



UEMC

EMC Filters



Important Notes

The following applies to all products named in this publication:

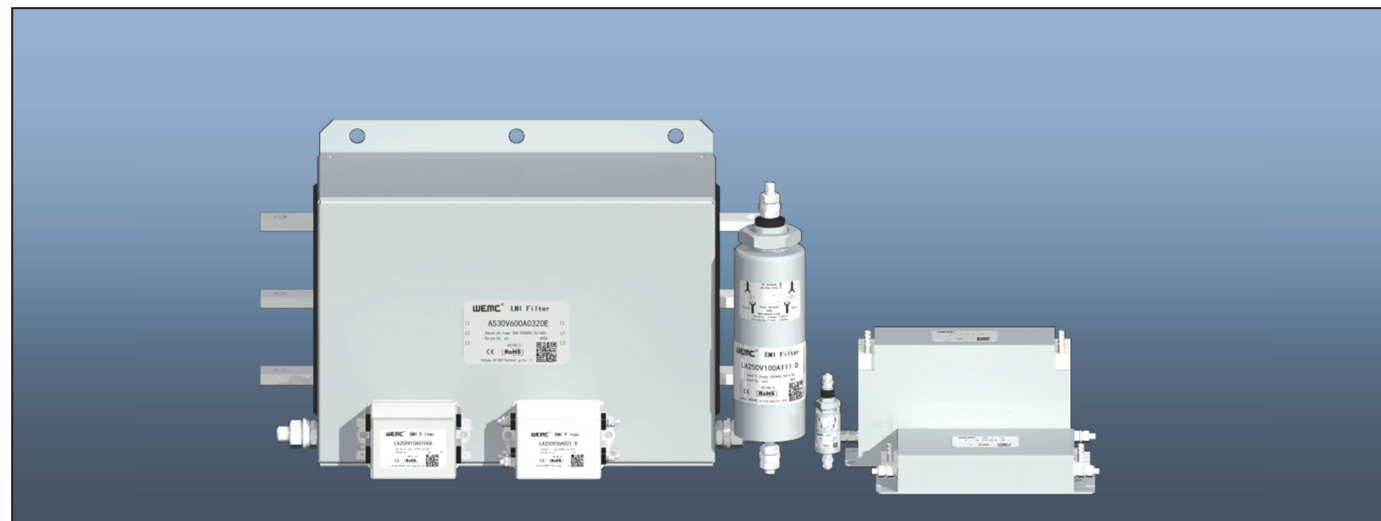
■ Some parts of this publication contain statements about the suitability of our products for certain areas of application. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application. As a rule, UEMC 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 UEMC product with the properties described in the product specification is suitable for use in a particular customer application.

■ We also point out that in individual cases, a malfunction of passive electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the part, 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 a passive 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 a passive electronic component.

■ The warnings, cautions and product-specific notes must be observed.

■ 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"). Should you have any more detailed questions, please contact our sales offices.

■ We constantly strive to improve our products. Consequently, the products described in this publication may change from time to time.



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About us

UEMC, Inc. is one of the major manufacturers of power supply filters for the development and production of electromagnetic compatibility and information security products.

It mainly produces single-phase, three-phase AC power supply filters and DC power supply filters. At present, the product has been widely used in information security, EMC testing, aerospace, industrial control, rail transit, measuring instruments, medical equipment, military equipment, inverter inverters and electric drive systems, etc., covering all areas of electromagnetic interference control.

Electromagnetic compatibility is indispensable in today's products and EMC components are the key to ensuring it.

This publication is intended to help you choose the right solutions, and presents our broad selection of chokes and filters for power line applications.

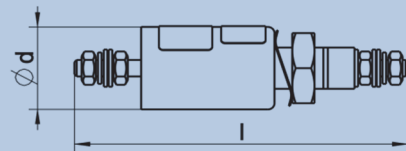
Feedthrough capacitors



NEW

- Soloder MKP technology
- Dielectric: metallized Polypropylene
- Dry, self-healing
- Metal case, potted (UL94 V-0)
- Centeal screw fixing
- Terminal: see table

Schematic representations



Standards : IEC 60384-14
 Climatic category : 40/085/56
 Rated temperature : 40°C
 Cap.tolerance: ±20%

Case diameter 55 mm

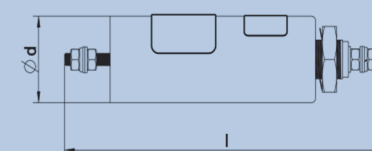
I _R	C _R	V _R		V _{test}	Insertion loss		Terminals	Dimensions	Ordering code
		V AC	V DC		typ.@50Ω(dB)				
A	μF			V DC	100kHz	100MHz		∅dxl(mm)	
63	0.47	250	600	3000	15	80	■-M6	55×100	LA250V63A1101D
	2.2	250	600	2500	30	>90	■-M6	55×130	LA250V63A1102D
	4.7	250	600	2000	35	>90	■-M6	55×130	LA250V63A1103D
100	0.47	250	600	3000	15	80	■-M8	55×110	LA250V100A1101D
	2.2	250	600	2500	30	>90	■-M8	55×140	LA250V100A1102D
	4.7	250	600	2000	35	>90	■-M8	55×140	LA250V100A1103D
200	0.47	250	600	3000	15	80	■-M10	55×120	LA250V200A1101D
	2.2	250	600	3000	15	80	■-M10	55×120	LA250V200A1102D
	4.7	250	600	3000	15	80	■-M10	55×120	LA250V200A1103D

Feedthrough filters



- Soloder MKP technology
- Dielectric: metallized Polypropylene
- Dry, self-healing
- Metal case, potted (UL94 V-0)
- Centeal screw fixing
- Terminal: see table

Schematic representations



Standards : IEC60939
 Climatic category : 40/085/56
 Rated temperature : 40°C
 Cap.tolerance: ±20%

Case diameter 16 mm

I _R	C _R	V _R		V _{test}	Insertion loss		Terminals	Dimensions	Ordering code
		V AC	V DC		typ.@50Ω(dB)				
A	μF			V DC	100kHz	100MHz		∅dxl(mm)	
16	2×0.0025	250	600	2700	-	>80	■-M2	16×80	LA250V16A1111D
	2×0.0025	250	600	2700	-	>80	■-∅2mm	16×155	LA250V16A1111B

Case diameter 30 mm

32	2×0.1	250	600	3000	10	>100	■-M6	30×130	LA250V32A1111D
	2×0.47	250	600	2000	25	>100	■-M6	30×130	LA250V32A1112D
	2×1.0	250	500	1700	30	>100	■-M6	30×130	LA250V32A1113D
75	2×0.1	250	600	3000	10	>100	■-M6	30×130	LA250V75A1111D
	2×0.47	250	600	2000	25	>100	■-M6	30×130	LA250V75A1112D
	2×1.0	250	500	1700	30	>100	■-M6	30×130	LA250V75A1113D

Feedthrough filters									
Case diameter 55 mm									
I _R	C _R	V _R		V _{test}	Insertion loss		Terminals	Dimensions	Ordering code
		V AC	V DC		typ.@50Ω(dB)	100kHz			
63	2×0.5	250	600	3000	25	> 100	M6	55×166	LA250V63A1111D
	2×1.0	250	600	2500	30	> 100	M6	55×166	LA250V63A1112D
	2×2.0	250	600	2500	35	> 100	M6	55×166	LA250V63A1113D
	2×4.7	250	350	1700	40	> 100	M6	55×166	LA250V63A1114D
100	2×0.5	250	600	3000	25	> 100	M8	55×180	LA250V100A1111D
	2×1.0	250	600	2500	30	> 100	M8	55×180	JLA250V100A1112D
	2×2.0	250	600	2500	35	> 100	M8	55×180	LA250V100A1113D
	2×4.7	250	350	1700	40	> 100	M8	55×180	LA250V100A1114D
200	2×0.5	250	600	3000	25	> 100	M10	55×185	LA250V200A1111D
	2×1.0	250	600	2500	30	> 100	M10	55×185	LA250V200A1112D
	2×2.0	250	600	2500	35	> 100	M10	55×185	LA250V200A1113D
	2×4.7	250	350	1700	40	> 100	M10	55×185	LA250V200A1114D
300	2×0.5	250	600	3000	25	> 100	M12	55×195	LA250V300A1111D
	2×1.0	250	600	2500	30	> 100	M12	55×195	LA250V300A1112D
	2×2.0	250	600	2500	35	> 100	M12	55×195	LA250V300A1113D
	2×4.7	250	350	1700	40	> 100	M12	55×195	LA250V300A1114D
400	2×0.5	250	600	3000	25	> 100	M16	55×245	LA250V400A1111D
	2×1.0	250	600	2500	30	> 100	M16	55×245	LA250V400A1112D
	2×2.0	250	600	2500	35	> 100	M16	55×245	LA250V400A1113D
	2×4.7	250	350	1650	40	> 100	M16	55×245	LA250V400A1114D
500	2×0.5	250	600	3000	25	> 100	M18	55×250	LA250V500A1111D
	2×1.0	250	600	2500	30	> 100	M18	55×250	LA250V500A1112D
	2×2.0	250	600	2500	35	> 100	M18	55×250	LA250V500A1113D
	2×4.7	250	350	1650	40	> 100	M18	55×250	LA250V500A1114D

General purpose application							
		<ul style="list-style-type: none"> For 1-phase systems For switch-mode power supplies and DC applications Metal case, potted (UL94 V-0) Terminal: see table 					
<p>Schematic representations</p>		<p>Rated voltage: 250 V AC 50/60 Hz 250 V DC</p> <p>Climatic category: 40/085/21 Rated temperature: 40°C</p>					
standard version							
I _R	C _R -X2	C _R -Y2	L _R	I _{leak}	Terminals	Dimensions	Ordering code
A	μF	pF		mA		l×b×h(mm)	
3	2×0.1	2×4700	2×1.5mH	0.369	A6.3*0.8	32.5×43.3×29	LA250V3A0211A
6	2×0.1	2×4700	2×1.8mH	0.369	A6.3*0.8	32.5×43.3×29	LA250V6A0211A
10	2×0.1	2×4700	2×870μH	0.369	A6.3*0.8	32.5×43.3×29	LA250V10A0211A
16	2×0.1	2×4700	2×650μH	0.369	A6.3*0.8	50×44×29	LA250V16A0211A
20	2×0.1	2×4700	2×430μH	0.369	A6.3*0.8	50×44×29	LA250V20A0211A
25	2×0.1	2×4700	2×660μH	0.369	M4	63×51×38	LA250V25A0211D
36	2×0.47	2×10000	2×400μH	0.785	M4	63×51×38	LA250V36A0211D
Low leakage current application							
3	2×0.1	–	2×1.5mH	0	A6.3*0.8	32.5×43.3×29	LA250V3A0212A
6	2×0.1	–	2×1.8mH	0	A6.3*0.8	32.5×43.3×29	LA250V6A0212A
10	2×0.1	–	2×870μH	0	A6.3*0.8	32.5×43.3×29	LA250V10A0212A
16	2×0.1	–	2×650μH	0	A6.3*0.8	50×44×29	LA250V16A0212A
20	2×0.1	–	2×430μH	0	A6.3*0.8	50×44×29	LA250V20A0212A
25	2×0.1	–	2×660μH	0	M4	63×51×38	LA250V25A0212D
36	2×0.47	–	2×400μH	0	M4	63×51×38	LA250V36A0212D

2-Line Filters

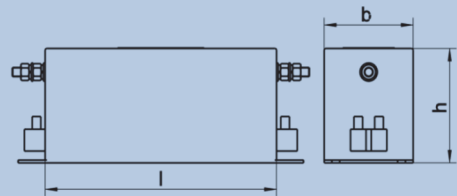


For converters and power electronics



- For 1-phase systems
- Anti-electric shock terminal
- Metal case, potted (UL94 V-0)
- Terminal: see table

Schematic representations



Rated voltage: 500 V AC
50/60 Hz
1000 V DC
Climatic category: 40/085/21
Rated temperature: 40°C

standard version

I_R A	Terminal cross section mm^2	I_{leak} mA	R_{TVS} mΩ	Approx. weight kg	Terminals	Dimensions l×b×h(mm)	Ordering code
25	4	7.7	4.2	1.0		200×60×90	LA500V25A0240F
36	10	7.7	2.9	1.6		200×60×90	LA500V36A0240F
55	10	7.7	1.9	1.6		200×60×90	LA500V55A0240F
75	16	7.7	1.3	2.5		200×60×150	LA500V55A0240F
100	35	7.7	0.9	4.0		250×90×150	LA500V100A0240F
130	35	7.8	0.7	8.0		250×90×150	LA500V130A0240F

2-Line Filters

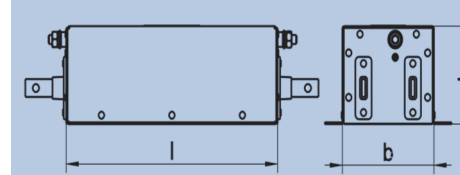


Converter in traction systems



- Power line for DC system
- Metal case, potted (UL94 V-0)
- Terminal: see table

Schematic representations



Rated voltage: 1000 V DC
~1500 V DC
Climatic category: 40/085/21
Rated temperature: 40°C

standard version

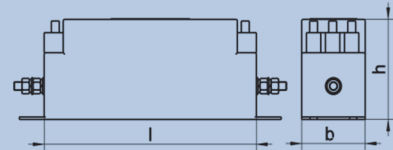
I_R A	I_{pk} kA	Terminal cross section mm^2	R_{TVS} mΩ	Approx. weight kg	Terminals	Dimensions l×b×h(mm)	Ordering code
180	25	20×3	0.110	4.9		200×150×120	LD1000V180A0200E
	25	20×3	0.110	4.9		200×150×120	LD1500V180A0200E
250	25	20×3	0.110	5.0		200×150×120	LD1000V250A0200E
	25	20×3	0.110	5.0		200×150×120	LD1500V250A0200E
320	50	25×5	0.051	7.8		230×140×120	LD1000V320A0200E
	50	25×5	0.051	7.8		230×140×120	LD1500V320A0200E
400	50	25×5	0.048	7.8		230×140×120	LD1000V400A0200E
	50	25×5	0.048	7.8		230×140×120	LD1500V400A0200E
600	50	30×5	0.043	7.9		230×140×120	LD1000V600A0200E
	50	30×5	0.043	7.9		230×140×120	LD1500V600A0200E
1000	75	40×8	0.029	19.9		300×210×150	LD1000V1000A0200E
	75	40×8	0.029	19.9		300×210×150	LD1500V1000A0200E
1250	75	50×10	0.022	19.9		300×210×150	LD1000V1250A0200E
	75	40×8	0.029	19.9		300×210×150	LD1500V1250A0200E
1600	75	50×10	0.022	24.5		300×210×150	LD1000V1600A0200E
	75	50×10	0.022	24.5		300×210×150	LD1500V1600A0200E

Book-size filters



- For 3-phase systems
- For converters and power electronics
- Finger-safe terminal blocks
- Metal case, potted (UL94 V-0)
- Terminal: see table

Schematic representations



Rated voltage: 305/530VAC
50/60Hz
Climatic category: 40/085/21
Rated temperature: 50°C

standard version
标准型

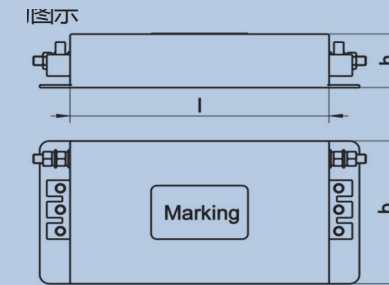
I_R -50°C	I_R -40°C	Terminal cross section mm ²	I_{leak} mA	R_{typ} mΩ	Terminals	Dimensions l×b×h(mm)	Ordering code
A	A						
3	3.5	4	2.6	40		160×50×100	LA530V3A0310F
8	9	4	4.8	14		160×50×100	LA530V8A0310F
12	13	4	4.8	10		160×50×100	LA530V12A0310F
17	19	10	4.8	7		230×50×100	LA530V17A0310F
25	27	10	4.8	4		230×50×100	LA530V25A0310F
33	36	10	4.8	3		230×50×100	LA530V33A0310F
44	48	25	6.8	2		280×50×100	LA530V44A0310F
60	66	35	12	1.5		210×85×120	LA530V60A0310F
83	91	50	14	1.2		280×80×200	LA530V83A0310F
90	98	50	14	1.2		280×80×200	LA530V90A0310F
103	113	50	14	1.2		280×110×200	LA530V103A0310F
120	131	50	14	0.9		280×110×200	LA530V120A0310F
140	153	50	14	0.8		280×100×270	LA530V140A0310F
150	164	50	14	0.8		280×100×270	LA530V150A0310F
180	197	95	16	0.7		390×130×220	LA530V180A0310F
220	241	95	17	0.5		390×130×220	LA530V220A0310F
275	301	150	17	0.4		450×180×230	LA530V275A0310F
280	306	240	17	0.4		450×180×230	LA530V280A0310F

Flat filters



- For 3-phase systems
- Finger-safe terminal blocks
- Metal case, potted (UL94 V-0)
- Low weight
- Terminal: see table

Schematic representations




Rated voltage: 305/530VAC
50/60Hz
Climatic category: 40/085/21
Rated temperature: 40°C

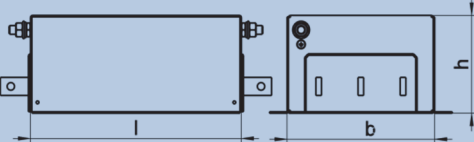
standard version

I_R	Terminal cross section mm ²	I_{leak} mA	R_{typ} mΩ	Terminals	Dimensions l×b×h(mm)	Ordering code
A						
6	2.5	3.5	72		180×80×45	LA530V6A0240E
12	2.5	3.5	21		200×150×45	LA530V12A0240E
25	2.5	6	8.5		220×190×60	LA530V25A0240E

Compact filters with busbars



Schematic representations



- For 3-phase systems
- Finger-safe terminal blocks
- For converters and power electronics
- Metal case, potted (UL94 V-0)
- Low weight
- Terminal: see table


Rated voltage: 305/530VAC
440/760VAC
50/60Hz

Climatic category: 40/085/21
Rated temperature: 40°C

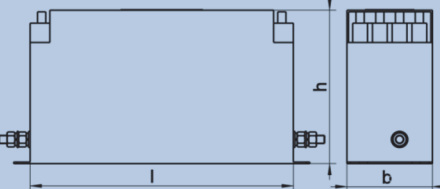
standard version

V _R V AC	I _R A	I _{leak} mA	R _{tvp} μΩ	Terminals	Dimensions l×b×h(mm)	Ordering code
305/530	150	13	140	☐	280×150×150	LA530V150A0320E
	180	13	140	☐	280×150×150	LA530V180A0320E
	250	13	63	☐	300×150×120	LA530V250A0320E
	320	13	67	☐	300×220×120	LA530V320A0320E
	400	13	67	☐	300×220×120	LA530V400A0320E
	600	13	52	☐	350×220×120	LA530V600A0320E
	1000	13	33	☐	350×250×180	LA530V1000A0320E
	1600	13	22	☐	400×250×180	LA530V1600A0320E
	2500	13	15	☐	650×320×240	LA530V2500A0320E
440/760	150	18	140	☐	280×150×150	LA760V150A0320E
	180	18	140	☐	280×150×150	LA760V180A0320E
	250	18	63	☐	300×150×120	LA760V250A0320E
	320	19	67	☐	300×220×120	LA760V320A0320E
	400	19	67	☐	300×220×120	LA760V400A0320E
	600	19	52	☐	350×250×120	LA760V600A0320E
	1000	19	33	☐	350×250×180	LA760V1000A0320E
	1600	13	22	☐	400×250×180	LA760V1600A0320E
	2500	13	15	☐	650×320×240	LA760V2500A0320E

Converters/power electronics



Schematic representations



- For 3-phase systems
- Anti-electric shock terminal
- Metal case, potted (UL94 V-0)
- Low leakage current
- Terminal: see table

Rated voltage: 250/440VAC
50/60 Hz

Climatic category: 40/085/21
Rated temperature: 50°C

standard version

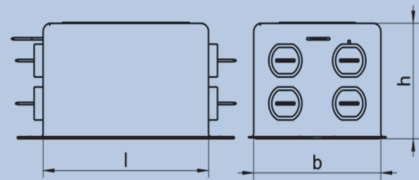
I _R A	Terminal cross section mm ²	I _{leak} mA	R _{tvp} mΩ	Approx. weight kg	Terminals	Dimensions l×b×h(mm)	Ordering code
8	4	0.314	14.0	1.6	☐	200×80×60	LA440V8A0410F
16	4	0.314	7.0	1.6	☐	200×80×60	LA440V16A0410F
25	4	0.314	3.8	1.7	☐	200×80×60	LA440V25A0410F
36	10	0.314	3.1	2.2	☐	230×100×60	LA440V36A0410F
50	10	0.314	1.3	2.2	☐	230×100×60	LA440V50A0410F
66	16	0.314	1.1	3.6	☐	260×100×80	LA440V66A0410F
90	25	0.314	0.75	5.1	☐	250×130×100	LA440V90A0410F
120	50	0.314	0.58	9.5	☐	250×130×130	LA440V120A0410F
150	95	0.314	0.40	12.0	☐	250×160×130	LA440V150A0410F
200	95	0.314	0.27	13.0	☐	250×160×130	LA440V200A0410F

Installations and systems



- For 3-phase systems
- Metal case, potted(UL94 V-0)
- Terminal: see table

Schematic representations
结构图示



Rated voltage: 250/440VAC
50/60 Hz
Climatic category: 40/085/21
Rated temperature: 40°C

standard version

I_R A	I_{leak} mA	R_{TYP} mΩ	Terminals	Dimensions l×b×h(mm)	Ordering code
6	3.5	14.0	-A6.3*0.8	63×51×38	LA440V6A0420A
10	3.5	14.0	-A6.3*0.8	63×51×38	LA440V10A0420A
20	3.5	7.0	-A6.3*0.8	63×51×38	LA440V10A0420A

For high frequency pulse



- Feed-through filters
- For MRI
- Metal case
- Low weight
- Small dimensions
- High insertion loss in high frequency part
- Small capacitance and inductance, have little influence on the original circuit

Rated voltage: 1000~2000Vp
DC-10kHz
Climatic category: 40/085/21
Rated temperature: 40°C

Customer-specific filters

V_R V AC	I_R A	I_{peak} A	R_{TYP} μΩ	Terminals	Ordering code
1000Vp	300	700	185	-M12	FC-300
1500Vp	450	1000	113	-M16	FC-450-D3
2000Vp	600	1500	62	-M16	FC-600-L1



The UEMC EMC Laboratory in Jiangsu offers comprehensive, in-depth EMC services: from consulting and pre-compliance investigations on prototypes to conformity testing of series production equipment.

Investigations performed side by side with the development process determine the measures required to observe the EMC limits these measures are documented in the measurement report in a manner that is transparent for the developers.

Our applications engineers develop individual EMC solutions for our customers, and support them with measurements including on-site. Our test engineers conduct measurements and tests to international EMC standards in our own laboratory in Liyang City, Jiangsu Province, China. Tests from this laboratory can be used for the rectification.

UEMC is an EMC solution provider, supporting our customers throughout the entire product development cycle from the design phase up to volume production. We offer solutions and make rectification measures.

EMC standards			
		China	World
Generic standards			
	Emission	GB 17799.3/4	IEC 61000-6-3/-4
	Immunity	GB 17799.1/2	IEC 61000-6-1/-2
Basic standards			
Measuring	Emission	GB/T6113-x	CISPR 16-1- x
Measuring methods	Emission	GB/T6113-x	CISPR 16-2- x
ESD	Immunity	GB/T 17626.2	IEC 61000-4-2
Fast transients (burst)	Immunity	GB/T 17626.4	IEC 61000-4-4
Surge	Immunity	GB/T 17626.5	IEC 61000-4-5
Product family standards			
ISM equipment	Emission	GB 4824	CISPR 11
Domestic appliances	Emission	GB 4343.1	CISPR 14-1
Lighting	Emission	GB 17743	CISPR 15
Military equipment and subsystems	Emission	GJB 151B	-
Military equipment and subsystems	Immunity	GJB 151B	-

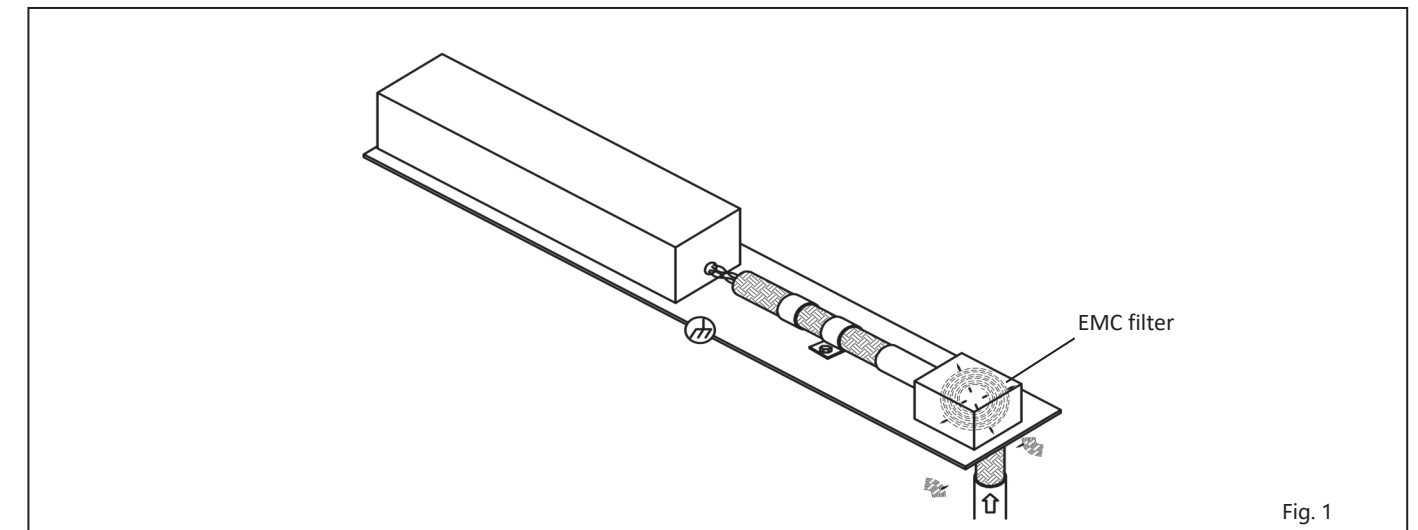
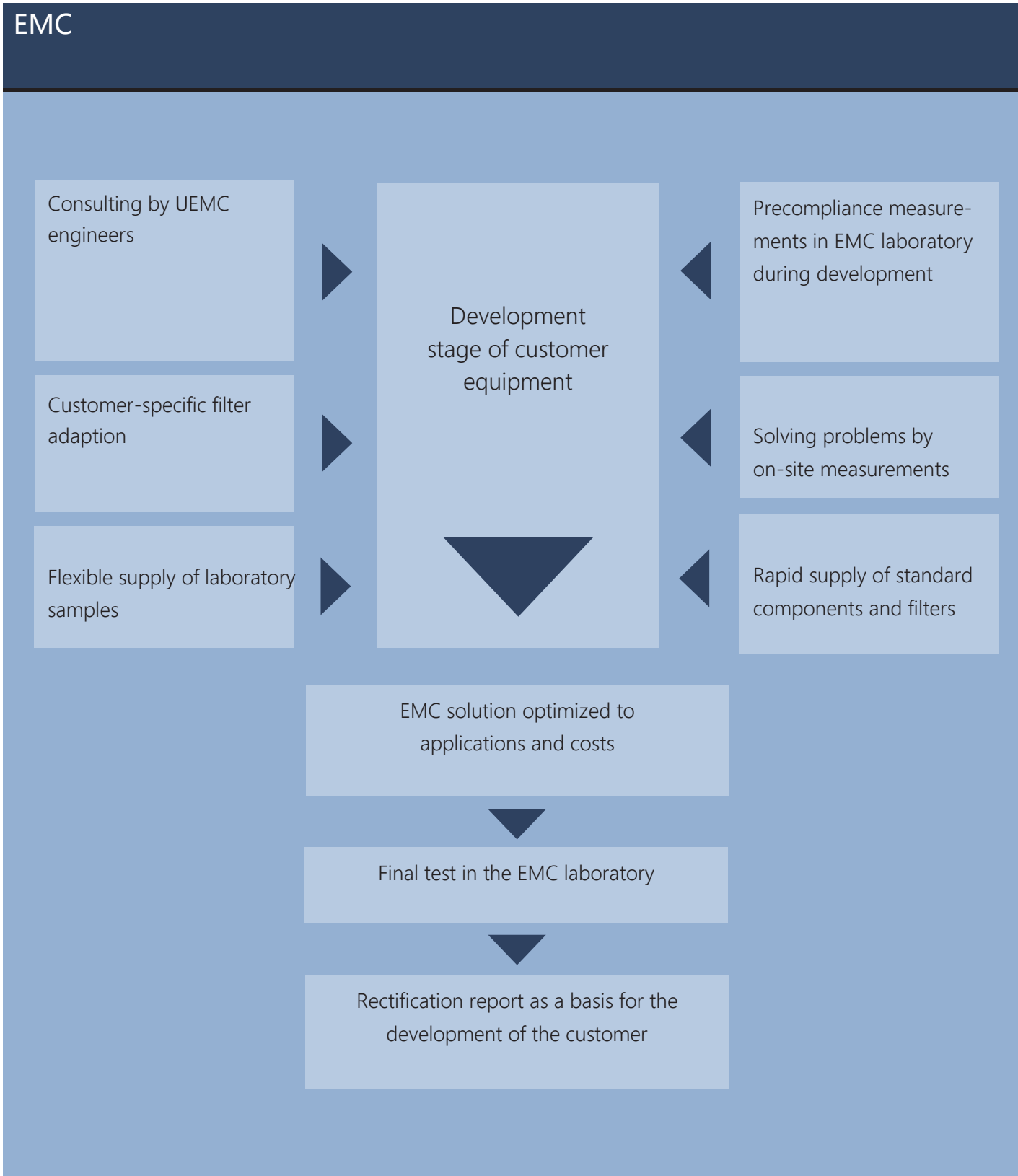


Fig. 1

EMC cannot be assured by the use of EMC filters alone. Every system should be considered as an integrated whole and careful planning and preparation are required to ensure success. Measures such as shielded motor cables, grounding and spatial separation are mandatory parts of an integrated concept.

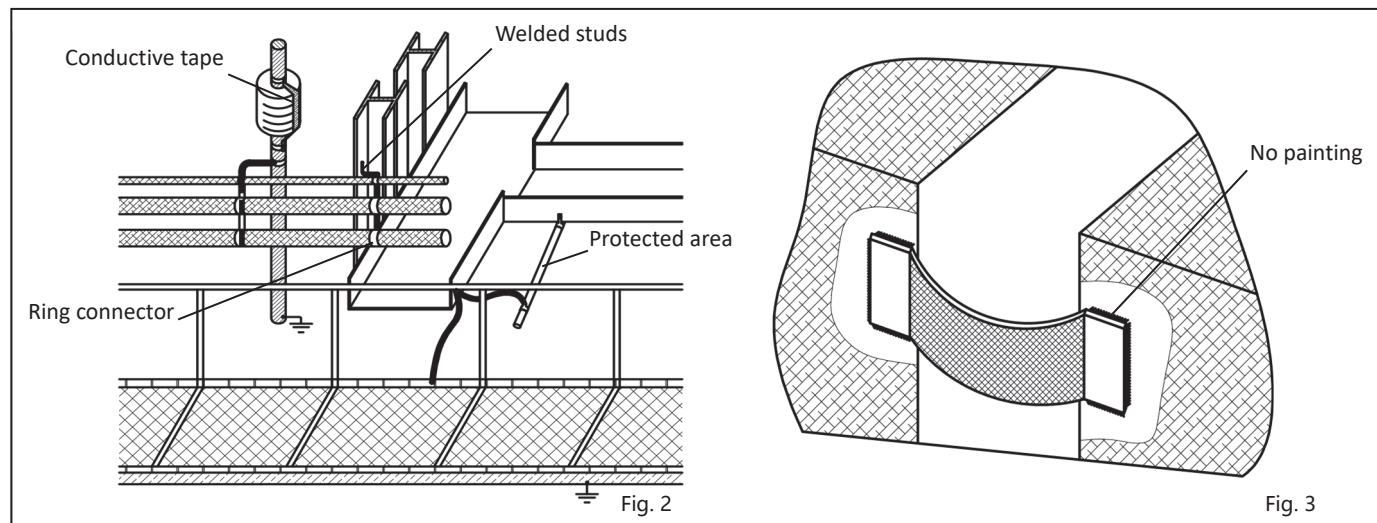
- Identify interference sources (with interference emissions) and disturbed equipment (electrical equipment or components with limited interference immunity).
- Assign interference sources and disturbed equipment to specific zones and separate them spatially from each other.
- Plan the cabling in wiring categories in accordance with interference emissions and interference immunity.

The legally stipulated protection objectives and technical risks must be taken into consideration as early as the development stage of the system.

In order to achieve electromagnetic compatibility of the over all system the following points must be observed:

- The filter case should be connected across a large area to ground and to the other equipment (Fig. 1)

For example, a blank metal mounting plate should be provided jointly for filters and converters. It should be well grounded and connected to the switch cabinet via large-area low-inductance connection. If necessary, use shortcopper tapes and EMC seals (e.g. connection to switch cabinet doors).

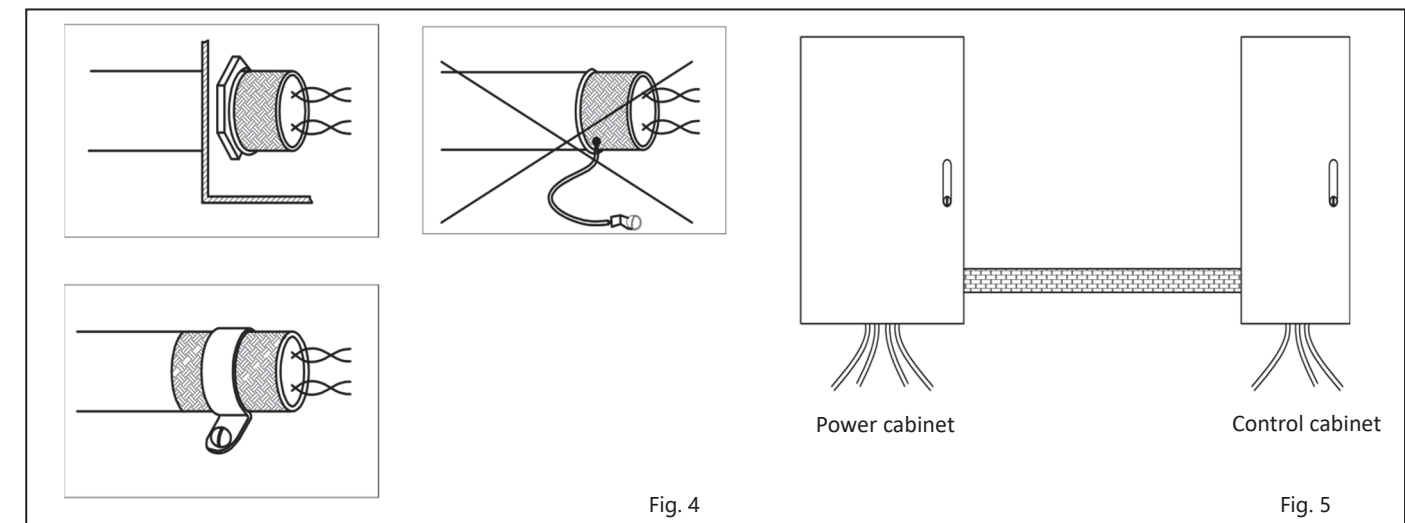


■ A distinction should be made between:

- The protective earth connection of the EMC filter, which is used to secure protection against hazardous body currents.
 - The large-area grounding of the filter, which is required for its interference suppression function.
- Warning: For operating currents greater than 250A, 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. This is because of the restricted area of the cable lug of the PE connection to the filter housing. Ideally, the PE feed line should be connected with the PE output line to a PE busbar which also carries the PE terminal(s) of the EMC filter. The number of necessary PE connections to the filter depends on the cross section and the required KUFactor as a function of the magnitude of the leakage currents. The PE conductor connections must satisfy the requirements defined in IEC 60364-5-54. For currents >1000A and/or short-circuit currents >25kA, it is not permissible to loop the PE conductor through the filter housing.

■ In your system, set up connections at the same reference potential. All metallic reference potentials of housings, machines and installations should be linked via a low-impedance connection suited for RF and intermeshed as far as possible (Fig. 2).

Set up large-area metallic connections, use equipment busbars and set up short connections to ground via flat ribbon cables (Fig. 2) The following conditions apply:



- Large-area ground connection.
- Low-inductance connection (preferably a copper ribbon and not circular conductors).
- Short connections (rule of thumb: length L divided by width B < 3) (Fig 3).

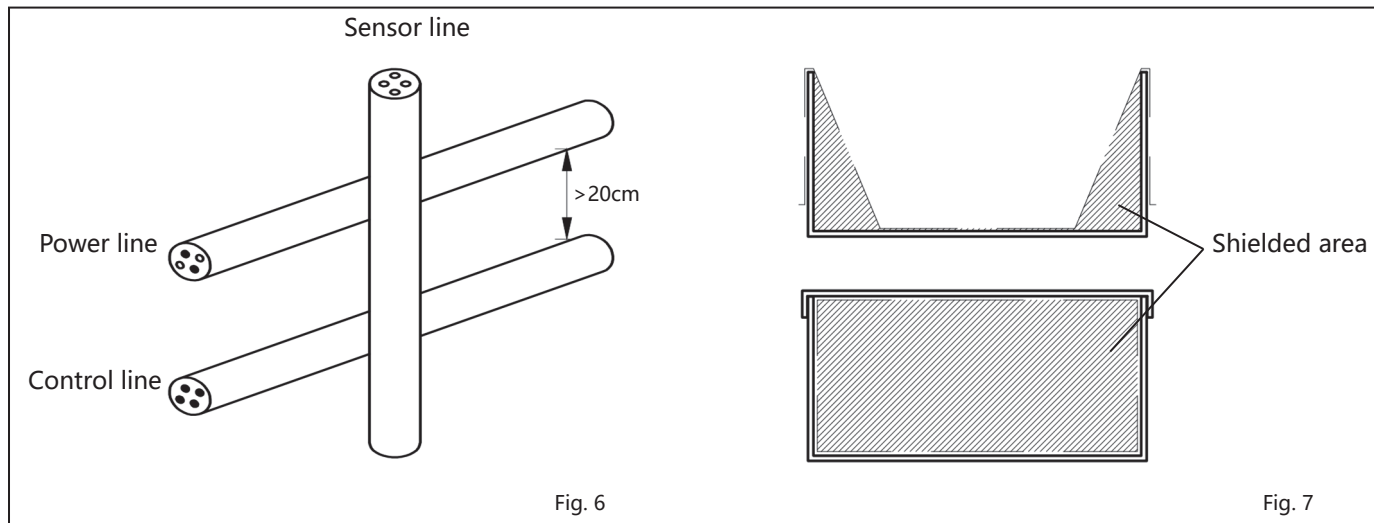
■ Keep cables from the interference source as short as possible. Examples:

- Short connection from the converter to the EMC filter; ideally a flange mounted filter to avoid emissions.
- Connection cables of minimum length between converter output and motor (also to reduce asymmetrical currents caused by the parasitic capacitances of the cable shield).

■ Interference-carrying cables must be shielded.

Examples:

- Connection cables between frequency converter and motor, if no corresponding output filter is used.
- Connection cables filter and converter on the line side, where not directly flanged on.
- It should be noted that the shielding effect of different cables can differ widely (foil shield, braided shield with various degree of coverage, combinations).



■ Connect shielded cables on both sides and across a large-area with reference potential, as far as possible directly or close to the input or output sides of the housing (Fig 4).

Use:

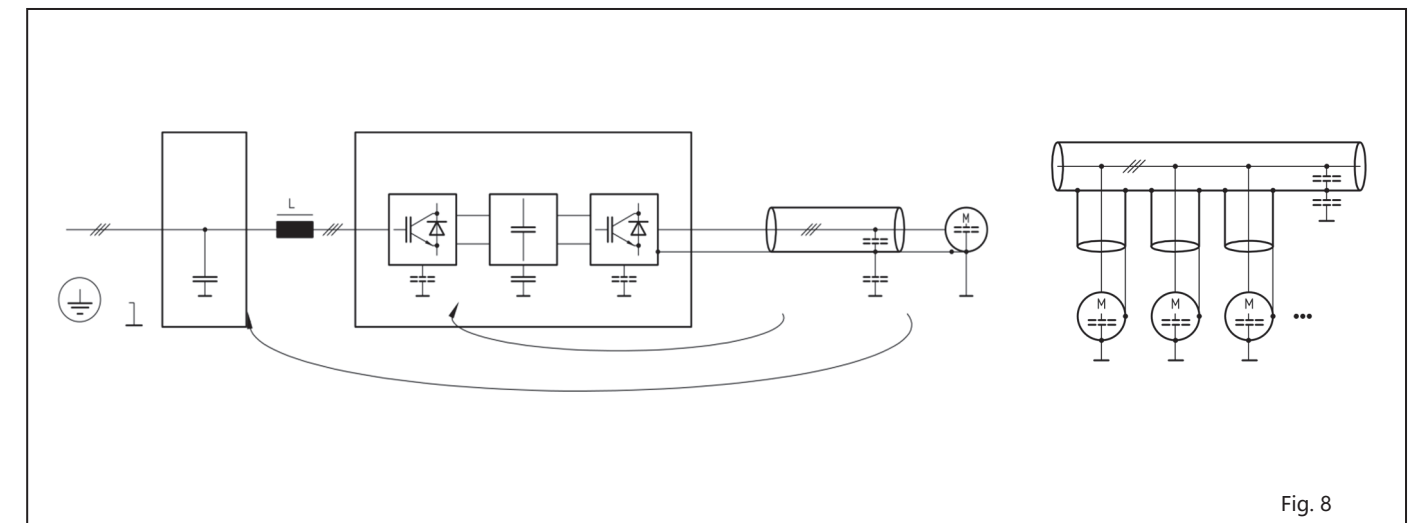
- EMC-compliant cable fittings (360° contact).
 - EMC baseplate.
 - Large-area contacting of the cable shield by suitable metal clips.
- Avoid shielded terminals connected via top lines (twisted shield braiding; soldered cable lugs etc.) (Fig 4).

Ensure that an EMC-compliant cable gland is provided at the motor terminal box. It must correspond to the degree of protection for its respective location of use. The motor terminal box shall be made of metal, the connection between cable gland and terminal box must be of large-area design. If the lacquer has been removed, it may be necessary to restore the corrosion-protection layer.

■ Arrange EMC filters as far as possible directly at the entry or exit points of the housing (Fig. 1).

Examples:

- Line terminals are accessible via the corresponding opening of the equipment (ensure protection against electric shock).
- Use of suitable EMC filters.
- Use of corresponding housing matching elements to ensure the required shielding attenuation.



■ Spatial separation between interference-emitting and "clean" cables must be ensured (Fig. 5).

Noisy cables include those between converter and filter, whereas "clean" cables include those between mains supply and filter.

Avoid running cables in parallel (to reduce coupled interference).

Note the spatially separated laying of signal and power cables in order to avoid coupling routes (minimum recommended spacing 20 cm). Use separating metal plates and ground them across a wide area if necessary (Fig. 5).

As far as possible, run cable crossovers at right angles and keep them well separated (Fig 6).

■ In order to reduce interference coupling, as far as possible run the cables close to metal parts which are connected to the reference potential (mounting plates, switch cabinet etc).

Live cables should also be run as close as possible to the reference potential (to reduce inductively coupled interference).

In order to improve electromagnetic compatibility, cable channels, cable trays and installation tubes which are made of metal rather than plastic parts should be preferred (Fig 7).

■ In the case of unshielded signal cables (forward and return lines) use twisted-pair lines in order to minimize the area between the wires (to avoid magnetic coupling). The same applies to avoiding loops.

■ Connect suitable EMC components close to switched inductors (e.g. contactors, relays, magnetic valves etc.).

- For control signals in the vicinity of high interference levels, use transmission techniques such as:
 - Differential-mode transmission systems with twisted pair lines in conjunction with data line chokes (see also our data book "Chokes and Inductors").
 - Transmission of digital signals acc to the RS-422 standard or in extreme cases crossing the interference region with fiber-optic cables.
- Note the mounting position of the filters! The assembly must always take care not to impair natural convection. This includes the use of ventilation slits in the filter housing and sufficient spacing to the other components. Over-head mounting is never permissible.
- Noise minimization

A choke made of highly diverse core materials represents a significant frequency-dependent filter component. Electro-acoustic effects must inevitably be expected in AC applications. The materials and processing used generate (for industrial sector) suitable noise levels by operation in networks with harmonics complying to IEC62749. However, these can rise significantly in the event of higher harmonic components.
- Length of motor cables and motor types used (Fig. 8).

For converter applications, output voltages are generated that typically have almost rectangular waveforms. These are essentially characterized by the rise rate expressed as the dv/dt value and the switching frequency of the converter. The cables and motors present in the output network of the converter with their inductive and capacitive components significantly determine the EMC properties of the system. Thus resonances of the cable/motor combination are often reflected in the resonance of the interference voltage measurement at the converter input.

The parasitic capacitances of the cable and motor should be treated with special care. Whereas the parasitic capacitances of the motor depend on its design those of the cables depend on the insulation material cable structure, type of shielding and especially on their length. A high-frequency current flows through the grounded parts of the equipment as a function of the switching frequency, the dv/dt value and the magnitude of the parasitic capacitances.

Here are some of the possible effects:

- As the parasitic currents flow via the ground connection of the installation, the sum of the input currents into the filter is no longer equal to zero. A specific magnitude of the parasitic current can lead to a saturation of the common-mode choke in the EMC filter and consequently exceed the permissible interference level. The interference voltage should therefore be measured on the installed equipment.
- The parasitic currents also flow to the interference source via the filter housing and the capacitors connected in the filter. Impermissibly high currents can over load the capacitors and thus endanger the equipment.

We use our technological expertise to design and manufacture our passive electronic components in the most environmentally compatible way possible. We are continuously optimizing our products and processes in order to use materials in a way that minimizes the impact on resources, to use substitutes for hazardous materials wherever possible, and to reduce waste to a minimum.

All EMC filters in this publication are RoHS-compatible:

- DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL dated 13 February 2003 restricting the use of certain hazardous substances in electrical and electronic equipment.
- According to 2005/618/EC dated August 18th, 2005, amending Directive 2002/95/EC of the European Parliament and of the Council for the purpose of establishing the maximum concentration levels for certain hazardous substances in electrical and electronic equipment, a maximum concentration value of 0.1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenylethers (PBDE), and of 0.01% by weight in homogeneous materials for cadmium, shall be tolerated.
- It should be noted that the concentration levels specified above may be exceeded for some products or product groups in the event of technical necessity and on the basis of the exceptional stipulations of the Annex to 2005/95/EU including relevant extensions by decision of the Commission.

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

Notes:

I_L = leakage current let-go.

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. A value of $KU=4.5$ with respect to interceptions is attained with a permanent connected protective earth circuit $> 1.5 \text{ mm}^2$. With a protective earth circuit $> 22.5 \text{ mm}^2$ connected via shroud connectors (IEC 60309-2). $KU=6$ with respect to interceptions is achieved for fixed-connection lines $> 10 \text{ mm}^2$ where the type of connection and line layout correspond to the requirements for PEN conductors as specified in relevant standards.

Symbols and terms		
Symbol	Term	Bedeutung
C_R	Rated capacitance	
f_{meas}	Measuring frequency	
I_{leak}/I_{Abl}	Leakage current of filter	
I_R	Rated current	
L_R	Rated inductance	
P_{loss}/P_V	Power loss	
R_{max}	DC resistance, maximum value	
R_{typ}	DC resistance, typical value	
V_{test}	Test voltage	
V_R	Rated voltage	
Z_L	Line impedance	

Legend		
Terminal type:		
Tab connectors	Soldering tags	
Axial leads	Pins	
IEC connectors	Threaded studs	
Terminal blocks	Litz wires	
Busbars		
Design :		
C=Compact filter	RF=RF-proof metal case	
S=Special designs		



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