September 2017

SCHAFFNER
shaping electrical power

Ecosine
Passive Harmonic Mitigation Portfolio

www.myecosine.com

Schaffner Group

The Schaffner Group is the international leader in development and production of solutions which ensure efficient and reliable operation of electronic systems. The Group's broad range of product and services includes EMC/EMI components, harmonic filters and magnetic components as well as development and implementation of customized solutions. Schaffner components are deployed in energy-efficient drive systems and electronic motor controls, in wind and photovoltaic systems, rail technology, machine tools and robotics as well as power supplies for numerous electronic devices in sectors such as medical technology or telecommunications. Schaffner provides on-site service to customers around the world through an efficient, global organization and makes ongoing investments in research, development, production and sales to systematically expand its position as leader on the international market.

A global one-stop shop

EMC/EMI filters

- PCB filters
- IEC inlet filters / Power entry modules
- DC filters
- Single-phase filters
- Three-phase filters
- Three-phase + neutral line filters
- Open frame filters

EMC/EMI chokes

Feedthrough filters and capacitors

Automotive components

Customized solutions

Power Quality products

- Line reactors
- dv/dt reactors and filters
- Sine wave filters
- Harmonic filters
- Regen reactors and filters
- Transformers

Customized solutions

Product Index

Image	Product	System Frequency		Rectifier Type		Performance at rated power	Nominal Voltage	Rating Range	PAGE
		50 Hz	60 Hz	Diode	SCR	THID			
	RWK 212 Reactors	X	X			see table on datasheet	380…500 VAC	1,5…830 kW	12
	FN 3440 ecosine evo	X		X	X	< 5 %	380…415 VAC	1…200 kW	14
	FN 3441 ecosine evo	X		X		< 5 % with L_{dc}			16
	FN 3450 ecosine evo	X		X	X	< 5 %	440…500 VAC	1…250 kW	18
	FN 3451 ecosine evo	X		X		< 5 % with L_{dc}			20
	FN 3452 ecosine evo		X	X	X	< 5 %	440…480 VAC	1.5…300 HP	22
	FN 3453 ecosine evo		X	X		< 5 % with L_{dc}			24
	FN 3410 HV ecosine	X		X	X	< 5 %	690 VAC	7,5…37 kW	26
						~5 % with L_{dc}	690 VAC	45…250 kW	
	FN 3416 ecosine	X		X	X	< 10 % with L_{dc} < 15 % without L_{dc}	380…500 VAC	4…160 kW	27
	FN 3418 ecosine		X	X	X		380…480 VAC	5…250 HP	28
	FN 3416 LV ecosine	X		X	X	< 7 % with L_{dc} < 13 % without L_{dc}	200…240 VAC	2,5…90 kW	29
	FN 3418 LV ecosine		X	X	X			2,5…125 HP	30
	FN 3410 ecosine High power line	X		X		~5 % with L_{dc} < 15 % without L_{dc} (de-reated power)	380…500 VAC	200…400 kW	31
	FN 3411 ecosine High power line	X			X				
	FN 3412 ecosine High power line		X	X			380…480 VAC	300…500 HP	32
	FN 3413 ecosine High power line		X		X				
	FN 3410 ecosine High power line	X		X		~5 % with L_{dc} < 15 % without L_{dc} (de-reated power)	380…500 VAC	200…400 kW	33
	FN 3411 ecosine High power line	X			X				
	FN 3412 ecosine High power line		X	X			380…480 VAC	300…500 HP	34
	FN 3413 ecosine High power line		X		X				
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Efficient solutions for power quality

Non-linear loads like three-phase diode bridge rectifiers cause harmonic distortion of the electricity supply system. This distortion results in currents in the systems, which are of higher magnitude than expected and contain harmonic frequency components. The amplitude of the resulting current is often under-estimated and can reach a level up to 140 %, which tremendously loads the installed conductor. Furthermore, overcurrent protections which are typically rated close to the nominal current are prone to so-called nuisance tripping.

Schaffner passive harmonic mitigation products represent efficient solutions to the challenge of reducing the harmonics in three-phase installations. With superior benefit-cost ratio and more compact dimensions than comparable devices on the market, they can be quickly installed and easily commissioned.

The installation of Schaffner passive harmonic filters and reactors will be immediately beneficial for the electrical system, since they will help to limit the amplitudes of the current harmonics and thus allow to reduce losses and to operate the equipment more efficiently.

Schaffner offers a broad portfolio of passive harmonic filters and reactors for low-voltage 50 Hz and 60 Hz systems, as well as further solutions for power quality like active harmonic filters. The Schaffner passive harmonic filter portfolio includes:

- Ecosine evo line filters, for the most demanding harmonic mitigation tasks, which reduce the THDi level down to 5 %. They are modular and can be adapted to customer or application needs.
- Ecosine Economy Line filters, which represent an excellent cost-effective solution to limit the THDi at 10 %. The filters are very compact, have a high power density and provide superior power factor performance at partial load.
- Ecosine Low-Voltage filters, which extends the Economy Line down to the range 200 V–240 V and offers superior THDi performance of about 7 %.
- Ecosine High-Power Line, which extends the power range of the standard line up to 400 kW or 500 HP, and it is provided as modular, open-frame solution and as cabinet.
- Ecosine High-Voltage Line, which serves the 690 V, 50 Hz applications and offers 5 % THID.

The Schaffner passive harmonic mitigation products increase efficiency and reliability of electric installations. Additionally, they help to maximize utilization of the electric system capacity and they represent the enablers to meet power quality standards and requirements such as IEEE 519.

Compliance with IEEE-519 and more other benefits

International power quality standards such as IEEE 519-2014, EN 61000-3-12, EN 50160, EN 12015, G5/4, AS 2279 or D.A.CH.CZ provide, among other requirements, distortion limits and recommend harmonics mitigation practices. IEEE 519-2014 is a widely recognized set of recommendations which include the maximum permissible current and voltage distortion values at the point of common coupling (PCC). The distortion limit is given as function of the system loading, i.e. the relation between the maximum short circuit current (I_{SC}) and the maximum demand load current (I_L) at the PCC.

IEEE 519-2014 current distortion limits [%] **Harmonic order (odd harmonics)**

I_{SC}/I_L	TDD	< 11	11 ≤ h < 17	17 ≤ h < 23	23 ≤ h < 35	35 ≤ h
< 20	5.0	4.0	2.0	1.5	0.6	0.3
20 < 50	8.0	7.0	3.5	2.5	1.0	0.5
50 < 100	12.0	10.0	4.5	4.0	1.5	0.7
100 < 1000	15.0	12.0	5.5	5.0	2.0	1.0
> 1000	20.0	15.0	7.0	6.0	2.5	1.4

Maximum harmonic current distortion in percent of I_L (even harmonics are limited to 25 % of the odd harmonic limits above).

Ecosine passive harmonic filters and reactors once installed in the electric system will reduce the harmonics such that the requirements of most common international standards are met.

Schaffner ecosine filters and reactors unload lines and transformer upstream of the non-linear load, e.g. a three-phase diode bridge rectifier, hence reducing the system overall losses and operating temperature.

In addition, the total power factor is significantly improved through the installation of the ecosine passive harmonic filters and will remain close to unity even at partial load. For loading below 30 % or no-load conditions, the Schaffner ecosine passive harmonic filters provide an elegant possibility to easily disconnect the filter's capacitors, thus further improving the overall system efficiency.

The problem of harmonics is therefore solved by the use of Schaffner ecosine filters and reactors with the following benefits:

- Efficient mitigation of harmonic currents
- Compliance with IEEE 519 and other power quality standards
- Increased equipment operating lifetime and system reliability and availability in mission-critical applications
- Enhanced utilization of electric system capacity
- Power factor correction
- Long-term savings in system operation and maintenance costs
- Fast and simple plug-and-play operation
- Very compact and light-weight filter concept, high power density
- Seamless integration with previously installed DC-link chokes or EMC/EMI filters

Most electrical loads are non-linear

- **Harmonics are not generated by the utility.** Electric utilities have to constantly deal with customer applications having problems due to harmonics. However, disturbances like electromagnetic interferences or harmonics are not attributable to the utility company, but to the users and the non-linear nature of their loads.

- **Most electrical loads do not behave like resistors.** This means that a sinusoidal applied voltage, which is typically provided by the utility through the distribution transformers, does not yield to a resulting sinusoidal current. Only for resistive-type components, like for instance resistive heating systems or incandescent-type illumination devices, voltage and current have proportional sinusoidal waveforms.

- **Non-linear loads as source of harmonic currents and voltages.** Modern consumers of power, such as variable speed motor drives, switched-mode power supplies in home appliances or ballasts in fluorescent lamps, contribute significantly to energy savings and to a more efficient use of electricity. However, they cause non-sinusoidal currents to be drawn from the grid.

- **Harmonic voltages.** Harmonic currents which flow through the system impedances of transformers and reactors give rise to harmonic voltages. The distorted voltage will cause interferences and decrease the equipment lifetime, performance and reliability of other loads connected to the same grid.

- **Harmonics have a serious impact.** Harmonics reduce system efficiency. Harmonic currents overload electric installations, distribution transformers, breakers, fuses, conductors, etc. They cause overheating and premature system ageing or make necessary the increase of the electric system capacity. Harmonics overload capacitor banks in reactive compensation systems and cause malfunctions of electronic controllers, disturbances in sensitive medical devices or crashes in communication networks.

- **No risk of system resonance through a patented solution.** The impedance of the filter can theoretically resonate with the system's natural inductance or the capacitance of an EMI filter, (if installed). Schaffner ecosine filters are designed such that their first natural frequency is below that of any predominant harmonic. Furthermore, a damper module reduces the amplitude of possible resonance, thus ensuring the system reliability and availability.

Harmonic mitigation for a wide range of applications

Schaffner ecosine filters can be applied to any kind of low-voltage six-pulse rectifier, where harmonic current distortion needs to be limited. Typical applications of the filters are within AC motor drives or DC motor drives having a three-phase diode bridge or a three-phase thyristor bridge as interface, respectively. Typical applications include:

- Equipment with six-pulse rectifier front-end
- Motor drives
- Fan and pump applications
- HVAC systems
- Induction furnaces
- UPS and three-phase power supplies
- Water/wastewater treatment facilities
- Oil and gas exploration
- Heavy industry and machinery
- Marine vessels
- Battery chargers
- Mission-critical processes

The cost of poor power quality

The benefit of investing in harmonic mitigation by installing Schaffner ecosine filters and reactors is more than just reducing harmonics. Current and voltage harmonics affect the correct operation of equipment sharing the same supply. This is only one, probably the most evident, of the many issues which harm the whole electric installation system.

- **Quality has its cost, but poor quality has definitely a higher cost.**
  If no measures against current harmonics are taken in a power system, the total power factor and system's efficiency decrease and the transformer and generator capacity are dramatically reduced.

- **Financial consequences.** Harmonics mitigation is considered to be expensive. The decision to ignore such issues in an early stage can potentially lead to a much more substantial cost impact. The capacity of electric installations may need to be upgraded. Equipment may fail prematurely. Disturbances may cause production downtime. Utility companies may issue power quality violation penalties.

It is estimated* that power quality problems are causing costs of about 10 billion Euro per annum for industry and commerce in the EU while expenditure on preventive measures is less than 5 % of this. Similar figures can be derived for other countries like US and China.
(*European Copper Institute "The Cost of Poor Power Quality", *online available*)

Ecosine, high performance not only at full load

- **Harmonics eliminated at their source.** Harmonics should be eliminated right at their source, i.e. at the terminals of the non-linear load. Only in this way the propagation of harmonic currents and voltages throughout the system can be avoided. Schaffner ecosine filters provide a low impedance path for harmonic currents required by the rectifier, thus dramatically reducing the amount of harmonics flowing through the electric distribution system. As a result, the non-linear load virtually draws a sinusoidal current from the grid.

- **High performance at all load conditions.** Often manufacturers promote filter performance only at full load because light load conditions can be a challenge in terms of both harmonics mitigation and capacitive current. Schaffner ecosine filters not only guarantee a superior THID level over the entire load range, but also limit the amount of capacitive current under all conditions.

- **Equipment longevity, reliable production uptime.** Because of their unique design, ecosine filters add impedance to the supply, thus providing all the benefits of the traditional Schaffner AC line reactors on top of the conventional passive harmonic filter performance. In motor drive applications, for example, they eliminate nuisance tripping and protect the rectifier and DC-link capacitors during transients. Longer equipment service life and reliable operation of mission-critical applications reduce cost of ownership and help safeguard profits.

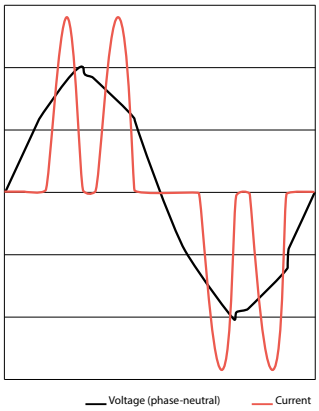
- **Simple installation and operation.** Schaffner ecosine filters can be easily incorporated into existing designs without requiring an in-depth system analysis or highly trained specialists. ecosine filters do not draw harmonics from other parts of the system and do not cause system resonances. They have been designed to operate smoothly with DC-link chokes and EMC/EMI filters installed in the same system. A superior inductor design and an advanced thermal management result in the most compact filter package on the market.

- **Straightforward filter selection.** Schaffner ecosine filters are available for 50 Hz and 60 Hz power grids. The ideal filter can easily be selected by determining the actual total power rating of the load (e.g. motor drive) to be connected to the filter. Over-specified filters should be avoided because filters operate best close to full load.

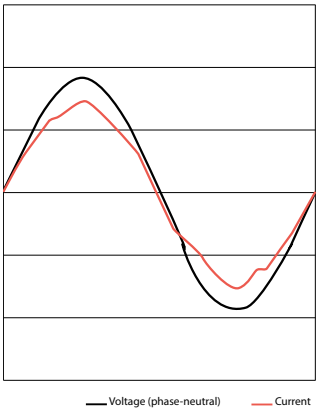
Back in sinusoidal shape

Cost and energy savings. Schaffner ecosine filters reduce harmonics and ensure that a clean sinusoidal current is drawn from the grid. Both true RMS and peak current are reduced in the process, thus lowering the burden on the electric installation.

Without Schaffner ecosine



With Schaffner ecosine

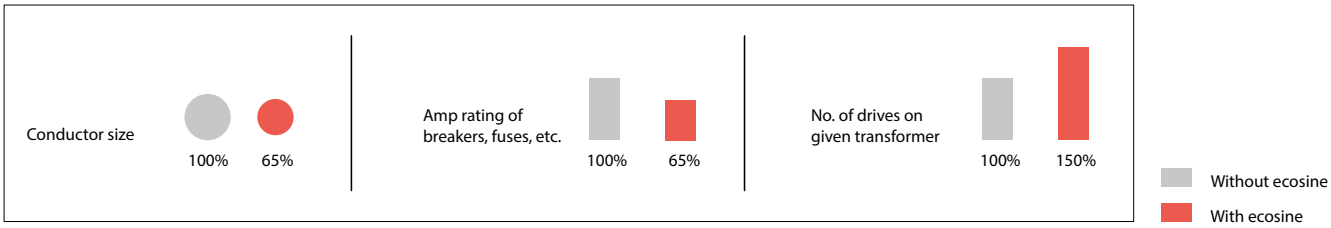


Example of 37 kW drive without and with ecosine evo FN 3440-37-115-E2FAJRX

Current without ecosine:	Current with ecosine:
I_{in} = 63.9A_{rms} (for power = 37 kW)	I_{in} = 49.4A_{rms} (for power = 37 kW)
THID = 80.2 % (for R_{sce} = 150)	THID = 4.9 %
PWHD = 28.8 %	PWHD = 6.2 %
Individual harmonics: 5th: 67 %	Individual harmonics: 5th: 2.5 %
7th: 43 %	7th: 4.0 %
11th: 8 %	11th: 3.0 %
13th: 6.5 %	13th: 1.6 %

Voltage without ecosine:	Voltage with ecosine:
U_{in} = 400 V_{rms} (phase-phase)	U_{in} = 400 V_{rms} (phase-phase)
THVD = 5.1 % (for I_{sc}/I_L = 150)	THVD = 0.55 % (for I_{sc}/I_L = 150)

Transformers, conductors, fuses, breakers etc. experience less electric and thermal stress, and can therefore be downsized already in the planning phase. In an existing installation, the capacity of the distribution transformer can be utilized more efficiently, and more electric consumers (e.g. motor drives) can be operated without investments in electric system upgrades.

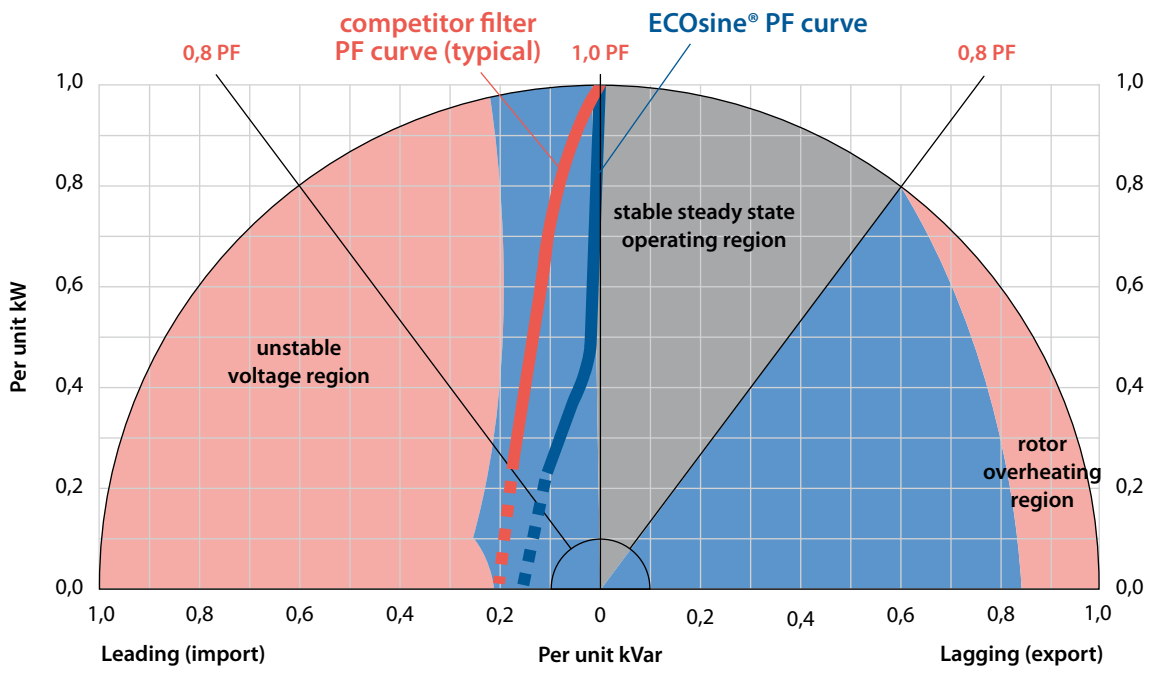


Superior Power Factor Characteristic

Unity Power Factor Operation. Different than other manufacturers' filters, Schaffner's ecosine filters show resistive behavior at nominal load as well as at partial load down to typically 35 %, hence the absorption of reactive power in this range is nearly zero. In order to completely eliminate no-load losses of the supplying transformer or to ease the operation of circuit breakers, ecosine filters do also offer the possibility to disconnect the trap branch.

Superior Filter Design. The performance of a single tuned passive harmonic filter is crucially dependent on the proper dimensioning of its LC trap circuit, which is a trade off between target harmonic mitigation and components' size. In ecosine filters, the impedance of the trap capacitors is typically limited to approximately 15 %. This feature allows to drastically limit the value of leading power factor at partial load and fulfills very demanding operating conditions such as in generator application in weak networks.

Generator applications in weak networks. Three-phase generator sets are typically rated for 0,8 PF loads and single-phase generator sets for 1,0 PF loads. Lower PFs require larger alternators or generator sets to serve the load properly. Leading power factor loads can cause generator sets to lose voltage control. The impedance of ecosine filters is designed to vary within the stable area of the generator reactive capability curve. Furthermore, a good practice in order to improve stability is loading the generator set with lagging power factor loads prior to leading power factor loads.



AC Line Reactors RWK 212

(UL508C up to 400 A)

Technical specifications	
Maximum continuous operating voltage	3 × 500/288 VAC
Operating frequency	50 to 60 Hz
Impedance	4 % @ 400 VAC, 50 Hz and rated current
Design corresponding to	EN 61558-2-20 (VDE 0570-2-20), UL508C, CSA C22.2 NO.14
High potential test voltage	P → E 3000 VAC for 3 sec P → P 3000 VAC for 3 sec
Insulation class	T40/N (200 °C) for ≤ 400 A types T40/F (155 °C) for ≥ 500 A types T40/H (180 °C) for 1500 A types
Protection category	IP 00 (KL types according to VBG 4)
Rated currents	4 to 1500 A @ 40 °C
Overload capability	2 × rated current at switch on for 30 seconds 1.5 × rated current for 1 minute, once per hour
Flammability corresponding to	UL 94 V-2 or better
Temperature range (operation and storage)	–25 °C to +100 °C (25/100/21)
MTBF @ 40 °C/400 V (Mil-HB-217F)	> 500 000 hours
Earthing System	TT, TN, IT

Reactor selection table

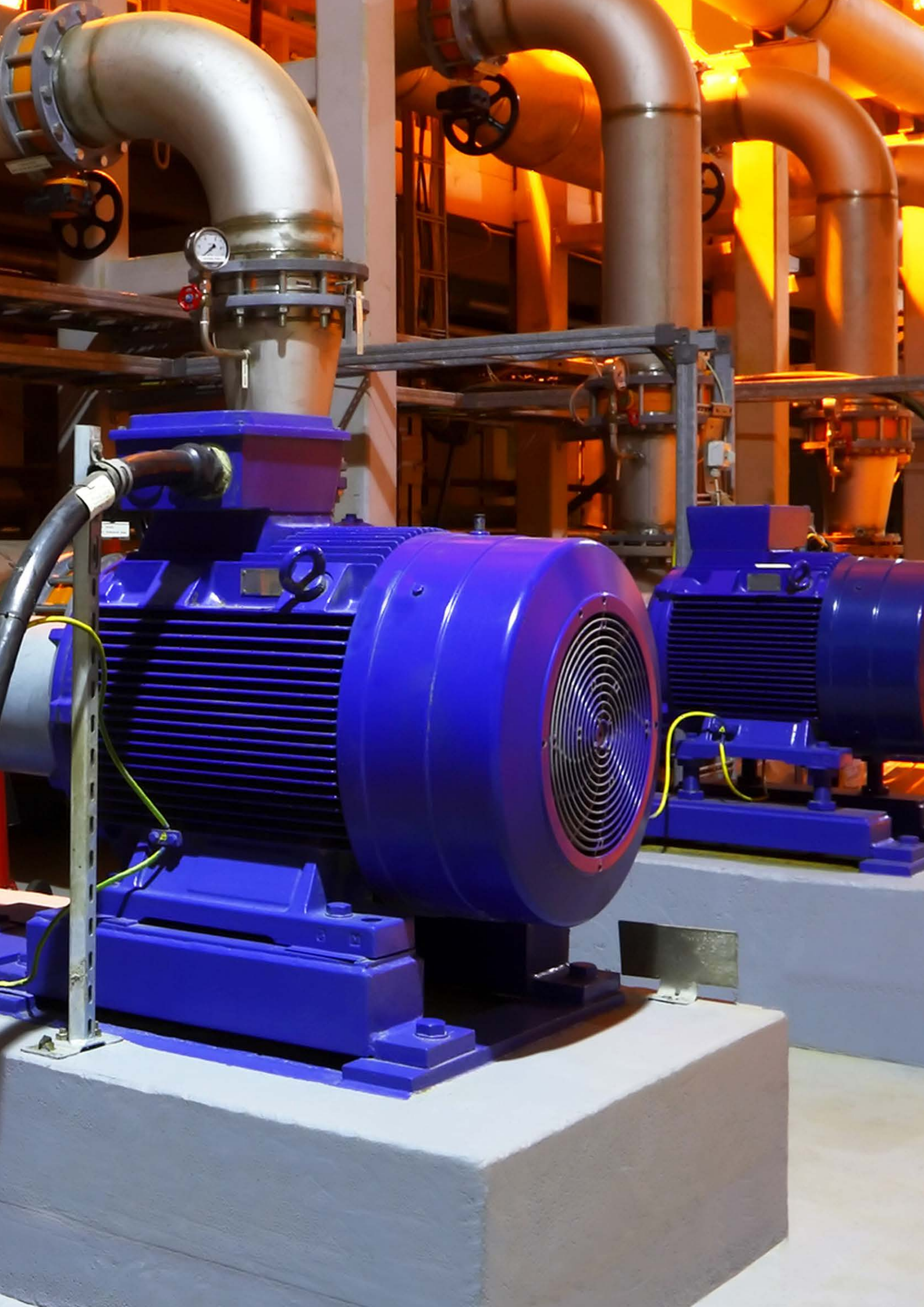
Reactor	Rated current @ 40 °C [A]	Typical drive power rating* [kW]	Nominal inductance [mH]	Typical power loss** [W]	Input/Output connections		Weight Total [kg]	Earthing bolt
RWK 212-4-KL	4	1.5	7.3	23	KL		2.1	AMP 6,3 × 0,8
RWK 212-7-KL	7	3	4.2	36	KL		2.5	M4
RWK 212-11-KL	11	4	2.6	37	KL		2.5	M4
RWK 212-16-KL	16	7.5	1.8	59	KL		3.9	M5
RWK 212-21-KL	21	11	1.4	66	KL		5.4	M5
RWK 212-29-KL	29	15	1	69	KL		5.4	M5
RWK 212-35-KL	35	18.5	0.84	70	KL		5.9	M5
RWK 212-46-KL	46	22	0.64	99	KL		11	M6
RWK 212-60-KL	60	30	0.49	138	KL		15	M6
RWK 212-75-KL	75	37	0.39	133	KL		15	M6
RWK 212-95-KL	95	45	0.3	166	KL		22	M8
RWK 212-124-KS	124	55	0.23	172		KS	25	M8
RWK 212-156-KS	156	75	0.19	249		KS	25	M8
RWK 212-182-KS	182	90	0.16	245		KS	32	M8
RWK 212-230-KS	230	110/132	0.13	301		KS	35	M8
RWK 212-280-KS	280	160	0.1	335		KS	41	M8
RWK 212-330-KS	330	160	0.09	386		KS	56	M8
RWK 212-400-S	400	200	0.073	692		S	57	M10
RWK 212-500-S	500	250	0.058	761		S	67	M10
RWK 212-600-S	600	315	0.049	825		S	76	M10
RWK 212-680-S	680	355	0.043	876		S	80	M10
RWK 212-790-S	790	400	0.037	956		S	90	M10
RWK 212-910-S	910	450	0.032	1022		S	107	M10
RWK 212-1100-S	1100	630	0.026	1036		S	135	M10
RWK 212-1310-S	1310	725	0.023	1050		S	100	M10
RWK 212-1500-S***	1500	830	0.020	1000		S	225	M10

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

* Calculated at rated current, 400 VAC 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/50 Hz, considering a typical harmonic spectrum of a motor drive with B6U rectifier bridge.

*** Operating voltage up to 600 V



FN 3440 ecosine evo passive harmonic filters for 50 Hz diode and thyristor (SCR) rectifiers without DC-link choke 380–415 VAC

(depending on filter configuration)

Technical specifications

Nominal operating voltage	3 × 380 to 415 VAC
Operating frequency	50 Hz ± 1 Hz
Nominal motor drive input power rating	1.1 to 200 kW
Total harmonic current distortion THID *	≤ 5 % @ rated power
Total demand distortion TDD	According to IEEE-519
Efficiency	98 % for rated voltage and power
High potential test voltage	P → E 2160 VAC (1 s)
Protection category	IP 00, IP 20
Cooling	Internal fan cooling or external cooling **
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to + 45 °C fully operational +45 °C to + 70 °C derated operation *** –25 °C to + 85 °C transport and storage
Flammability corresponding to	UL 94 V-2
Design corresponding to	Filter: UL 61800-5-1, EN 61800-5-1 Chokes: EN 61558-2-20 or EN 60076-6
MTBF @ 45 °C/415 VAC (Mil-HB-217F)	> 200 000 hours
SCCR ****	100 kA
Earthing System	TT, TN, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers.
SCR rectifier front-ends will produce different results, dependent upon the firing angle of the thyristors.
THID ~5 % at rated power for filter < 6 kW

** Please refer to the datasheet for inlet air flow required for cooling .

*** $I_{derated} = I_{nominal} \cdot \sqrt{(70\,°C - T_{amb})/25\,°C}$

**** External UL-rated fuses required. Please consult the user manual.

Filter selection table – IP 00 enclosure

Filter	Rated load power @ 400 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3440-1-110-E0_ _ _ _ _*	1.1	3	1.63	6.6	110	A
FN 3440-2-110-E0_ _ _ _ _*	2.2	5.5	3.26	9.6	110	A
FN 3440-4-112-E0_ _ _ _ _*	4	10	5.93	13.2	112	B
FN 3440-6-112-E0_ _ _ _ _*	5.5	13	8.17	16.9	112	C
FN 3440-8-112-E0_ _ _ _ _*	7.5	16	11.1	20.9	112	C
FN 3440-11-113-E0_ _ _ _ _	11	24	16.3	28.2	113	D
FN 3440-15-113-E0_ _ _ _ _	15	32	22.2	32.0	113	D
FN 3440-19-113-E0_ _ _ _ _	19	38	28.2	33.3	113	D
FN 3440-22-115-E0_ _ _ _ _	22	45	32.5	47.5	115	E
FN 3440-30-115-E0_ _ _ _ _	30	60	44.4	49.3	115	E
FN 3440-37-115-E0_ _ _ _ _	37	75	54.8	59.8	115	E
FN 3440-45-115-E0_ _ _ _ _	45	90	66.7	66.8	115	E
FN 3440-55-115-E0_ _ _ _ _	55	110	81.6	69.3	115	E
FN 3440-75-116-E0_ _ _ _ _	75	150	111	117.6	116	G
FN 3440-90-116-E0_ _ _ _ _	90	180	134	138.6	116	G
FN 3440-110-118-E0_ _ _ _ _	110	210	164	157.9	118	H
FN 3440-132-118-E0_ _ _ _ _**	132	260	197	176.3	118	H
FN 3440-160-118-E0_ _ _ _ _**	160	320	240	201.8	118	H
FN 3440-200-118-E0_ _ _ _ _**	200	400	300	249.7	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Filter selection table - IP 20 enclosure

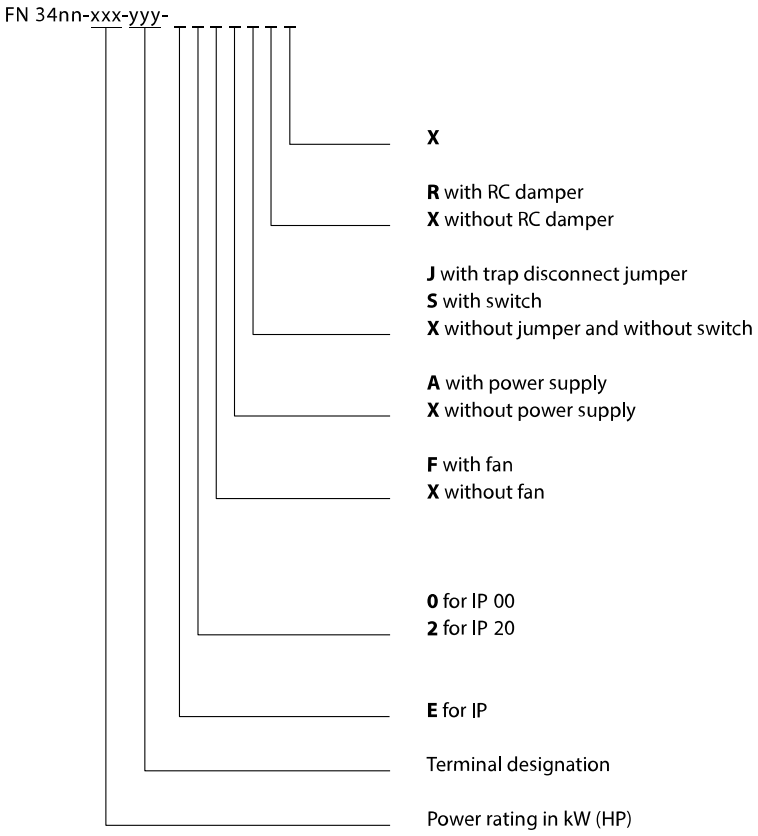
Filter	Rated load power @ 400 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3440-1-110-E2_ _ _ _ _*	1.1	3	1.63	8	110	A
FN 3440-2-110-E2_ _ _ _ _*	2.2	5.5	3.26	11	110	A
FN 3440-4-112-E2_ _ _ _ _*	4	10	5.93	15	112	B
FN 3440-6-112-E2_ _ _ _ _*	5.5	13	8.17	19	112	C
FN 3440-8-112-E2_ _ _ _ _*	7.5	16	11.1	23	112	C
FN 3440-11-113-E2_ _ _ _ _	11	24	16.3	32	113	D
FN 3440-15-113-E2_ _ _ _ _	15	32	22.2	36	113	D
FN 3440-19-113-E2_ _ _ _ _	19	38	28.2	37	113	D
FN 3440-22-115-E2_ _ _ _ _	22	45	32.5	53	115	E
FN 3440-30-115-E2_ _ _ _ _	30	60	44.4	55	115	E
FN 3440-37-115-E2_ _ _ _ _	37	75	54.8	66	115	E
FN 3440-45-115-E2_ _ _ _ _	45	90	66.7	73	115	E
FN 3440-55-115-E2_ _ _ _ _	55	110	81.6	75	115	E
FN 3440-75-116-E2_ _ _ _ _	75	150	111	126	116	G
FN 3440-90-116-E2_ _ _ _ _	90	180	134	147	116	G
FN 3440-110-118-E2_ _ _ _ _	110	210	164	175	118	H
FN 3440-132-118-E2_ _ _ _ _**	132	260	197	194	118	H
FN 3440-160-118-E2_ _ _ _ _**	160	320	240	219	118	H
FN 3440-200-118-E2_ _ _ _ _**	200	400	300	267	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Product selector



FN 3441 ecosine evo passive harmonic filters for 50 Hz diode rectifiers with DC-link choke 380–415 VAC

(depending on filter configuration)

Technical specifications

Nominal operating voltage	3 × 380 to 415 VAC
Operating frequency	50 Hz ± 1 Hz
Nominal motor drive input power rating	1.1 to 200 kW
Total harmonic current distortion THID *	≤ 5 % @ rated power
Total demand distortion TDD	According to IEEE-519
Efficiency	98 % for rated voltage and power
High potential test voltage	P → E 2160 VAC (1 s)
Protection category	IP 00, IP 20
Cooling	Internal fan cooling or external cooling **
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to + 45 °C fully operational +45 °C to + 70 °C derated operation *** –25 °C to + 85 °C transport and storage
Flammability corresponding to	UL 94 V-2
Design corresponding to	Filter: UL 61800-5-1, EN 61800-5-1 Chokes: EN 61558-2-20 or EN 60076-6
MTBF @ 45 °C/415 VAC (Mil-HB-217F)	> 200 000 hours
SCCR ****	100 kA
Earthing System	TT, TN, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers with 8% DC-link choke.
THID ~5% at rated power for filter < 6 kW

** Please refer to the datasheet for inlet air flow required for cooling .

*** $I_{derated} = I_{nominal} * \sqrt{((70\,°C - T_{amb})/25\,°C)}$

**** External UL-rated fuses required. Please consult the user manual.

Filter selection table – IP 00 enclosure

Filter	Rated load power @ 400 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3441-1-110-E0_ _ _ _ _*	1.1	1.7	1.62	6	110	A
FN 3441-2-110-E0_ _ _ _ _*	2.2	3.4	3.23	9	110	A
FN 3441-4-112-E0_ _ _ _ _*	4	6.2	5.9	12	112	B
FN 3441-6-112-E0_ _ _ _ _*	5.5	8.5	8.1	15	112	C
FN 3441-8-112-E0_ _ _ _ _*	7.5	12	11	16	112	C
FN 3441-11-113-E0_ _ _ _ _	11	17	16	23	113	D
FN 3441-15-113-E0_ _ _ _ _	15	23	22	26	113	D
FN 3441-19-113-E0_ _ _ _ _	19	29.3	28	30	113	D
FN 3441-22-115-E0_ _ _ _ _	22	34	32	38	115	E
FN 3441-30-115-E0_ _ _ _ _	30	46	44	43	115	E
FN 3441-37-115-E0_ _ _ _ _	37	57	54	48	115	E
FN 3441-45-115-E0_ _ _ _ _	45	70	66	54	115	E
FN 3441-55-115-E0_ _ _ _ _	55	85	81	63	115	E
FN 3441-75-116-E0_ _ _ _ _	75	116	110	98	116	G
FN 3441-90-116-E0_ _ _ _ _	90	140	133	106	116	G
FN 3441-110-118-E0_ _ _ _ _	110	171	162	127	118	H
FN 3441-132-118-E0_ _ _ _ _**	132	205	195	149	118	H
FN 3441-160-118-E0_ _ _ _ _**	160	249	238	167	118	H
FN 3441-200-118-E0_ _ _ _ _**	200	312	297	209	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Filter selection table – IP 20 enclosure

Filter	Rated load power @ 400 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3441-1-110-E2_ _ _ _ _*	1.1	1.7	1.62	7	110	A
FN 3441-2-110-E2_ _ _ _ _*	2.2	3.4	3.23	9	110	A
FN 3441-4-112-E2_ _ _ _ _*	4	6.2	5.9	13	112	B
FN 3441-6-112-E2_ _ _ _ _*	5.5	8.5	8.1	16	112	C
FN 3441-8-112-E2_ _ _ _ _*	7.5	12	11	18	112	C
FN 3441-11-113-E2_ _ _ _ _	11	17	16	27	113	D
FN 3441-15-113-E2_ _ _ _ _	15	23	22	30	113	D
FN 3441-19-113-E2_ _ _ _ _	19	29.3	28	34	113	D
FN 3441-22-115-E2_ _ _ _ _	22	34	32	44	115	E
FN 3441-30-115-E2_ _ _ _ _	30	46	44	48	115	E
FN 3441-37-115-E2_ _ _ _ _	37	57	54	54	115	E
FN 3441-45-115-E2_ _ _ _ _	45	70	66	59	115	E
FN 3441-55-115-E2_ _ _ _ _	55	85	81	68	115	E
FN 3441-75-116-E2_ _ _ _ _	75	116	110	107	116	G
FN 3441-90-116-E2_ _ _ _ _	90	140	133	115	116	G
FN 3441-110-118-E2_ _ _ _ _	110	171	162	144	118	H
FN 3441-132-118-E2_ _ _ _ _**	132	205	195	166	118	H
FN 3441-160-118-E2_ _ _ _ _**	160	249	238	185	118	H
FN 3441-200-118-E2_ _ _ _ _**	200	312	297	226	118	H

* Filter rating which does not require forced cooling or fan module
** Filter rating which does not require RC damping module for rectifiers with EMI filter
*** Motor drive input current without harmonic filter

Product selector

FN 34nn-xxx-yyy- _ _ _ _ _ _

X

R with RC damper
X without RC damper

J with trap disconnect jumper
S with switch
X without jumper and without switch

A with power supply
X without power supply

F with fan
X without fan

0 for IP 00
2 for IP 20

E for IP

Terminal designation

Power rating in kW (HP)

FN 3450 ecosine evo passive harmonic filters for 50 Hz diode and thyristor (SCR) rectifiers without DC-link choke 440–500 VAC

c UL us LISTED

c UL us RoHS CE

(depending on filter configuration)

Technical specifications

Nominal operating voltage	3 × 440 to 500 VAC
Operating frequency	50 Hz ±1 Hz
Nominal motor drive input power rating	1.1 to 250 KW
Total harmonic current distortion THID*	≤ 5 % @ rated power
Total demand distortion TDD	According to IEEE-519
Efficiency	> 98 % for rated voltage and power
High potential test voltage	P → E 2160 VAC (1 s)
Protection category	IP 00, IP 20
Cooling	Internal fan cooling or external cooling **
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +70 °C derated operation *** –25 °C to +85 °C transport and storage
Flammability corresponding to	UL 94 V-2
Design corresponding to	Filter: UL 61800-5-1, EN 61800-5-1 Chokes: EN 61558-2-20 or EN 60076-6
MTBF @ 45 °C/415 VAC (Mil-HB-217F)	> 200 000 hours
SCCR ****	100 kA
Earthing System	TT, TN, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers.
SCR rectifier front-ends will produce different results, dependent upon the firing angle of the thyristors.
THID ~5 % at rated power for filter < 6 kW

** Please refer to the datasheet for inlet air flow required for cooling .

*** $I_{derated} = I_{nominal} \cdot \sqrt{((70\,°C - T_{amb})/25\,°C)}$

**** External UL-rated fuses required. Please consult the user manual.

Filter selection table – IP 00 enclosure

Filter	Rated load power @ 480 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3450-1-110-E0_ _ _ _ _*	1.1	1.5	1.35	5.8	110	A
FN 3450-2-110-E0_ _ _ _ _*	2.2	3	2.75	8.4	110	A
FN 3450-4-112-E0_ _ _ _ _*	4	5.5	4.99	11.3	112	B
FN 3450-6-112-E0_ _ _ _ _*	5.5	10	6.77	14.0	112	B
FN 3450-8-112-E0_ _ _ _ _*	7.5	13	9.24	16.9	112	C
FN 3450-11-112-E0_ _ _ _ _*	11	16	13.6	20.9	112	C
FN 3450-15-113-E0_ _ _ _ _	15	24	18.5	28.2	113	D
FN 3450-19-113-E0_ _ _ _ _	19	32	23.3	32.0	113	D
FN 3450-22-113-E0_ _ _ _ _	22	38	27.0	36.0	113	D
FN 3450-30-115-E0_ _ _ _ _	30	45	36.9	47.5	115	E
FN 3450-37-115-E0_ _ _ _ _	37	60	45.4	53.9	115	E
FN 3450-45-115-E0_ _ _ _ _	45	75	55.2	63.1	115	E
FN 3450-55-115-E0_ _ _ _ _	55	90	67.5	66.8	115	F
FN 3450-75-115-E0_ _ _ _ _	75	110	92.5	88.1	115	F
FN 3450-90-116-E0_ _ _ _ _	90	150	111	120.1	116	G
FN 3450-110-116-E0_ _ _ _ _	110	180	135	140.6	116	G
FN 3450-132-118-E0_ _ _ _ _	132	210	163	160.9	118	H
FN 3450-160-118-E0_ _ _ _ _**	160	260	198	181.1	118	H
FN 3450-200-118-E0_ _ _ _ _**	200	320	248	216.8	118	H
FN 3450-250-118-E0_ _ _ _ _**	250	400	310	256.7	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Filter selection table – IP 20 enclosure

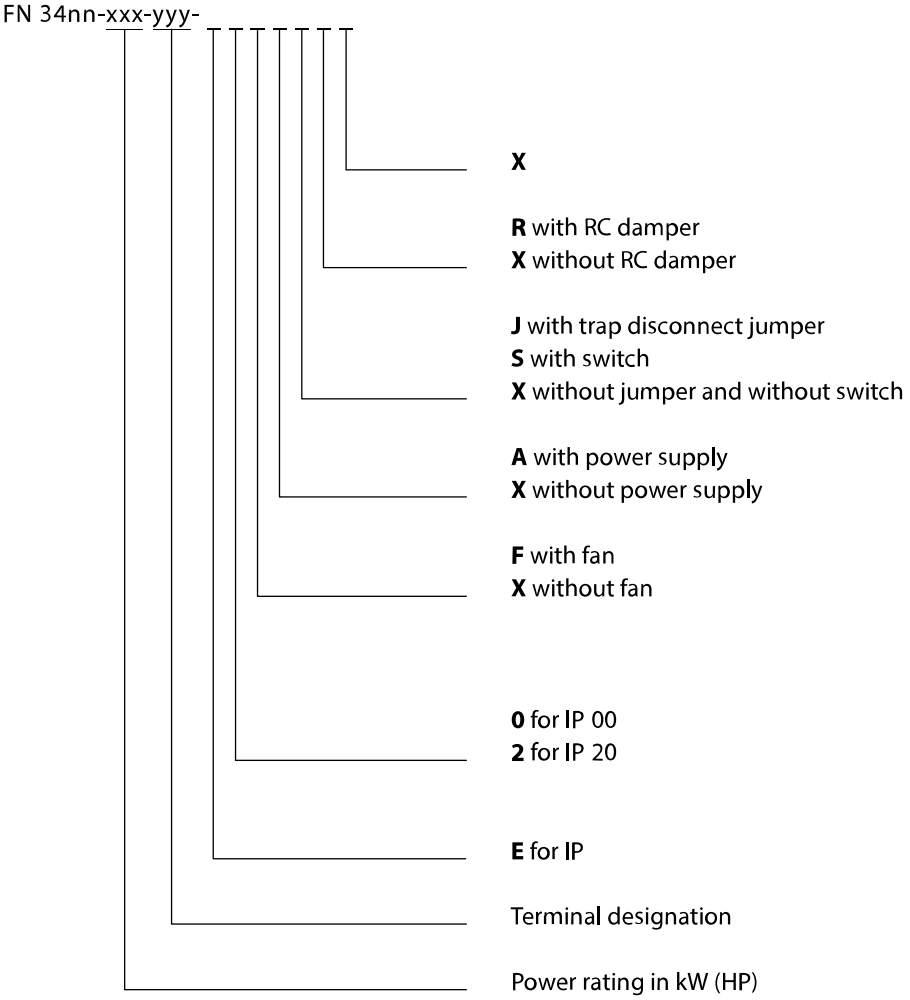
Filter	Rated load power @ 480 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3450-1-110-E2_ _ _ _ _*	1.1	1.5	1.35	7	110	A
FN 3450-2-110-E2_ _ _ _ _*	2.2	3	2.75	9	110	A
FN 3450-4-112-E2_ _ _ _ _*	4	5.5	4.99	13	112	B
FN 3450-6-112-E2_ _ _ _ _*	5.5	10	6.77	15	112	B
FN 3450-8-112-E2_ _ _ _ _*	7.5	13	9.24	19	112	C
FN 3450-11-112-E2_ _ _ _ _*	11	16	13.6	23	112	C
FN 3450-15-113-E2_ _ _ _ _	15	24	18.5	32	113	D
FN 3450-19-113-E2_ _ _ _ _	19	32	23.3	36	113	D
FN 3450-22-113-E2_ _ _ _ _	22	38	27.0	40	113	D
FN 3450-30-115-E2_ _ _ _ _	30	45	36.9	53	115	E
FN 3450-37-115-E2_ _ _ _ _	37	60	45.4	60	115	E
FN 3450-45-115-E2_ _ _ _ _	45	75	55.2	69	115	E
FN 3450-55-115-E2_ _ _ _ _	55	90	67.5	74	115	F
FN 3450-75-115-E2_ _ _ _ _	75	110	92.5	95	115	F
FN 3450-90-116-E2_ _ _ _ _	90	150	111	129	116	G
FN 3450-110-116-E2_ _ _ _ _	110	180	135	149	116	G
FN 3450-132-118-E2_ _ _ _ _	132	210	163	178	118	H
FN 3450-160-118-E2_ _ _ _ _**	160	260	198	198	118	H
FN 3450-200-118-E2_ _ _ _ _**	200	320	248	234	118	H
FN 3450-250-118-E2_ _ _ _ _**	250	400	310	274	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Product selector



FN 3451 ecosine evo passive harmonic filters for 50 Hz diode rectifiers with DC-link choke 440–500 VAC

c UL US LISTED

c UL us (depending on filter configuration) RoHS CE

Technical specifications

Nominal operating voltage	3 × 440 to 500 VAC
Operating frequency	50 Hz ±1 Hz
Nominal motor drive input power rating	1.1 to 250 KW
Total harmonic current distortion THID *	≤ 5 % @ rated power
Total demand distortion TDD	According to IEEE-519
Efficiency	> 98 % for rated voltage and power
High potential test voltage	P → E 2160 VAC (1 s)
Protection category	IP 00, IP 20
Cooling	Internal fan cooling or external cooling **
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +70 °C derated operation *** –25 °C to +85 °C transport and storage
Flammability corresponding to	UL 94 V-2
Design corresponding to	Filter: UL 61800-5-1, EN 61800-5-1 Chokes: EN 61558-2-20 or EN 60076-6
MTBF @ 45 °C/415 VAC (Mil-HB-217F)	> 200 000 hours
SCCR ****	100 kA
Earthing System	TT, TN, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers with 8 % DC-link choke.
THID ~ 5 % at rated power for filter < 6 kW

** Please refer to the datasheet for inlet air flow required for cooling .

*** $I_{derated} = I_{nominal} \cdot \sqrt{((70\,°C - T_{amb})/25\,°C)}$

**** External UL-rated fuses required. Please consult the user manual.

Filter selection table – IP 00 enclosure

Filter	Rated load power @ 480 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3451-1-110-E0_ _ _ _ _*	1.1	1.4	1.3	5	110	A
FN 3451-2-110-E0_ _ _ _ _*	2.2	2.8	2.7	7	110	A
FN 3451-4-112-E0_ _ _ _ _*	4	5.1	4.9	10	112	B
FN 3451-6-112-E0_ _ _ _ _*	5.5	7.1	6.7	12	112	B
FN 3451-8-112-E0_ _ _ _ _*	7.5	9.6	9.2	15	112	C
FN 3451-11-112-E0_ _ _ _ _*	11	14.1	13.4	17	112	C
FN 3451-15-113-E0_ _ _ _ _	15	19.3	18.3	24	113	D
FN 3451-19-113-E0_ _ _ _ _	19	24.4	23	27	113	D
FN 3451-22-113-E0_ _ _ _ _	22	28	27	31	113	D
FN 3451-30-115-E0_ _ _ _ _	30	38.5	36.6	38	115	E
FN 3451-37-115-E0_ _ _ _ _	37	47.5	45	43	115	E
FN 3451-45-115-E0_ _ _ _ _	45	58	55	49	115	E
FN 3451-55-115-E0_ _ _ _ _	55	71	67	54	115	F
FN 3451-75-115-E0_ _ _ _ _	75	97	92	70	115	F
FN 3451-90-116-E0_ _ _ _ _	90	116	110	100	116	G
FN 3451-110-116-E0_ _ _ _ _	110	142	135	108	116	G
FN 3451-132-118-E0_ _ _ _ _	132	170	162	130	118	H
FN 3451-160-118-E0_ _ _ _ _**	160	207	197	149	118	H
FN 3451-200-118-E0_ _ _ _ _**	200	259	246	183	118	H
FN 3451-250-118-E0_ _ _ _ _**	250	324	308	221	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Filter selection table – IP 20 enclosure

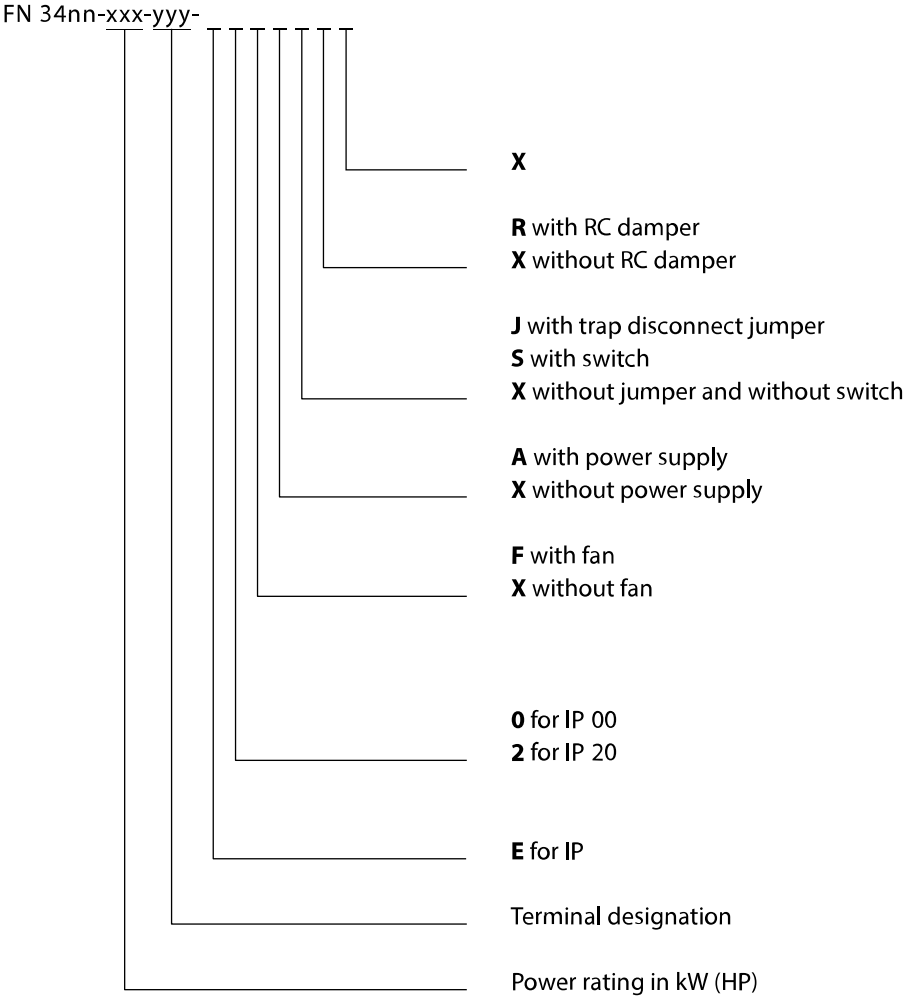
Filter	Rated load power @ 480 VAC/50 Hz [kW]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	Terminal	Frame size
FN 3451-1-110-E2_ _ _ _ _*	1.1	1.4	1.3	6	110	A
FN 3451-2-110-E2_ _ _ _ _*	2.2	2.8	2.7	8	110	A
FN 3451-4-112-E2_ _ _ _ _*	4	5.1	4.9	11	112	B
FN 3451-6-112-E2_ _ _ _ _*	5.5	7.1	6.7	13	112	B
FN 3451-8-112-E2_ _ _ _ _*	7.5	9.6	9.2	16	112	C
FN 3451-11-112-E2_ _ _ _ _*	11	14.1	13.4	19	112	C
FN 3451-15-113-E2_ _ _ _ _	15	19.3	18.3	28	113	D
FN 3451-19-113-E2_ _ _ _ _	19	24.4	23	30	113	D
FN 3451-22-113-E2_ _ _ _ _	22	28	27	34	113	D
FN 3451-30-115-E2_ _ _ _ _	30	38.5	36.6	44	115	E
FN 3451-37-115-E2_ _ _ _ _	37	47.5	45	49	115	E
FN 3451-45-115-E2_ _ _ _ _	45	58	55	55	115	E
FN 3451-55-115-E2_ _ _ _ _	55	71	67	62	115	F
FN 3451-75-115-E2_ _ _ _ _	75	97	92	77	115	F
FN 3451-90-116-E2_ _ _ _ _	90	116	110	109	116	G
FN 3451-110-116-E2_ _ _ _ _	110	142	135	117	116	G
FN 3451-132-118-E2_ _ _ _ _	132	170	162	147	118	H
FN 3451-160-118-E2_ _ _ _ _**	160	207	197	166	118	H
FN 3451-200-118-E2_ _ _ _ _**	200	259	246	200	118	H
FN 3451-250-118-E2_ _ _ _ _**	250	324	308	238	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Product selector



FN 3452 ecosine evo passive harmonic filters for 60 Hz diode and thyristor (SCR) rectifiers without DC-link choke

(depending on filter configuration)

Technical specifications

Nominal operating voltage	3 × 440 to 480 VAC
Operating frequency	60 Hz ±1 Hz
Nominal motor drive input power rating	1.5 to 300 HP
Total harmonic current distortion THID *	≤ 5 % @ rated power
Total demand distortion TDD	According to IEEE-519
Efficiency	> 98 % for rated voltage and power
High potential test voltage	P → E 2160 VAC (1 s)
Protection category	IP 00, IP 20
Cooling	Internal fan cooling or external cooling **
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +70 °C derated operation *** –25 °C to +85 °C transport and storage
Flammability corresponding to	UL 94 V-2
Design corresponding to	Filter: UL 61800-5-1, EN 61800-5-1 Chokes: EN 61558-2-20 or EN 60076-6
MTBF @ 45 °C/415 VAC (Mil-HB-217F)	> 200 000 hours
SCCR ****	100 kA
Earthing System	TT, TN, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers with 8 % DC-link choke.
THID ~ 5 % at rated power for filter < 6 kW

** Please refer to the datasheet for inlet air flow required for cooling

*** $I_{derated} = I_{nominal} \cdot \sqrt{((70\,°C - T_{amb})/25\,°C)}$

**** External UL-rated fuses required. Please consult the user manual.

Filter selection table – IP 00 enclosure

Filter	Rated load power @ 480 VAC/60 Hz		Motor drive input current	Rated filter input current	Weight		Terminal	Frame size
	[kW]	[HP]	[Arms] ***	[Arms]	[kg]	[lbs]		
FN 3452-1-110-E0_ _ _ _ _*	1.1	1.5	2	1.37	5.7	12.6	110	A
FN 3452-3-110-E0_ _ _ _ _*	2.2	3	4	2.76	7.9	17.4	110	A
FN 3452-5-112-E0_ _ _ _ _*	3.7	5	7	4.57	10.1	22.3	112	B
FN 3452-8-112-E0_ _ _ _ _*	5.6	7.5	11	6.91	12.7	28.0	112	B
FN 3452-10-112-E0_ _ _ _ _*	7.5	10	14	9.29	15.7	34.6	112	C
FN 3452-15-112-E0_ _ _ _ _*	11	15	21	13.8	18.0	39.7	112	C
FN 3452-20-113-E0_ _ _ _ _	15	20	27	18.5	26.8	59.1	113	D
FN 3452-25-113-E0_ _ _ _ _	19	25	34	23.1	30.8	67.9	113	D
FN 3452-30-113-E0_ _ _ _ _	22	30	44	27.8	35.6	78.5	113	D
FN 3452-40-115-E0_ _ _ _ _	30	40	52	37.2	46.0	101.4	115	E
FN 3452-50-115-E0_ _ _ _ _	37	50	66	46.2	51.1	112.6	115	E
FN 3452-60-115-E0_ _ _ _ _	45	60	83	55.6	59.2	130.5	115	E
FN 3452-75-115-E0_ _ _ _ _	56	75	103	69.3	59.9	132.0	115	F
FN 3452-100-115-E0_ _ _ _ _	75	100	128	92.5	82.4	181.6	115	F
FN 3452-125-116-E0_ _ _ _ _	93	125	165	115	116.2	256.1	116	G
FN 3452-150-116-E0_ _ _ _ _	112	150	208	139	137.1	302.2	116	G
FN 3452-200-118-E0_ _ _ _ _	149	200	240	184	169.7	374.0	118	H
FN 3452-250-118-E0_ _ _ _ _**	186	250	320	231	186.9	411.9	118	H
FN 3452-300-118-E0_ _ _ _ _**	224	300	403	279	251.9	555.2	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Filter selection table – IP 20 enclosure

Filter	Rated load power @ 480 VAC/60 Hz		Motor drive input current	Rated filter input current	Weight		Terminal	Frame size
	[kW]	[HP]	[Arms] ***	[Arms]	[kg]	[lbs]		
FN 3452-1-110-E2_ _ _ _ _*	1.1	1.5	2	1.37	7	15.4	110	A
FN 3452-3-110-E2_ _ _ _ _*	2.2	3	4	2.76	9	19.8	110	A
FN 3452-5-112-E2_ _ _ _ _*	3.7	5	7	4.57	11	24.3	112	B
FN 3452-8-112-E2_ _ _ _ _*	5.6	7.5	11	6.91	14	31	112	B
FN 3452-10-112-E2_ _ _ _ _*	7.5	10	14	9.29	17.4	38	112	C
FN 3452-15-112-E2_ _ _ _ _*	11	15	21	13.8	20	44	112	C
FN 3452-20-113-E2_ _ _ _ _	15	20	27	18.5	31	68	113	D
FN 3452-25-113-E2_ _ _ _ _	19	25	34	23.1	35	77	113	D
FN 3452-30-113-E2_ _ _ _ _	22	30	44	27.8	40	88	113	D
FN 3452-40-115-E2_ _ _ _ _	30	40	52	37.2	52	115	115	E
FN 3452-50-115-E2_ _ _ _ _	37	50	66	46.2	57	126	115	E
FN 3452-60-115-E2_ _ _ _ _	45	60	83	55.6	65	143	115	E
FN 3452-75-115-E2_ _ _ _ _	56	75	103	69.3	67	147	115	F
FN 3452-100-115-E2_ _ _ _ _	75	100	128	92.5	90	198	115	F
FN 3452-125-116-E2_ _ _ _ _	93	125	165	115	125	276	116	G
FN 3452-150-116-E2_ _ _ _ _	112	150	208	139	146	322	116	G
FN 3452-200-118-E2_ _ _ _ _	149	200	240	184	187	412	118	H
FN 3452-250-118-E2_ _ _ _ _**	186	250	320	231	204	450	118	H
FN 3452-300-118-E2_ _ _ _ _**	224	300	403	279	269	593	118	H

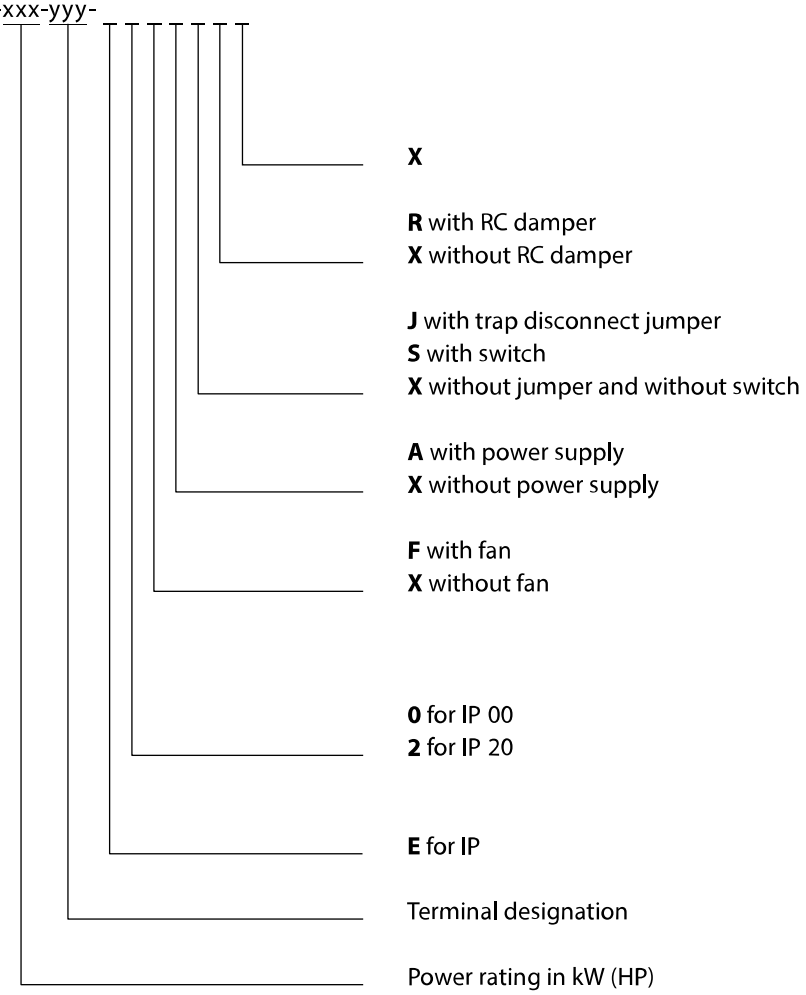
* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Product selector

FN 34nn-xxx-yyy- _ _ _ _ _ _



FN 3453 ecosine evo passive harmonic filters for 60 Hz diode rectifiers with DC-link choke

(depending on filter configuration)

Technical specifications

Nominal operating voltage	3 × 440 to 480 VAC
Operating frequency	60 Hz ±1 Hz
Nominal motor drive input power rating	1.5 to 300 HP
Total harmonic current distortion THID*	≤ 5 % @ rated power
Total demand distortion TDD	According to IEEE-519
Efficiency	> 98 % for rated voltage and power
High potential test voltage	P → E 2160 VAC (1 s)
Protection category	IP 00, IP 20
Cooling	Internal fan cooling or external cooling **
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +70 °C derated operation *** –25 °C to +85 °C transport and storage
Flammability corresponding to	UL 94 V-2
Design corresponding to	Filter: UL 61800-5-1, EN 61800-5-1
	Chokes: EN 61558-2-20 or EN 60076-6
MTBF @ 45 °C/415 VAC (Mil-HB-217F)	> 200 000 hours
SCCR ****	100 kA
Earthing System	TT, TN, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers with 8 % DC-link choke.
THID ~5 % at rated power for filter < 6 kW

** Please refer to the datasheet for inlet air flow required for cooling

*** $I_{derated} = I_{nominal} \cdot \sqrt{((70\,°C - T_{amb})/25\,°C)}$

**** External UL-rated fuses required. Please consult the user manual.

Filter selection table – IP 00 enclosure

Filter	Rated load power @ 480 VAC/60 Hz [kW]	[HP]	Motor drive input current [Arms] ***	Rated filter input current [Arms]	Weight [kg]	[lbs]	Terminal	Frame size
FN 3453-1-110-E0_ _ _ _ _*	1.1	1.5	1.44	1.37	5	11	110	A
FN 3453-3-110-E0_ _ _ _ _*	2.2	3	2.87	2.74	7	15.4	110	A
FN 3453-5-112-E0_ _ _ _ _*	3.7	5	4.75	4.52	9	19.8	112	B
FN 3453-8-112-E0_ _ _ _ _*	5.6	7.5	7.18	6.85	12	26.5	112	B
FN 3453-10-112-E0_ _ _ _ _*	7.5	10	9.6	9.2	13.6	30	112	C
FN 3453-15-112-E0_ _ _ _ _*	11	15	14.4	13.7	16	35.3	112	C
FN 3453-20-113-E0_ _ _ _ _	15	20	19.3	18.3	23	50.7	113	D
FN 3453-25-113-E0_ _ _ _ _	19	25	24	23	26	57.3	113	D
FN 3453-30-113-E0_ _ _ _ _	22	30	29	27.5	30	66.1	113	D
FN 3453-40-115-E0_ _ _ _ _	30	40	38.5	36.8	37	81.6	115	E
FN 3453-50-115-E0_ _ _ _ _	37	50	48	45.8	42	92.6	115	E
FN 3453-60-115-E0_ _ _ _ _	45	60	58	55	48	105.8	115	E
FN 3453-75-115-E0_ _ _ _ _	56	75	72	69	49	108	115	F
FN 3453-100-115-E0_ _ _ _ _	75	100	97	92	68	150	115	F
FN 3453-125-116-E0_ _ _ _ _	93	125	120	114	97	214	116	G
FN 3453-150-116-E0_ _ _ _ _	112	150	144	138	113	250	116	G
FN 3453-200-118-E0_ _ _ _ _	149	200	192	183	138	304	118	H
FN 3453-250-118-E0_ _ _ _ _**	186	250	241	229	152	335	118	H
FN 3453-300-118-E0_ _ _ _ _**	224	300	290	277	205	452	118	H

* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Filter selection table – IP 00 enclosure

Filter	Rated load power @ 480 VAC/60 Hz		Motor drive input current	Rated filter input current	Weight		Terminal	Frame size
	[kW]	[HP]	[Arms] ***	[Arms]	[kg]	[lbs]		
FN 3453-1-110-E2_ _ _ _ _*	1.1	1.5	1.44	1.37	6	13.2	110	A
FN 3453-3-110-E2_ _ _ _ _*	2.2	3	2.87	2.74	8	17.6	110	A
FN 3453-5-112-E2_ _ _ _ _*	3.7	5	4.75	4.52	10	22	112	B
FN 3453-8-112-E2_ _ _ _ _*	5.6	7.5	7.18	6.85	13	28.7	112	B
FN 3453-10-112-E2_ _ _ _ _*	7.5	10	9.6	9.2	15.7	34.6	112	C
FN 3453-15-112-E2_ _ _ _ _*	11	15	14.4	13.7	17	37.5	112	C
FN 3453-20-113-E2_ _ _ _ _	15	20	19.3	18.3	27	59.5	113	D
FN 3453-25-113-E2_ _ _ _ _	19	25	24	23	29	63.9	113	D
FN 3453-30-113-E2_ _ _ _ _	22	30	29	27.5	34	75	113	D
FN 3453-40-115-E2_ _ _ _ _	30	40	38.5	36.8	43	94.8	115	E
FN 3453-50-115-E2_ _ _ _ _	37	50	48	45.8	48	105.8	115	E
FN 3453-60-115-E2_ _ _ _ _	45	60	58	55	54	119	115	E
FN 3453-75-115-E2_ _ _ _ _	56	75	72	69	57	125.7	115	F
FN 3453-100-115-E2_ _ _ _ _	75	100	97	92	75	165.3	115	F
FN 3453-125-116-E2_ _ _ _ _	93	125	120	114	106	233.7	116	G
FN 3453-150-116-E2_ _ _ _ _	112	150	144	138	122	269	116	G
FN 3453-200-118-E2_ _ _ _ _	149	200	192	183	156	343.9	118	H
FN 3453-250-118-E2_ _ _ _ _**	186	250	241	229	170	374.8	118	H
FN 3453-300-118-E2_ _ _ _ _**	224	300	290	277	222	489.4	118	H

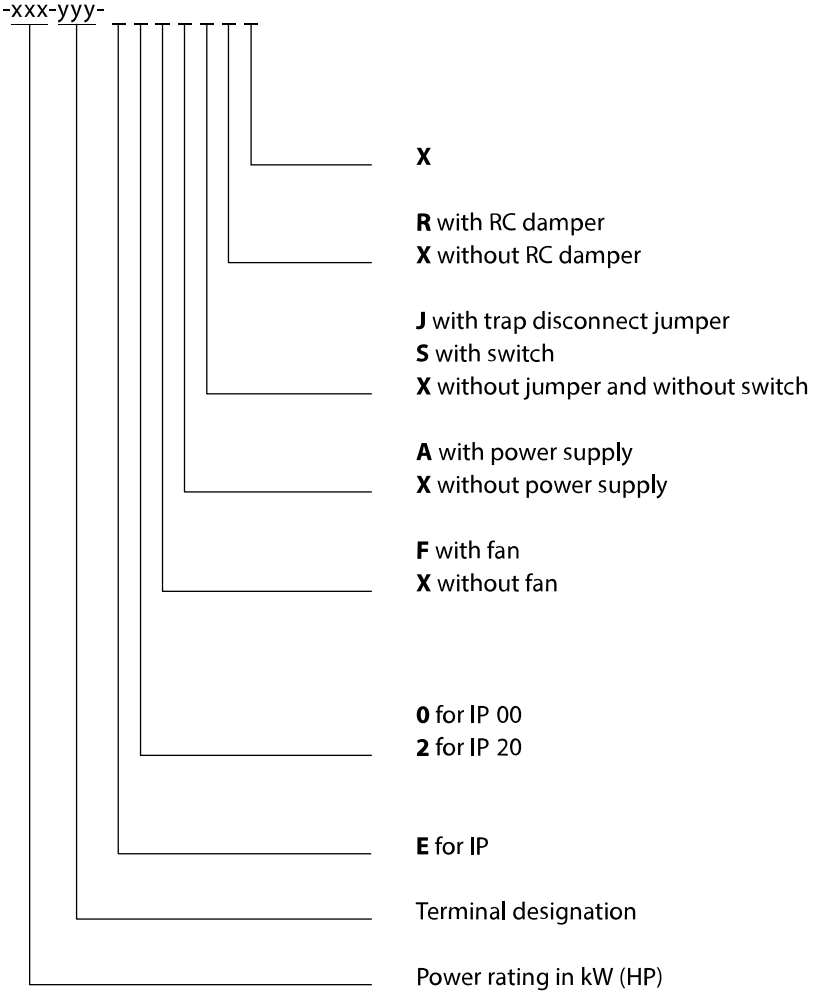
* Filter rating which does not require forced cooling or fan module

** Filter rating which does not require RC damping module for rectifiers with EMI filter

*** Motor drive input current without harmonic filter

Product selector

FN 34nn-xxx-yyy- _ _ _ _ _ _



Ecosine harmonic filters for 690 V/50 Hz systems FN 3410 HV for diode and thyristor (SCR) rectifiers

Technical specifications

Nominal operating voltage:	3 × 690 VAC
Voltage tolerance range:	3 × 586 to 760 VAC
Operating frequency:	50 Hz ±1 Hz
Nominal motor drive input current rating*:	10 to 320A @ 50 °C
Nominal motor drive input power rating:	7.5 to 250kW
Total harmonic current distortion THID**:	< 5 % @ rated power (filters ≤ 37 kW) ~5 % @ rated power with Ldc (filters ≥ 45 kW)
Total demand distortion TDD:	According to IEEE-519
Efficiency:	> 98 % @ nominal line voltage and power
High potential test voltage:	P → E 2500 VAC (1 min)
Protection category:	IP 20
Cooling:	Internal fan cooling
Overload capability:	1.6 × rated current for 1 minute, once per hour
Ambient temperature range:	–25 °C to +50 °C fully operational +50 °C to +70 °C derated operation *** –25 °C to +85 °C transport and storage
Flammability corresponding to:	UL 94V-2 or better
Design corresponding to:	UL508, EN61558-2-20, CE (LVD2006/95/EC)
MTBF @ 50°C/690V (Mil-HB-217F):	200 000 hours
SCCR ****	100 kA
Earthing System	TN, TT, IT

* Ecosine filters reduce RMS input and peak current by reducing harmonic currents and improving true power factor.

** System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers. SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

*** $I_{derated} = I_{nominal} * \sqrt{((70\,°C - T_{amb})/20)}\,°C$

**** External UL-rated fuses required. Please consult the user manual.

RoHS CE

Filter selection table

Filter*	Rated load power @ 690VAC/50Hz [kW]	Power loss** @ 690V [W]	Input/Output connections		Capacitor disconnections	Weight [kg]
FN 3410HV-10-44	7.5	150	–44		–44	20
FN 3410HV-13-44	11	209	–44		–44	21
FN 3410HV-16-33	15	270	–33		–44	29
FN 3410HV-24-33	18.5	333	–33		–44	33
FN 3410HV-32-53	22	374	–53		–33	44
FN 3410HV-38-53	30	480	–53		–33	48
FN 3410HV-45-53	37	555	–53		–33	56
FN 3410HV-60-35	45	610	–35		–34	58
FN 3410HV-75-35	55	690	–35		–34	62
FN 3410HV-90-35	75	860	–35		–34	77
FN 3410HV-110-35	90	960	–35		–34	91
FN 3410HV-150-40	110	1145	–40		–35	131
FN 3410HV-180-40	132	1275	–40		–35	147
FN 3410HV-210-40	160	1600	–40		–35	169
FN 3410HV-260-99	200	1940		–99	–35	230
FN 3410HV-320-99	250	2500		–99	–35	233

* Filter to be selected by system voltage and load (motor drive) power. Note: the harmonic filter will reduce RMS input current. Therefore, filter selection by current rating, as it is common for EMC/EMI filters, is not suitable.

** Calculated power loss at rated load power.

Ecosine Economy Line for 50 Hz systems FN 3416 for diode and thyristor rectifiers

Technical specifications

Nominal operating voltage	3 × 380 to 500 VAC ±10 %
Operating frequency	50 Hz ±1 Hz (FN 3416)
Total harmonic current distortion THID *	< 10 % @ rated power (with DC-Link choke) < 15 % @ rated power (without DC-Link choke)
Total demand distortion TDD	According to IEEE-519
Nominal motor drive input power rating	4 to 160 kW
Efficiency	> 98 % @ nominal line voltage and power
High potential test voltage	P → E 2500 VAC (2 sec)
Protection category	IP 20
Cooling	Internal fan cooling, unregulated
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +70 °C derated operation ** –25 °C to +85 °C transport and storage
Flammability corresponding to	UL 94 V-2 or better
Design corresponding to	UL 508, EN61558-2-20, CE (LVD2006/95/EC)
MTBF @ 45 °C/500 V (Mil-HB-217F) 1	200 000 hou rs
SCCR ***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers.
SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{((70\,°C - T_{amb})/25)}\ °C$

*** External UL-rated fuses required.

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Filter selection table

Filter*	Rated load power @ 400 VAC/50 Hz [kW]	Rated load power @ 500 VAC/50 Hz [kW]	Power loss** @ 25 °C/50 Hz [W]	Input/Output connections		Weight [kg]
FN 3416-10-44	4	5.5	63	–44		10
FN 3416-13-44	5.5	7.5	82	–44		10
FN 3416-16-44	7.5	11	105	–44		15
FN 3416-24-33	11	15	153	–33		20
FN 3416-32-33	15	18.5	294	–33		22
FN 3416-38-33	18.5	22	256	–33		25
FN 3416-45-33	22	30	306	–33		29
FN 3416-60-34	30	37	408	–34		37
FN 3416-75-34	37	45	410	–34		43
FN 3416-90-35	45	55	493	–35		47
FN 3416-110-35	55	75	546	–35		50
FN 3416-150-40	75	90	784	–40		86
FN 3416-180-40	90	110	817	–40		92
FN 3416-210-40	110	132	887	–40		100
FN 3416-260-99	132	160	947		-99	125
FN 3416-320-99	160	200	988		-99	135

* Filter to be selected by system voltage and load (motor drive) power. Note: the harmonic filter will reduce RMS input current.
Therefore, filter selection by current rating, as it is common for EMC/EMI filters, is not recommended.

** Calculated power loss at rated load power.

Ecosine Economy Line for 60 Hz systems FN 3418 for diode and thyristor rectifiers

Technical specifications

Nominal operating voltage	3 × 380 to 480 VAC ±10 %
Operating frequency	60 Hz ±1 Hz
Total harmonic current distortion THID*	< 10 % @ rated power (with DC-Link choke) < 15 % @ rated power (without DC-Link choke)
Total demand distortion TDD	According to IEEE-519
Nominal motor drive input power rating	5 to 250 HP
Efficiency	> 98 % @ nominal line voltage and power
High potential test voltage	P → E 2500 VAC (2 sec)
Protection category	IP 20
Cooling	Internal fan cooling, unregulated
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +70 °C derated operation** –25 °C to +85 °C transport and storage
Flammability corresponding to	UL 94 V-2 or better
Design corresponding to	UL 508, EN61558-2-20, CE (LVD2006/95/EC)
MTBF @ 45 °C/500 V (Mil-HB-217F) 1	200 000 hours
SCCR***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers.
SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{((70\,°C - T_{amb})/25)}$ °C

*** External UL-rated fuses required.

Filter selection table

Filter*	Rated load power @ 460 VAC/60 Hz [HP]	Power loss** @ 25 °C/60 Hz [W]	Input/Output connections		Weight [kg]
FN 3418-8-44	5	41	–44		10
FN 3418-11-44	7.5	81	–44		10
FN 3418-15-44	10	72	–44		16
FN 3418-21-33	15	152	–33		20
FN 3418-28-33	20	214	–33		22
FN 3418-35-33	25	277	–33		25
FN 3418-41-33	30	289	–33		28
FN 3418-53-34	40	383	–34		38
FN 3418-65-34	50	393	–34		42
FN 3418-80-35	60	493	–35		45
FN 3418-105-35	75	514	–35		54
FN 3418-130-40	100	741	–40		78
FN 3418-160-40	125	832	–40		87
FN 3418-190-40	150	873	–40		100
FN 3418-240-99	200	876		–99	126
FN 3418-310-99	250	984		–99	135

Ecosine Low-Voltage Economy Line for 50 Hz systems FN 3416 LV for diode and thyristor rectifiers

Technical specifications

Nominal operating voltage	3 × 200 to 240 VAC ± 10 %
Operating frequency	50 Hz ± 1 Hz (FN 3416 LV)
Total harmonic current distortion THID*	< 7 % @ rated power (with DC-Link choke) < 13 % @ rated power (without DC-Link choke)
Total demand distortion TDD	According to IEEE-519
Nominal motor drive input power rating	2.5 to 90 kW
Efficiency	> 98 % @ nominal line voltage and power
High potential test voltage	P → E 2500 VAC (2 sec)
Protection category	IP 20
Cooling	Internal fan cooling, unregulated
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +55 °C derated operation** –25 °C to +70 °C transport and storage
Flammability corresponding to	UL 94 V-2 or better
Design corresponding to	UL 508, EN61558-2-20, CE (LVD2006/95/EC)
MTBF @ 45 °C/500 V (Mil-HB-217F) 1	200 000 hours
SCCR***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers.
SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{((70\,°C - T_{amb})/25)}\ °C$

*** External UL-rated fuses required.

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Filter selection table

Filter*	Rated load power @ 220 VAC/50 Hz [kW]	Power loss** @ 25 °C/50 Hz [W]	Input/Output connections		Weight [kg]
FN 3416LV-10-44	2.5	63	–44		10
FN 3416LV-13-44	3	82	–44		10
FN 3416LV-16-44	4	105	–44		15
FN 3416LV-24-33	5.5	153	–33		20
FN 3416LV-32-33	7.5	294	–33		22
FN 3416LV-38-33	11	256	–33		25
FN 3416LV-45-33	15	306	–33		29
FN 3416LV-60-34	18.5	408	–34		37
FN 3416LV-75-34	22	410	–34		43
FN 3416LV-90-35	26	493	–35		47
FN 3416LV-110-35	30	546	–35		50
FN 3416LV-150-40	37	784	–40		86
FN 3416LV-180-40	45	817	–40		92
FN 3416LV-210-40	55	887	–40		100
FN 3416LV-260-99	75	947		–99	125
FN 3416LV-320-99	90	988		–99	135

* Filter to be selected by system voltage and load (motor drive) power. Note: the harmonic filter will reduce RMS input current. Therefore, filter selection by current rating, as it is common for EMC/EMI filters, is not recommended.

** Calculated power loss at rated load power.

Ecosine Low-Voltage Economy Line for 60 Hz systems FN 3418 LV for diode and thyristor rectifiers

Technical specifications

Nominal operating voltage	3 × 200 to 240 VAC ± 10 %
Operating frequency	60 Hz ± 1 Hz
Total harmonic current distortion THID *	< 7 % @ rated power (with DC-Link choke) < 13 % @ rated power (without DC-Link choke)
Total demand distortion TDD	According to IEEE-519
Nominal motor drive input power rating:	2.5 to 125 HP
Efficiency	> 98 % @ nominal line voltage and power
High potential test voltage	P → E 2500 VAC (2 sec)
Protection category	IP 20
Cooling	Internal fan cooling, unregulated
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +45 °C fully operational +45 °C to +55 °C derated operation ** –25 °C to +70 °C transport and storage
Flammability corresponding to	UL 94 V-2 or better
Design corresponding to	UL 508, EN61558-2-20, CE (LVD2006/95/EC)
MTBF @ 45 °C/500 V (Mil-HB-217F) 1	200 000 hours
SCCR ***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers. SCR rectifier front-ends will produce different results, dependent upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{((70\,°C - T_{amb})/25)}\,°C$

*** External UL-rated fuses required. Please consult the user manual.

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Filter selection table

Filter*	Rated load power @ 208 VAC/60 Hz [HP]	Power loss** @ 25 °C/60 Hz [W]	Input/Output connections		Weight [kg]
FN 3418LV-8-44	2.5	41	–44		10
FN 3418LV-11-44	3.5	81	–44		10
FN 3418LV-15-44	5	72	–44		16
FN 3418LV-21-33	7.5	152	–33		20
FN 3418LV-28-33	10	214	–33		22
FN 3418LV-35-33	12	277	–33		25
FN 3418LV-41-33	15	289	–33		28
FN 3418LV-53-34	20	383	–34		38
FN 3418LV-65-34	25	393	–34		42
FN 3418LV-80-35	30	493	–35		45
FN 3418LV-105-35	40	514	–35		54
FN 3418LV-130-40	50	741	–40		78
FN 3418LV-160-40	60	832	–40		87
FN 3418LV-190-40	75	873	–40		100
FN 3418LV-240-99	100	876		–99	126
FN 3418LV-310-99	125	984		–99	135

* Filter to be selected by system voltage and load (motor drive) power. Note: the harmonic filter will reduce RMS input current. Therefore, filter selection by current rating, as it is common for EMC/EMI filters, is not recommended.

** Calculated power loss at rated load power.

High power line for system integration 50 Hz
FN 3410 ecosine for diode rectifiers
FN 3411 ecosine for SCR rectifiers

Technical specifications	
Nominal operating voltage	3 × 380 to 500 VAC
Voltage tolerance range	3 × 342 to 550 VAC
Operating frequency	50 Hz ±1 Hz
Total harmonic current distortion THID*	~5 % @ rated power with Ldc < 15 % @ de-rated power without Ldc
Total demand distortion TDD	According to IEEE-519
Nominal motor drive input power rating	200 to 400 kW
Efficiency	≥ 99 % @ nominal line voltage and power
High potential test voltage	P → E 2500 VAC (2 sec)
Protection category	IP 00
Cooling	Forced air, to be provided by the installer/integrator
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +40 °C fully operational +40 °C to +55 °C derated operation ** –25 °C to +80 °C transport and storage
Flammability corresponding to	UL 94 V-2 or better
Design corresponding to	UL 508c, EN61558-2-20, CE (LVD 2006/95/EC)
SCCR ***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers.
SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{((55\,°C - T_{amb})/15)}\,°C$

*** External UL-rated fuses required

Filter selection table (50 Hz)

Filter*	Rated load power** @ 400 VAC/50 Hz [kW]	Rated load power** @ 500 VAC/50 Hz [kW]	Typ. power loss @ rated load [W]	Weight choke module [kg]	Weight total [kg]
FN 341x-380-99-O	200	250	1040	120	140
FN 341x-470-99-O	250	315	1370	135	157
FN 341x-580-99-O	315	355	1540	160	187
FN 341x-650-99-O	355	400	1550	215	247
FN 341x-710-99-O	400	450	1680	250	285

* To compile a part number, please replace the X with 0 for diode or 1 for SCR rectifiers.

** Power rating for motor drives with dc-link chokes. If no L_{dc} is available, load power of the filter has to be de-rated to 70 % of the specified value above. In this case, the THID will be between 10–15 %.

Scope of delivery

Filter*	Power [kW]	Freq. [Hz]	Rectifier	Chokes module	Capacitor modules		Damper module**	Installation manual
					Modules	Caps		
FN 341x-380-99-O	200	50	Diode	1	2	5	1	√
FN 341x-470-99-O	250	50	Diode	1	2	6	1	√
FN 341x-580-99-O	315	50	Diode	1	2	8	1	√
FN 341x-650-99-O	355	50	Diode	1	3	9	1	√
FN 341x-710-99-O	400	50	Diode	1	3	10	1	√

Remark: wiring material, cabinet/enclosure and fan(s) are not included in the scope of delivery.

* To compile a part number, please replace the X with 0 for diode or 1 for SCR rectifiers.

** for FN 3410 only

High power line for system integration 60 Hz
FN 3412 ecosine for diode rectifiers
FN 3413 ecosine for SCR rectifiers

Technical specifications

Nominal operating voltage	3 × 380 to 480 VAC
Voltage tolerance range	3 × 342 to 528 VAC
Operating frequency	60 Hz ±1 Hz
Total harmonic current distortion THID*	~5 % @ rated power with Ldc < 15 % @ de-rated power without Ldc
Total demand distortion TDD	According to IEEE-519
Nominal motor drive input power rating	300 to 500 HP
Efficiency	≥ 99 % @ nominal line voltage and power
High potential test voltage	P → E 2500VAC (2 sec)
Protection category	IP 00
Cooling	Forced air, to be provided by the installer/integrator
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +40 °C fully operational +40 °C to +55 °C derated operation** –25 °C to +80 °C transport and storage
Flammability corresponding to	UL 94V-2 or better
Design corresponding to	UL 508c, EN61558-2-20, CE (LVD 2006/95/EC)
SCCR***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers.
SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{((55\,°C - T_{amb})/15)}\,°C$

*** External UL-rated fuses required

Filter selection table

Filter*	Rated load power** @ 460 VAC/60 Hz [HP]	Typ. power loss @ rated load [W]	Weight choke module [kg]	Weight total [kg]
FN 341x-380-99-O	300	1090	120	135
FN 341x-440-99-O	350	1400	135	155
FN 341x-490-99-O	400	1480	150	170
FN 341x-540-99-O	450	1500	195	218
FN 341x-590-99-O	500	1520	235	260

* To compile a part number, please replace the X with 2 for diode or 3 for SCR rectifiers.

** Power rating for motor drives with dc-link chokes. If no L_{dc} is available, load power of the filter has to be de-rated to 70 % of the specified value above. In this case, the THID will be between 10–15 %.

Scope of delivery

Filter*	Power [HP]	Freq. [Hz]	Rectifier	Chokes module	Capacitor modules		Damper module**	Installation manual
					Modules	Caps		
FN 341x-380-99-O	300	60	Diode	1	1	4	1	√
FN 341x-440-99-O	350	60	Diode	1	2	5	1	√
FN 341x-490-99-O	400	60	Diode	1	2	5	1	√
FN 341x-540-99-O	450	60	Diode	1	2	6	1	√
FN 341x-590-99-O	500	60	Diode	1	2	7	1	√

Remark: wiring material, cabinet/enclosure and fan(s) are not included in the scope of delivery.

* To compile a part number, please replace the X with 2 for diode or 3 for SCR rectifiers.

** for FN 3412 only

High power line enclosed 50 Hz
FN 3410 ecosine for diode rectifiers
FN 3411 ecosine for SCR rectifiers

Technical specifications

Nominal operating voltage:	3 × 380 to 500 VAC
Operating frequency:	50 Hz +/– 1 Hz
Total harmonic current distortion THID*	~ 5 % @ rated power with Ldc < 15 % @ de-rated power without Ldc
Total demand distortion TDD	According to IEEE-519
Voltage tolerance range:	3 × 342 to 550 VAC
Nominal motor drive input power rating:	200 to 400 kW
Efficiency	≥ 99 % @ nominal line voltage and power
High potential test voltage	P → E 2500 VAC (2 sec)
Protection category	IP 23 for -E2 type filters IP 54 for -E5 type filters
Cooling	Forced air
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to + 40 °C fully operational +40 °C to + 55 °C de-rated operation** –25 °C to + 80 °C transport and storage
Flammability corresponding to	UL 94 V-2 or better
Design corresponding to	UL 508c, EN61558-2-20, CE (LVD 2006/95/EC)
SCCR***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers. SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{(55°C - T_{amb})/15°C}$

*** External UL-rated fuses required

c UL us LISTED RoHS CE

Filter selection table (-E2)

Filter*	Rated load power** @ 400 VAC/50 Hz [kW]	Rated load power** @ 500 VAC/50 Hz [kW]	Typ. power loss @ rated load [W]	Weight choke module [kg]	Weight total [kg]
FN 341x-380-99-E2	200	250	1040	120	241
FN 341x-470-99-E2	250	315	1370	135	265
FN 341x-580-99-E2	315	355	1540	160	292
FN 341x-650-99-E2	355	400	1550	215	373
FN 341x-710-99-E2	400	450	1680	250	410

* To compile a part number, please replace the X with 0 for diode or 1 for SCR rectifiers.

** Power rating for motor drives with dc-link chokes. If no Ldc is available, load power of the filter has to be de-rated to 70 % of the specified value above. In this case, the THID will be between 10–15 %.

Filter selection table (-E5)

Filter*	Rated load power* @ 400 VAC/50 Hz [kW]	Rated load power* @ 500 VAC/50 Hz [kW]	Typ. power loss @ rated load [W]	Weight choke module [kg]	Weight total [kg]
FN 341x-380-99-E5	200	250	1040	120	244
FN 341x-470-99-E5	250	315	1370	135	268
FN 341x-580-99-E5	315	355	1540	160	295
FN 341x-650-99-E5	355	400	1550	215	376
FN 341x-710-99-E5	400	450	1680	250	413

* To compile a part number, please replace the X with 0 for diode or 1 for SCR rectifiers.

** Power rating for motor drives with dc-link chokes. If no Ldc is available, load power of the filter has to be de-rated to 70 % of the specified value above. In this case, the THID will be between 10–15 %.

High power line enclosed 60 Hz
FN 3412 ecosine for diode rectifiers
FN 3413 ecosine for SCR rectifiers

Technical specifications

Nominal operating voltage	3 × 380 to 480 VAC
Operating frequency	60 Hz +/– 1 Hz
Total harmonic current distortion THID*	~5 % @ rated power with Ldc < 15 % @ de-rated power without Ldc
Total demand distortion TDD	According to IEEE-519
Voltage tolerance range	3 × 342 to 528 VAC
Nominal motor drive input power rating	300 to 500 HP
Efficiency	≥ 99 % @ nominal line voltage and power
High potential test voltage	P → E 2500VAC (2 sec)
Protection category	IP 23 for -E2 type filters IP 54 for -E5 type filters
Cooling	Forced air
Overload capability	1.6 × rated current for 1 minute, once per hour
Ambient temperature range	–25 °C to +40 °C fully operational +40 °C to +60 °C de-rated operation** –25 °C to +85 °C transport and storage
Flammability corresponding to	UL 94 V-2 or better
Design corresponding to	UL 508c, EN61558-2-20, CE (LVD 2006/95/EC)
SCCR***	100 kA
Earthing System	TN, TT, IT

* System requirements: THVD < 2 %, line voltage unbalance < 1 %
Note: performance specifications in this brochure refer to six-pulse diode rectifiers. SCR rectifier front-end will produce different results, depending upon the firing angle of the thyristors.

** $I_{derated} = I_{nominal} * \sqrt{(55\,°C - T_{amb})/15\,°C}$

*** External UL-rated fuses required

c UL us LISTED RoHS CE

Filter selection table (-E2)

Filter*	Rated load power** @ 460 VAC/60 Hz [HP]	Typ. power loss @ rated load [W]	Weight choke module [kg]	Weight total [kg]
FN 341x-380-99-E2	300	1090	120	236
FN 341x-440-99-E2	350	1400	135	263
FN 341x-490-99-E2	400	1480	150	275
FN 341x-540-99-E2	450	1500	195	343
FN 341x-590-99-E2	500	1520	235	385

* To compile a part number, please replace the X with 2 for diode or 3 for SCR rectifiers.

** Power rating for motor drives with dc-link chokes. If no Ldc is available, load power of the filter has to be de-rated to 70 % of the specified value above. In this case, the THID will be between 10–15 %.

Filter selection table (-E5)

Filter*	Rated load power** @ 460 VAC/60 Hz [HP]	Typ. power loss @ rated load [W]	Weight choke module [kg]	Weight total [kg]
FN 341x-380-99-E5	300	1090	120	239
FN 341x-440-99-E5	350	1400	135	266
FN 341x-490-99-E5	400	1480	150	278
FN 341x-540-99-E5	450	1500	195	346
FN 341x-590-99-E5	500	1520	235	388

* To compile a part number, please replace the X with 2 for diode or 3 for SCR rectifiers.

** Power rating for motor drives with dc-link chokes. If no Ldc is available, load power of the filter has to be de-rated to 70 % of the specified value above. In this case, the THID will be between 10–15 %.

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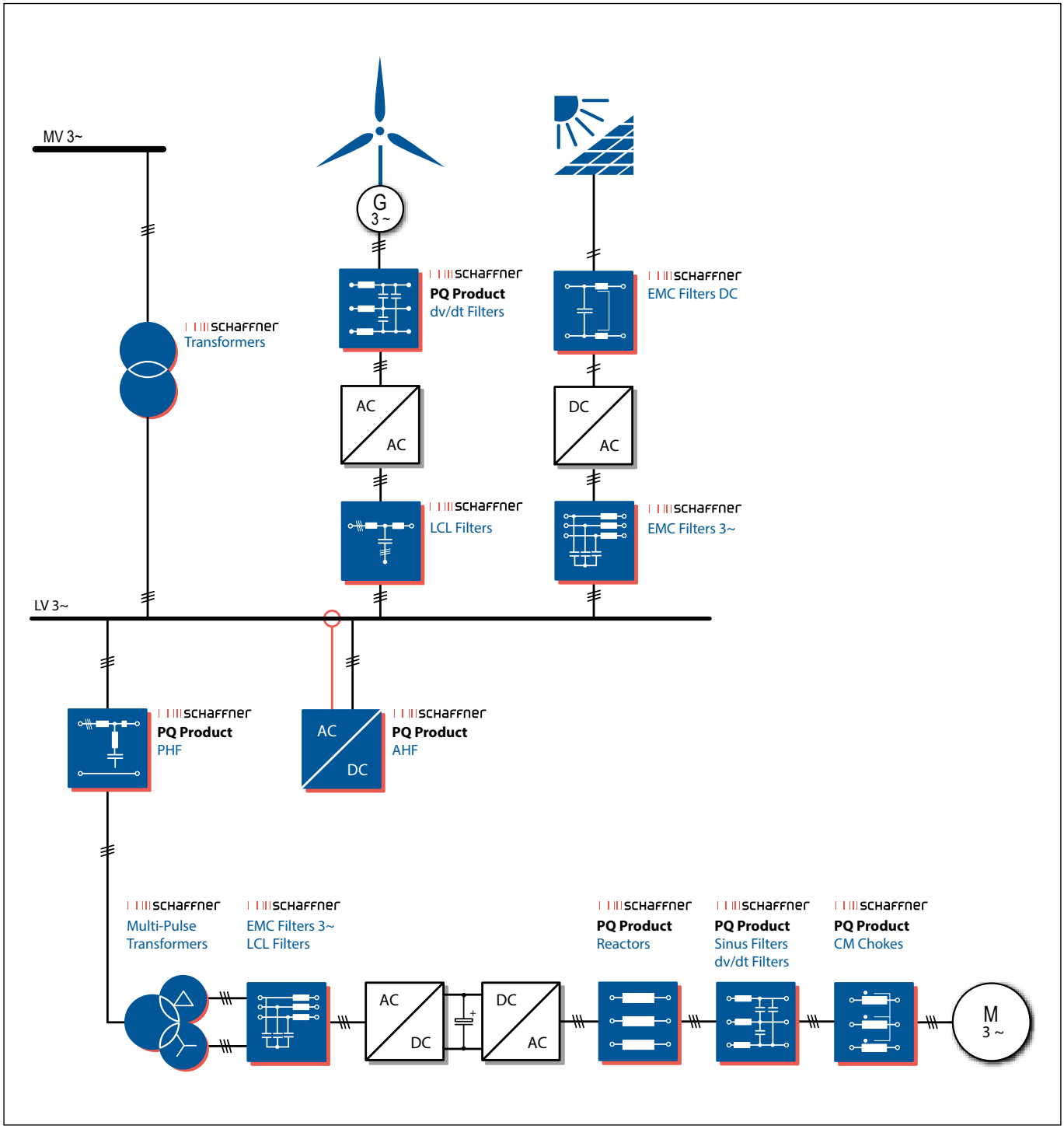
Variable-Speed-Drive Power Train, Wind and Photovoltaic Installations



Schaffner – more than just filters. Schaffner ecosine standard filters are available for different supply networks throughout the world. They are UL listed, CE marked, and fulfill the requirements of the low voltage directive. A broad selection of power, current, voltage and frequency ratings leaves the choice of filter up to the user. However, there are always occasions where different electric or mechanical requirements exist, or where more than just products are needed for the job at hand.

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Please contact your local Schaffner partner for comprehensive support. More information can also be obtained from the Schaffner ecosine user manual.

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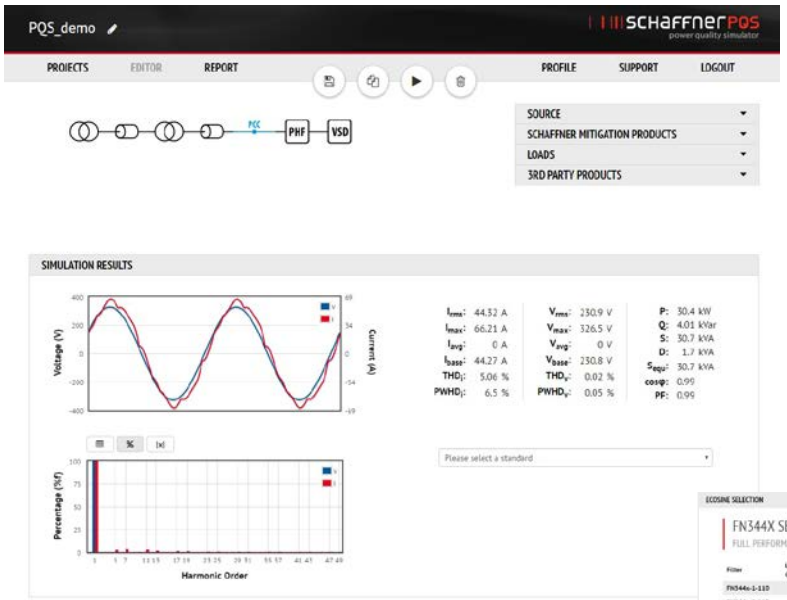
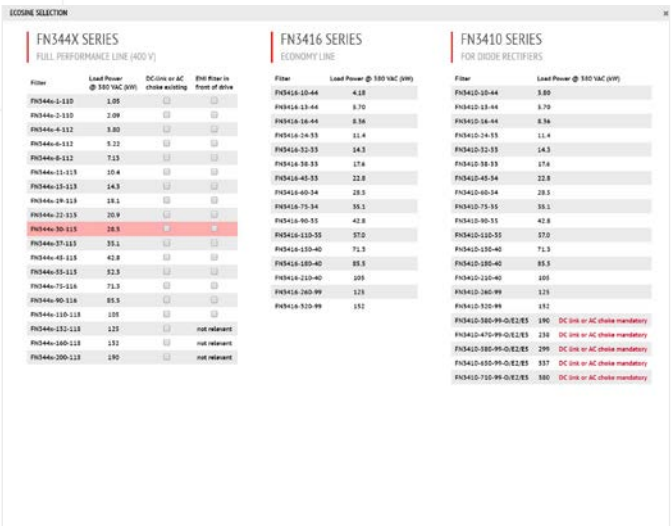
- Generator model included
- Customer specific AC line chokes functionality
- Schaffner 18-pulse autotransformer – «Mitigator» included

http://pqs.schaffner.com/



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