Heating, Ventilation,
Air Conditioning

Technology for green buildings
Ensures the reliability of HVAC systems

SCHAFFNER

energy efficiency and reliability

schaffner group

Schaffner is the international leader in the fields of electromagnetic compatibility and power quality, supplying components that support the efficient and reliable use of electric energy. Customers benefit from the technological know-how of the Schaffner Group in the development, manufacturing and marketing of high-performance products that offer optimized and fault-free operation and compliance with all major quality and performance standards. With its products and services, the Schaffner Group plays a key role in promoting technologies that support renewable energies, ensures the reliable functioning of electronic equipment and systems and meets the requirements for greater energy efficiency.

A global one-stop shop

EMC filters

- PCB filters
- IEC inlet filters
- Single-phase filters
- Three-phase filters
- Three-phase + neutral line filters
- Open frame filters

RFI suppression chokes

Feedthrough filters and capacitors

Automotive components

Customized solutions

Power Quality

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

Customized solutions

Global warming call for energy efficiency

- **Antarctic ice shelf collapse triggered by hotter summers!**
- **Large fires around the Mediterranean!**
- **Water shortage in the near future!**

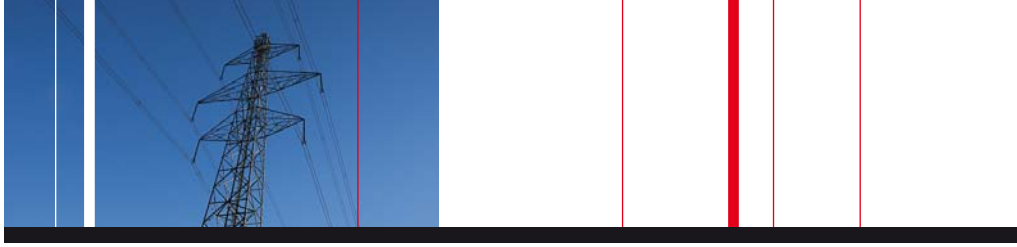
Such headlines in newspapers point to the effects of global warming. Climate change is one of the most important challenges in our global world. The abrupt changes between very cold and extremely hot increase the energy demand for heating and air conditioning in our buildings. Increasing energy efficiency is one way of dealing with this situation.

The EuP directive. The energy-using products (EuP) directive (2005/32/EC) allows the European commission to develop measures for reducing the eco-impact of products. Products that comply with these measures may have the CE label attached, those that do not could ultimately be banned from being traded within the European Community.

ENERGY STAR is a joint program of the U.S. Environment Protection Agency and the U.S. Department of Energy, helping to save money and protect the environment by employing energy efficient products and practices. Having awarded the ENERGY STAR means that the product meets strict energy efficiency guidelines. ENERGY STAR labeled central air conditioners have a higher seasonal efficiency rating (SEER) than standard models, they are about 14% more efficient.

East Asian countries are faced with increasing energy demands and are therefore compelled to improve energy efficiency. Several energy saving programs are in progress within the Asia-Pacific Economic Cooperation (APEC).

Energy costs. The rapid raise of energy costs force us to look for new efficient technologies. Improving the efficiency of their energy-consuming systems is one of the important tasks of facility managers. Manufacturers must respond by finding ways to squeeze more out of their heating, ventilation and air conditioning (HVAC) systems.



Power electronics in today's buildings

Today's buildings like offices, hotels, warehouses, and hospitals use hundreds of pumps and fans to control the heat, cool the air, and pump fresh water.

Fans
Supply and extract ventilation fans
Cooling tower fans
Condenser fans
Boiler fans
Car park ventilation fans
Stairway ventilation

Pumps
Chilling
Heating
Booster pump
Pressurization set

1 Cooling tower
2 Stairway ventilation
3 Supply and extract ventilation
4 Chilling and heating
5 Water pressurization

Advanced control features and high reliability of electronic systems are necessary for an energy efficient building. Variable speed drives with high efficiency motors provide an energy saving potential of 40%. That is why the demand for power electronic devices like AC motor drives increases for application in residential buildings as well as in office buildings, hotels, and warehouses. HVAC products must fulfill minimum requirements in order to comply with the European regulations regarding the CE mark. All electronic equipment must work together on the same power supply without any disturbance from line voltage interferences, therefore certain product standards must be considered with regard to the electromagnetic compatibility (EMC).

EN 61000-6-3 Emissions	**Generic EMC standard for residential, commercial and light industries**
EN 61000-6-1 Immunity	**Generic EMC standard for residential, commercial and light industries**
EN 55011	**For industrial, scientific and medical appliances**
EN 61800-3	**Product standard for power drive systems (PDS)**
EN 12015	**Product standard for lifts, escalators and moving walks**
FCC	**Part 15 of the Federal Communications Commission (FCC) rules and regulations covers unlicensed equipment that emits radio frequency energy**

The electric equipment connected to public power networks must also comply with the standards for harmonic limits to prevent the additional losses caused by harmonics in power distribution systems.

EN 61000-3-2	**Limits for harmonic current emissions**
EN 61000-3-12	**Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16A and ≤75A per phase**
EN 50160	**Voltage characteristics of electricity supplied by public distribution systems**
IEEE 519	**IEEE recommended practices and requirements for harmonic control in electrical power systems**




Schaffner EMC and Power Quality support

Electromagnetic compatibility. Building automation becomes more complex with using data processing for managing low voltage signal sensors and sensitive data lines. To achieve the reduction of the energy consumption, power electronic devices with fast switching semiconductors are increasingly used in building technology. That is a challenge for the electromagnetic compatibility.

The system integrators or responsible facility managers must be aware of the electromagnetic interferences (EMI) and voltage quality problems due to high harmonics in their building installations. The installers are responsible for installing only equipment that guarantees the full functionality in its environment. The manufactures have to guarantee that their products fulfill the related standards. Electromagnetic compatibility is a part of the reliability and quality of electronic equipment and of electric installations.

Schaffner, with its EMC and Power Quality components, supports solutions for efficient and reliable use of advanced HVAC equipment. Schaffner has more than 40 years experience in tackling interference and compliance problems associated with many different power electronic devices used in air conditioners and in fan and pump applications, particularly in the use of electronics for speed control and AC motor drives. And we are proud to support industry leaders in Europe, North America and Asia/Pacific in developing highly reliable and compliant variable speed drives.

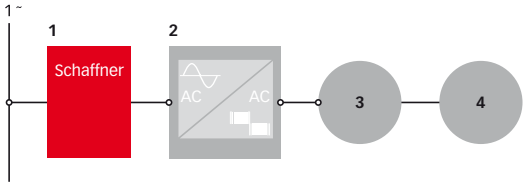
Benefits from engineered products. In addition to providing the broadest selection of off-the-shelf EMC and Power Quality components, Schaffner offers the full range of testing, engineering and custom design capabilities. Often these services are the key to the most cost-effective solution and lead to the best match to system requirements.


Schaffner services. Services including on-site testing, problem analysis, engineering advice, custom design and after-sales service shorten the development time. With support from Schaffner, manufacturers can achieve a faster time to market with their new products.

Always close to the customer. With five manufacturing sites in Europe and Asia as well as sales and application centers in 15 locations around the globe, Schaffner is always close to the customers. Extensive customer service and engineering resources are always available to support our customers worldwide.

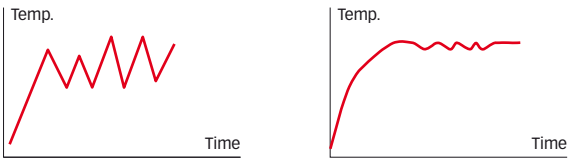
Inverters, a technology for the future

The inverter controls the compressor speed so that the system optimizes the load distribution to deliver the capacity needed to reach and maintain the required temperature. This technology can lower the energy consumption for any cooling or heating application, save money and make a contribution to a cleaner environment.



1 Schaffner EMC/EMI filter
2 Inverter
3 DC or AC motor
4 Compressor

Air conditioners using inverter technology. Advanced air-conditioning systems use inverter technology to provide optimal power control and efficient operation. An inverter regulates the voltage, current and frequency of the motor. Inverter air conditioners control the revolution of the compressor and hence the power consumption. They provide much finer temperature control and use less electricity than conventional systems, which are controlled by switching them on off.

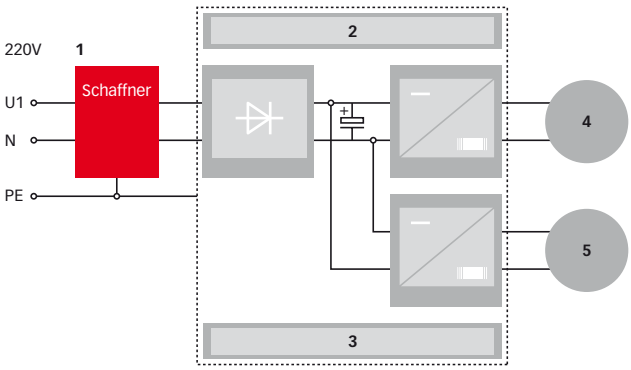


VRF technology. Variable refrigerant flow (VRF), also known as variable refrigerant volume (VRV), is a technology that consists of a number of air handling units connected to a modular external condensing unit. The refrigerant flow is varied using either an inverter controlled variable speed compressor or multiple compressors of varying capacity in response to changes in the cooling or heating requirement within the air conditioned space.

Room air conditioners

For single room air conditioning, mainly window type air conditioners are in use. The system is split into one indoor unit with a ventilator and one outdoor unit with the compressor. Multisystems with several indoor units and one outdoor unit are often used in residential houses or small offices. Often the conditioning systems can also be used as a heat pump in dual operation, for heating and cooling. Free-standing mobile air conditioners have the compressor and ventilation parts in one casing and use a duct to blow the warm air outside.

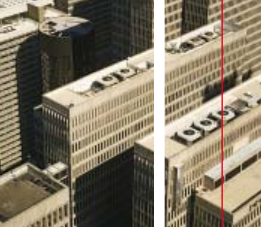
High performance DC inverters. A highly efficient DC motor can be used to operate the compressor with less power consumption than conventional AC motors.
In addition, voltage and current to the motor are controlled by the DC inverter technology to provide efficient operation and reduced vibration. Hybrid technology uses two different pulse mode patterns. The pulse amplitude modulation (PAM) operates the DC compressor at maximum power during the start-up phase to offer almost instant heating or cooling. When the desired air temperature is reached, the pulse width modulation (PWM) automatically adjusts the compressor's frequency to exactly meet the cooling or heating requirements of the room.

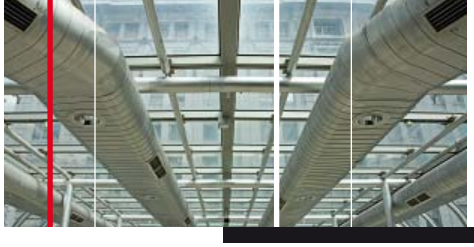


1 Schaffner EMC/EMI filter
2 DC inverter
3 Control board
4 Compressor
5 Ventilator

Schaffner products for room air conditioners

	Application and features	Products
Single-phase/three-phase EMC/EMI filters 	**EMI filters should be used in air conditioners to fulfill the CE requirements.** ■ Reduction of EMI noise ■ Fulfillment of required EMC standard ■ Improvement of reliability	**Custom designed EMC/EMI filters.** ■ Single-phase or three-phase ■ R&D experience ■ Compact mechanical design ■ Plastic moulding possibilities ■ International approvals on request
EMC/EMI suppression chokes 	**Current-compensated chokes should be used in air conditioners to limit electromagnetic interferences.** ■ Suppression of high interference levels ■ Fulfillment of required EMC standard on circuit board	**RN, EV and EH standard chokes.** ■ Voltage: 250VAC ■ Current: 0.3 to 10A ■ Approvals: UL, VDE
PCB filters 	**EMC/EMI PCB filters are excellent to be used on electronic boards.** ■ Very compact ■ Suppression of interference levels on PCB ■ Fulfillment of required EMC standard on circuit board	**FN 402, FN 405 and FN 406 standard filters.** ■ Voltage: 250VAC ■ Current: 0.5 to 10A ■ Very compact ■ Approvals: ENEC, UL, CSA
Single-phase EMC/EMI filters 	**EMC/EMI chassis filters are a compact solution in single-phase power line input wiring.** ■ Screened housing ■ High differential-mode performance ■ Economic solution	**FN 2010 , FN 2020 and FN 2030 standard filters.** ■ Voltage: 250VAC ■ Current: 1 to 60A ■ Very compact ■ Low leakage current ■ Approvals: ENEC, UL, CSA





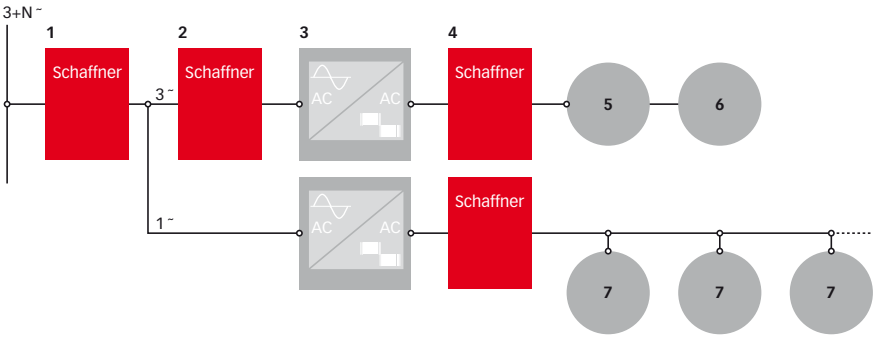
Central air conditioners

In large buildings like offices, warehouses, and hospitals, mainly central air conditioning systems are used. High power compressors for chillers or heat pumps are necessary and also a condenser with several ventilators to blow the outside air through the condenser rips. Speed-controlled compressor technology provides greater energy efficiency and is more ecological and reliable. The ventilating fans automatically regulate the airflow depending on the temperature of the outside air. Speed-controlled ventilators lower the noise level dramatically, particularly at night and in mid-season. Heat pumps and chillers of this new generation are more compact and quieter than ever before and guarantee increased comfort in the tertiary sector.

AC motor drives are used to adjust the speed for motors in ventilators and compressors. AC motor drives are also called variable speed drives (VSD) or adjustable frequency drives (AFD). They use high speed semiconductor switches and pulse width modulation (PWM) techniques to generate fast rise time voltage pulses to reduce the power losses, and they are ultra compact. The high rise time creates immediate electromagnetic interferences on both the line and the motor side wiring. Unfortunately, this creates a number of problems for OEMs and system integrators, from purely functional difficulties to serious motor damage.

For detailed information please read the Schaffner brochure: Total solutions for motor drives.

Schaffner offers a full range of EMC/EMI filters, harmonic filters and motor drive output filters for realizing power drive systems with the required performance.

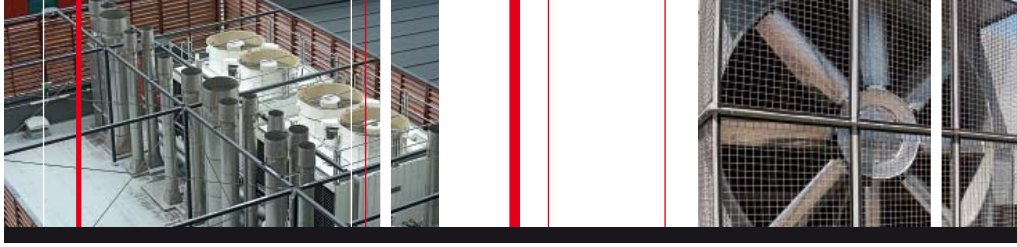


1 Schaffner EMC/EMI filter
2 Schaffner harmonic filter
3 AC motor drive
4 Schaffner LC sine wave filter
5 AC Motor
6 Compressor
7 Ventilator

Schaffner products increase the reliability and efficiency of the whole installation.

Schaffner products for central air conditioners

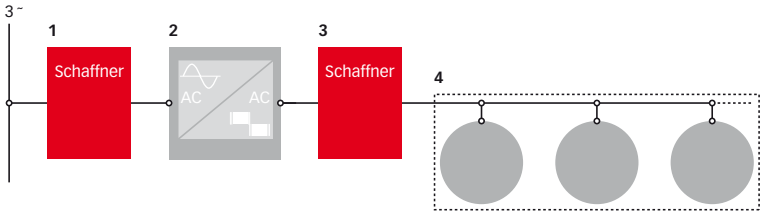
	Application and features	Products
Three-phase EMC/EMI filters 	**Three-phase EMC/EMI filters should be used in central air conditioners to protect nearby systems against electromagnetic malfunction.** ■ Reduction of EMI noise ■ Fulfillment of required EMC standard ■ Improvement of reliability ■ Compact solution	**FN 3270 and FN 3258 standard filters.** ■ Voltage: 3x 520 VAC ■ FN 3270: 10 to 1000A ■ FN 3258: 7 to 180A ■ Ambient temp: 50°C ■ Approvals: ENEC, UL, CSA
Three-phase and neutral line EMC/EMI filters 	**For three-phase installations with neutral line.** ■ Reduction of EMI noise additional on neutral line ■ Very low leakage current ■ Suitable for installations with a residual-current-operated protective device ■ Compact solution	**FN 3256 and FN 3280 standard filters.** ■ Voltage: 3x 520VAC ■ Current: 8 to 200A (up to 600A in preparation) ■ Ambient temp: 50°C ■ Approvals: ENEC, UL, CSA
Harmonic filters 	**ECOsine™ harmonic filters smooth the power line harmonics of AC motor drives.** ■ Efficient use of power ■ Reduce installation cost ■ Compliance with IEEE 519, EN 61000-3-12	**ECOsine™ FN 3410 and FN 3412 standard filters.** ■ Voltage: Up to 3x 500VAC ■ 50Hz filters: Up to 160kW ■ 60Hz filters: Up to 250HP ■ Higher power range in preparation ■ THID: <5% ■ Approvals: CE, UL
LC sine wave filters 	**LC sine wave filters should be used to save the motor against voltage overshoot caused by long motor cable length.** ■ Smoothing of motor drive output voltage ■ Efficient motor protection ■ Reduce acoustic noise ■ Protect from bearing damage ■ Suitable for multi-motor (fan) application	**FN 5010 standard filters.** ■ Voltage: 3x 400VAC ■ 0.75 to 355kW ■ Ripple voltage <5% ■ Up to 400m motor cable length ■ 1.5 times overload



Fans, ventilators and pumps

Fans and ventilators.

Ventilators are used in cooling towers, heat exchangers, refrigerated display cabinets, air handling units, and air conditioners. Different types of axial fans like ducted axial flow or propeller fans, centrifugal (radial) fans with belt or direct drive were designed to suit different applications. Often a constant air flow is not required, in such cases the speed can be controlled by inverter technology to reduce power consumption as much as possible and to achieve quieter operation. Depending on the power, the inverter can be integrated or a separate standard AC motor drive can be used. The ventilator manufactures often require output filtering in combination with AC motor drives. Especially with long motor cabling and multi-motor installations an LC sine wave filter is necessary, due to the pulse pattern operation, to protect the motor windings.



1 Schaffner EMC/EMI filter
2 Variable speed drive
3 Schaffner LC sine wave filter
4 Multiple motors

Advanced ventilators with integrated electronics. The latest generation of ventilators offers integrated electronics for controlling the motor speed. New technologies for AC or DC motors are designed using power semiconductors to adjust the air flow. The EMC requirements must be fulfilled with these designs. Current-compensated chokes or custom filters with special mechanical design provide cost-effective solutions.

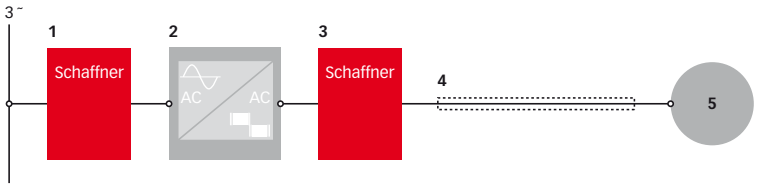
Variable speed drives for cooling towers. Installing variable speed drives in cooling towers allows the regulation of the ventilator speed for stable operating conditions and thus the optimization of the refrigeration efficiency. Often a single AC motor drive runs sets of ventilators, with long motor cables of up to 200 meters in parallel formation. Using a sine wave filter between the motor drive and the motor provides smooth voltage and overcomes the inherent problems of capacitance in long parallel cable runs.

Pumps.

Thirty percent of the electric motors used worldwide drive pumps for transporting fluids. The main areas of use as booster pump or as boiler feed pump are in water supply installations, industrial circulation systems, in process technology, cooling water systems, fire extinguishers, and in washing and sprinkler installations. Using variable speed drives can save up to 20% energy, because pump systems are always run at their optimal working point.

Integrated motor inverters. Low power applications like circulation pumps in residential housing provide the required water pressure by controlling the speed of the pump using integrated inverters. The electronic design has to comply with EMC standards. EMI suppression components limit interferences if they are inserted in the DC link or power lines.

External AC motor drives. External AC motor drives are in operation with the pump system to save energy and provide optimal fluid pressure. Most pump suppliers state in their product documentation special requirements for the operation of the pump with frequency converters. To avoid overloading the motor coil to the extent that it is damaged and to avoid increasing acoustic noise levels, an LC sine wave filter should be installed between the frequency converter and the motor. Particularly when using long motor cables, a sine wave filter is necessary to protect the motor coil against high over voltage spikes.



1 Schaffner EMC/EMI filter
2 Variable speed drive
3 Schaffner LC sine wave filter
4 Long motor cable
5 Motor

Schaffner products for fans, ventilators and pumps

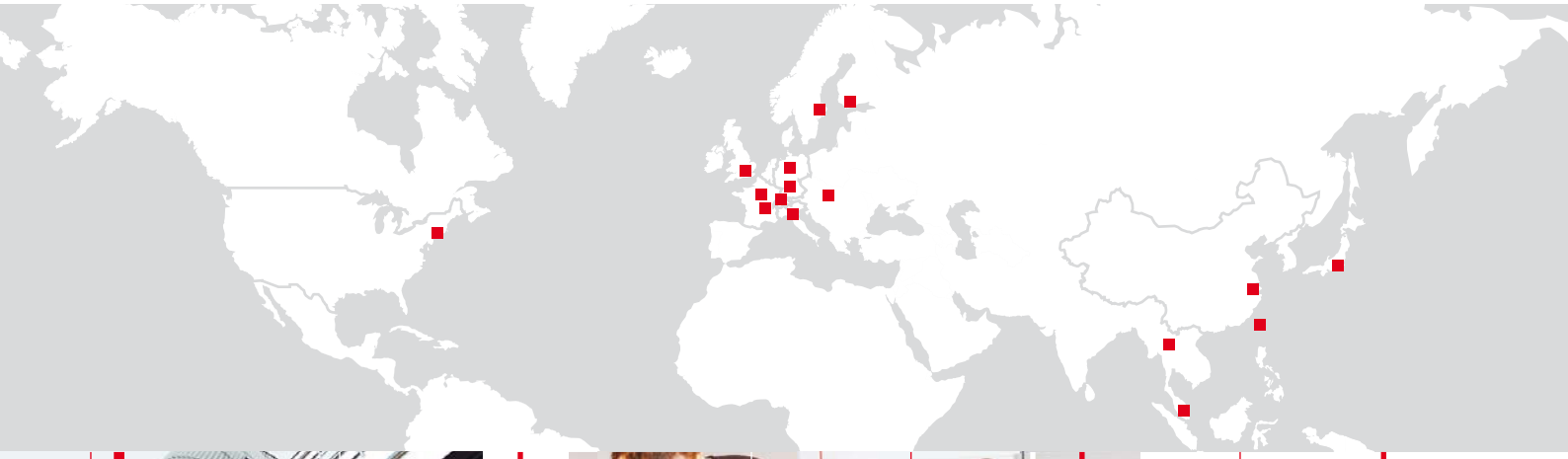
	Application and features	Products
Single-phase/three-phase EMC/EMI filters 	**EMC/EMI filters should be used in devices with integrated electronics to fulfill the CE requirements.** ■ Reduction of EMI noise ■ Fulfillment of required EMC standard ■ Improvement of reliability	**Custom designed EMC/EMI filters.** ■ Single-phase or three-phase ■ R&D experience ■ Compact mechanical design ■ Plastic moulding possibilities ■ International approvals on request
EMC/EMI suppression chokes 	**Current-compensated chokes should be used in devices with integrated electronic to limit electromagnetic noises.** ■ Suppression of high interference levels ■ Fulfillment of required EMC standard on circuit board	**RN standard chokes.** ■ Voltage: 250VAC ■ Current: 0.3 to 10A ■ Approvals: VDE, UL
Three-phase EMC/EMI filters 	**For three-phase installations with variable speed drive (VSD)/adjustable frequency drives (AFD).** ■ Reduction of EMI noise ■ Fulfillment of required EMC standard ■ Improvement of reliability ■ Compact solution	**FN 3270 and FN 3258 standard filters.** ■ Voltage: 3x 520VAC ■ FN 3270: 10 to 1000A ■ FN 3258: 7 to 180A ■ Ambient temp: 50°C ■ Approvals: ENEC, UL, CSA
LC sine wave filters 	**LC sine wave filters should be used to protect the motor against voltage overshoot caused by long motor cable length.** ■ Smoothing of motor drive output voltage ■ Efficient motor protection ■ Reducing acoustic noise ■ Protecting from bearing damage ■ Suitable for multi motor (fan) application	**FN 5010 standard filters.** ■ Voltage: 3x 400VAC ■ 0.75 to 355kW ■ Ripple voltage <5% ■ Up to 400m motor cable length ■ 1.5 times overload

Worldwide presence, global experience, unique proximity to customers

With its EMC and power quality components and modules, plus a wide range of services for equipment manufacturers and systems integrators, the Schaffner Group strives for market leadership in all product and service categories. Strong sourcing, manufacturing and logistics, combined with unrivaled products, reliable delivery and a high degree of flexibility, help support and enhance customers' competitiveness.

With 15 customer service and application centers around the world, Schaffner is always close to the customer. Our own manufacturing plants in Switzerland, Germany, Hungary, Thailand and China allow us to build both highly specialized parts as well as high volume commodities. Being the largest EMC/EMI filter manufacturer in the world, our global procurement network ensures the lowest raw material costs in times of soaring copper and steel prices, savings that we pass on to our customers.

Please feel free to contact your local Schaffner partner any time to discuss how we can support you in dealing with your individual challenges in the dynamic HVAC marketplace.



energy efficiency and reliability

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