



Line reactors and harmonic filters

FN 3400	87
RWK 212	90

Three-phase harmonic and EMC filter

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energy efficiency and reliability



- EMC filter for applications with high noise levels
- Integrated line reactor for low frequency interference and harmonics reduction
- Compact all-in-one solution for motor drives
- Significant increase of conducted immunity across a broad frequency spectrum

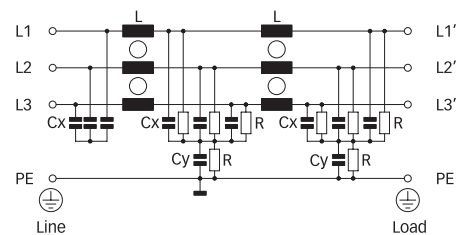
Approvals



Technical specifications

Maximum continuous operating voltage:	3x 480/277VAC
Operating frequency:	dc to 60Hz
Rated currents:	8 to 24A @ 50°C
Reactor impedance (uk):	4% @ 400VAC, 50Hz & rated current
High potential test voltage:	P → E 2800VDC for 2 sec P → P 2120VDC for 2 sec
Protection category:	IP20
Overload capability:	4x rated current at switch on 1.5x rated current for 1 minute, once per hour
Temperature range (operation and storage):	-25°C to +100°C (25/100/21)
Flammability corresponding to:	UL 94V-2 or better
Design corresponding to:	UL 1283, CSA 22.2 No.8 1986, IEC/EN 60939
MTBF @ 50°C/400V (Mil-HB-217F):	>100,000 hours

Typical electrical schematic




Features and benefits

- Broadband EMC mains filter with exceptional low frequency attenuation performance.
- Combines the benefits of EMC filter and 4% impedance line reactor.
- Reduction of mains harmonics and commutation notches.
- Protection of motor drive electronics and dc link capacitors against mains transients and inrush currents.
- Improves also conducted immunity.
- Cost-effective 2-in-1 solution to save mounting space and time.

Typical applications

- Motor drives
- Elevators
- Robots
- Machinery
- Applications where both EMC filter and line reactor is required
- SCR dc drives

Filter selection table

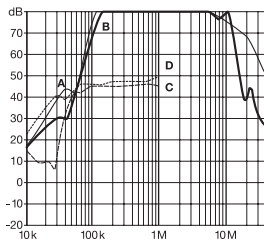
Filter	Rated current @ 50°C (40°C) [A]	Typical drive power rating* [kW]	Leakage current @ 440VAC/50Hz** [mA]	Power loss @ 25°C/50Hz [W]	Input/Output connections 	Weight [kg]
FN 3400-8-29	8 (8.8)	4	12	23.1	-29	3.3
FN 3400-16.5-33	16.5 (18.1)	7.5	12	32.7	-33	5.2
FN 3400-24-33	24 (26.3)	11	12	34.6	-33	7.0

* Calculated at rated current, 440VAC and cos phi = 0.8. The exact value depends upon the efficiency of the drive, the motor and the entire application.
 ** Maximum leakage under normal operating conditions. Note: if two phases are interrupted, worst case leakage could reach 5.6 times higher levels.

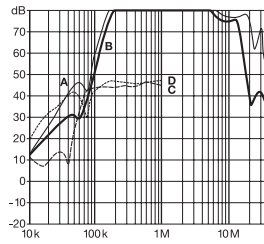
Typical filter attenuation

Per CISPR 17; A = 50Ω/50Ω sym; B = 50Ω/50Ω asym; C = 0.1Ω/100Ω sym; D = 100Ω/0.1Ω sym

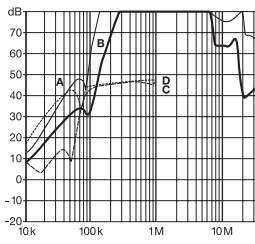
8A types



16.5A types



24A types

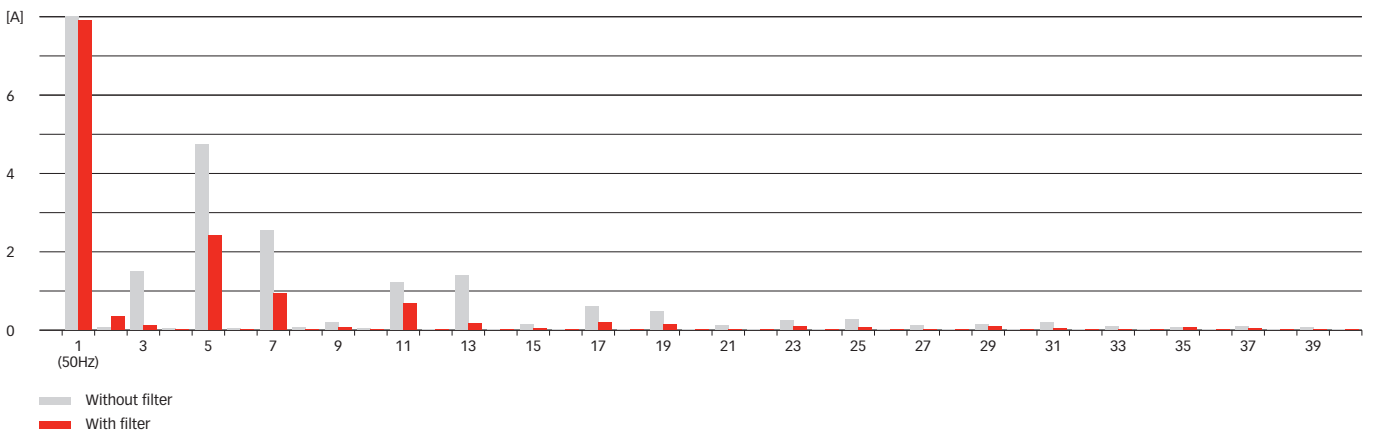


Harmonics reduction

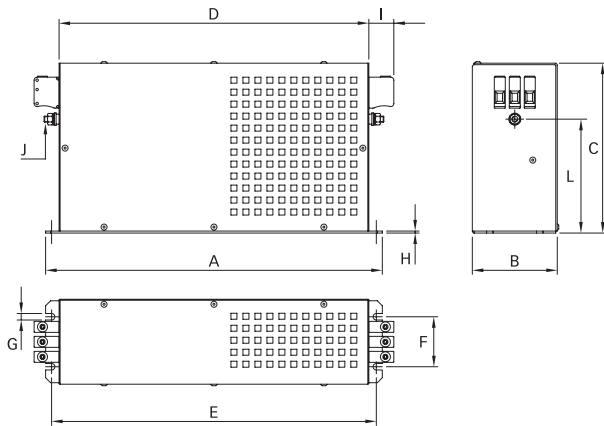
FN 3400 filters contribute significantly to the reduction of low frequency interference and mains harmonics. Most common functional problems related to harmonics – such as overheating of components and conductors or malfunctions of sensitive electronics – can

be solved reliably. However, FN 3400 is not designed to meet harmonic standards like EN 61000-3-2 or IEEE 519. To meet these standards, more complex, bigger and more expensive active or passive harmonic filters are required.

Following results were measured under full load operational conditions and show the actual effect of FN 3400-8-29 on mains harmonics in a three-phase power drive system.



Mechanical data



Dimensions

	8A	16.5A	24A
A	280	337	337
B	65	85	100
C	140	170	170
D	250	310	310
E	270	325	325
F	35	50	50
G	6.5	6.5	6.5
H	2	2	2
I	11.5	25	25
J	M6	M6	M6
L	94	114	114

All dimensions in mm; 1 inch = 25.4mm
Tolerances according : ISO 2768 / EN 22768

Filter input/output connector cross sections

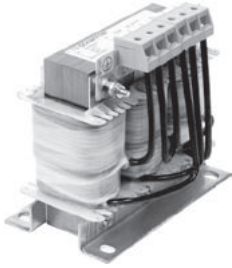
	-29	-33
Solid wire	6mm ²	16mm ²
Flex wire	4mm ²	10mm ²
AWG type wire	AWG 10	AWG 6
Recommended torque	0.6 - 0.8Nm	1.5 - 1.8Nm

Please visit www.schaffner.com to find more details on filter connectors.

Three-phase line reactor for motor drive applications

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- Provision of 4% impedance
- Reduction of mains harmonics
- Reduction of commutation notches
- Protection of motor drive electronics
- Limitation of inrush currents
- Improvement of true power factor

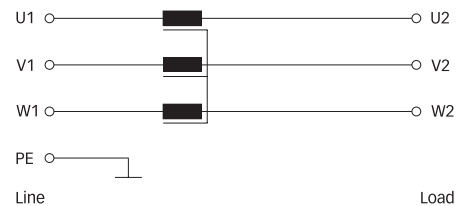
Approvals



Technical specifications

Maximum continuous operating voltage:	3x 500/288VAC
Operating frequency:	50 to 60Hz
Rated currents:	4 to 1100A @ 40°C
Impedance (uk):	4% @ 400VAC, 50Hz & rated current
Typical harmonics reduction:	See table on next page
High potential test voltage:	P → E 3000VAC for 3 sec P → P 3000VAC for 3 sec
Protection category:	IP00 (KL types according to VBG 4)
Overload capability:	2x rated current at switch on for 30 seconds 1.5x rated current for 1 minute, once per hour
Temperature range (operation and storage):	-25°C to +100°C (25/100/21)
Insulation class:	T40/B (130°C) → RWK 212: ≤95A T40/F (155°C) → RWK 212: >95A
Flammability corresponding to:	UL 94V-2 or better
Design corresponding to:	EN 61558-2-20 (VDE 0570-2-20)
MTBF @ 40°C/400V (Mil-HB-217F):	>200,000 hours

Typical electrical schematic






Features and benefits

- Ensure reliability, performance and a long service life of electrical consumers.
- Reduction of mains harmonics and commutation notches.
- Help to meet international power quality standards such as IEEE 519 or EN 61000-3-2.
- Protection of motor drive electronics and dc link capacitors against mains transients.
- Reduction of inrush and peak currents.
- Reduction of conducted LF emission.
- Improvement of conducted LF immunity.
- Prevention from nuisance tripping caused by power line voltage spikes.
- Improvement of true power factor.

Typical applications

- Motor drives and various adjustable speed drive systems, such as:
 - Elevators
 - Robots
 - Machinery
 - Process automation equipment

Reactor selection table

Reactor	Rated current @ 40°C	Typical motor power rating*	Nominal inductance	Typical power loss**	Input/Output connections			Total	Cu.	Weight Al.
	[A]	[kW]	[mH]	[W]				[kg]	[kg]	[kg]
RWK 212-4-KL	4	1.5	7.3	23	KL			2.1	0.21	
RWK 212-7-KL	7	3	4.2	36	KL			2.5	0.31	
RWK 212-11-KL	11	4	2.6	37	KL			2.5	0.7	
RWK 212-16-KL	16	7.5	1.8	59	KL			3.9	0.85	
RWK 212-21-KL	21	11	1.4	66	KL			5.4	0.95	
RWK 212-29-KL	29	15	1	69	KL			5.4	1.63	
RWK 212-35-KL	35	18.5	0.84	70	KL			5.9	2.25	
RWK 212-46-KL	46	22	0.64	99	KL			11	2.3	
RWK 212-60-KL	60	30	0.49	138	KL			15	2.35	
RWK 212-75-KL	75	37	0.39	133	KL			15	3.7	
RWK 212-95-KL	95	45	0.3	166	KL			22	3.4	
RWK 212-124-KS	124	55	0.23	172		KS		25	3.4	
RWK 212-156-KS	156	75	0.19	249		KS		25	5.1	
RWK 212-182-KS	182	90	0.16	245		KS		32	7.45	
RWK 212-230-KS	230	110/132	0.13	301		KS		35	9.55	
RWK 212-280-KS	280	160	0.1	335		KS		41	8.5	
RWK 212-330-KS	330	160	0.09	386		KS		56	9.25	
RWK 212-400-S	400	200	0.073	692			S	57	3.4	4.7
RWK 212-500-S	500	250	0.058	761			S	67	4.5	5.74
RWK 212-600-S	600	315	0.049	825			S	76	4.5	6.6
RWK 212-680-S	680	355	0.043	876			S	80	5.6	8
RWK 212-790-S	790	400	0.037	956			S	90	6.8	8.7
RWK 212-910-S	910	450	0.032	1022			S	107	6.8	8.7
RWK 212-1100-S	1100	630	0.026	1096			S	138	9.2	9.6

Customized line reactors with different electrical and mechanical specifications are available on request.

* Calculated at rated current, 400VAC and cos phi = 0.8. The exact value depends upon the efficiency of the drive, the motor and the entire application.

** Power loss at 25°C/50Hz, considering a typical harmonic spectrum of a motor drive with 6u rectifier bridge.

Harmonics reduction

Line reactors are a cost-effective way for the limitation of mains harmonics. The harmonics reduction capability is related to the reactor impedance. A higher impedance translates directly into lower harmonic

currents, but of course also into a larger component with a higher voltage drop – and vice versa. 4% impedance reactors like RWK 212 provide an excellent cost/benefit ratio and are

particularly beneficiary in the most diverse motor drive applications. The table below shows various reactor impedance values and their calculated effect in terms of harmonics reduction.

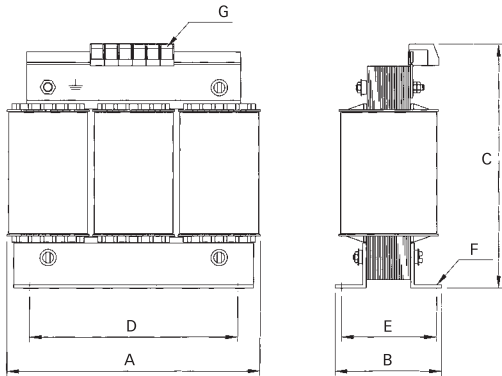
Harmonic number / Input impedance (uk) vs. remaining harmonics [%]

	0.5%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
5th	80	60	46	40	34	32	30	28	26	24	23
7th	60	37	22	16	13	12	11	10	9	8.3	7.5
11th	18	12	9	7.3	6.3	5.8	5.2	5	4.3	4.2	4
13th	10	7.5	5.8	4.9	4.2	3.9	3.6	3.3	3.15	3	2.8
17th	7.3	5.2	3.6	3	2.4	2.2	2.1	0.9	0.7	0.5	0.4
19th	6	4.2	2.8	2.2	2	0.8	0.7	0.4	0.3	0.25	0.2
%THD-I	102.5	72.2	52.3	44.13	37.31	34.96	32.65	30.35	28.04	25.92	24.68

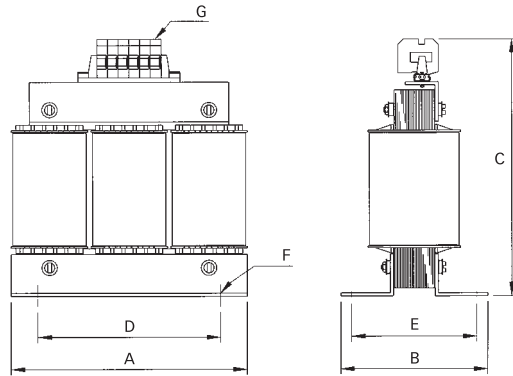
Reading example: a 4% impedance reactor typically reduces the 5th harmonic to 34% of its value without reactor.

Mechanical data

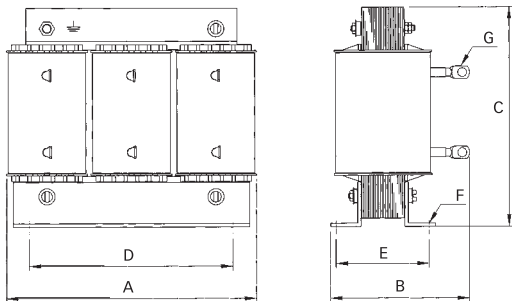
4 to 46A types



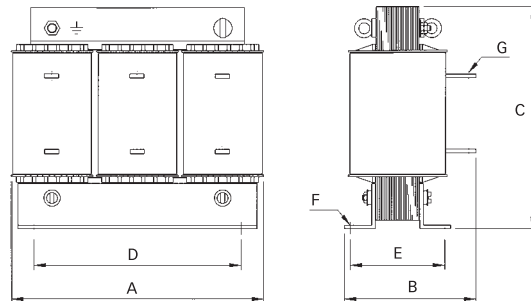
60 to 95A types



124 to 330A types



400 to 1100A types



Dimensions

	A	B	C	D	E	F	G
4A	100	75	125	56	43	5 x 8	2.5mm ²
7 and 11A	125	75	130	100	55	5 x 8	2.5mm ²
16A	155	80	150	130	55	8 x 12	2.5mm ²
21 and 29A	155	95	150	130	70	8 x 12	4mm ²
35A	155	110	175	130	70	8 x 12	10mm ²
46A	190	120	200	170	78	8 x 12	10mm ²
60A	210	135	255	175	95	8 x 12	16mm ²
75A	210	150	225	175	95	8 x 12	16mm ²
95A	230	210	275	180	122	8 x 12	35mm ²
124A and 156A	240	210	210	190	130	11 x 15	Ø10
182A	265	210	240	215	114	11 x 15	Ø10
230A	300	210	270	240	134	11 x 15	Ø12
280A	300	218	270	240	142	11 x 15	Ø12
330A	300	255	270	240	165	11 x 15	Ø12
400A	420	205	390	370	134	11 x 15	Ø11
500A	420	215	390	370	140	11 x 15	Ø11
600A	420	225	390	370	149	11 x 15	Ø14
680A	420	225	390	370	150	11 x 15	Ø14
790A	420	240	390	370	162	11 x 15	Ø18
910A	420	255	390	370	177	11 x 15	2 x Ø11
1100A	420	290	390	370	200	11 x 15	2 x Ø11

All dimensions in mm; 1 inch = 25.4mm
Tolerances according: ISO 2768 / EN 22768