

## **EMC filters**

2-line filters IEC inlet filters

Series/Type: B84771 Date: November 2017

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**B8477**<sup>-</sup>

#### 2-line filters

**IEC** inlet filters

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





#### **IEC inlet filters**

#### Marking

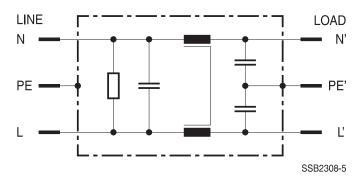
Marking on component:

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

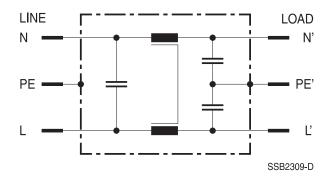
Minimum data on packaging:

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

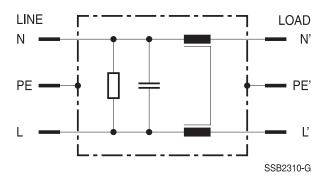
# Typical circuit diagram of B84771A\* (with discharge resistor)



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



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





#### **IEC** inlet filters

## Technical data and measuring conditions

250 V AC (50/60 Hz) / 250 V DC
Referred to 50 °C rated temperature
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)
At $V_{\rm B}$ and 50 Hz
25/085/21 (-25 °C/+85 °C/21 days damp heat test)
EN 60939, UL 1283, CSA C22.2 No.8



**IEC** inlet filters

#### Screw mounting versions with tab connectors $6.3 \times 0.8 \ mm^2$

#### Characteristics and ordering codes

I <sub>R</sub>	C <sub>R</sub>	C <sub>R</sub>	L <sub>R</sub>	I <sub>LK</sub> <sup>1)</sup>	R <sub>dis</sub>	Approx.	Ordering code	Арр	rovals	;
	X2	Y2				weight				
А	μF	pF	mH	mA	MΩ	g		<b>10</b>	71	c <b>7</b> 1
V <sub>R</sub> =	$V_R = 250 \text{ V AC/DC}$									
1	1 × 0.1	$2 \times 2200$	2 × 12	0.173	1	40	B84771A0001A000	×	×	×
1	1 × 0.1	$2 \times 2200$	2 × 12	0.173	_	40	B84771C0001A000	×	×	×
1	1 × 0.1	_	2 × 12	0	1	40	B84771M0001A000	×	×	×
3	1 × 0.1	$2 \times 2200$	2× 2.5	0.173	1	40	B84771A0003A000	×	×	×
3	1 × 0.1	$2 \times 2200$	2× 2.5	0.173	—	40	B84771C0003A000	×	×	×
3	1 × 0.1	_	2× 2.5	0	1	40	B84771M0003A000	×	×	×
6	1 × 0.1	$2 \times 2200$	2× 0.84	0.173	1	40	B84771A0006A000	×	×	×
6	1 × 0.1	$2 \times 2200$	2× 0.84	0.173	—	40	B84771C0006A000	×	×	×
6	1 × 0.1	_	2× 0.84	0	1	40	B84771M0006A000	×	×	×
8	1 × 0.1	$2 \times 2200$	2× 0.45	0.173	1	40	B84771A0008A000	×	×	×
8	1 × 0.1	$2 \times 2200$	2× 0.45	0.173	—	40	B84771C0008A000	×	×	×
8	1 × 0.1	—	2× 0.45	0	1	40	B84771M0008A000	×	×	×
10	1 × 0.1	$2 \times 2200$	2× 0.24	0.173	1	40	B84771A0010A000	×	×	×
10	1 × 0.1	$2 \times 2200$	2× 0.24	0.173	—	40	B84771C0010A000	×	×	×
10	1 × 0.1	—	2× 0.24	0	1	40	B84771M0010A000	×	×	×
12	1 × 0.1	$2 \times 2200$	2× 0.14	0.173	1	40	B84771A0012A000	$\times^*$	×	×
12	1 × 0.1	$2 \times 2200$	2× 0.14	0.173	—	40	B84771C0012A000	$\times^*$	×	×
12	1 × 0.1	—	2× 0.14	0	1	40	B84771M0012A000	$\times^*$	×	×
15	1 × 0.1	$2 \times 2200$	2× 0.09	0.173	1	40	B84771A0015A000	$\times^*$	×	×
15	1 × 0.1	$2 \times 2200$	2× 0.09	0.173	—	40	B84771C0015A000	$\times^*$	×	×
15	1 × 0.1	—	2× 0.09	0	1	40	B84771M0015A000	$\times^*$	×	×
16	1 × 0.33	$2 \times 2200$	2× 0.4	0.173	1	130	B84771A0016A000	×	×	×
16	$1 \times 0.33$	—	2× 0.4	0	1	130	B84771M0016A000	×	×	×
20	$1 \times 0.33$	$2 \times 2200$	2× 0.3	0.173	1	130	B84771A0020A000	$\times^*$	×	×
20	$1 \times 0.33$	—	2× 0.3	0	1	130	B84771M0020A000	$\times^*$	×	×

 $\times$  = Approval granted

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

 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.



**IEC** inlet filters

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#### Snap-in versions with tab connectors $6.3 \times 0.8 \text{ mm}^2$

#### Characteristics and ordering codes

I <sub>R</sub>	C <sub>R</sub>	C <sub>R</sub>	L <sub>R</sub>	<b>I</b> <sub>LK</sub> <sup>1)</sup>	$R_{dis}$	Approx.	Ordering code	Арр	rovals	;
	X2	Y2				weight				
А	μF	pF	mH	mA	MΩ	g		<b>E</b> 10	71	c <b>71</b>
V <sub>R</sub> =	$V_{\rm R} = 250 \text{ V AC/DC}$									
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	$\times^*$	×	×
12	1 × 0.1	_	2× 0.14	0	1	40	B84771M3012A000	$\times^*$	×	×
15	1 × 0.1	2 × 2200	2× 0.09	0.173	1	40	B84771A3015A000	$\times^*$	×	×
15	1 × 0.1	_	2× 0.09	0	1	40	B84771M3015A000	$\times^{*}$	×	×

 $\times$  = Approval granted

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

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 μA to be expected due to the insulation resistance values of the used materials.



#### **IEC** inlet filters

#### Screw mounting versions with litz wires

#### Characteristics and ordering codes

I <sub>R</sub>	C <sub>R</sub>	C <sub>R</sub>	L <sub>R</sub>	I <sub>LK</sub> <sup>1)</sup>	R <sub>dis</sub>	Approx.	Ordering code	Approvals		;
	X2	Y2				weight				
А	μF	pF	mH	mA	MΩ	g		<b>E</b> 10	<b>71</b>	c <b>7</b>
V <sub>R</sub> =	= 250 V A(	C/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	$\times^*$	×	×
12	1 × 0.1	_	2× 0.14	0	1	40	B84771M0012L000	$\times^*$	×	×
15	1 × 0.1	2 × 2200	2× 0.09	0.173	1	40	B84771A0015L000	$\times^*$	×	×
15	1 × 0.1	_	$2 \times 0.09$	0	1	40	B84771M0015L000	$\times^*$	×	×

 $\times$  = Approval granted

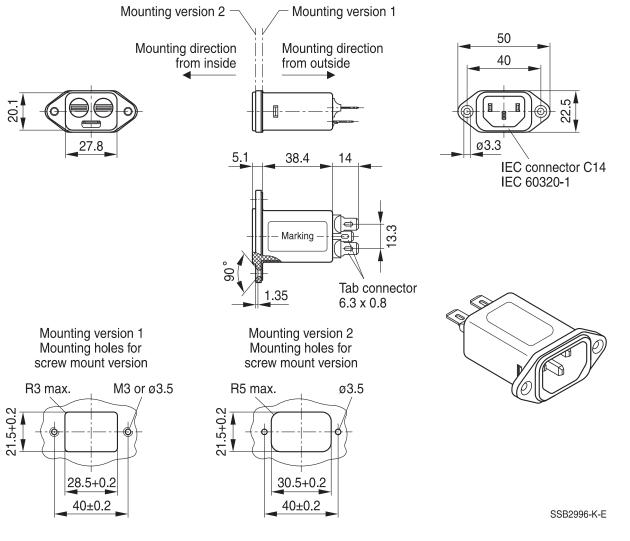
\* = ENEC approval at 12 A and 15 A types with 10 A

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 μA to be expected due to the insulation resistance values of the used materials.



#### **IEC** inlet filters

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



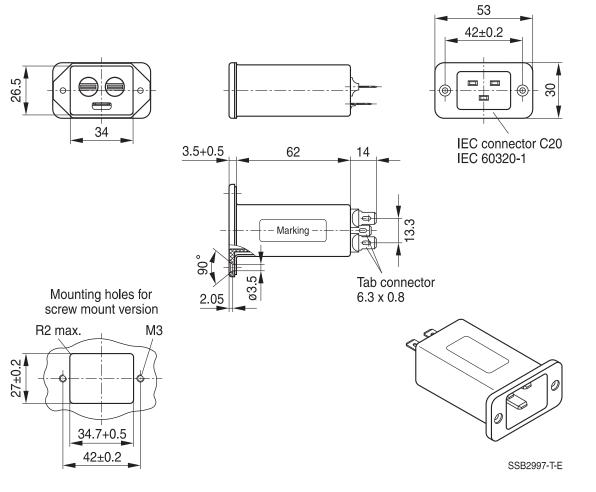


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## 2-line filters

#### **IEC inlet filters**

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



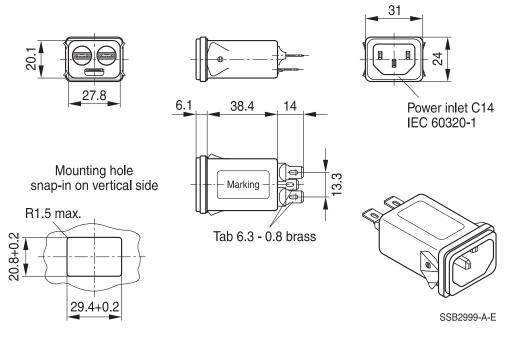


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## 2-line filters

#### **IEC** inlet filters

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

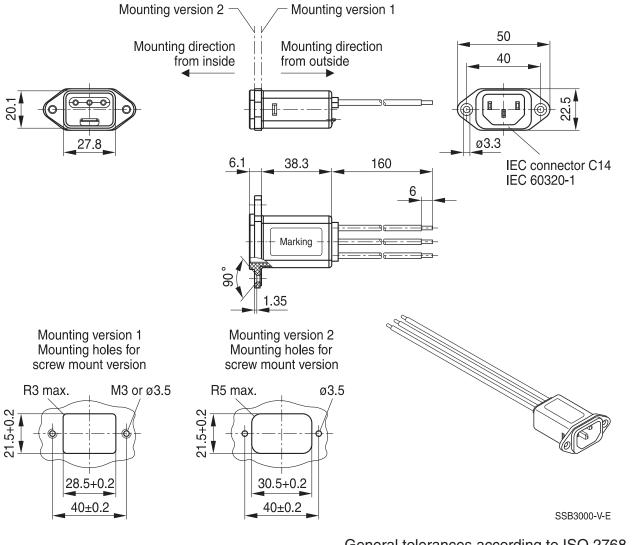




#### IEC inlet filters

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## Dimensional drawings of versions with litz wire output



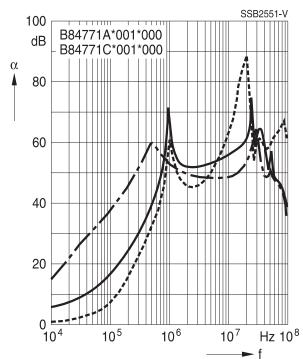


#### **IEC inlet filters**

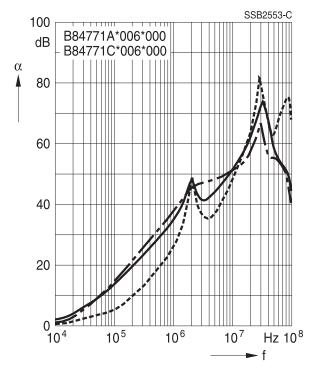
**Insertion loss** (typical values at  $Z = 50 \Omega$ )

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

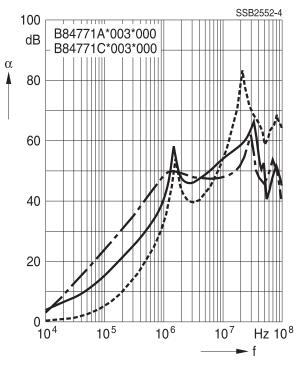
#### Filters for 1 A



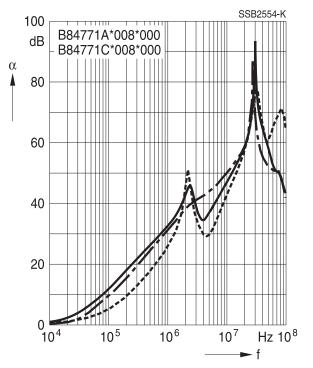
Filters for 6 A



Filters for 3 A







Please read *Cautions and warnings* and *Important notes* at the end of this document.

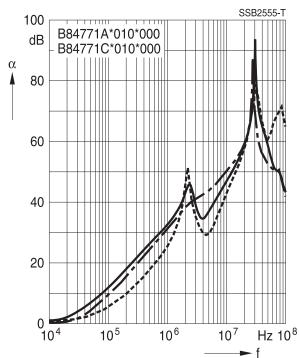


#### **IEC** inlet filters

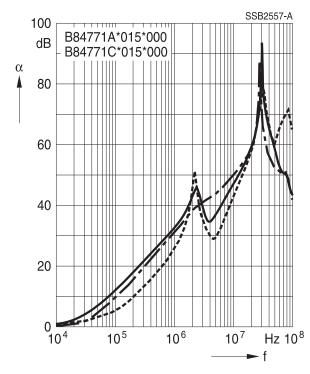
#### **Insertion loss** (typical values at $Z = 50 \Omega$ )

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

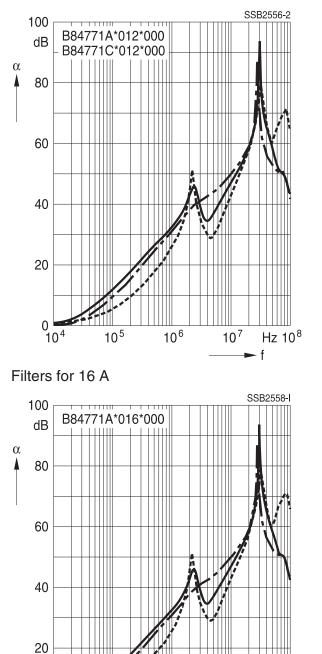
#### Filters for 10 A



Filters for 15 A



Filters for 12 A



10<sup>6</sup>

10<sup>7</sup>

Hz 10<sup>8</sup>

f

Please read *Cautions and warnings* and *Important notes* at the end of this document.

0

10<sup>4</sup>

10<sup>5</sup>

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## 2-line filters

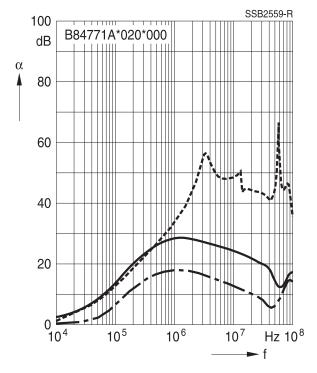
#### **IEC inlet filters**

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

	unsymmetri
<u> </u>	common me

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

#### Filters for 20 A



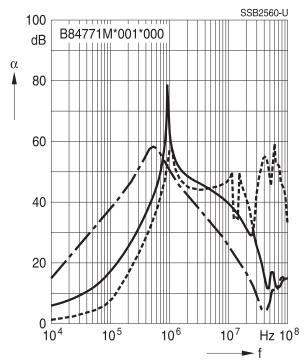


#### **IEC** inlet filters

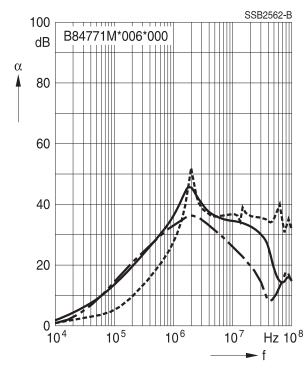
#### **Insertion loss for medical version** (typical values at $Z = 50 \Omega$ )

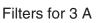
- \_\_\_\_\_
- unsymmetrical, adjacent branches terminated common mode, all branches in parallel (asymmetrical)
  - differential mode (symmetrical)

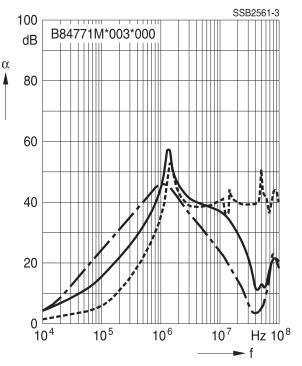
## Filters for 1 A



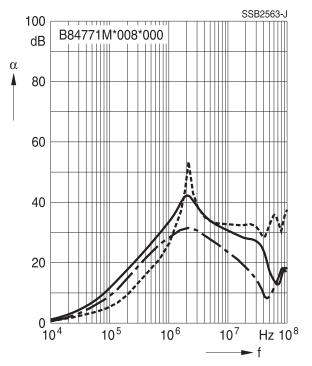
Filters for 6 A













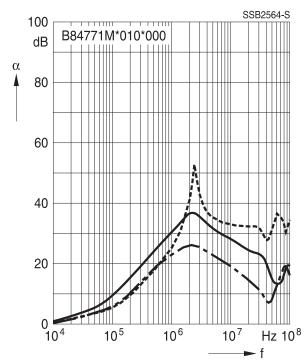
#### **IEC** inlet filters

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

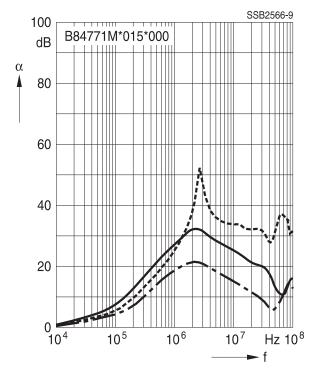
- \_\_\_\_\_
- common mode, all branches in parallel (asymmetrical) differential mode (symmetrical)

unsymmetrical, adjacent branches terminated

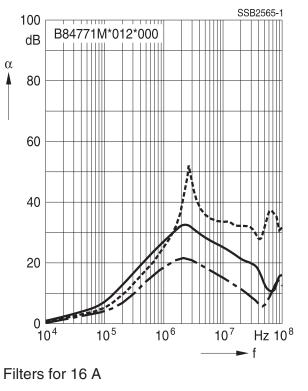
#### Filters for 10 A

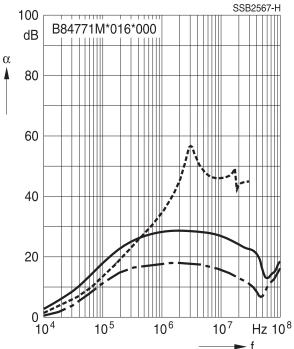


Filters for 15 A



Filters for 12 A





Please read *Cautions and warnings* and *Important notes* at the end of this document.

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## 2-line filters

#### **IEC** inlet filters

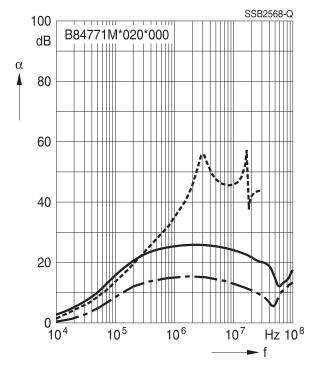
## **Insertion loss for medical versions** (typical values at $Z = 50 \Omega$ )

	unsymmetrical, adjacent branches terminated
<u> </u>	common mode, all branches in parallel (asymm
	differential mode (symmetrical)

common mode, all branches in parallel (asymmetrical)

differential mode (symmetrical)

## Filters for 20 A





**IEC inlet filters** 

#### **Cautions and warnings**

Please read all safety and warning notes carefully before installing the filter and putting it into operation (see  $\underline{M}$ ). 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 lowvoltage 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.

#### Marning

- 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<sub>L</sub><sup>1</sup> ≤10 mA the PE conductor must have a KU value<sup>2</sup> of 4.5<sup>3</sup>; for leakage currents I<sub>L</sub> >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!

- A value of KU = 4.5 with respect to interruptions is attained with: a) permanently connected protective earth connection ≥1.5 mm<sup>2</sup> and b) a protective earth connection ≥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  $\geq 10 \text{ mm}^2$  where the type of connection and installation correspond to the requirements for PEN conductors as specified in relevant standards.

<sup>1)</sup>  $I_L$  = leakage current let-go

<sup>2)</sup> 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.



#### IEC inlet filters

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.

Торіс	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 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, 6.2
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.	, ,
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.	8.4 Leakage current,
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.	<b>0</b>
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



#### IEC inlet filters

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Торіс	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.	instructions,
Mounting position	Note the mounting position of the filters! It must always be ensured that natural convection is not impaired.	· ·
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 order-ing 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.



**IEC** inlet filters

#### Symbols and terms

Symbol	English	German
α	Insertion loss	Einfügungsdämpfung
C <sub>R</sub>	Rated capacitance	Bemessungskapazität
C <sub>x</sub>	Capacitance X capacitor	Kapazität X-Kondensator
C <sub>Y</sub>	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 <sub>M</sub>	Converter output frequency	Motorfrequenz
f <sub>P</sub>	Pulse frequency	Pulsfrequenz
f <sub>R</sub>	Rated frequency	Bemessungsfrequenz
f <sub>res</sub>	Resonant frequency	Resonanzfrequenz
I <sub>C</sub>	Current through capacitor	Strom durch Kondensator
I <sub>LK</sub>	Filter leakage current	Filter-Ableitstrom
I <sub>max</sub>	Maximum current	Maximalstrom
I <sub>N</sub>	Nominal current	Nennstrom
I <sub>op</sub>	Operating current (design current)	Betriebsstrom
I <sub>pk</sub>	Rated peak withstand current	Bemessungs-Stoßstromfestigkeit
l <sub>q</sub>	Capacitive reactive current	Kapazitiver Blindstrom
I <sub>R</sub>	Rated current	Bemessungsstrom
ls	Interference current	Störstrom
L	Inductance	Induktivität
L <sub>R</sub>	Rated inductance	Bemessungsinduktivität
L <sub>stray</sub>	Stray inductance	Streuinduktivität
PL	Power loss	Verlustleistung
R	Resistance	Widerstand
R <sub>is</sub>	Insulation resistance	Isolationswiderstand
R <sub>typ</sub>	DC resistance, typical value	Gleichstromwiderstand, Richtwert
T <sub>A</sub>	Ambient temperature	Umgebungstemperatur
$T_{max}$	Upper category temperature	Obere Kategorietemperatur
$T_{min}$	Lower category temperature	Untere Kategorietemperatur
T <sub>R</sub>	Rated temperature	Bemessungstemperatur
U <sub>k</sub>	Refered voltage drop in %	Bezogener Spannungsabfall in %
$V_{eff}$	RMS voltage	Effektivspannung
Vκ	Voltage drop	Spannungsabfall
$V_{LE}$	Voltage line to earth; voltage line to ground	Spannung Phase zu Erdpotential
V <sub>N</sub>	Nominal voltage	Nennspannung
V <sub>R</sub>	Rated voltage	Bemessungsspannung
$V_{peak}$	Peak voltage	Spitzenspannung
V <sub>test</sub>	Test voltage	Prüfspannung
V <sub>X</sub>	Voltage over X capacitor	Spannung über X-Kondensator
V <sub>Y</sub>	Voltage over Y capacitor	Spannung über Y-Kondensator
$X_L$	Inductive reactance	Induktiver Blindwiderstand
Z	Impedance	Scheinwidertand
IZI	Impedance, absolute value	Scheinwiderstand (Betragswert)

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