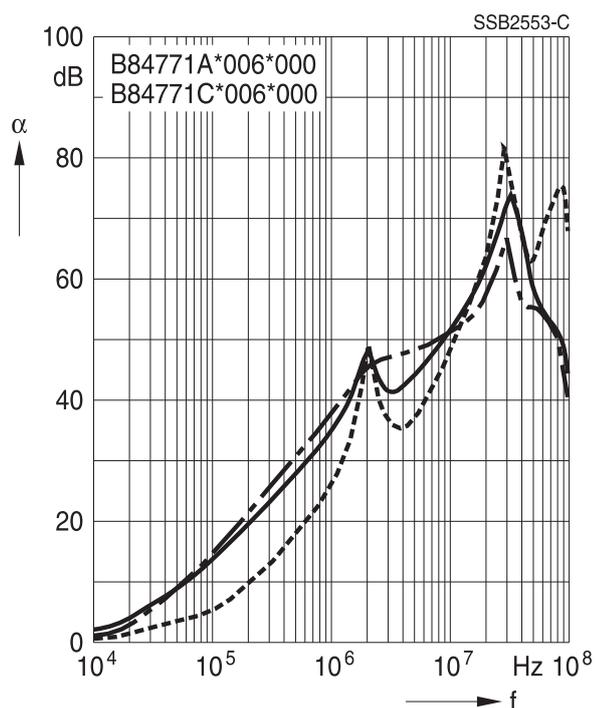
Filters for 1 A



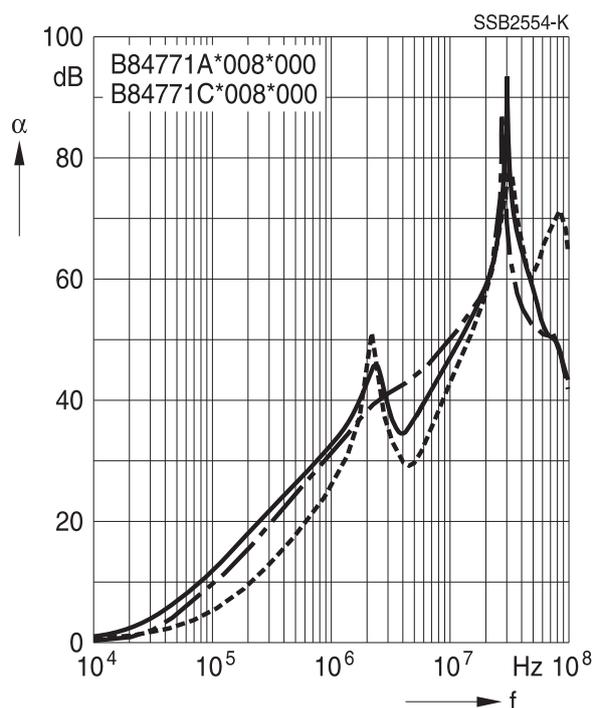
Filters for 3 A



Filters for 6 A



Filters for 8 A

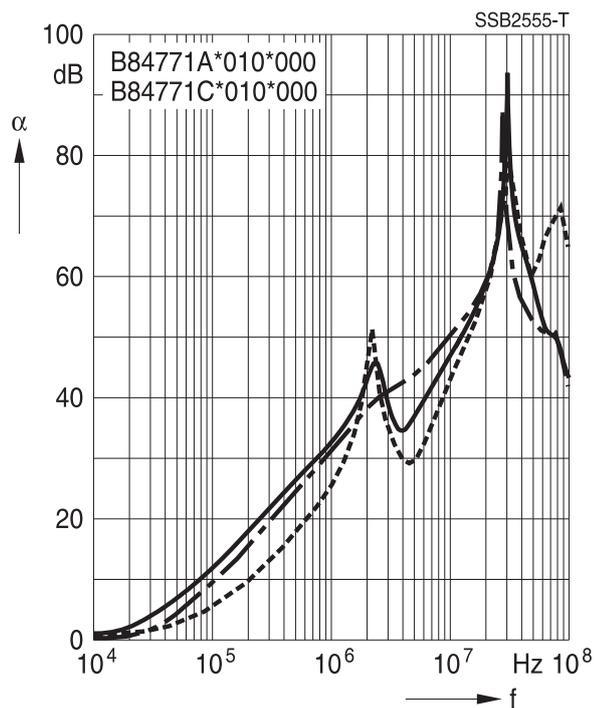


IEC inlet filters

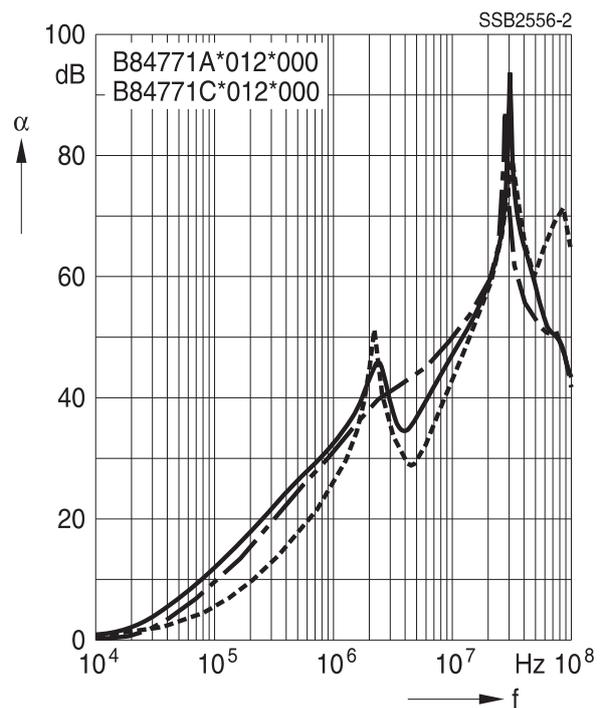
**Insertion loss** (typical values at  $Z = 50 \Omega$ )

- unsymmetrical, adjacent branches terminated
- - - - - common mode, all branches in parallel (asymmetrical)
- - - - - differential mode (symmetrical)

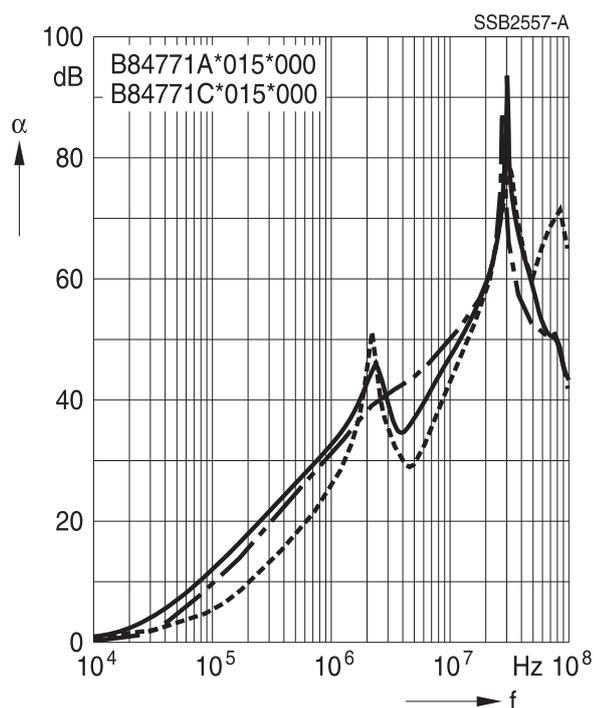
Filters for 10 A



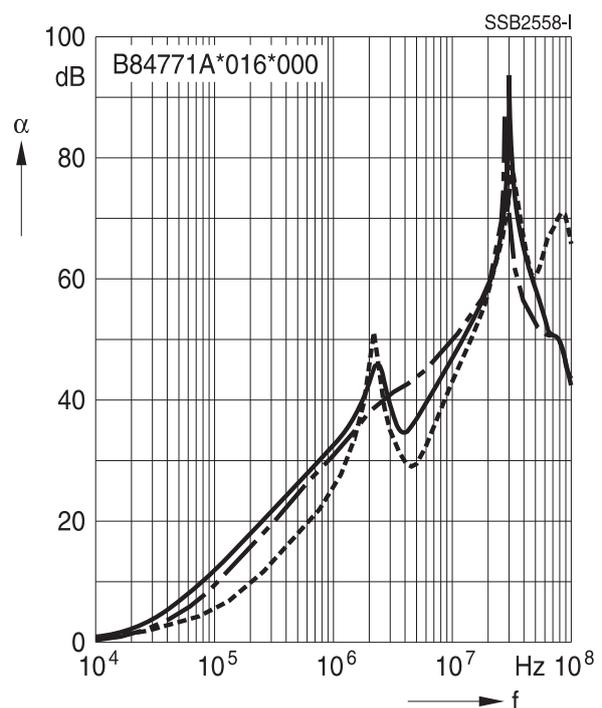
Filters for 12 A



Filters for 15 A



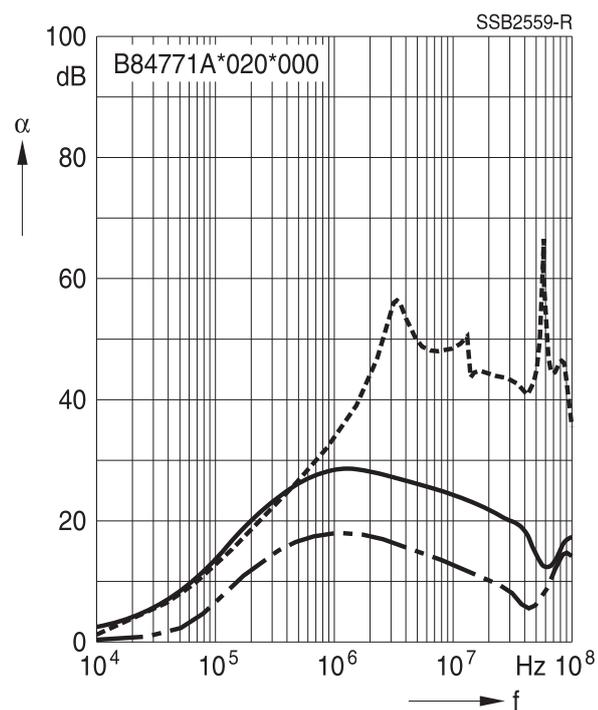
Filters for 16 A



**Insertion loss** (typical values at  $Z = 50 \Omega$ )

- unsymmetrical, adjacent branches terminated
- - - - - common mode, all branches in parallel (asymmetrical)
- - - - - differential mode (symmetrical)

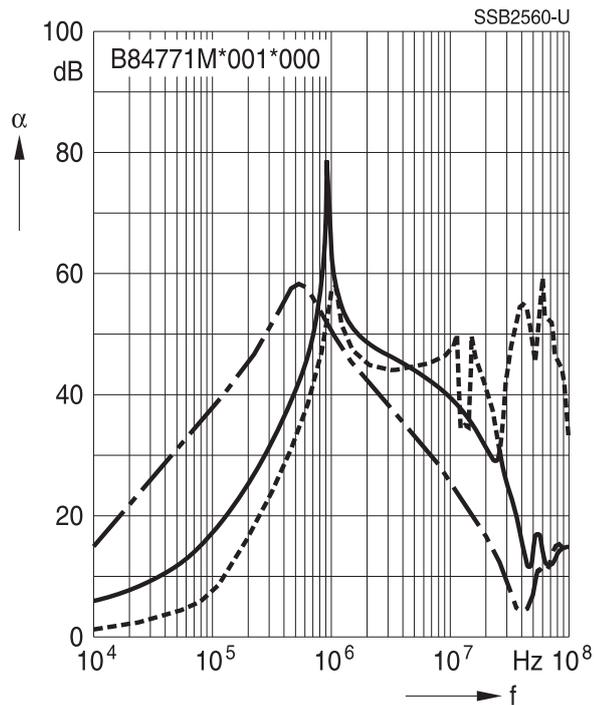
Filters for 20 A



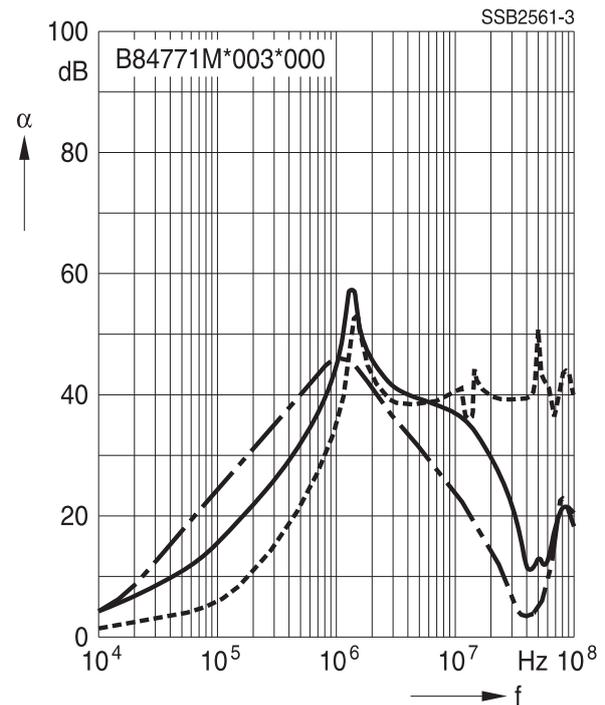
**Insertion loss for medical version** (typical values at  $Z = 50 \Omega$ )

- unsymmetrical, adjacent branches terminated
- - - - - common mode, all branches in parallel (asymmetrical)
- - - - - differential mode (symmetrical)

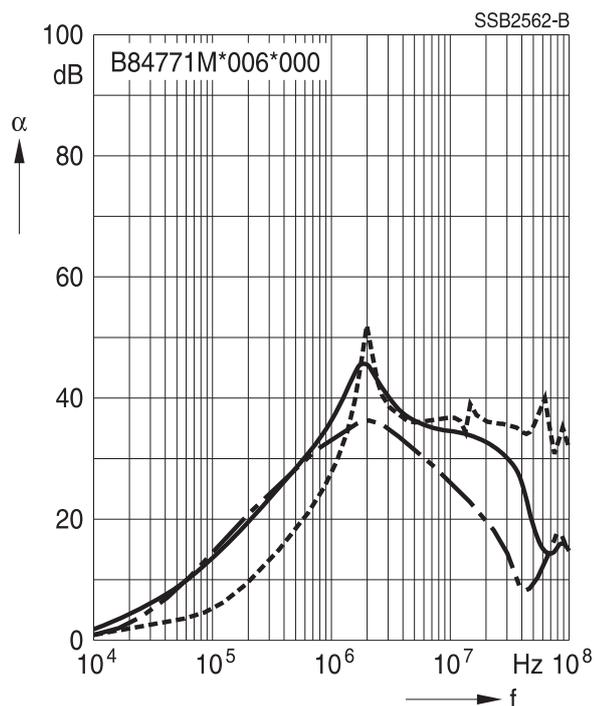
Filters for 1 A



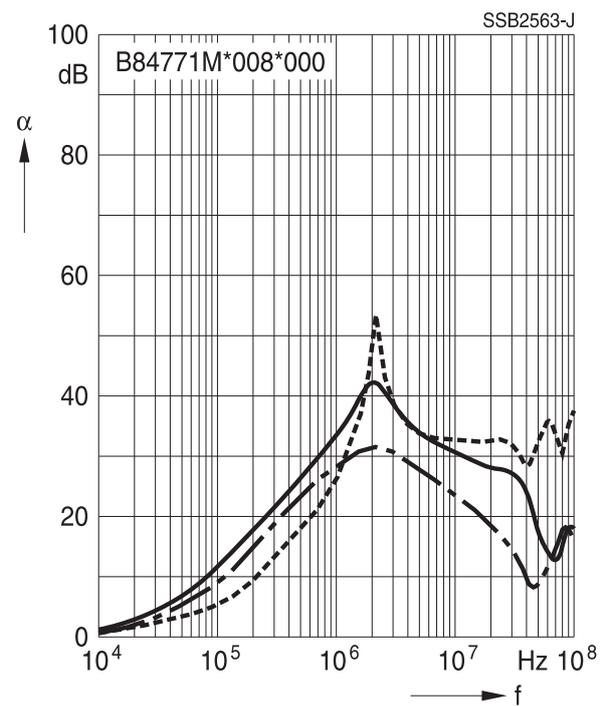
Filters for 3 A



Filters for 6 A



Filters for 8 A

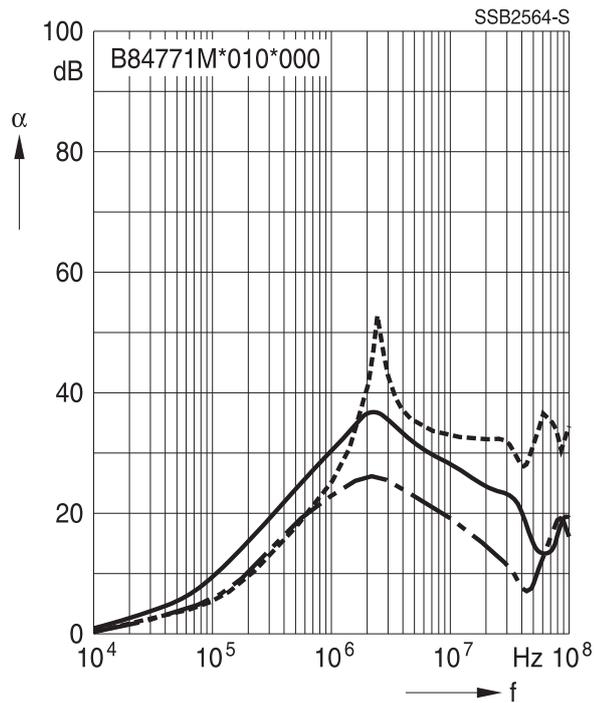


IEC inlet filters

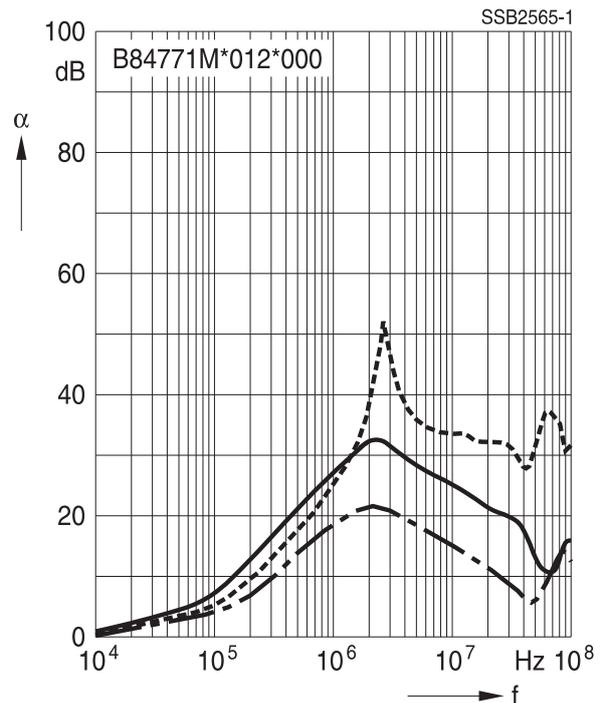
Insertion loss for medical versions (typical values at  $Z = 50 \Omega$ )

- unsymmetrical, adjacent branches terminated
- - - - - common mode, all branches in parallel (asymmetrical)
- - - - - differential mode (symmetrical)

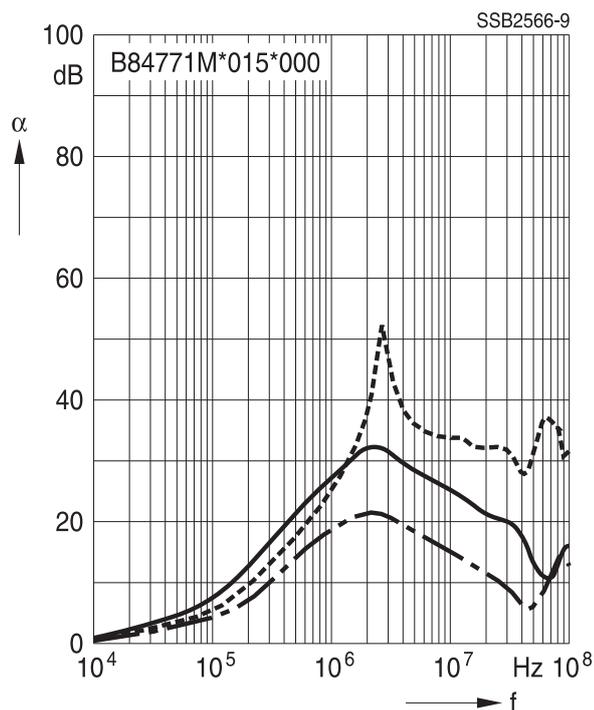
Filters for 10 A



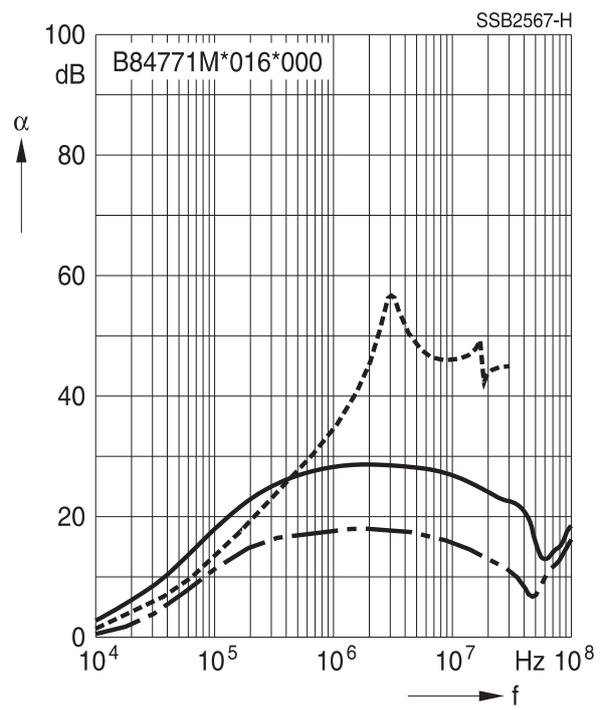
Filters for 12 A



Filters for 15 A



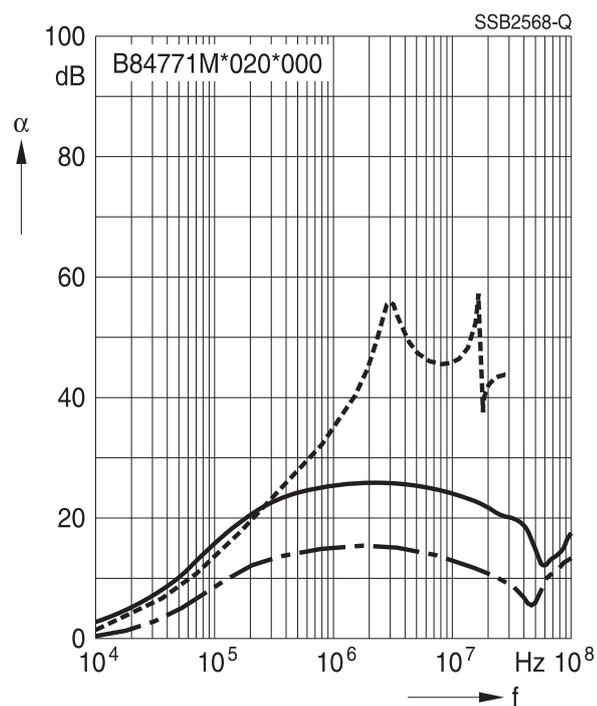
Filters for 16 A



**Insertion loss for medical versions** (typical values at  $Z = 50 \Omega$ )

- unsymmetrical, adjacent branches terminated
- - - - - common mode, all branches in parallel (asymmetrical)
- - - - - differential mode (symmetrical)

Filters for 20 A



## Cautions and warnings

Please read all safety and warning notes carefully before installing the 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 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. 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 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 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).
- Filters must be protected in the application against impermissible exceeding of the rated currents by overcurrent protective devices.
- 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  $I_L^{1)} \leq 10$  mA the PE conductor must have a KU value<sup>2)</sup> of 4.5<sup>3)</sup>; for leakage currents  $I_L > 10$  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.
- Because the product 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!

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) permanently connected protective earth connection  $\geq 1.5$  mm<sup>2</sup> and b) a protective earth connection  $\geq 2.5$  mm<sup>2</sup> via connectors for industrial equipment (IEC 60309-2)

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 installation correspond to the requirements for PEN conductors as specified in relevant standards.

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.

<b>Topic</b>	<b>Instructions</b>	<b>Reference chapter (data book), paragraph</b>
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 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.  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  Safety regulations, 6.2
Installing and removing of filters 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 Leakage current, 8.6
Voltage derating 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

<b>Topic</b>	<b>Instructions</b>	<b>Reference chapter (data book), paragraph</b>
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

### Display of ordering codes for EPCOS products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of EPCOS, 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.epcos.com/orderingcodes](http://www.epcos.com/orderingcodes).

**IEC inlet filters**
**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 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)

## 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, EPCOS is 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 an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
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## Important notes

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