

# **EMC filters**

## Selection guide

Date: August 2022

## Selection guide

### 1 Selection based on parameters

#### Feedthrough filters

Type	Dia- meter mm	$I_R$ A	$V_R$ AC V	$C_R$ $\mu\text{F}$	Termi- nal type	Insertion loss in the frequency range (Hz) <sup>1)</sup>		
						10 <sup>5</sup>	10 <sup>6</sup>	10 <sup>7</sup>
B85321A*160	16	16	250	2 x 0.0025				
B85321A*A250 B85321A*A750	30	25, 75	250	2 x 0.1 ... 2 x 1.0				
B85321A*A630, A101 ... A501	55	63 ... 500	250	2 x 0.5 ... 2 x 4.7				

Terminal type:

Tab connectors

Soldering tag

Axial leads

Threaded studs

1) Insertion loss: Performance increases from light grey (standard) to dark grey (very high)

## Selection guide

### 2-line filters

Type	$I_R$	$V_R$ AC	Design	Terminal type	Insertion loss in the frequency range (Hz) <sup>1)</sup>		
					10 <sup>5</sup>	10 <sup>6</sup>	10 <sup>7</sup>
A		V					

### IEC inlet filters

B84771	1 ... 20	250 AC	C						
B84773	1 ... 10	250 AC	C						
B84776	1 ... 10	250 AC	C						

### SIFI filters

B84111F	2 ... 36	250 AC/DC	C						
B84112G	2 ... 36	250 AC/DC	C						
B84113H	2 ... 36	250 AC/DC	C						
B84111A	1 ... 20	250 AC/DC	C						
B84112B	1 ... 20	250 AC/DC	C						
B84113C	3 ... 10	250 AC/DC	C						
B84114D	1 ... 10	250 AC/DC	C						
B84115E	1 ... 20	250 AC/DC	C						

### PCB mounting

B84110A	0.5 ... 6	250 AC/DC	P						
B84110B	1.4	250 AC/DC	P						

### Filters for converters and power electronics

B84142A*166	10 ... 30	250 AC/DC	C						
B84142A*R000	10 ... 60	250 AC/DC	C						
B84142B*R000	8 ... 25	250 AC/DC	C						
B84742A*R190	25 ... 130	500 AC 1000 DC	C						
B84142A/C/J*S081	180 ... 1600	1000 DC 1500 DC	C						

Design:

C Compact filter

P PCB filter

Terminal type:

Tab connectors

Terminal blocks

Busbars

Pins

IEC connectors

Threaded studs

1) Insertion loss: Performance increases from light grey (standard) to dark grey (very high)

## Selection guide

### 3-line filters

Type	$I_R$ A	$V_R$ AC V	De- sign	Terminal type	Motor cable length (m) <sup>1)</sup>		Insertion loss in the frequency range (Hz) <sup>2)</sup>		
					Class A	Class B	10 <sup>5</sup>	10 <sup>6</sup>	10 <sup>7</sup>
B84143A*166	10 ... 35 50	520 530	C		25	10			
B84143A*R107	10 ... 100	520	C		25	10			
B84243A*N107 <b>NEW</b>	10 ... 100	520	C		25	10			
B84143A*R106	10 ... 100	520	C		25	10			
B84243A*000 <b>NEW</b>	3 .. 280	530	B		50	25			
B84143A*R105	8 ... 150	520	B		50	25			
B84143A*R000	8 ... 180	480	C		50	25			
B84143D*R127	16 ... 200	530	B		300	100... 200			
B84143*R410	35 ... 230	520	B		100	50			
B84143A*R021	25 ... 180	760	C		50	25			
B84143B*S080	180 ... 1600	520	C		25	10			
B84143*S081		760							
B84143B*S020	150 ... 2500	530	C		50	20			
B84143B*S021		760							
B84143B*S024		690							
B84143C*250	160 ... 2500	530	C		50	20			
B84143C*251		760							

Design: C Compact filter  
B Book-size filter

Terminal type: Terminal blocks  
 Busbars  
 Tab connectors

- 1) Motor cable lengths for observing the limits according to DIN EN 55011 (2003), typical values. These specifications are designed as a qualitative help in selecting the right filter. The maximum motor cable length depends on several factors, including the pulse frequency, the interference level of the converter and the capacitance of the motor cable: it may in an individual case diverge both upwards and downwards from the specified values. Observance of the limits must always be verified by relevant measurements. On this point, see also chapter "EMC services and EMC laboratory".
- 2) Insertion loss: Performance increases from light grey (standard) to dark grey (very high)

## Selection guide

### 4-line filters

Type	$I_R$ A	$V_R$ AC V	Lines	De- sign	Terminal type	Insertion loss in the frequency range (Hz) <sup>1)</sup>		
						10 <sup>5</sup>	10 <sup>6</sup>	10 <sup>7</sup>
B84144A*R120	8 ... 200	520	3 + N	C		Light grey	Dark grey	Very dark grey
B84144A*R140	8 ... 200	520	3 + N	C		Light grey	Dark grey	Very dark grey
B84144A*R249 <b>NEW</b>	80	520	3 + N	C		Light grey	Dark grey	Very dark grey
B84144A*R000	16 ... 180	440	3 + N	C		Light grey	Dark grey	Very dark grey
B84131	6 ... 63	440	3 + N	C		Light grey	Dark grey	Very dark grey
B84144B*S120 B84144B*S121	250 ... 600	250 ... 600	3 + N	C		Light grey	Dark grey	Very dark grey

Design:

C Compact filter

P PCB filter

Terminal type:

Tab connectors

Threaded studs

Terminal blocks

Busbars

### Active leakage current filter LeaXield

Type	$I_R$ A	$V_R$ AC V	Minimum operating voltage V AC	Frequency range	Maximum leakage current $I_{LK-Load}$ (peak) A
B84233A1500R000	50	530	360	150 Hz ... 30 kHz	1

1) Insertion loss: Performance increases from light grey (standard) to dark grey (very high)

## Selection guide

### Output filters

Type	$I_R$	$V_R$ AC	Terminal type	Motor cable length <sup>1)</sup>	Shielded motor cable required for EMC	Asymmetric attenuation	Max. $f_M$ <sup>2)</sup>	Max. $f_P$ <sup>3)</sup>
	A	V		m			Hz	kHz

#### dv/dt chokes

B86301U	8 ... 1500	520		50	yes	low	400	2.5 ... 16
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#### Sine-wave filters

B84143V*R227	4 ... 320 <sup>4)</sup>	520, 690		1000	yes	low	100	6 ... 16
B84143V*R/S229	4 ... 390	520		1000	yes	low	100	4 ... 10
B84143V*R/S230	10 ... 207	690		1000	yes	low	100	6 ... 10

#### Sine-wave EMC output filter SineFormer®

B84143V*R127 SineFormer®	6 ... 320 <sup>4)</sup>	520	 	1000	no	high	100	4 ... 8
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Terminal type: Terminal blocks Busbars Cable

1) Typical values. The maximum permissible motor cable length applies to unshielded lines and depends on the application and must be checked.

2)  $f_M$  = Motor frequency

3)  $f_P$  = Pulse frequency

4) Higher currents on request

## Selection guide

### Chokes for power electronics and LCL filter

Type	$I_R$ A	$V_R$ AC V	$v_k$ %	Terminal type	THDi (THC) ca.1) %	Converter input	Pulse frequency	
							Min. $f_p$ 2) kHz	Max. $f_p$ 2) kHz

#### Line chokes

B86302L <b>NEW</b>	4 ... 900	520	2		70	uncontrolled	–	–
B86305L	4 ... 900	520	5		40	uncontrolled	–	–
B86306A <b>NEW</b>	14 ... 418	520	6		18	regenerative	–	16
B86310A <b>NEW</b>	8 ... 570	530	10		14	regenerative	–	16

#### LCL filter

B84143G <sup>*</sup> R/S405	16 ... 400	520	–		5	regenerative	4	16
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Terminal type:

Terminal blocks

Busbars

1) In dependance of converter and mains conditions

2)  $f_p$  = Pulse frequency

## Selection guide

### 2 Selection based on questions

#### EMC filters

##### How many lines do I need?

- Particularly high attenuation in high frequency ranges for special applications => (1-line filters) **Feedthrough filters**
- 1-phase or DC applications => **2-line filters**
- 3-phase symmetrical loads without neutral conductor => **3-line filters**
- 3-phase loads with neutral conductor => **4-line filters**

In the next step we recommend opening the second page of the respective chapter (x-line filters). There you will find a selector guide for the next steps. Further explanations can also be found under "Technical information", "Key parameters of filters and chokes".



##### Is use intended for an application other than with TT and TN system?

- If NO, proceed to the next selection step.
- If you plan to use in the IT system, observe the chapter "Special features of the IT system". Please check whether the deviating rated voltage in the data sheet is specified for IT system applications. Should you have any doubts, please ask for help from your relevant TDK salesperson or distributor during the selection.
- If the ratio between the voltage of the conductor to reference potential and line-to-line voltage deviate by  $\sqrt{3}$  values, please ensure that the specified rated voltages are not exceeded!



##### What rated current $I_R$ do I need?

- The maximum current in the application must always be lower or equal to the rated current of the filter. Short-time current peaks are to be defined in the data sheet under "Overload".
- Is my ambient temperature  $\leq$  rated temperature  $T_R$ ?  
If YES, now you should know your rated current.

##### What rated voltage $V_R$ do I need?

- The nominal voltage of the power supply system multiplied by the factor for the positive tolerance results in the rated voltage.
- Example:  $V_N = 230/400 \text{ V } \pm 10 \% \Rightarrow \times 1.1 \Rightarrow V_R = 253/440 \text{ V}$





## Selection guide

### Preselection of suitable filter series

- By specifying the rated current  $I_R$  and rated voltage  $V_R$ , you should now be able to perform a preselection of suitable filter series.



### Do you know the required motor lead length and limit value class according to EN 55011?

- If YES, then you can further restrict the selection with the motor lead class A and B columns.
- If you do not know the limit value class, please use the following table.

### Selection according to product standard for electrical drive systems EN 61800-3

Sales channel	General availability	Limited availability		
Environment	First environment <sup>1)</sup>	First and second environment <sup>1)2)</sup>	Second environment <sup>2)</sup>	
Voltage/current	< 1000 V			>1000 V $I_R > 400 A^3)$ IT network
EMC expertise	No requirements	Installation and commissioning by an EMC specialist		EMC plan required
Category	C1	C2	C3	C4
Limit value according to EN 55011	Class B	Class A / $\leq 20$ kVA with additional installation requirements	Class A / > 20 kVA with additional installation requirements	—

1) First environment: Residential, business and commercial areas, small businesses

2) Second environment: Industrial environments

3) Rated current  $I_R$



### In which frequency range is attenuation required?

With your knowledge of the appliance or system, or with the results of the conducted interference voltage values, you should now **consider the insertion loss column to the selection**.

- The darker the area in question is coloured, the higher the insertion loss of the filter is in this area.



## Selection guide

### Please check the design of selected filters.

- Preliminary information can be found in the "Design" column.
  - K = compact filter (filter with cuboidal housing in compact design)
  - B = Book-size filter (filter with cuboidal housing similar to a book, whereby the "book spine" points upwards)
  - P = PCB filter (filter without housing for PCB mounting)
- Under "Connection type", symbols are shown for the following variants:
  - Stranded wire
  - Terminal block
  - Busbars
  - Flat connectors
- Details can be found in the dimensional diagrams of the respective data sheet.

### ➔ We hope that you have found the right filter.

If this is not the case, please contact your sales partner with your requirements. The filters listed on our website only show a selection of the available types.

Customer-specific solutions are also possible for appropriate minimum order quantities.

We provide you with EMC measurement support in our accredited laboratory in Regensburg. Components can also be rented from there for testing purposes. See also the "Services and EMC laboratory" Chapter.

## Selection guide

### Output filter

We firstly recommend opening the selector guide on page 16. From there you can select the suitable output filter using the following steps.

#### dv/dt chokes, Sine-wave filters, Sine-wave EMC output filter

Which tasks should the output filter perform? See the table below for the selection.

Task	dv/dt choke	Sine-wave filter	EMC sine-wave filter
Protect the insulation of the motor	X	X	X
Reduce motor noise		X	X
Reduce EMC interference		(X)	X
Reduce parasitic currents through capacitance of cable shielding			X
Use unshielded motor cables			X



- Check the specified rated voltage.
- Select the rated current. The maximum current in the application must always be lower or equal to the rated current of the filter. Brief current peaks are to be defined in the data sheet under "Overload".
- At temperatures  $>$  rated temperature  $T_R$ , in the chapter "Current derating depending on the ambient temperature", you need to define the current derating factor and proceed with the increased value for the rated current  $I_R$  in the selector guide.
- Are the specified frequencies maintained?
- Do the inductance values match the impedance of your system?
- Check the design of filters selected. Details can be found in the dimensional diagrams of the respective data sheet.
- We recommend checking a sample filter under critical operating conditions in order to measure heating effects based on the respective pulse pattern.

➔ **We hope that you have found the right filter.**

If this is not the case, please contact your sales partner with your requirements. The filters listed on our website only show a selection of the available types. Customer-specific solutions are also possible for appropriate minimum order quantities.

## Selection guide

### Chokes for power electronics

We firstly recommend opening page 16. From there you can select the suitable choke using the following steps.

#### Where do you plan to use the choke?

- |                                     |    |   |                                   |
|-------------------------------------|----|---|-----------------------------------|
| ■ On the line side of the converter | => | <b>3-phase power line chokes for converters</b> | } Request from your sales partner |
| ■ In the DC supply                  | => | Smoothing choke                                 |                                   |
| ■ For power factor correction       | => | Filter circuit choke                            |                                   |
| ■ For suction circuit applications  | => | Filter circuit choke                            |                                   |



#### 3-Phase power line chokes for converters: Use for regenerative converters?

- YES => 3-phase power line chokes for regenerative converters.
- NO => 3-phase power line chokes for converters.
- Check the specified rated voltage.
- Observe the maximum peak input voltages  $V_{peak}$ .
- Select the rated current. The maximum current in the application must always be lower or equal to the rated current of the filter. Brief current peaks are to be defined in the data sheet under "Overload".
- At temperatures  $>$  rated temperature  $T_R$ , in the chapter "Current derating depending on the ambient temperature", you need to define the current derating factor and proceed with the increased value for the rated current  $I_R$  in the selector guide.
- Are the specified frequencies maintained?
- Do the inductance values match the impedance of your system?
- Check the design of chokes selected. Details can be found in the dimensional diagrams of the respective data sheet.
- We recommend checking a sample choke under critical operating conditions in order to measure heating effects based on the respective pulse pattern.

➔ **We hope that you have found the right choke.**

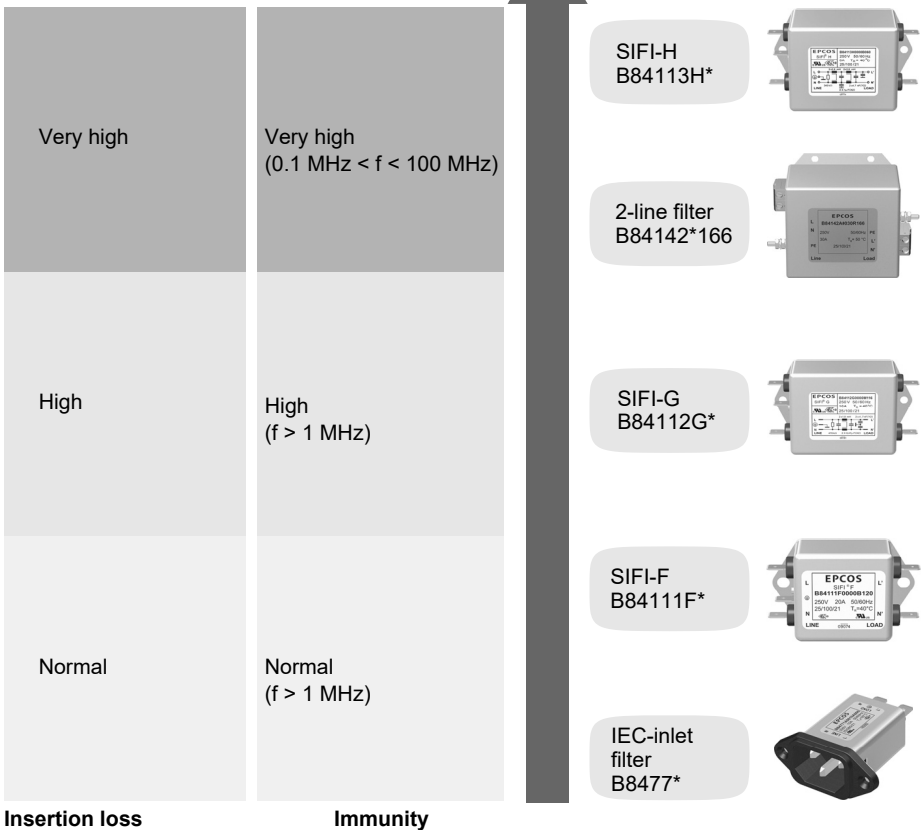
If this is not the case, please contact your sales partner with your requirements. The chokes listed on our website only show a selection of the available types. Customer-specific solutions are also possible for appropriate minimum order quantities.

## Selection guide

### 3 Selection based on the application

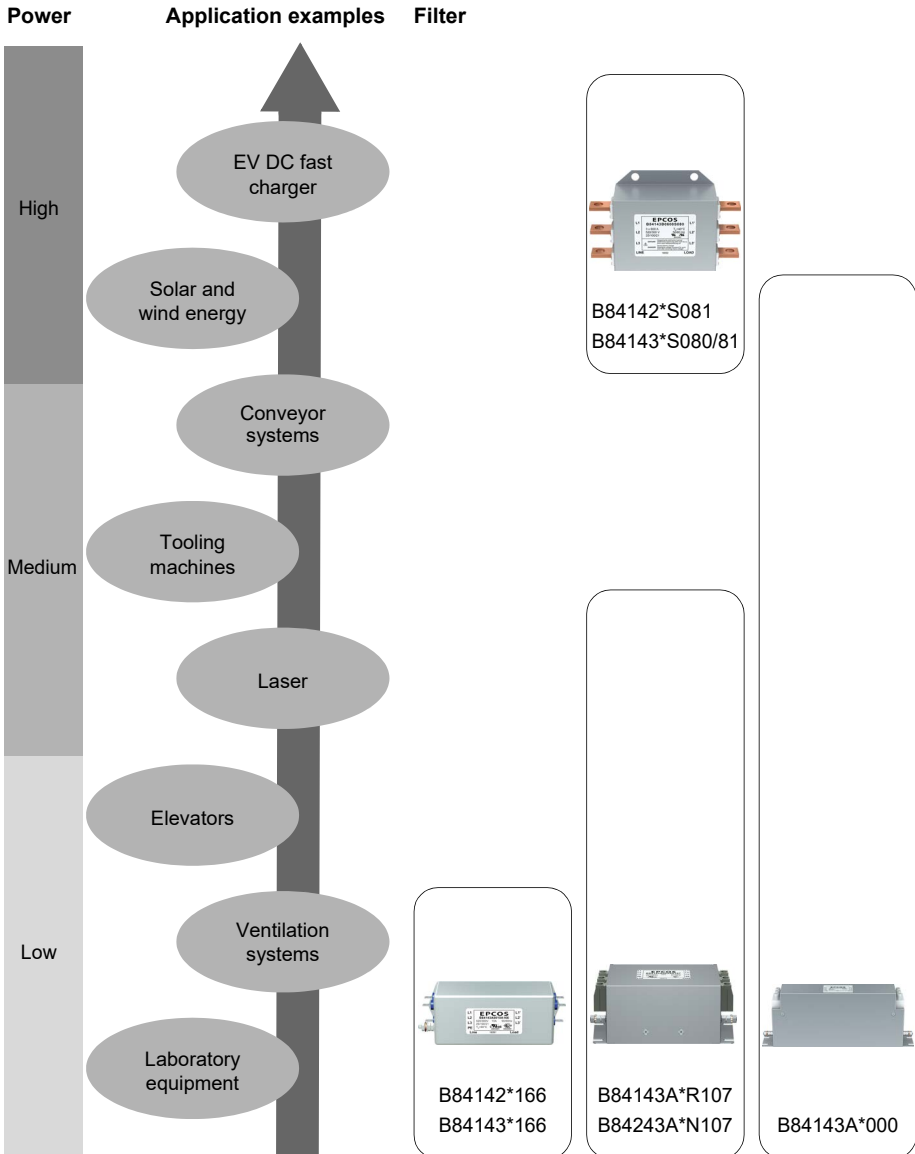
#### 2-line filters for applications with low power

- Medical equipment,
- Measuring equipment,
- Control units,
- PCs, electronic displays,
- Switch-mode power supplies,
- Small single-phase variable-speed drives,
- Fitness equipment etc.



## Selection guide

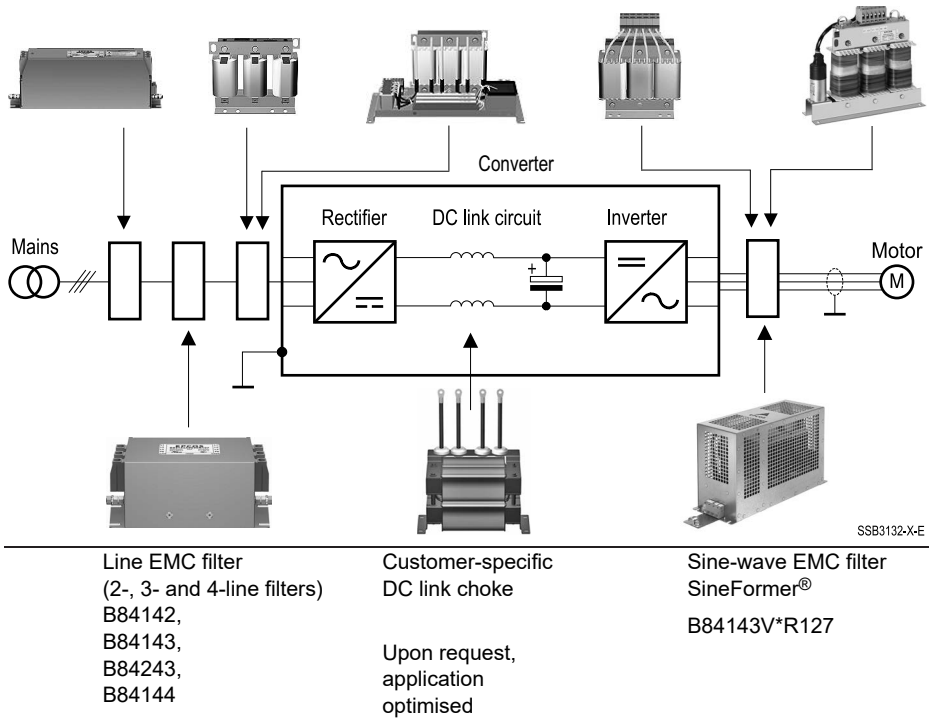
### 2 and 3-line filters for industrial applications



## Selection guide

### Complete product range for frequency converter applications

Active Leaxield™ filter	Power line choke	LCL filter	dv/dt choke	Sine-wave filter
B84233A1500R000	B86302L B86305L B86306A B86310A	B84143G*405	B86301U	B84143V*R227 B84143V*R/S229 B84143V*R/S230



## Selection guide

### 4 Selection based on power

Our experience has shown that the filters listed below have proved their worth in converters for EMC measurements and in practice. However, the following points must be observed:

- The rated data of the converter (such as the rated input current, rated voltage and harmonic content etc.) as well as the derating notes in the "Technical information" Chapter, section 9 "Derating factors" must be considered without fail when selecting the filters.
- Application-referred measurements must be used to ensure observation of the EMC specifications in each individual case. In the case of long motor cables, the filter effort may be significantly higher than for shorter lead lengths
- The correct installation of filters and additional measures designed to observe the EMC directive must be assured (on this point, see also the Chapter on "Technical information", section 20 "Mounting instructions")

### 2-line filters (250 V AC) for converters for electric drives (examples)

Motor power (1 AC 230 V)	Recommended filters for suppression according to	
	EN 55011, class A EN 61800-31 <sup>1)</sup> , category C2	EN 55011, class B EN 61800-31 <sup>1)</sup> , category C1
0.55 kW	B84142A0010A166	B84142B0008R000
0.75 kW	B84142A0010A166	B84142B0008R000
1.1 kW	B84142A0016A166	B84142B0012R000
1.5 kW	B84142A0030R166	B84142B0025R000
2.2 kW	B84142A0030R166	B84142B0025R000
3.0 kW	B84142A0030R166	

1) Table 16 from EN IEC 61800-3, edition 2018



## Selection guide

### 3-line filters (440 V AC) for converters for electric drives (examples)

Motor power (3 AC 400 V)	Recommended filters for suppression according to	
	EN 55011, class A EN 61800-31 <sup>1)</sup> , category C2	EN 55011, class B EN 61800-31 <sup>1)</sup> , category C1
1.5 kW	B84143A0010A166 B84243A8008W000	B84243A8008W000 B84143D0016R127
2.2 kW	B84143A0010A166 B84243A8008W000	B84243A8008W000 B84143D0016R127
3.0 kW	B84143A0020A166 B84243A8012W000	B84243A8012W000 B84143D0016R127
4.0 kW	B84143A0020A166 B84243A8012W000	B84243A8012W000 B84143D0016R127
5.5 kW	B84143A0020A166 B84243A8017W000	B84243A8017W000 B84143D0016R127
7.5 kW	B84143A0020A166 B84243A8025W000	B84143D0025R127 B84243A8025W000
11 kW	B84143A0035R166 B84243A8033W000	B84143D0036R127 B84243A8033W000
15 kW	B84143A0035R166 B84243A8033W000	B84143D0036R127 B84243A8033W000
18.5 kW	B84143A0050R105 B84243A8044X000	B84143D0050R127 B84243A8044X000
22 kW	B84143A0050R105 B84243A8044X000	B84143D0050R127 B84243A8044X000
30 kW	B84143A0066R105 B84243A6083Z000	B84143D0075R127 B84243A6083Z000
37 kW	B84143A0090R105 B84243A6083Z000	B84143D0090R127 B84243A6083Z000
45 kW	B84143A0120R105 B84243A6103Z000	B84143D0120R127 B84243A6103Z000
55 kW	B84143A0150R000 B84243A6120Z000	B84143D0150R127 B84243A6120Z000
75 kW	B84143A0150R000 B84243A6150Z000	B84143D0150R127 B84243A6150Z000
90 kW	B84243A6180Z000 B84143B0180S080	B84143D0200R127 B84243A6180Z000
110 kW	B84143B0250S020 B84143B0250S080	B84243A6220B000
132 kW	B84143B0250S020 B84143B0250S080	B84243A6275A00 B84243A6280A00

1) Table 16 from EN IEC 61800-3, edition 2018

## Selection guide

Motor power (3 AC 400 V)	Recommended filters for suppression according to	
	EN 55011, class A EN 61800-31 <sup>1)</sup> , category C2	EN 55011, class B EN 61800-31 <sup>1)</sup> , category C1
160 kW	B84143B0320S020 B84143B0320S080 B84143C0315S250	B84143C0315S250
200 kW	B84143B0400S020 B84143B0400S080 B84143C0400S250	B84143C0400S250
250 kW	B84143B0600S020 B84143B0600S080 B84143C0630S250	B84143C0630S250
315 kW	B84143B0600S020 B84143B0600S080 B84143C0630S250	B84143C0630S250
400 kW	BB4143B1000S020 B84143B1000S080 B84143C0800S250	B84143C0800S250
500 kW	B84143B1000S020 B84143B1000S080 B84143C1000S250	B84143C1000S250
630 kW	B84143B1600S020 B84143B1600S080 B84143C1250S250	B84143C1250S250
710 kW	B84143B1600S020 B84143B1600S080 B84143C1600S250	B84143C1600S250
900 kW	B84143B1600S020 B84143B1600S080 B84143C1600S250	B84143C1600S250
1100 kW	B84143B2500S020 B84143C2500S250	B84143C2500S250
1300 kW	B84143B2500S020 B84143C2500S250	B84143C2500S250
1500 kW	B84143B2500S020 B84143C2500S250	B84143C2500S250

1) Table 16 from EN IEC 61800-3, edition 2018

## Selection guide

### 4-line filters for control cabinet interference suppression (examples)

Motor power (3 AC 400 V)	Recommended filters for suppression according to	
	EN 55011, class A EN 61800-31 <sup>1)</sup> , category C2	EN 55011, class B EN 61800-31 <sup>1)</sup> , category C1
5.5 kW	B84144A0008R120	
11 kW	B84144A0016R120	
17 kW	B84144A0025R120	
25 kW	B84144A0036R120	
34.5 kW	B84144A0050R120	
45.5 kW	B84144A0066R120	
62 kW	B84144A0090R120	
83 kW	B84144A0120R120	
103 kW	B84144A0150R120	
138 kW	B84144A0200R120	
172 kW	B84144B0250S120	B84144B0250S121
276 kW	B84144B0400S120	B84144B0400S121
474 kW	B84144B0600S120	B84144B0600S121

1) Table 16 from EN IEC 61800-3, edition 2018