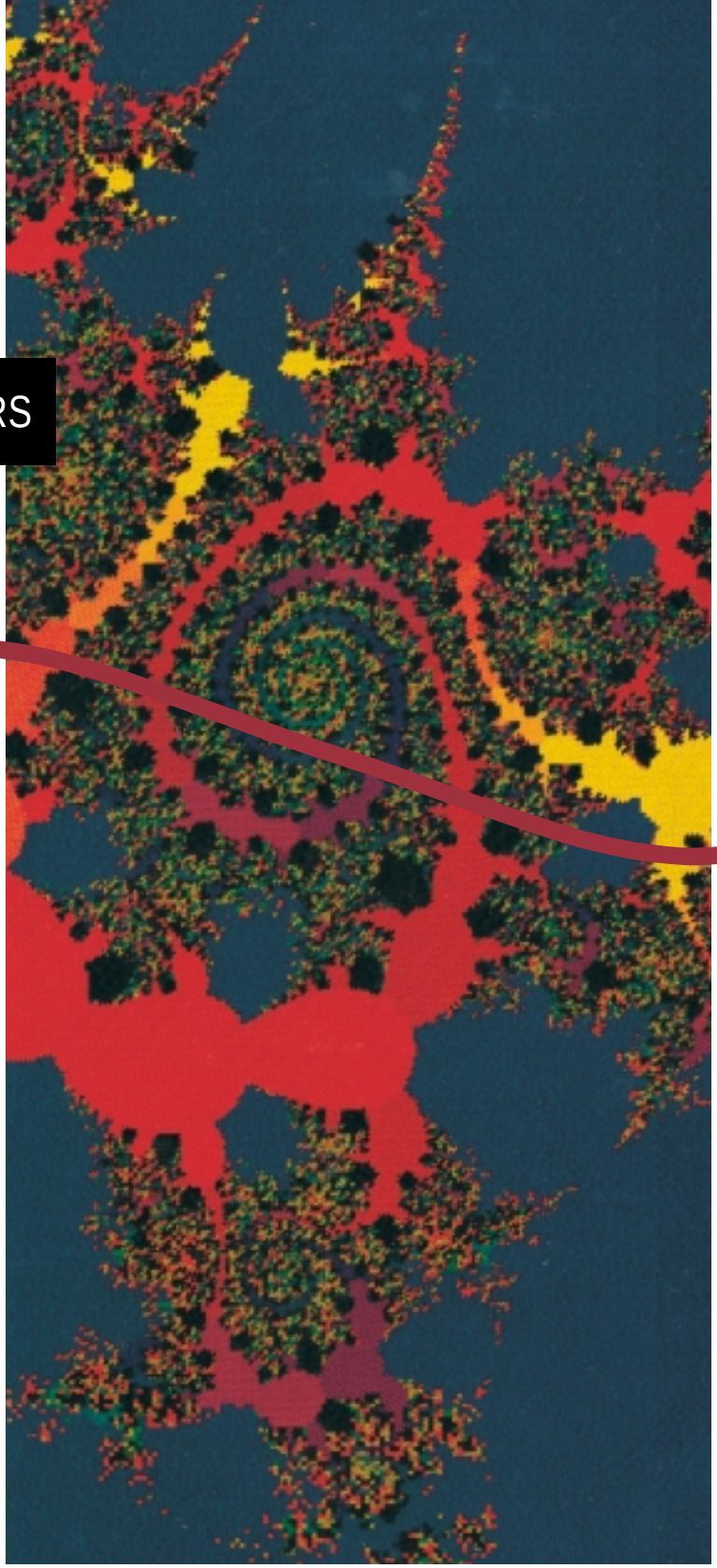
SINGLE PHASE FILTERS

for chassis- and PCB-mounting



SCHAFFNER

Your number one name for EMC

Single-phase filters for chassis- and PCB-mounting

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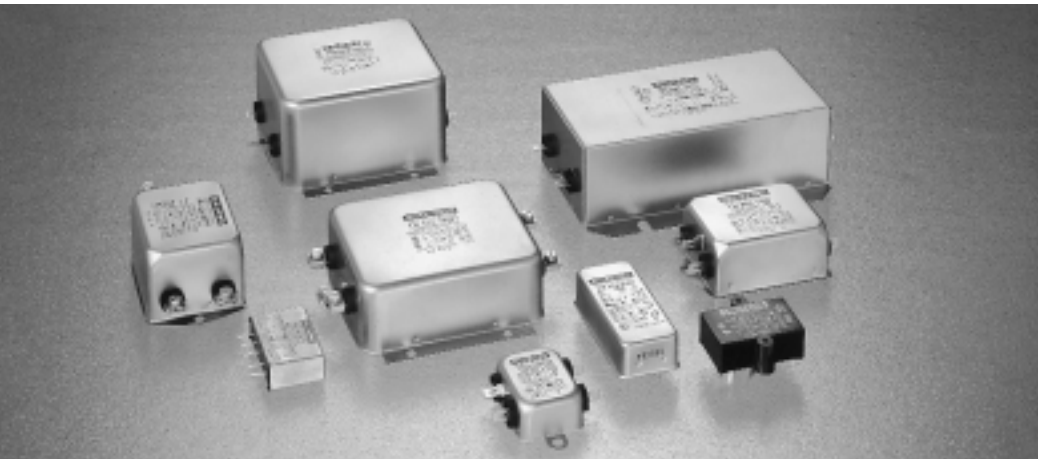

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Powerline filters
- a vital element of today's electronic designs

In today's world, more electrical energy is being generated at increasing levels of power, and more and more low power energy is being used for the transmission and processing of data. The result is vastly increased 'electronic smog' or noise. This noise can disrupt, and even destroy, electronic devices: an unacceptable situation, and shortly an illegal one in certain markets. ***The electronics industry must strive to protect equipment against such 'noise'.***

Noise, or interference, travels two ways. Switches - such as semiconductors - can emit interference, and be susceptible to it. The same is true for data processing equipment. The most common method of protection is the use of powerline filters coupled with screening or gasketting materials.

The mains, or powerline, filter is the key element in eliminating mains-borne interference. This filter not only has to meet the requirements of electro-magnetic compatibility (EMC), but safety aspects as well. For some applications, the filter also has to prevent the radiation of classified information from the mains line ('Tempest' applications). Other applications require a filter to protect equipment from destructive voltages on the power line, like those caused by lightning or nuclear explosion (NEMP).

Schaffner's breadth of product range, the high attenuation characteristics of our filters under various load conditions, our dedication to quality - and above all our organization's unique experience in filter design and manufacturing - spanning more than 25 years - is your guarantee of excellence.

Total commitment to quality

Schaffner's aim is to provide our customers with fault-free products. To achieve this, 100% of our products undergo rigorous final testing. To ensure high quality we have instituted a system which meets all the stringent requirements of the ISO 9001 / EN 29001. The phrase 'Quality Assurance' is not just a slogan for us; it is applied in practice, and the Schaffner brand truly stands for reliability and quality.

Schaffner's single-phase filter range provides an off-the-shelf solution for the vast majority of electronic equipment noise problems. Our standard product range is particularly wide, embracing both chassis-mounting and PCB-mounting types, allowing users to select an optimal choice in both performance and cost efficiency terms.

Chassis-mount types

In general, chassis mount filters provide a higher performance solution, in metal cases for optimum connection to earth and good high frequency performance. With the space available for up to three circuit stages for attenuation of noise, users can usually find an option with the performance to provide an off the shelf solution for even the most difficult of EMC problems (to retrofit an EMC solution to an existing design for instance). Schaffner offers chassis-mounting versions for a very wide range of power levels - from less than 1A to 55A - covering a majority of higher power office equipment and low to medium power industrial applications.

At the lower power levels, users have the additional choice of opting for a PCB-mounting version (see following section), or an IEC inlet type which typically handle currents of up to 6-10A and are ideal for small office and industrial equipment. The associated IEC 950 specification is a key safety requirement for computer and office/business equipment, developed to provide a consistent world standard, which in turn simplifies the certification process. The standard specifies requirements intended to ensure safety against electrical and fire hazards for the operator and layman who may come into contact with the equipment, and where specifically stated, for service personnel. IEC 950-compliance is required for products shipped in Europe, and has either already become - or is in the process of becoming - a de-facto standard in all other world markets. It has been adopted by European countries under EN60950, and by the USA under UL 1950. Two filter families in this catalogue are available with IEC inlets, one of which is compliant with IEC 950 (request separate IEC inlet/IEC 950 catalogue for full details of Schaffner's range).

PCB-mount types

PCB filters are designed for compactness and ease of assembly, and avoid the need for extra mounting components and installation operations necessary with chassis styles, but at the expense of finite available space for filtering circuitry. Consequently, they typically offer just a single stage of attenuation, with limitations on the maximum power handling capability (up to 6.5A current ratings). This typically makes these filters ideal for those companies who have planned for EMC protection throughout the equipment design process, and are completing equipment protection with these low cost components. When designing these components in, care needs to be taken to provide a low impedance connection to earth, and to minimize the potential for any noise


SQS

Swiss Association for Quality and Management Systems

Schaffner Electronics Ltd.
CH-4542 Luterbach
Whole company / Electromagnetic compatibility

the SQS Certificate ISO, 9001

radiation from the mains inlet connection.

Time to market

The key reasons for choosing ready-made filters are convenience, compactness and cost. Although you can design your own mains inlet and filter using discrete components, or have a custom solution designed and assembled for you, the timescales involved in getting safety approvals will often rule this approach out, especially for higher volume products such as photocopiers which necessitate very fast design cycles.

Ready-made chassis- and PCB-mount filters provide a convenient single-source solution, with the additional benefits of custom-engineered housings for compactness. The following guide to Schaffner's single-phase products - with brief details on key parameters - will help you to identify one or more filters for closer review of specifications (there are some 170 options available in the total range). From this initial selection, a review of the circuit diagram and detailed specifications in the following pages will tell you if the module is suitable for your application, allowing you to choose a unit (or units) for trial.

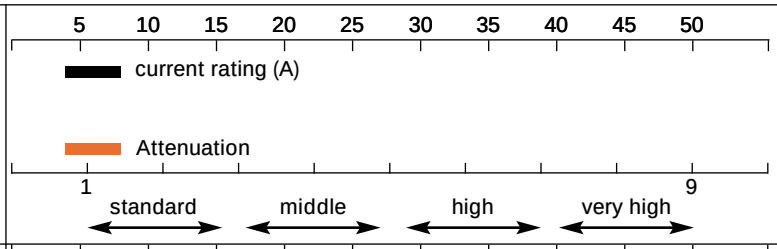
Schaffner is one of the world's leading suppliers of EMC equipment, and our extensive experience allows us to offer one of the widest EMC filtering ranges available - spanning both general-purpose and specialist needs like TEMPEST. This breadth of range greatly assists designers, allowing optimum choices to be made, whether the need is for maximum performance or lowest cost.

Our worldwide organization - with its numerous application engineering teams - will gladly help your engineers select and trial suitable power line filters, and provides an efficient support structure to assist multi-national organizations with dispersed design and manufacturing facilities.

As a review of this catalogue will show you, Schaffner designs power line filters using high grade components in order to optimize reliability. And we construct modules under the control of the most advanced quality system. Whichever power line filter you choose, you can rely on Schaffner's quality.

Schaffner's chassis- and PCB-mounting filter range

Rapid selection Using the current rating and attenuation performance indicators, together with the major features shown on the right, this table allows you to quickly identify a 'short list' of filter families which are potentially suitable for your application, for subsequent detailed investigation using the technical specifications on the following pages.



Filter family	with earth line choke	with overvoltage protection	2 stage	3 stage	with IEC inlet	for SMPS	for medical equipment	NEMP, TEMPEST	for printed-circuit mounting	for motor drives
FN 22									✓	
FN 250, 350						✓				✓
FN 332		✓					✓			
FN 343	✓		✓							
FN 346					✓	✓				
FN 352Z		✓		✓		✓				
FN 401 ...406							✓		✓	
FN 410			✓						✓	
FN 610, 612							✓			
FN 660, 670			✓			✓	✓			✓
FN 680, 685			✓			✓				✓
FN 700Z		✓		✓	✓	✓		✓		
FN 9675/76						✓	✓			✓

Understanding EMC standards and filter specifications

This section introduces the standards and regulations associated with EMC protection, and provides detailed information to help you understand filter design and specifications. It will help you identify for your application the right specifications and type of filter.

Interference protection standards

Until recently most countries have had their own regulations and standards governing electro-magnetic interference (EMI) or radio frequency interference (RFI). However, on the 1 January 1992 the European Directive 89/336/EMC on electro-magnetic compatibility (EMC) came into force. This directive brings a common approach to EMC to every member state of the European Union. Common standards will be used throughout Europe to ensure that technical trade barriers are removed. As well as controlling EMI emissions from equipment, the directive also calls for equipment to be immune to external electro-magnetic disturbances.

The task of elaborating the standards to be used has been given to the European organisation called CENELEC. The member countries of CENELEC are:

Austria	Italy
Belgium	Luxembourg
Denmark	Netherlands
Finland	Norway
France	Portugal
Germany	Spain
Greece	Sweden
Iceland	Switzerland
Ireland	United Kingdom

Most of the European standards will be based upon international standards from CISPR and IEC. The numbering system used in the European standards is:

EN *xx yyy*

EN = European Norm. *xx* = 50 denotes that the standard is a standard of CENELEC origin; *xx* = 55 means the standard is based on a CISPR standard *yyy*; *xx* = 60 means the standard is based on an IEC standard *yyy*.

Once the European standard is complete the individual members of the European Union will produce national harmonised standards and will usually give their harmonised standard a national number, *eg* the British harmonised standard of EN 55011 is BS EN 55011.

Types of standards:

Basic standards describe the general and fundamental rules for meeting the requirements. Terminology, phenomena, compatibility levels, measurement, test techniques and classification of EM environments are so described within.

Generic standards refer to specific environments. They set minimal EMI levels which equipment in these environments must meet. Where no product specific standards exist then the generic standards are to be used. Generic standards describe household and industrial EMI environments.

Products standards are for specific products or product groups. These standards are coordinated with the generic standards.

In countries outside Europe other standards will be used, such as the FCC in the USA. Table 1 shows the main European standards.

Permissible noise limits

The various standards set down limits for conducted EMI emissions. These limits are measured in voltage and given in dBμV where 0dB is 1μV. The interference is measured using measurement equipment which has defined bandwidths and receivers. The two receivers used are a quasi-peak detector, and an average detector.

To ensure repeatability of the measurements, the impedance of the mains supply must be constant. The standards calls for a defined artificial mains network - sometimes called a line impedance stabilisation network (LISN) - which gives a defined impedance to the noise and also helps filter any noise on the mains which may affect the measurements.

Figure 1 shows the limits of EN 50081-1 the European generic standard for residential, commercial and light industrial environments, and Figure 2 of EN 50081-2, the European generic standard for the industrial environment.

Above 30MHz, radiated noise interference is measured instead of conducted noise. This takes place on an open field test site using defined antennas.

Product type	**Emissions**			**Immunity**
	Harmonics	**Voltage fluctuations**	**Radio interference**	**All aspects**
Household appliances & portable tools: vacuum cleaners, washing machines, heating, cooking equipment, dimmers	EN60555-2	EN60555-3	EN55014	EN50082-1
Luminaires with discharge lamps	EN60555-2		EN55015	EN50082-1
TV receivers	EN60555-2		EN55013	EN55020
Information Technology Equipment (ITE)	EN60555-2		EN55022	EN55024 all parts
Mains signalling equipment			EN50065-1	EN50082-2
Industrial, scientific and medical eqpt. designed to generate RF energy			EN55011	EN50082-2
Industrial electronic power and control equipment			EN50081-2	EN50082-2
Industrial non-electronic equipment			EN50081-2 (if producing RF interference)	

Table 1. European EMC standards

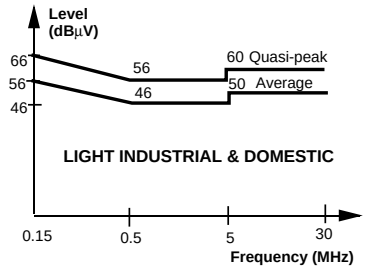


Figure 1. *Permissible interference limits for EN 50081-1*

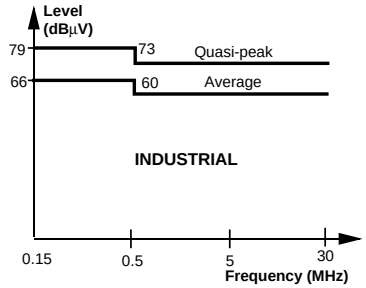


Figure 2. *EN 50081-2 limits*

Interference sources and spectrums

The most common source of conducted EMI is power electronic products such as switched mode power supplies (SMPS), pulse width modulated (PWM) frequency converters or motor drives, and phase angle controllers.

The emissions spectrum typically starts off very large at low frequency and rolls off as frequency increases. The point at which the noise falls below the permitted limits depends on several factors, the most important being the frequency of operation and the rise time of the semiconductor devices.

Interference spectrums generated can be either continuous, as in the case of phase angle controllers, (Figure 3) or discrete which is typical of the SMPS (Figure 4).

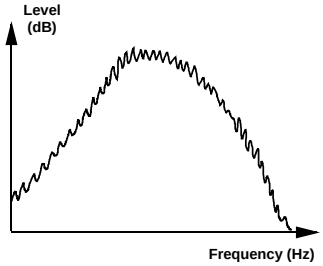


Figure 3. *Continuous spectrum*

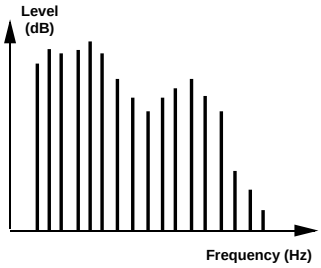


Figure 4. *Discrete spectrum*

Interference propagation

EMI can propagate by two means:

- by radiation - where the energy can be coupled either through magnetic or electric field, or as an electro-magnetic wave between the source and the victim
- by conduction - where the EMI energy will propagate along power supply lines and data cables

Radiated and conducted EMI cannot be thought of as totally separate problems, because noise conducted along a cable may be radiated as the cable acts as an antenna. The radiation will increase as the cable length becomes comparable to the wavelength of the noise. Also, the cable will act as a receiving antenna and pick up radiated interference.

Below around 150MHz, the most efficient radiating devices in a system are usually the power supply and data cables. Proper filtering of these cables will reduce radiation due to the cables as well as conducted interference.

Above around 150MHz, PCB tracks and short internal cables will start to become efficient antennas. To reduce this radiation a PCB should be laid out to reduce track length and loop areas; ground planes should be used if possible. Decoupling of digital ICs is very important and shielding may be necessary.

Interference types

To understand the problems associated with conducted EMI it is first necessary to understand the two modes of conducted noise: differential mode (or symmetrical mode) and common mode (or asymmetrical mode). Differential mode interference creates a voltage between the phases of the system and is independent of earth; the differential mode currents flow along one phase and returns along another phase (Figure 5).

Common mode noise creates a voltage between each phase and the earth. The common mode currents flow from the noise source to the earth (usually via a parasitic capacitance) along the earth path and returns along the phases. (See Figure 6) A power line filter must be designed to attenuate both common mode and differential mode interference.

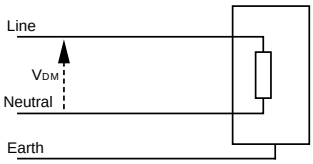


Figure 5. *Differential mode interference* (VDM)

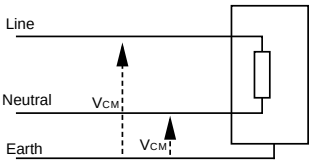


Figure 6. *Common mode interference* (VCM)

Mains filters

Maximum power transfer occurs when source and load impedances are matched. A power line filter is an inductor-capacitor network that aims to cause maximum mismatch between impedances, and therefore reduces the amount of EMI power to be transferred from the noise source onto the power line cable. Figure 7 shows a typical single-phase power line filter.

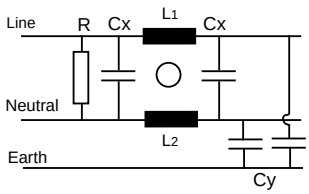


Figure 7. *A typical single-phase power line filter*

The inductors L1 and 2 are usually wound - in a current compensated fashion - on a toroidal core. This winding method allows flux due to differential mode currents and mains currents to cancel each other, while common mode currents will be added together. This gives a large inductance to common mode currents and ensures that the inductor will not be saturated by the large magnetic flux produced by the mains current.

The capacitors placed between the phases, known as 'X' class capacitors must offer a high pulse voltage rating and are used to attenuate differential mode interference. The capacitors between the phase lines and earth, known as 'Y' class capacitors must have a more stringent rating and are used to attenuate common mode interference. The value of the Y capacitor is restricted by the permissible leakage current allowed. The maximum leakage current is governed by standards and regulations and depends upon the type of equipment. The leakage current is given by:

$$I_L = 2 \cdot \pi \cdot U \cdot f \cdot c$$

where I_L is the leakage current; U the voltage across the capacitor; f the frequency of the mains voltage across the capacitor, and c the capacitance.

Mains filters should be mounted as close as possible to power entry so that high frequency interference does not bypass the filter. IEC inlet modules are ideally suited for this task.

To achieve higher attenuation or an increase in the effective working frequency range more complex filters than the one shown in Figure 7 can be made using more common mode or differential mode inductors and capacitors.

Insertion loss

The insertion loss characteristics for each filter shown on the datasheets, are measured in accordance with CISPR 17. Two test conditions are employed: one using 50Ω termination impedances, the other using an input impedance of 0.1Ω and an output impedance of 100Ω (and reverse conditions). Both test methods can be found in section 4.2 of CISPR 17, and in 'CISPR 17 Measurements', a document published by Schaffner and available on request.

In the 50Ω test condition, two sets of insertion loss curves are given. One is common (asymmetrical) mode insertion loss. The other one for differential mode interference.

In general, Schaffner filters perform against common mode interference in the manner shown by the 50Ω insertion loss tests. But in differential mode, the 50Ω is not representative of effective performance. Therefore Schaffner includes the 0.1/100Ω differential mode test to show how a filter will perform in real life situations.

For this 0.1/100Ω test condition, only differential mode insertion loss is given. In this test, mismatched impedances illustrate effective filter performance in a piece of equipment.

Both types of insertion loss testing is carried out without load current. In equipment under load, the inductance - and therefore the insertion loss - may change due to saturation. To allow for this Schaffner measures the inductance variation with current. A typical filter has an inductance variation as shown in Figure 8. CISPR17, and/or the application note 'Everything you wanted to know ...' can provide more detailed information.

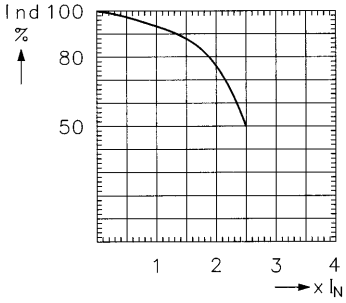


Figure 8. *Typical saturation curve*

General technical data

All technical data are given at 25ºC unless otherwise specified.

Current ratings

The current ratings given for each type is the maximum allowable current authorised by safety agencies at an ambient temperature of 40°C. Current at other temperatures is shown in the derating curve, or can be ascertained by the formula:

$$I = I_N \sqrt{(85 - \theta)/45}$$

Voltage ratings

The maximum rated voltage is 250V at 50/60Hz unless otherwise stated on the individual datasheets. Use of capacitors within Schaffner filters which conform to IEC 384 - 14 permit operation at voltages of 10% above this value.

High voltage testing

The high voltage rating of our filters is devided into two specifications, one for type testing and one for production testing. This is in accordance with guidelines laid down in various IEC recommendations. Type testing shall be a minimum of 2121 VDC for a minimum of 60 seconds between all terminals. However, the discharge resistor inside the filter shall be removed for this test according to IEC recommendations. All values given in this catalogue are 100% production tests for a minimum of two seconds. Repetition of voltage tests shall not exceed 80% of the specified values.

Leakage current

The leakage current to ground for each type is given as a maximum value per phase, at 230V/50Hz.

Safety approvals Filters in this catalogue are approved by the major world safety approval agencies. Each datasheet indicates the current safety approval status. The relevant file numbers for our filters are:

UL E64388	Test: UL 1283
CSA LR 44788	Test: CSA 22.2 No. 8-M1986
SEV	Test: IEC 939
VDE 7226-4730-10..	Test: VDE 0565-3
SEMKO	Test: IEC 939

Almost all of the filters in this catalogue meet the requirements of IEC 950 for Class I and Class III installations with Basic and Supplementary Insulation. For further information see Schaffner's application note 'IEC 950'.

Flammability class All filters in this catalogue are UL 94V2 or UL94V0.

MTBF figures In addition to safety approvals, Schaffner filters also have the high reliability shown in the MTBF (mean time between failure) values given for each filter family. This is the lowest typical value for any filter in the particular family and is calculated according to Mil-HB 217-F, for maximum rated current and voltage in an ambient temperature of 40°C. MTBF is stated in hours.

Components The component values given in the detailed product pages are nominal. The value of inductors and capacitors can vary from this nominal value. The tolerance and test conditions for these components is shown in the following table:

Parameter	**- Tol.**	**+ Tol.**	**Test**
Inductance	30%	50%	1kHz
Capacitance	20%	20%	1kHz
Resistance	10%	10%	DC

Climatic classification Schaffner filters fulfil the requirements of the HPF climatic classification according to DIN 40040 (ambient temperature -25 to +85°C).

Filters with a connecting cable - such as types FN 0.8 to FN 20 meet the requirements of the HSF climatic classification (ambient temperature -25 to +70°C).

The letters of the climatic classification are coded as follows:

1st letter: Lower temperature limit:
H ≅ -25°C
2nd letter: Upper temperature limit:
S ≅ +70°C P ≅ +85°C
3rd letter: Permissible humidity (relative):
F ≅ 75% yearly average
95% highest value for 30 days
85% highest for all other days

According DIN IEC 68 Part 1, the climatic category is given by three numbers, separated by /

Sample: 25/085/21

1st number: Lower temperature limit:
-25°C
2nd number: Upper temperature limit:
+85°C
3rd number: Humidity, 90-95% R.H.
21 days

Filters with a greater temperature range, for special applications and for military use, are available on request.

Filters with earth line chokes

It is possible to get interference induced on all cables of a system simultaneously. In this case the same noise will also be induced onto the earth cable. A standard filter will reduce the noise on the phase lines but not on the earth. The noise on the earth line will then be able to enter the equipment and may cause the equipment to malfunction. To reduce this interference earth line chokes may be fitted or incorporated into the filter. The earth line choke will also provide extra attenuation for normal common mode currents.

Care must be taken not to bypass earth line chokes in systems. For example a PC may have a filter with an earth line choke fitted, if this PC is connected to a printer that is powered from the mains supply, and if the printer does not have an earth line choke, the noise may find a path from the mains into the printer and along the data cable into the PC bypassing the earth line choke in the PC.

Filters for medical equipment

For enhanced safety in medical applications, Schaffner offers 'B' versions of many of its filters, offering lower leakage current (3µA typical), a discharge resistor, and higher potential test values (for example FN 326B).

Special filters for NEMP

A nuclear electro-magnetic pulse (NEMP) is a high intensity, short duration, electro-magnetic field produced as a result of a nuclear explosion outside the atmosphere (exo-atmospheric). The most critical threat for technically highly developed nations is an exo-atmospheric burst (at an altitude of more than 40 km) producing a NEMP inducing in antennas, power transmission networks etc, such high voltages and currents that it may leave a whole continent without power, telephone or radio communications. Electronic equipment can be protected against a NEMP if it is placed in special room or housing which screen it from the electro-magnetic fields, and if all feed lines to these areas are protected with voltage limiting devices such as varistors, gas discharge tubes and suppressor diodes.

Special filters for TEMPEST

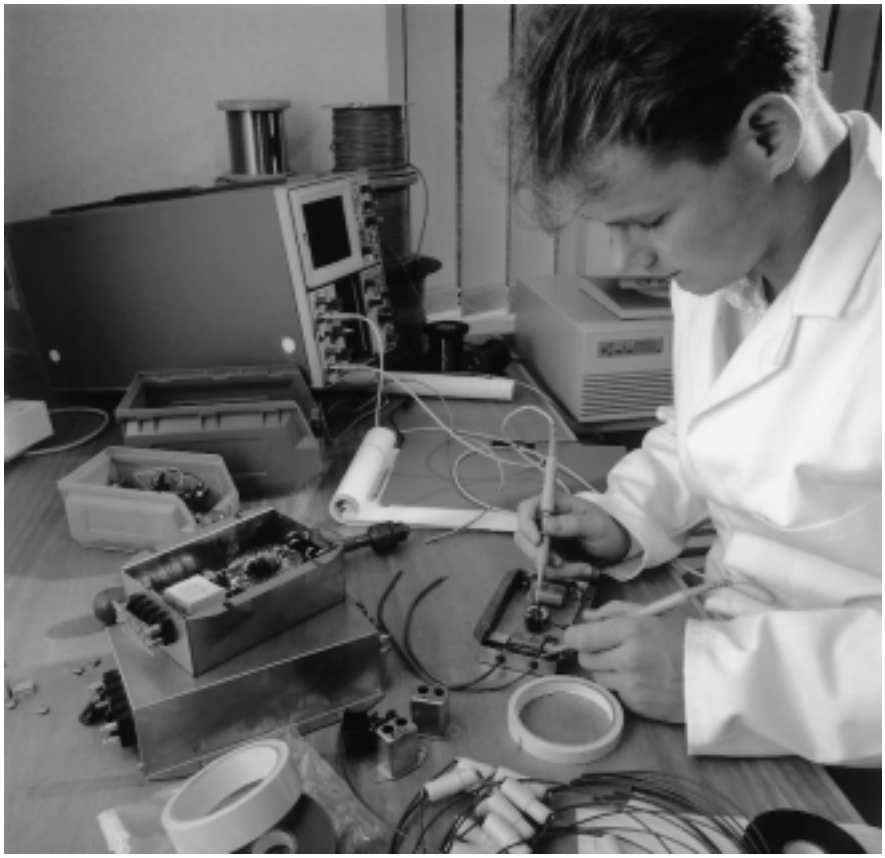
Telecommunication or data processing equipment can radiate signals, or propagate them along power lines, providing a mechanism for unauthorised persons to access classified information. The study and blocking of such sensitive signals is known as TEMPEST. Mains filters with high attenuation over a large frequency range are necessary. An optimum filter solution can only be found by an exact specification of requirements. The FN 700Z filter series has been used in many TEMPEST applications. Other suitable filters are available on request.

Customer-specific filters

Schaffner's standard range of filters cover the majority of customers' requirements. But depending on the application, specific criteria might need to be considered. With our many years of experience, as well as the flexibility and capability of our five development centers located throughout the world, Schaffner can offer companies an efficient and reliable custom engineering service. To date, Schaffner has produced over 4000 custom filters, ranging from 0.1 amps up to 1200 amps, from a matchbox size to rack mount designs, with up to 23 input connections, used in all forms of environments from offices to submarines to factories to military armoured vehicles.

EMC measurement and engineering services

In addition to offering one of the world's most comprehensive ranges of standard filter products, Schaffner offers the full complement of measurement and engineering services to support equipment manufacturers and users.



EMC testing

Schaffner operates the most sophisticated EMC test facilities available anywhere today - with extensive investment in screened rooms, specialist test equipment, and application engineering teams - distributed at seven locations throughout the world. Services available at these locations include:

- Faraday cage and open field testing
- harmonics instrumentation for current and voltage to the 49th harmonic
- radio emission measurements to CISPR, EN, VDE, FCC, Mil or SEV
- simulation of electro-magnetic fields
- simulation of short-term DC or AC mains failures
- simulation of transient parasitic voltages
- electro-static discharges to IEC 801-2, VDE 0843 part 2 specifications
- AC and DC insulation testing

Engineering services

Schaffner has the largest world engineering experience in solving EMC problems. In addition to testing and measuring services Schaffner can provide the expert engineering support to help you bring your equipment to market quickly and efficiently; services available include:

- custom filter design
  - to optimize filter performance, and solve space, layout, mounting or connection problems
- circuit and equipment design
  - advising on circuit and equipment or enclosure design to overcome EMC problems
- turnkey component design and build

Ordering information

For all single-phase filters (except FN 22)

FN 250 & - x / y

- connections
  - 01 = solder-lug
  - 02 = pin for PCB mounting
  - 03 = clamp terminal with M4 screw
  - 05 = AMP fast-on
  - 06 = solder-lug/fast-on combination
  - 07 = wire
  - 10 = screw feed-through
  - 13 = AMP fast-on
  - 16 = mini fast-on
  - 23 = clamp terminal
  - 29 = terminal block
  - 33 = terminal block
  - 38 = AMP fast-on

  for details see mechanical data pages
- current rating (A)
- A = low leakage (small Y capacitors)
  B = medical version (without Y capacitors)
  Z = surge voltage protection
- filter type

Examples:
FN 670-1.8/07 Type FN 670; current rating 1.8A; with wire connections
FN 350-55/33 Type FN 350; current rating 55A; with safety terminal block connections

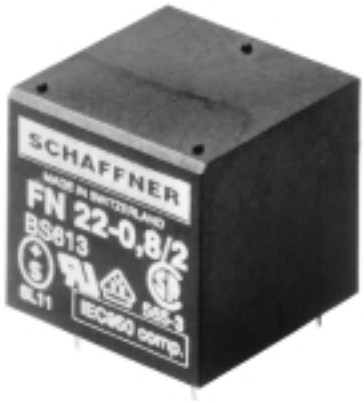
SCHAFFNER

Compact PCB-mounting filter

FN 22

Provided in a compact plastic housing suitable for use with automatic assembly equipment, this PCB-mounting filter offers good basic performance, with a profile which suits equipment designs such as monitors, terminals and power supplies.

- **compact PCB-mounting design**
- **auto-insertion machine friendly**



See Mechanical Data (pages 59 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/2 or /3** to determine the component value.

Approvals

Family	Connections	Current ratings A at 40°C (25°)		Capacitance Cx nF	Capacitance Cy nF	Inductance L mH	Housing	Weight g
FN 22 -0.8 /2	✓	0.8	(0.95)	47	2.2	10	KA1	30
FN 22 -0.8 /3	✓	0.8	(0.95)	15	2.2	0.3	KA1	30

Additional specifications

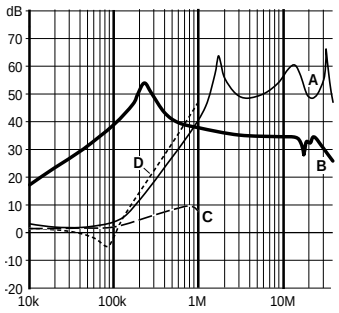
Filter type	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VDC
Standard types	190	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 2,750,000 hours.

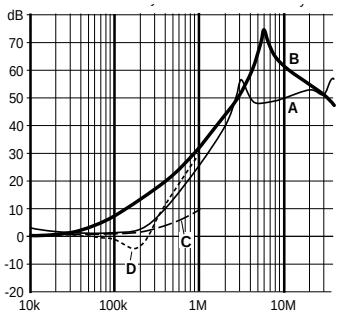
Insertion loss

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

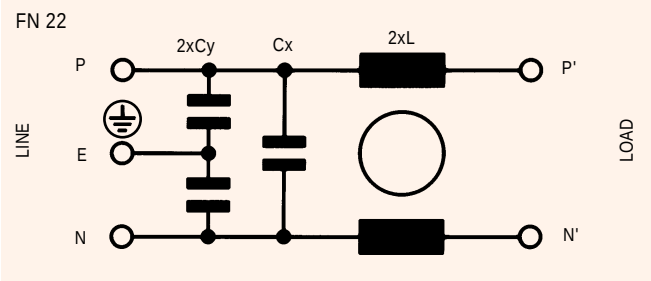
FN 22-0.8/2 types



FN 22-0.8/3 types



Electrical schematics



See tables for component values.

SCHAFFNER

Input filter for motor drives

FN 250

High inductance and capacitance values optimized for common mode attenuation in the 0.1-1MHz range make this filter ideal for a large variety of motor drive applications. Long wire connections give great installation flexibility, simplifying assembly for drive manufacturers.

- **6 to 20A current ratings**
- **compact housings with long wire connections**
- **meets EN55011(A) for drives with motor cables <20m**

See Mechanical Data (pages 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 250-6/07 is a 6A filter with wire connections.

Approvals

Family	Connections	Current ratings A at 40°C (25°)	Capacitance Cx/Cx1 µF	Capacitance Cy nF	Res. R MΩ	Power loss W	Inductance L mH	Housing	Weight g
FN 250 -6 /??	/07	6 (6.9)	0.47/0.47	15	0.47	2.5	5.7	K11	240
FN 250 -12 /??	/07	12 (13.8)	1/1	15	0.47	6	2.7	K22	310
FN 250 -20 /??	/07	20 (23)	2.2/2	15	0.22	8	1.9	L4	600

Additional specifications

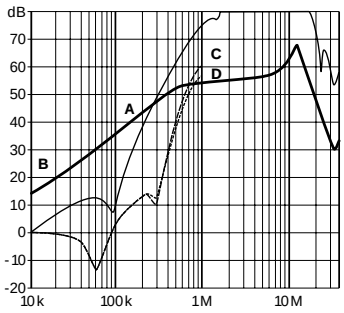
Filter type	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VDC
Standard types	1300	250	50/60	DC to 400	2000	1100

MTBF at 40°C, 230V, per Mil-HB-217F: 295,000 hours.

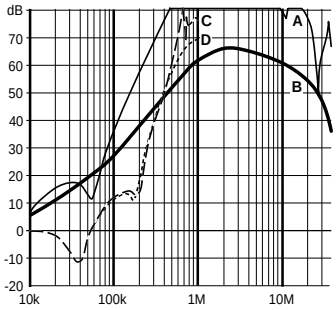
Insertion loss

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

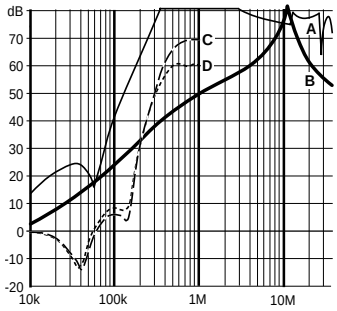
6 amp types



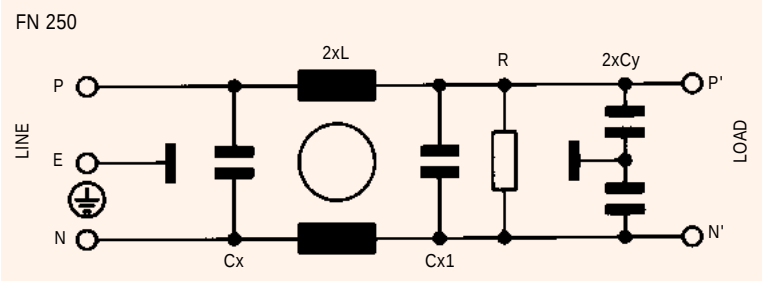
12 amp types



20 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

Performance filter

FN 332

Designed for suppressing high interference levels, this filter is available in a wide choice of current ratings, and also in an optional Z version with a varistor for protection against high surge voltages.

- **1 to 10A current ratings**
- **compact housing with solder or fast-on connections**
- **optional surge voltage protection (Z types)**

See Mechanical Data (pages 57 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 332-6/01 is a 6A filter with solder lug connections.

Approvals

Family	Connections		Current ratings A at 40°C (25°)		Inductance L mH	Housing	Weight g
FN 332 -1 /??	/01	/05	1	(1.2)	10	G1	65
FN 332 -3 /??	/01	/05	3	(3.6)	2	G1	65
FN 332 -6 /??	/01	/05	6	(7.3)	0.8	G1	65
FN 332 -10A /??	/01	/05	10	(12)	0.5	G1	70

Additional specifications

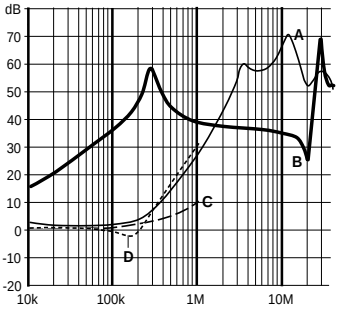
Filter type	Capacitance Cx nF	Capacitance Cy nF	Surge current A	Energy absorption J	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VDC
Standard types	15	2.2	-	-	190	250	50/60	DC to 400	2000	1700
FN 332Z types (surge protected)	15	2.2	1200	26	190	250	50/60	DC to 400	2000	350

MTBF at 40°C, 230V, per Mil-HB-217F: 710,000 hours.

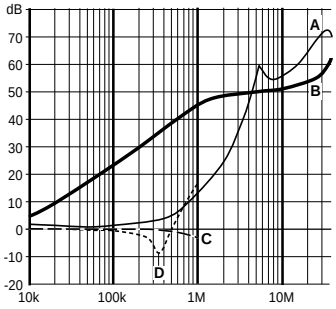
Insertion loss

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

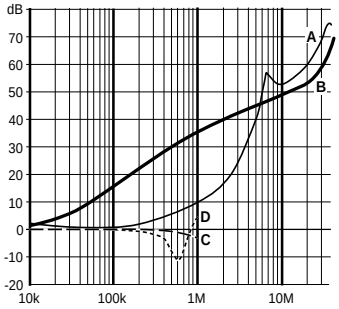
1 amp types



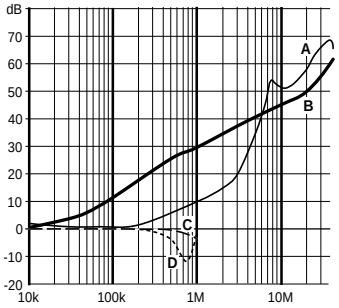
3 amp types



6 amp types

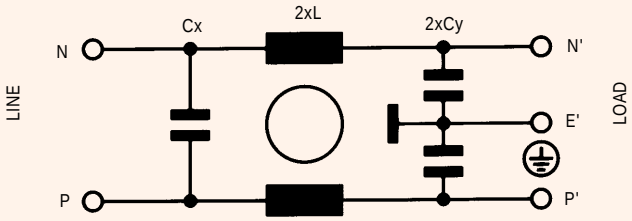


10 amp types

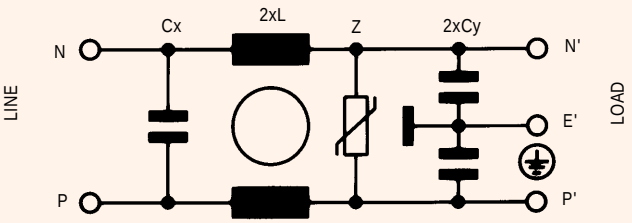


Electrical schematics

FN 332



FN 332Z



See tables for component values.

SCHAFFNER

Two-stage filter

FN 343

A general-purpose filter with a two-stage design and integral earth line choke for high performance with good common mode attenuation.

- **1 to 10A current ratings**
- **2-stage design with earth line choke**

See Mechanical Data (pages 57 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 343-3/01 is a 3A filter with solder lug connections.

Approvals

Family	Connections		Current ratings A at 40ºC (25º)		Inductance $L/L_1/L_2$ mH	Housing	Weight g
FN 343 -1 /??	/01	/05	1	(1.15)	5.6/10/0.4	J2	160
FN 343 -3 /??	/01	/05	3	(3.4)	1.1/2/0.4	J2	160
FN 343 -6 /??	/01	/05	6	(6.9)	0.43/0.77/0.4	J2	160
FN 343 -10 /??	/01	/05	10	(11.5)	0.27/0.66/0.4	J2	170

Additional specifications

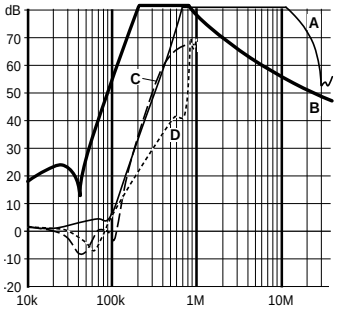
Filter type	Capacitance Cx/Cx_1 nF	Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VAC
Standard types	100/100	2.2	1	190	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 970,000 hours.

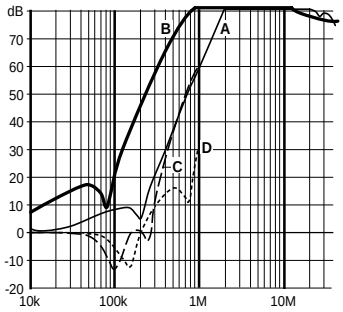
Insertion loss

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

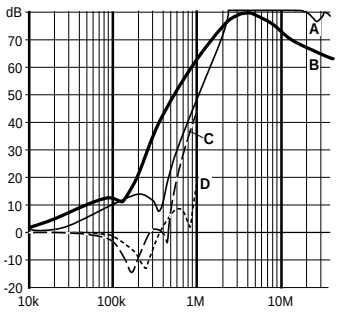
1 amp types



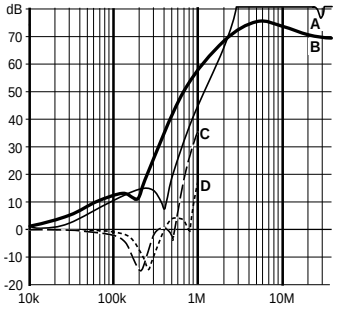
3 amp types



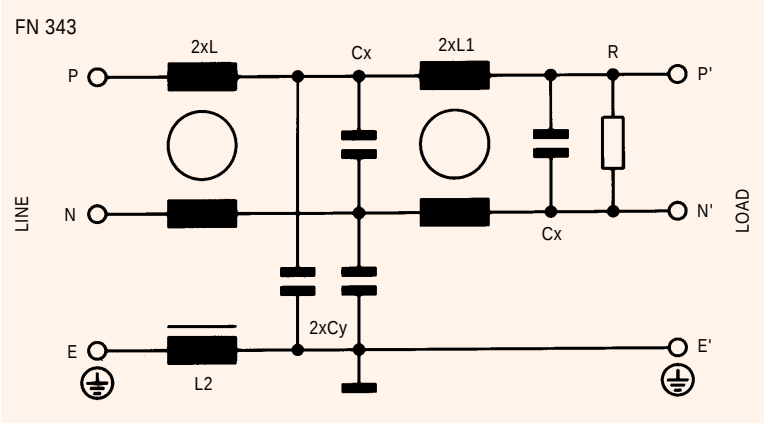
6 amp types



10 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

High-performance filter

FN 346

This filter offers IEC 320-compliant power entry with excellent filtering performance thanks to the use of a U-core plus large inductor and capacitor components. Very high symmetrical attenuation makes the filter an ideal choice for switched-mode power supply equipment applications, and any other form of circuitry involving non-sinusoidal waveforms.

- **up to 10A current ratings**
- **very high performance filtering**
- **optional medical versions (B types)**

See Mechanical Data (pages 56 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 346-10/06 is a 10A filter with fast-on connections.

Approvals

Family	Connections	Current ratings A at 40°C (25°)		Inductance L mH	Housing	Weight g
FN 346 -1.6 /??	/06	1.6	(1.9)	34	B27	330
FN 346 -2.5 /??	/06	2.5	(3)	18	B27	330
FN 346 -6 /??	/06	6	(7.3)	3	B27	330
FN 346 -10 /??	/06	10	(12)	0.7	B27	330

Additional specifications

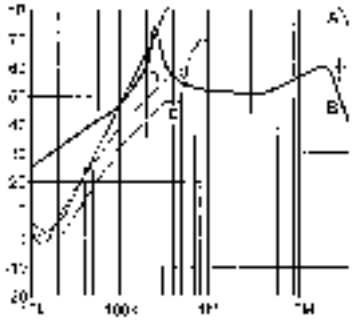
Filter type	Capacitance Cx/Cx1 nF	Capacitance Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VDC
Standard types	470/220	4.7	0.47	410	250	50/60	DC to 400	2000	1700
B types (medical)	470/220	-	0.47	5	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 330,000 hours.

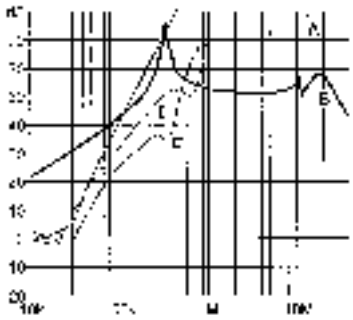
Insertion loss

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

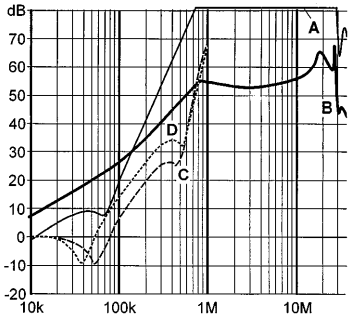
1.6 amp types



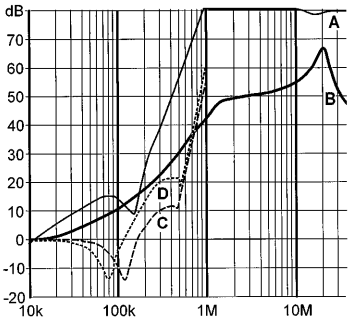
2.5 amp types



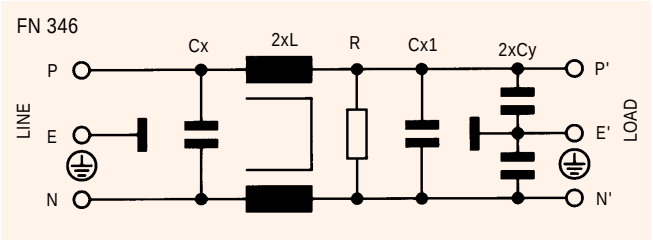
6 amp types



10 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

High power filter for drives

FN 350

High inductance and capacitance values optimized for common and differential mode attenuation in the lower frequency range make this filter ideal for a large variety of motor drive applications. Supplied in a relatively small footprint design with terminal blocks for easy installation and servicing in industrial environments; also meets IEC 950 extending applications flexibility.

- **8 to 55A current ratings**
- **screwdriver-connect terminations**
- **meets EN55011/14/22 VDE 0871/75/78**
- **meets IEC 950**

See Mechanical Data (pages 55, 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 350-55/33 is a 55A filter with terminal connections suitable for AWG 6/16mm^2 wire.

Approvals

Family	Connections		Current ratings A at 40ºC (25º)		Capacitance Cx/Cx$_1$ µF	Cy/Cy$_1$ nF	Inductance L mH	Maximum leakage µA/phase	Power loss W	Housing	Weight g
FN 350 -8 /??	/29	-	8	(9.2)	2/0.68	10/47	10	4900	4.2	L21	700
FN 350 -12 /??	/29	-	12	(13.8)	2.2/1	10/47	7.5	4900	5.2	L21	900
FN 350 -20 /??	/29	-	20	(23)	2.2/1	10/47	3.2	4900	5.7	L21	950
FN 350 -30 /??	-	/33	30	(34.5)	2.2/1	15/47	1.3	5300	5.9	L21	950
FN 350 -55 /??	-	/33	55	(63)	4.4/1	33/94	1	11 000	8.2	B21	1800

Additional specifications

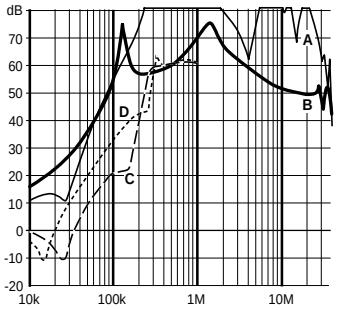
Filter type	Res R MΩ	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VDC	P→N VDC
Standard types	1	250	50/60	DC to 60	2800	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 420,000 hours.

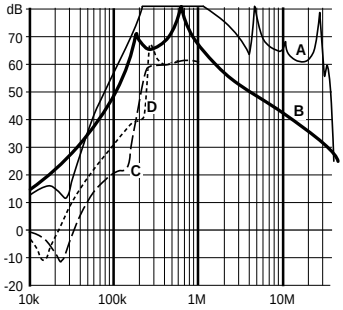
Insertion loss

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

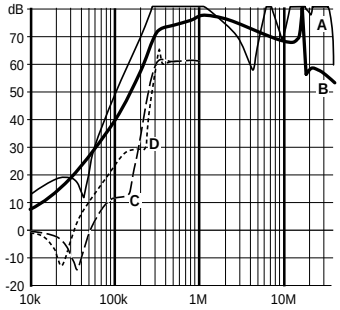
8 amp types



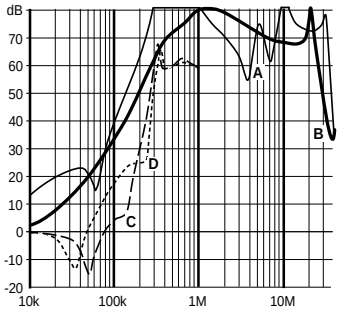
12 amp types



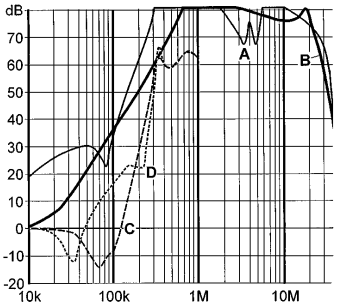
20 amp types



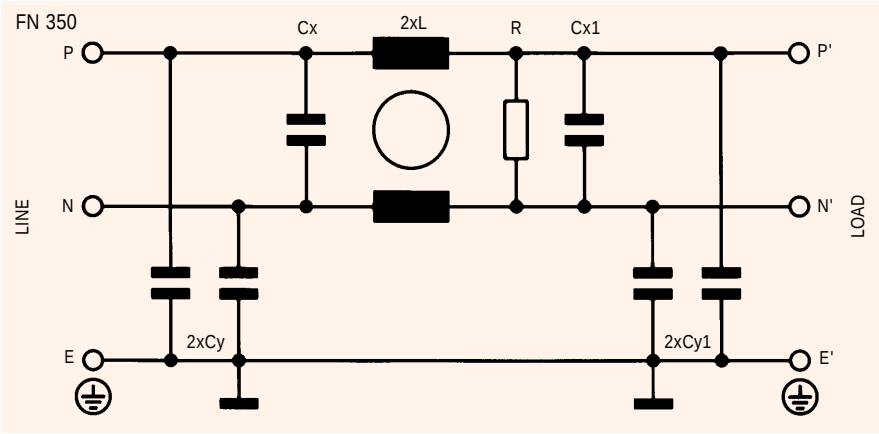
30 amp types



55 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

Multi-stage filter

FN 352Z

This filter family provides a high performance two- or three-stage circuit design with a varistor for protection against high surge voltages of up to 2000A. The 353Z version packages the same circuit design around a differential mode core for greater compactness.

- **6 to 30A current ratings**
- **integral surge voltage protection to 2kA**
- **solder or screwdriver connections**

See Mechanical Data (pages 55 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 352Z-6/06 is a 6A filter with fast-on connections.

Approvals

Family	Connections		Current ratings A at 40ºC (25º)		Capacitance Cx/Cx1 nF	Cy/Cy1 nF	Res. R MΩ	Inductance L/L1/L2 mH	Maximum leakage µA/phase	Housing	Weight g
FN 352Z -6 /??	/06	-	6	(7.2)	470/220	3.3/1.5	0.47	3/3/-	420	B22	575
FN 352Z -10 /??	-	/29	10	(12)	220/220	15/15	0.47	5/0.06/0.003	1300	B8	1320
FN 352Z -20 /??	-	/29	16	(20)	220/220	15/15	0.47	3.5/0.06/0.0035	1300	B13	2950
FN 353Z -30 /??	-	/33	24	(30)	470/220	15/15	0.23	2.3/0.025/0.035	1300	B13	3100

Additional specifications

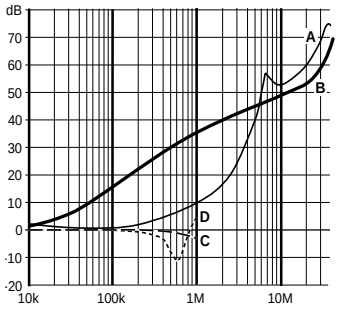
Filter type	Energy absorption J	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VDC
Standard types	40	250	50/60	DC to 400	2000	350

MTBF at 40°C, 230V, per Mil-HB-217F: 230,000 hours.

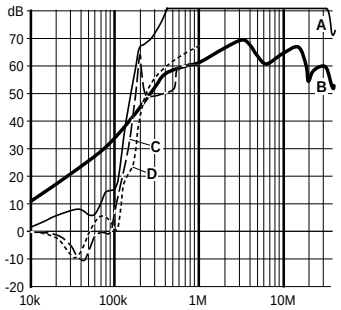
Insertion loss

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

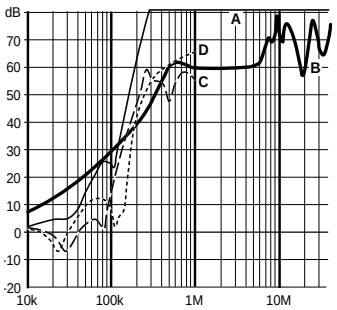
6 amp types



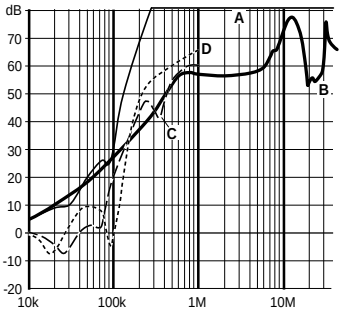
10 amp types



20 amp types

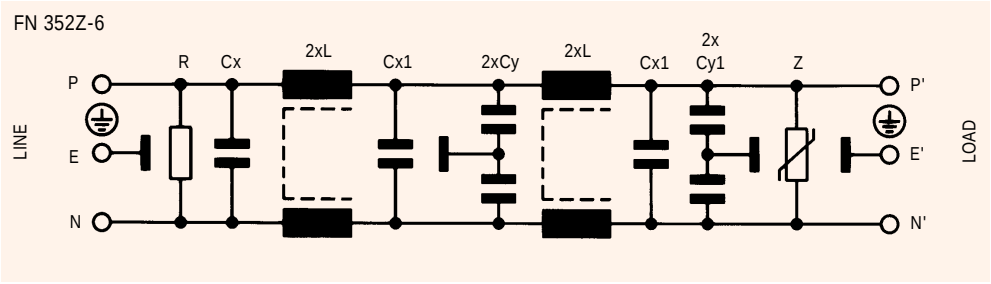


30 amp types

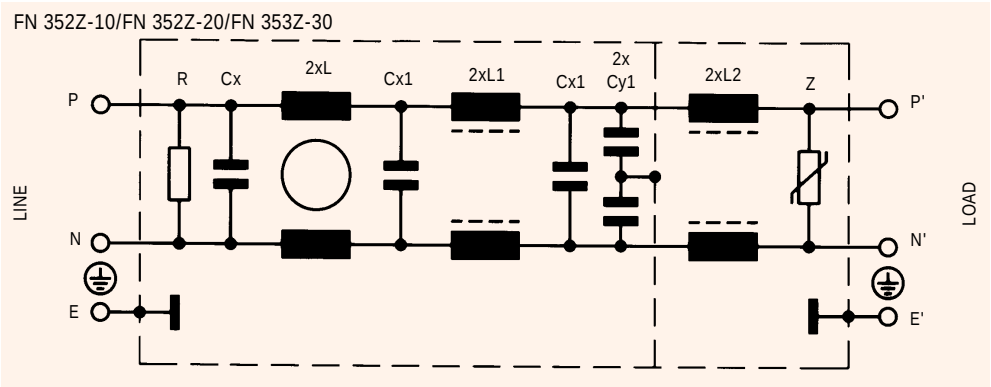


Electrical schematics

FN 352Z-6



FN 352Z-10/FN 352Z-20/FN 353Z-30



See tables for component values.

SCHAFFNER

Two-stage filter for motor drives

FN 357

This two-stage filter offers good low-to-medium power performance aimed at the frequency ranges encountered in typical motor drive applications, and also lower frequency (sub 100kHz) equipment. Terminal blocks simplify installation and servicing.

- **6 to 16A current ratings**
- **screwdriver-connect terminations**
- **meets EN55011/14/22 VDE 0871/75/78**

See Mechanical Data (pages 55 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 357-10/29 is a 10A filter with terminal connections suitable for AWG 10/6mm^2 wire.

Approvals

Family	Connections	Current ratings A at 40ºC (25º)		Capacitance Cx/Cx$_1$ µF	Capacitance Cy/Cy$_1$ nF	Res. R MΩ	Inductance L/L$_1$ mH	Maximum leakage µA/phase	Power loss W	Housing	Weight g
FN 357 -6 /??	/29	6	(6.9)	1.5/2.2	22/-	0.1	3.5/0.75	3800	5.5	B7	1450
FN 357 -10 /??	/29	10	(11.5)	2.2/2.2	22/33	0.1	2.8/0.45	4800	6.2	B7	1500
FN 357 -16 /??	/29	16	(18.4)	3/3	47/47	0.075	2.3/0.4	8100	8.4	B11	3000

Additional specifications

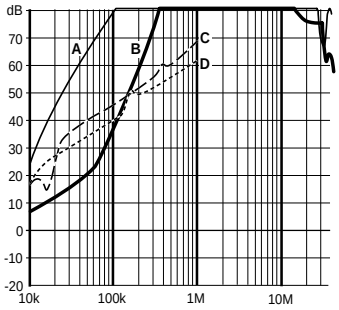
Filter type	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VDC	Hipot test voltage P→N VDC
Standard types	250	50/60	DC to 60	2800	1100

MTBF at 40°C, 230V, per Mil-HB-217F: 250,000 hours.

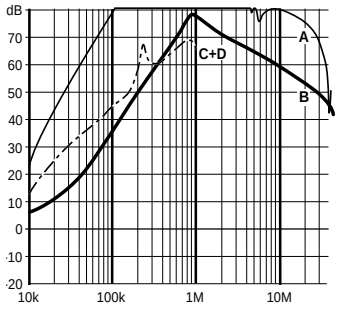
Insertion loss

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

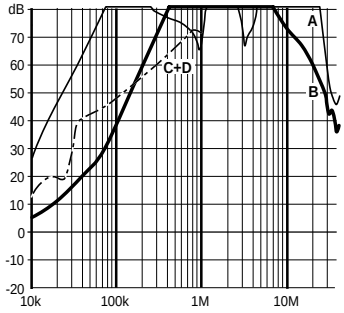
6 amp types



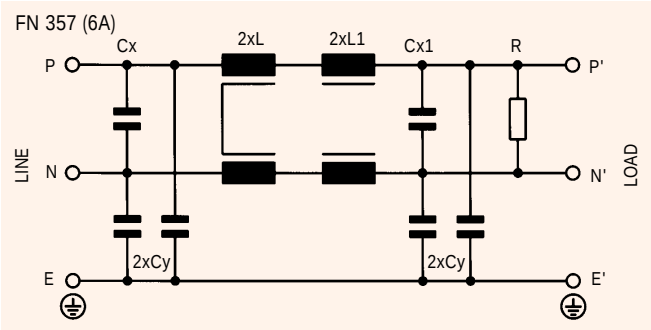
10 amp types

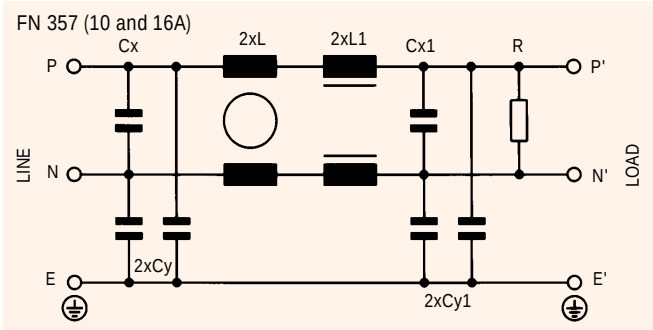


16 amp types



Electrical schematics





See tables for component values.

SCHAFFNER

Performance PCB-mount filter

FN 401

Offering excellent filtering with high component values for good asymmetric and common mode attenuation, suitable for demanding applications such as switched-mode power supplies, this filter is supplied in a low-profile plastic PCB-mount package in a choice of two low power ratings.

- **0.8-1.5A current ratings**
- **compact PCB-mount footprint**
- **low profile design**

See Mechanical Data (pages 59 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 401-1.5/02 is a 1.5A filter with pin connections.

Approvals

Family	Connections	Current ratings	Capacitance			Res.	Inductance	Housing	Weight
		A at 40ºC (25º)	Cx nF	Cx_1 nF	Cy nF	R MΩ	L mH		g
FN 401 -0.8 /??	/02	0.8 (0.95)	68	15	2.2	-	20	KA2	30
FN 401 -1.5 /??	/02	1.5 (1.8)	100	–	2.2	1	20	KA3	90

Additional specifications

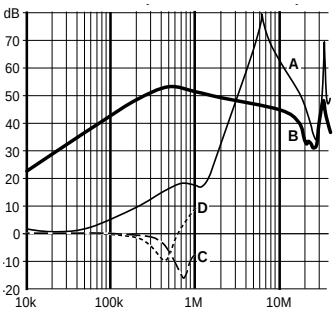
Filter type	Maximum leakage µA/phase	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VDC
Standard types	190	250	50/60	DC to 400	2000	1100

MTBF at 40°C, 230V, per Mil-HB-217F: 1,000,000 hours.

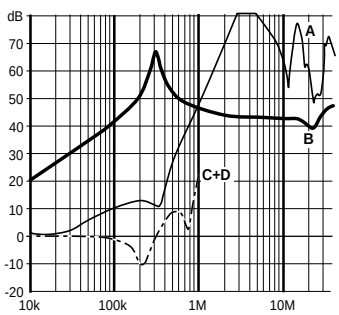
Insertion loss

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

0.8 amp types

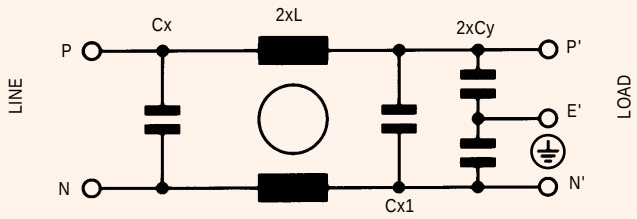


1.5 amp types

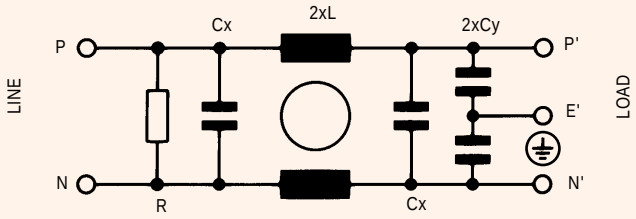


Electrical schematics

FN 401 (0.8A)



FN 401 (1.5A)



See tables for component values.

SCHAFFNER

Low-cost PCB/chassis-mount filter FN 402

Provided in a very compact and low profile PCB- or chassis-mounting plastic enclosure, with a choice of six current ratings and four output connections, this filter combines great versatility with economy.

- **0.5-6.5A current ratings**
- **compact PCB- or chassis-mountable design**
- **four connection style choices**
- **very low profile**
- **optional medical versions (B types)**

See Mechanical Data (pages 59 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 402-4/16 is a 4A filter with mini fast-on connections.

Approvals

Family	Connections				Current ratings A at 40ºC (25º)		Inductance L mH	Housing	Weight g
FN 402 -0.5 /??	/02	/07*	/16	/38	0.5	(0.6)	40	KA/KB	40
FN 402 -1 /??	/02	/07*	/16	/38	1	(1.2)	10	KA/KB	40
FN 402 -1.6 /??	/02	/07*	/16	/38	1.6	(1.9)	6	KA/KB	40
FN 402 -2.5 /??	/02	/07*	/16	/38	2.5	(3.0)	2	KA/KB	40
FN 402 -4 /??	/02	/07*	/16	/38	4	(4.7)	1	KA/KB	40
FN 402 -6.5 /??	/02	/07*	/16	/38	6.5	(7.5)	1	KA/KB	40

* /07 outputs add 5g to weight

Additional specifications

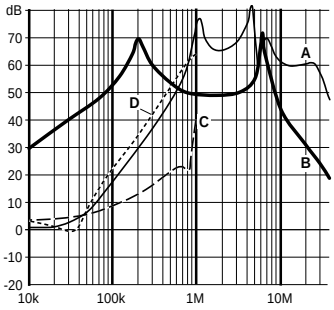
Filter type	Capacitance Cx nF	Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VDC
Standard types	100	2.2	1	190	250	50/60	DC to 400	2000	1700
B types (medical)	100	-	1	2	250	50/60	DC to 400	2500	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 1,900,000 hours. (standard types); 1,200,000 hours (B types)

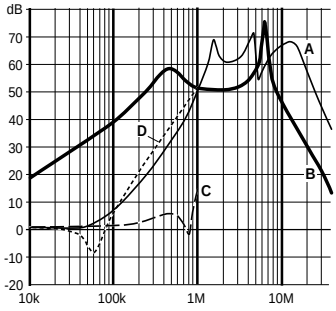
Insertion loss

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

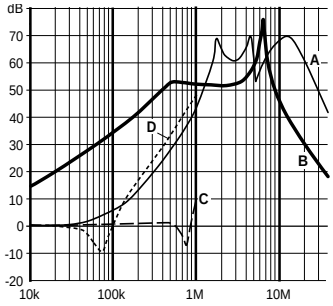
0.5 amp types



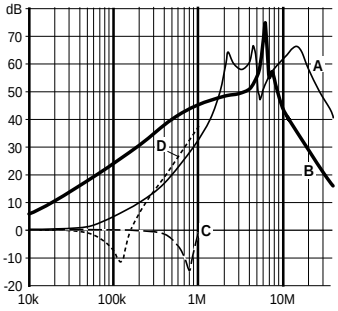
1 amp types



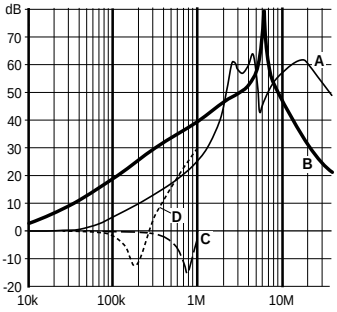
1.6 amp types



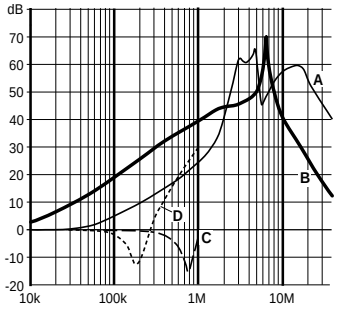
2.5 amp types



4 amp types

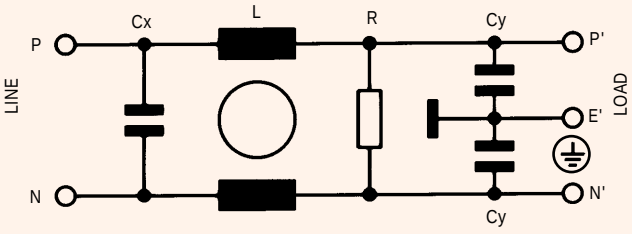


6.5 amp types

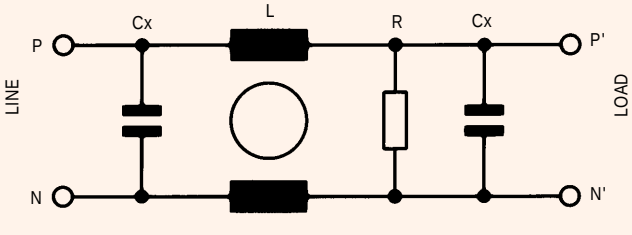


Electrical schematics

FN 402



FN 402B



See tables for component values.

SCHAFFNER

PCB-mounting filter

FN 405

General-purpose filter for PCB mounting applications, supplied in a plastic housing.

- **0.5-6A current ratings**
- **PCB-mounting**
- **low profile**

See Mechanical Data (pages 59 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 405-6/02 is a 6A filter with pin connections.

Approvals

Family	Connections	Current ratings A at 40°C (25°)		Inductance L mH	Housing	Weight g
FN 405 -0.5 /??	/02	0.5	(0.6)	24	KA4	40
FN 405 -1 /??	/02	1	(1.2)	10	KA4	40
FN 405 -3 /??	/02	3	(3.6)	2	KA4	40
FN 405 -6 /??	/02	6	(6.9)	0.8	KA4	40

Additional specifications

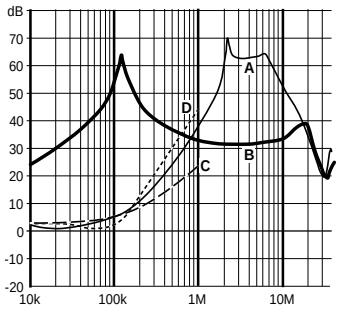
Filter type	Capacitance Cx nF	Cy nF	Maximum leakage µA/phase	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VDC
Standard types	15	2.2	190	250	50/60	DC to 400	2000	1100

MTBF at 40°C, 230V, per Mil-HB-217F: 1,600,000 hours.

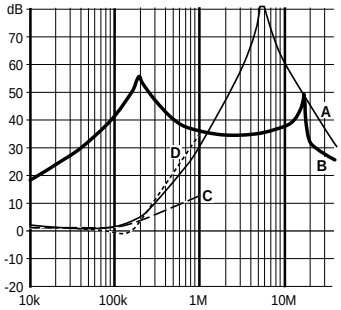
Insertion loss

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

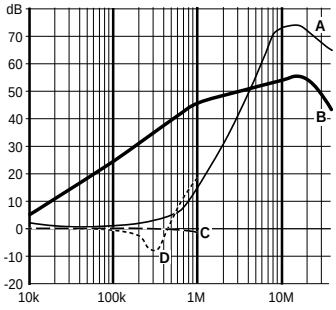
0.5 amp types



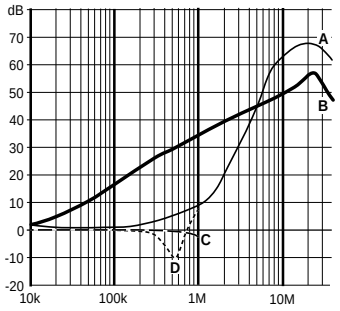
1 amp types



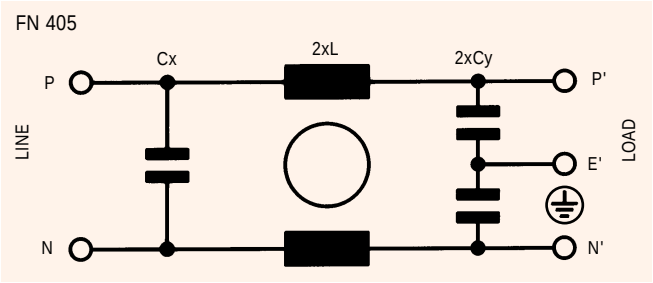
3 amp types



6 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

Ultra-compact EMC filter

FN 406

The FN 406 PCB-mounting EMC filter offers high performance in an exceptionally compact form, and is ideal for equipment applications where space is at a premium. With a footprint of just 15 x 45 mm, it greatly reduces the PCB area required compared with using discrete components, with a height profile which does not exceed the capacitors and transformers typically used in circuitry such as switched mode power supplies. Performance is also enhanced, thanks to an aluminium housing - providing excellent RF shielding to protect against coupling effects from nearby components.

- **0.5-6A current ratings**
- **aluminium case**
- **very compact PCB-mounting design**
- **low profile**

See Mechanical Data (pages 54 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 406-6/02 is a 6A filter with pin connections.

Approvals

Family	Connections	Current ratings A at 40ºC (25º)		Inductance L mH	Housing	Weight g
FN 406 -0.5/??	/02	0.5	(0.6)	24	A6	36
FN 406 -1 /??	/02	1	(1.2)	12	A6	36
FN 406 -3 /??	/02	3	(3.5)	2.5	A6	36
FN 406 -6 /??	/02	6	(6.9)	0.78	A6	36

Additional specifications

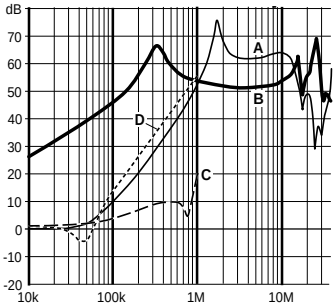
Filter type	Capacitance Cx nF	Capacitance Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VAC
Standard types	100	2.2	1	190	250	50/60	DC to 400	2000	1700
B types (medical)	100	-	1	2	250	50/60	DC to 400	2500	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 1,900,000 hours.

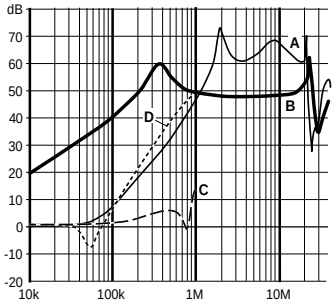
Insertion loss

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

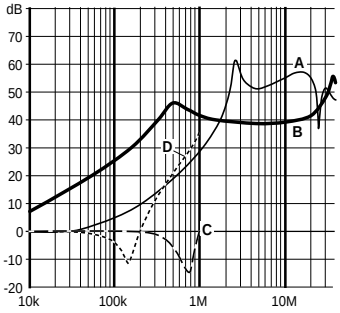
0.5 amp types



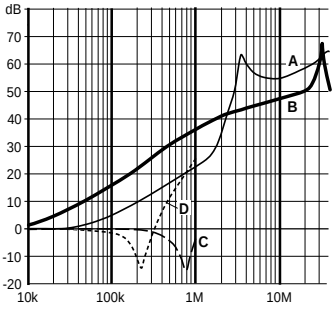
1 amp types



3 amp types

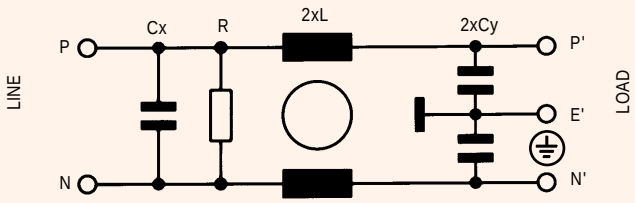


6 amp types

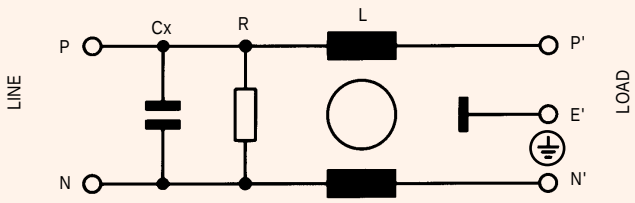


Electrical schematics

FN 406



FN 406B



See tables for component values.

SCHAFFNER

Two-stage PCB filter

FN 410

This filter, with its two-stage inductor design, offers high attenuation in a metal-cased PCB-mounting form.

- **0.5-6A current ratings**
- **high attenuation 2-stage design**
- **PCB-mounting**

See Mechanical Data (pages 54 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 410-6/02 is a 6A filter with pin connections.

Approvals

Family	Connections	Current ratings A at 40°C (25°)		Inductance L/L_1 mH	Housing	Weight g
FN 410 -0.5 /??	/02	0.5	(0.6)	24/24	E1	85
FN 410 -1 /??	/02	1	(1.2)	10/10	E1	85
FN 410 -3 /??	/02	3	(3.6)	2/2	E1	85
FN 410 -6 /??	/02	6	(6.9)	0.8/0.8	E1	85

Additional specifications

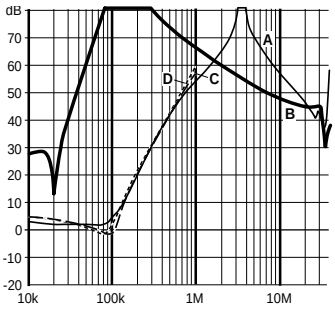
Filter type	Capacitance Cx nF	Cy nF	Maximum leakage µA/phase	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VDC
Standard types	33	2.2	190	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 675,000 hours.

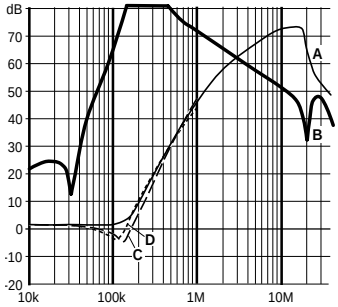
Insertion loss

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

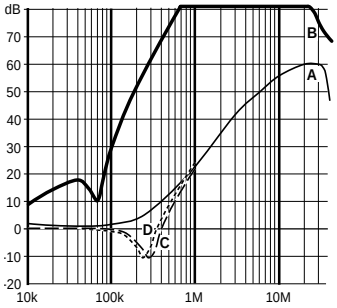
0.5 amp types



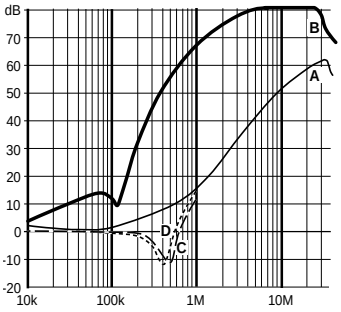
1 amp types



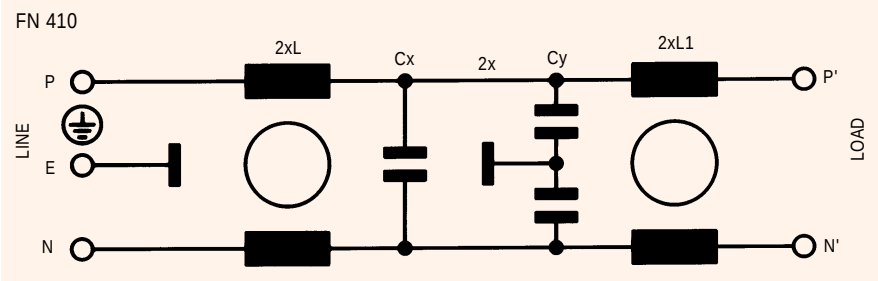
3 amp types



6 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

Versatile easy-mount filter

FN 420

This low-cost filter is supplied in a flat case with rounded edges, making it easy to mount in almost any location - for great versatility and problem solving. Its medium-performance filter design is aimed at general-purpose applications.

- **0.6-6.5A current ratings**
- **low profile case**
- **designed for easy-mounting**

See Mechanical Data (pages 54 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 422-4/13 is a 4A filter with mini fast-on connections.

Approvals

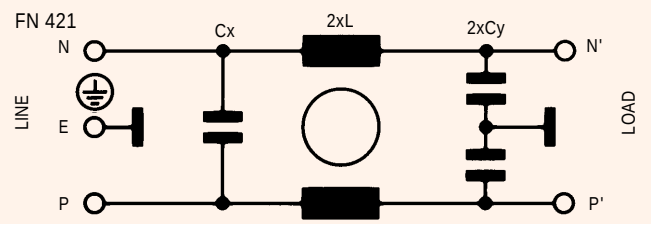
Family	Connections	Current ratings A at 40°C (25°)		Inductance L mH
FN 42? -0.6 /??	/13	0.6	(0.7)	22.5
FN 42? -1 /??	/13	1	(1.2)	13
FN 42? -2.5 /??	/13	2.5	(3)	3.4
FN 42? -4 /??	/13	4	(4.8)	2
FN 42? -6.5 /??	/13	6.5	(7.3)	0.75

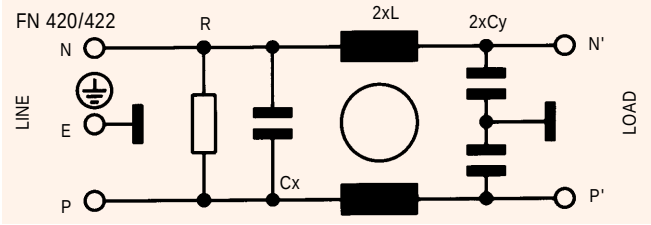
Filter type	Capacitance Cx nF	Capacitance Cy n F	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VDC	Housing	Weight g
FN 420 types	150	2.2	1	190	250	50/60	DC to 400	2000	1700	A7B	70
FN 421 types	100	2.2	-	190	250	50/60	DC to 400	2000	1700	A7A	60
FN 422 types	150	4.7	1	190	250	50/60	DC to 400	2000	1700	A7B	70

MTBF at 40°C, 230V, per Mil-HB-217F: 625,000 hours.

Electrical schematics

See tables for component values.

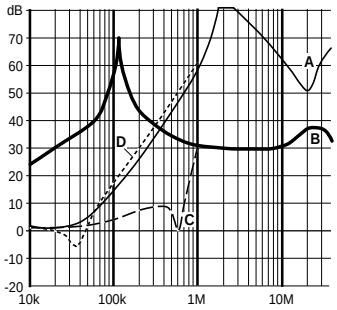




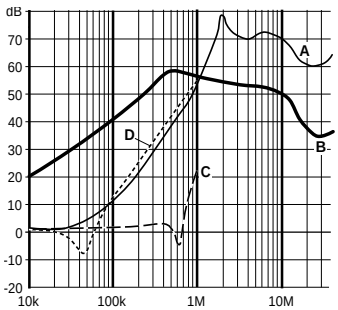
Insertion loss

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

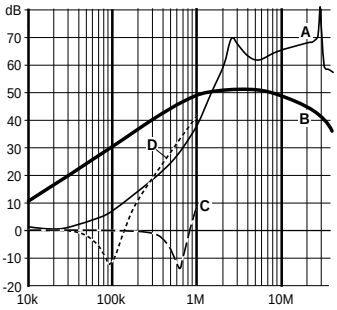
FN 420 0.6 amp types



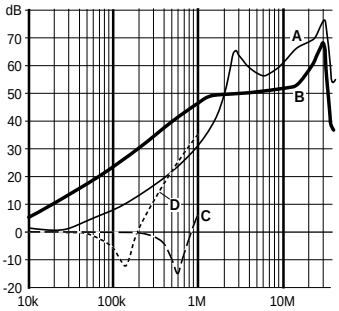
FN 420 1 amp types



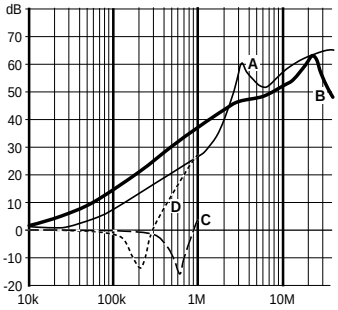
FN 420 2.5 amp types



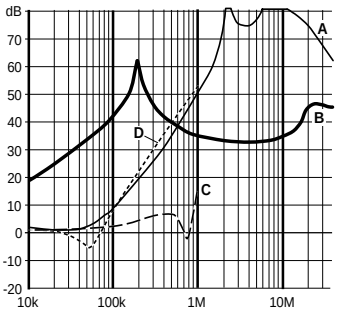
FN 420 4 amp types



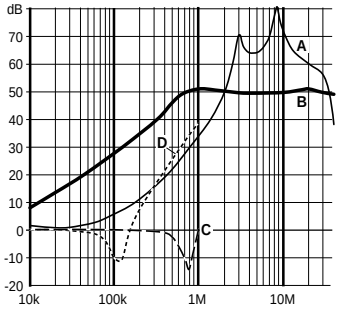
FN 420 6.5 amp types



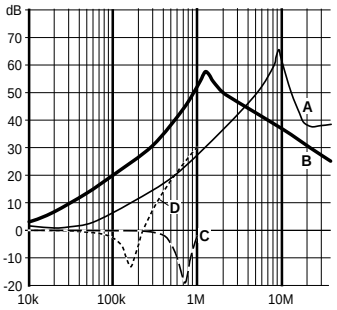
FN 421 1 amp types



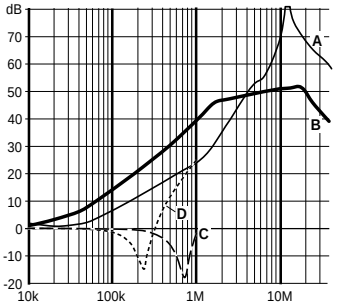
FN 421 2.5 amp types



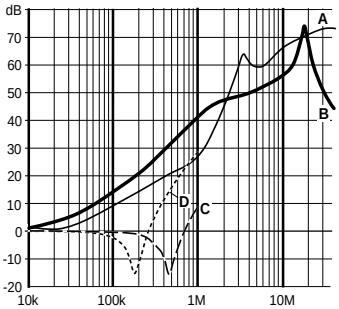
FN 421 4 amp types



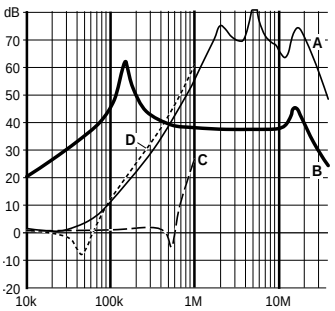
FN 421 6.5 amp types



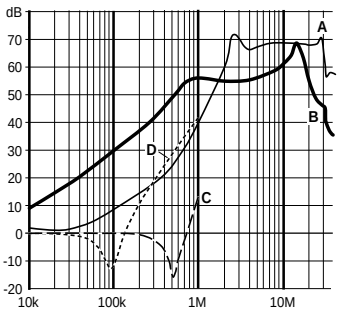
FN 422 0.6 amp types



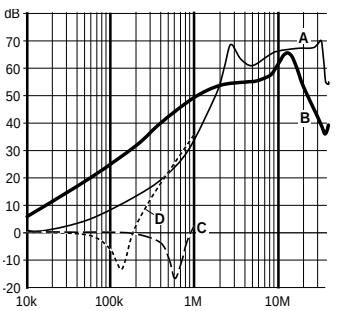
FN 422 1 amp types



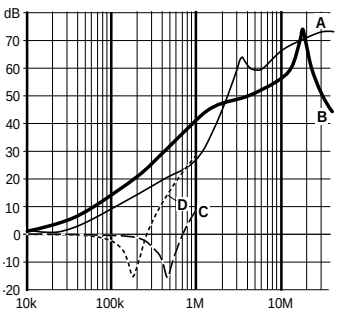
FN 422 2.5 amp types



FN 422 4 amp types



FN 422 6.5 amp types



SCHAFFNER

General-purpose filter

FN 610

This family is designed to provide an economic solution for many general-purpose filtering requirements. Available in over 19 versions, with current ratings from 1 to 30A and with a choice of four different styles of connections, application requirements are easily and economically matched.

- **current ratings from 1 to 30A**
- **general-purpose filtering performance**
- **four choices of connector style**
- **optional medical version (B types)**
- **optional safety version (A types)**

See Mechanical Data (pages 57, 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 610-10/06 is a 10A filter with fast-on connections.

Approvals

(10A max. for Semko)

Family	Connections				Current ratings A at 40°C (25°)		Inductance L mH	Housing	Weight g /??	/07
FN 610 -1 /??	-	/06	/07	-	1	(1.15)	3	F1	55	65
FN 610 -3 /??	-	/06	/07	-	3	(3.4)	2	F1	60	70
FN 610 -6 /??	-	/06	/07	-	6	(6.9)	0.75	F1	60	70
FN 610 -10 /??	-	/06	/07	-	10	(11.5)	0.45	F2	85	95
FN 610 -20 /??	-	/06	-	-	20	(23)	0.48	J1	220	-
FN 610 -30 /??	/03	-	-	/10	30	(34)	0.61	L1	630	-

Additional specifications

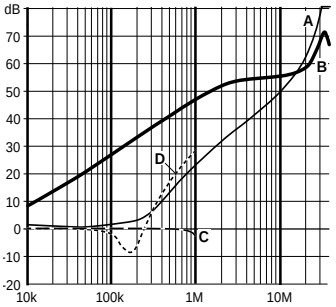
Filter type	Capacitance Cx nF	Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VAC
Standard types	33	2.2	-	190	250	50/60	DC to 400	2000	1700
A types (safety)	33	0.47	1	40	250	50/60	DC to 400	2500	1700
B types (medical)	33	-	1	2	250	50/60	DC to 400	2500	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 1,200,000 hours.

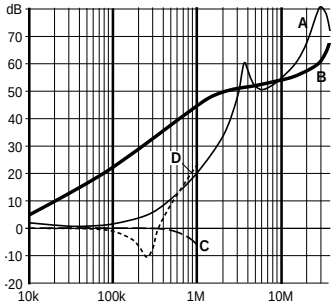
Insertion loss

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

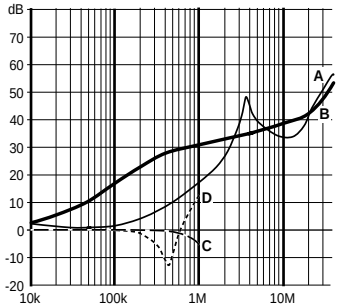
1 amp types



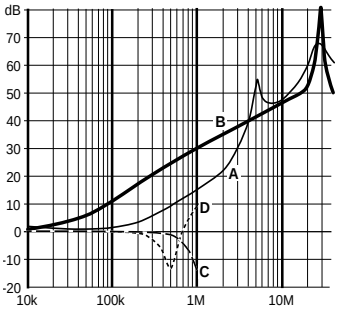
3 amp types



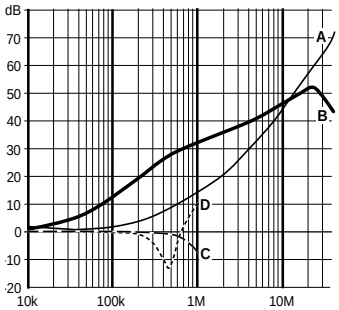
6 amp types



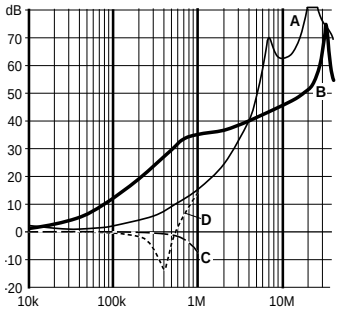
10 amp types



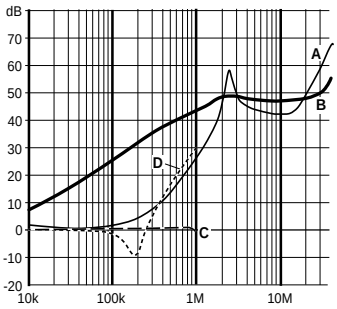
20 amp types



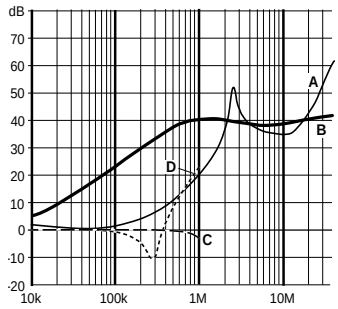
30 amp types



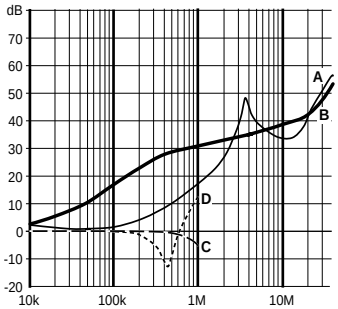
1 amp (A types)



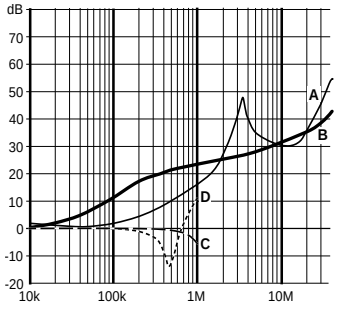
3 amp (A types)



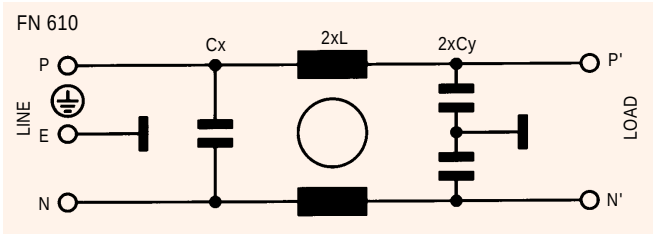
6 amp (A types)

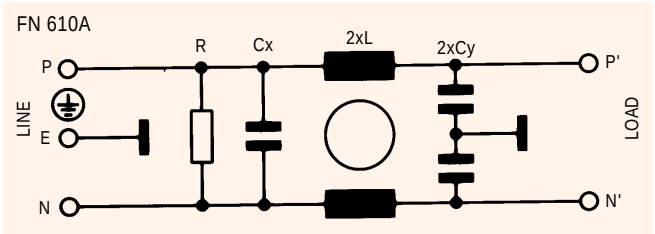


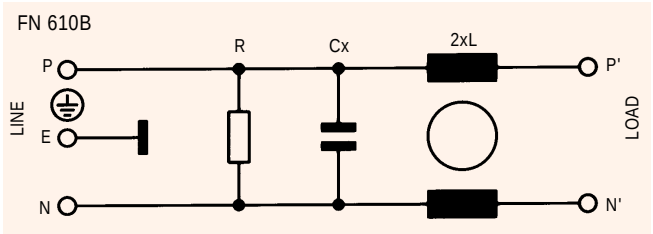
10 amp (A types)



Electrical schematics







See tables for component values.

SCHAFFNER

General-purpose filter

FN 612

Like the FN 610, but with additional capacitance for improved differential mode performance, this family is designed to provide an economic solution for many general-purpose filtering requirements. Available in numerous versions, with current ratings from 1 to 30A and with a choice of four different styles of connection, application requirements are easily and economically matched.

- **current ratings from 1 to 30A**
- **good differential mode attenuation**
- **four choices of connector**
- **optional medical versions (B type)**

See Mechanical Data (pages 57, 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 612-1/06 is a 1A filter with fast-on connections.

Approvals

Family	Connections				Current ratings A at 40°C (25°)		Inductance L mH	Housing	Weight g			
									/03	/06	/07	/10
FN 612 -1 /??	-	/06	/07	-	1	(1.15)	3	H1	-	80	90	-
FN 612 -3 /??	-	/06	/07	-	3	(3.4)	2	H2	-	115	125	-
FN 612 -6 /??	-	/06	/07	-	6	(6.9)	0.75	H2	-	115	125	-
FN 612 -10 /??	-	/06	/07	-	10	(11.5)	0.45	H2	-	115	125	-
FN 612 -20 /??	/03	/06	-	/10	20	(23)	0.48	H2	290	260	-	290
FN 612 -30 /??	/03	-	-	/10	30	(34)	0.61	L1	630	-	-	630

Additional specifications

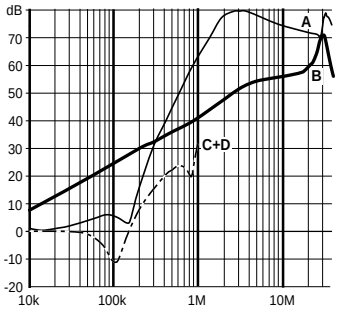
Filter type	Capacitance Cx nF	Capacitance Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VDC
Standard types	100	2.2	1	190	250	50/60	DC to 400	2000	1700
B types (medical)	100	-	1	2	250	50/60	DC to 400	2500	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 800,000 hours.

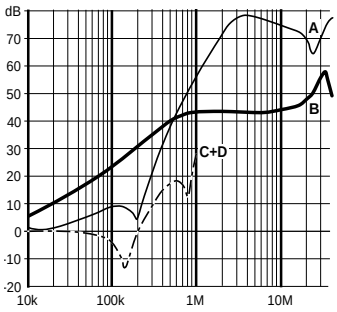
Insertion loss

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

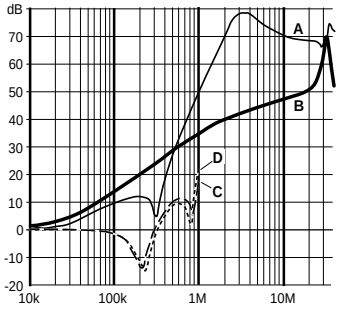
1 amp types



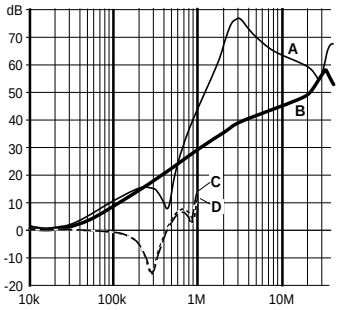
3 amp types



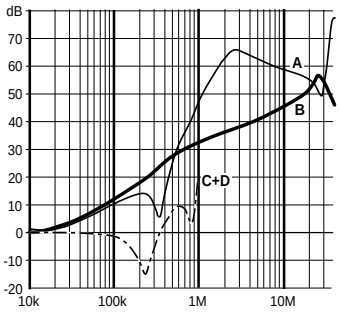
6 amp types



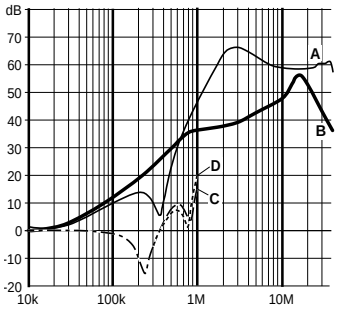
10 amp types



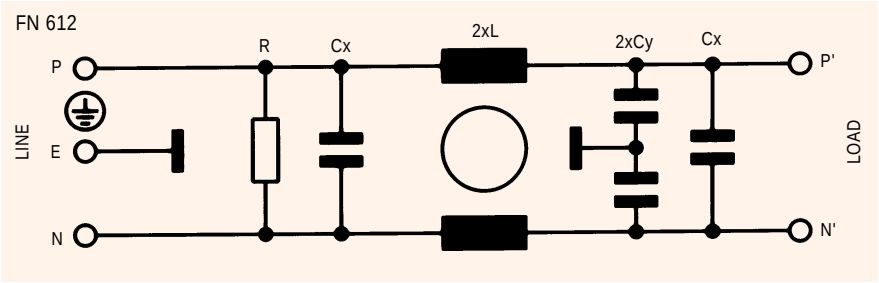
20 amp types



30 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

Two-stage general-purpose filter

FN 660

Like the FN 612, but with an additional inductance stage for higher common mode attenuation, this family is designed to provide an economic solution for many general-purpose filtering requirements. Available in 14 versions, with current ratings from 1 to 20A and with a choice of four different styles of connection, application requirements are easily and economically matched.

- **current ratings from 1 to 20A**
- **high differential and common mode attenuation**
- **four choices of output connector**
- **optional medical versions (B type)**

See Mechanical Data (pages 57, 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 660-3/07 is a 3A filter with wire connections.

Approvals

(16A max. for VDE)

Family	Connections				Current ratings A at 40°C (25°)		Inductance L/L_1 mH	Housing	Weight g			
									/03	/06	/07	/10
FN 660 -1 /??	-	/06	/07	-	1	(1.15)	3/3	H21	-	115	125	-
FN 660 -3 /??	-	/06	/07	-	3	(3.4)	2/2	K1	-	170	180	-
FN 660 -6 /??	-	/06	/07	-	6	(6.9)	0.75/0.75	K1	-	170	180	-
FN 660 -10 /??	-	/06	/07	-	10	(11.5)	0.45/0.45	K21	-	230	240	-
FN 660 -16 /??	/03	/06	-	/10	16	(18.4)	0.44/0.44	K2	290	260	-	290
FN 660 -20 /??	/03	/06	-	/10	20	(23)	0.48/0.48	L1	600	590	-	640

Additional specifications

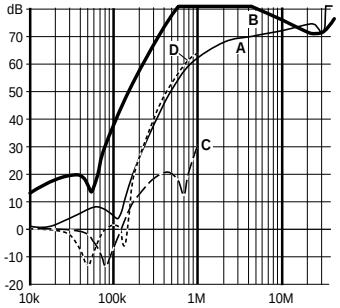
Filter type	Capacitance Cx nF	Capacitance Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VAC
Standard types	150	2.2	1	190	250	50/60	DC to 400	2000	1700
B types (medical)	150	-	1	2	250	50/60	DC to 400	2500	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 350,000 hours (for VDE-approved current ratings).

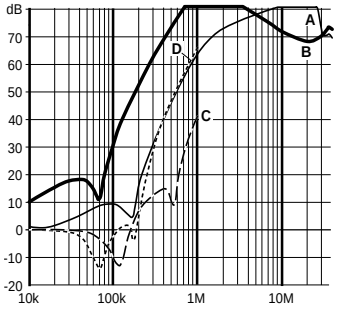
Insertion loss

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

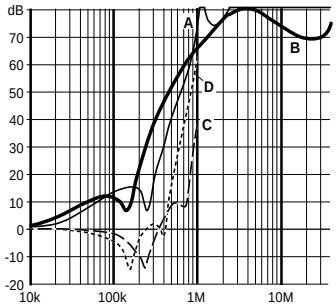
1 amp types



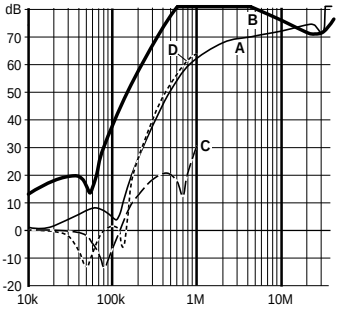
3 amp types



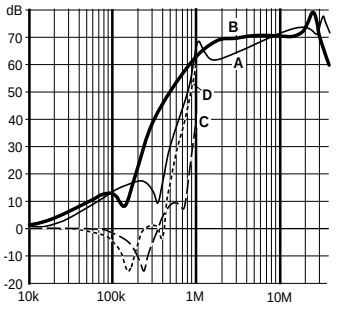
6 amp types



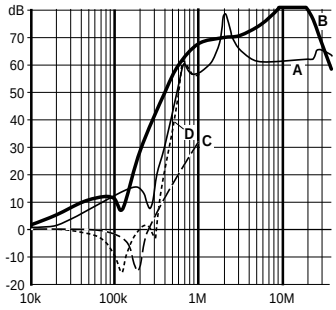
10 amp types



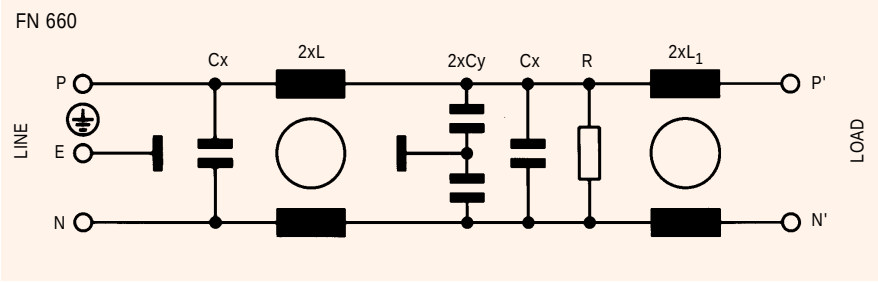
16 amp types



20 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

Two-stage performance filter

FN 670

Like the FN 660, but with even higher component values for excellent common- and differential- mode attenuation especially at high frequencies, this family is designed to provide an economic solution for broadband filtering requirements. Available in 12 versions, with current ratings to 10A, the filters are ideal for use with precision instrumentation, switched-mode power supplies and motor drives.

- **current ratings from 1.8 to 10A**
- **very high differential and common mode attenuation**
- **good high frequency attenuation**

See Mechanical Data (pages 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 670-3/06 is a 3A filter with fast-on connections.

Approvals

Family	Connections		Current ratings		Inductance	Housing	Weight	
			A at 40°C (25°)		L/L_1 mH		g /06	/07
FN 670 -1.8 /??	/06	/07	1.6	(1.8)	7.2/7.2	K2	225	240
FN 670 -3 /??	/06	/07	2.5	(3)	12.2/1.8	K2	240	245
FN 670 -6 /??	/06	/07	5	(6)	7/7	K2	245	260
FN 670 -10 /??	/06	/07	8.0	(10)	10.4/2.7	L1	570	620

Additional specifications

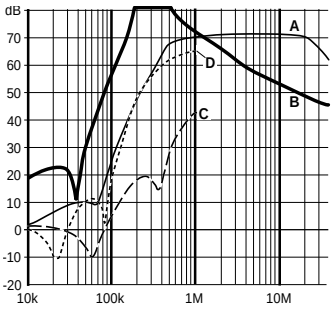
Filter type	Capacitance		Res.	Maximum leakage	Maximum operating voltage		Operating frequency	Hipot test voltage	
	Cx/Cx_1 nF	Cy nF	R MΩ	µA/phase	VAC	Hz	Hz	PN→E VAC	P→N VAC
Standard types	470/150	2.2	0.47	190	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 300,000 hours (for VDE-approved current ratings).

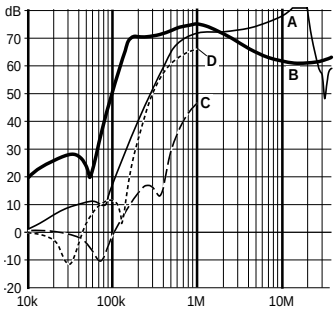
Insertion loss

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

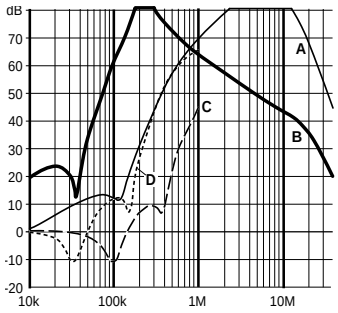
1.8 amp types



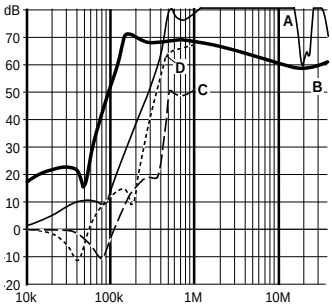
3 amp types



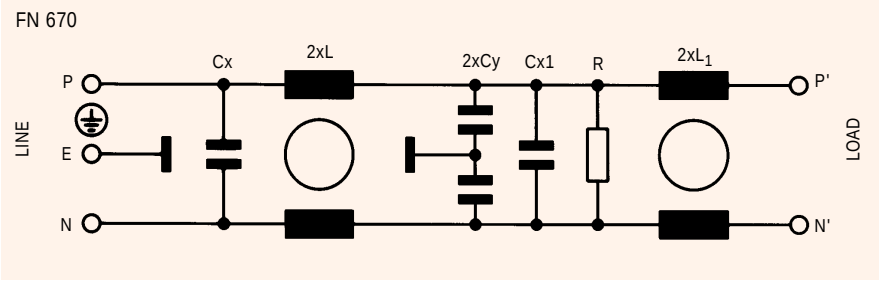
6 amp types



10 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

Two-stage performance filter

FN 680

Like the FN 670, but with improved component values and a rod core for excellent attenuation at all frequencies including low ranges, this general-purpose filter is an excellent choice for protecting against very high levels of interference, such as noisy power supplies. Available in 10 versions, with current ratings from 1 to 10A, application requirements are easily and economically matched.

- **current ratings from 1 to 10A**
- **very high differential and common mode attenuation**
- **good low frequency attenuation**

See Mechanical Data (pages 57, 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 682-4/07 is a 4A filter with wire connections.

Approvals

Family	Connections		Current ratings		Inductance L/L1 mH	Housing	Weight g	
			A at 40°C (25°)				/06	/07
FN 680 -1 /??	/06	/07	1	(1.2)	22.5/1.2	J11	120	130
FN 680 -2.5 /??	/06	/07	2.5	(3)	16/0.27	K2	230	245
FN 682 -4 /??	/06	/07	4	(4.8)	8/0.08	K2	250	255
FN 682 -6.5 /??	/06	/07	6.5	(7.8)	4.1/0.055	L1	590	600
FN 682 -10 /??	/06	/07	10	(12)	4/0.04	L2	950	970

Additional specifications

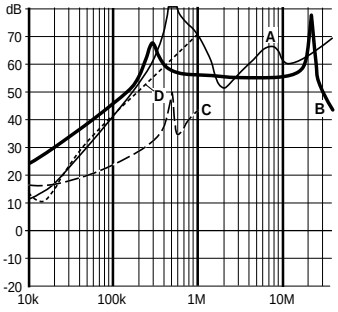
Filter type	Capacitance Cx nF	Capacitance Cy nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VDC
FN 680 types	220	4.7	1	410	250	50/60	DC to 400	2000	1700
FN 682 types (4A)	1000	22	0.33	1900	250	50/60	DC to 400	2000	1700
FN 682 types (6.5-10A)	470	22	0.47	1900	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 1,400,000 hours.

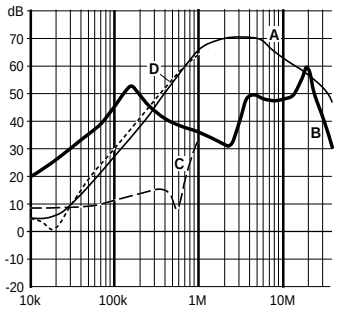
Insertion loss

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

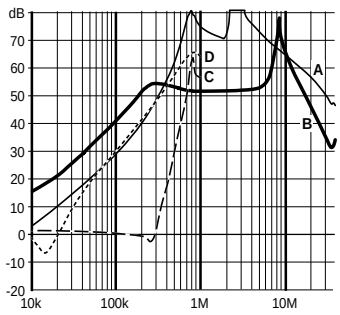
1 amp types



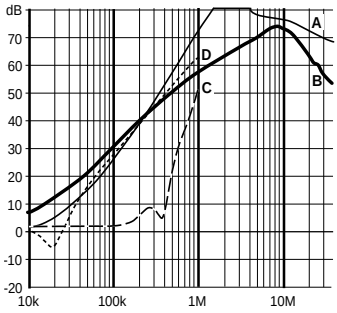
2.5 amp types



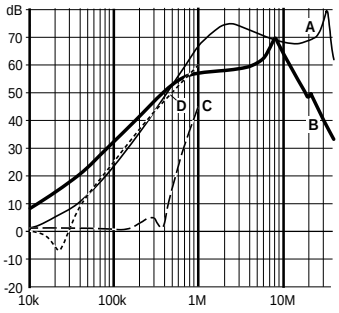
4 amp types



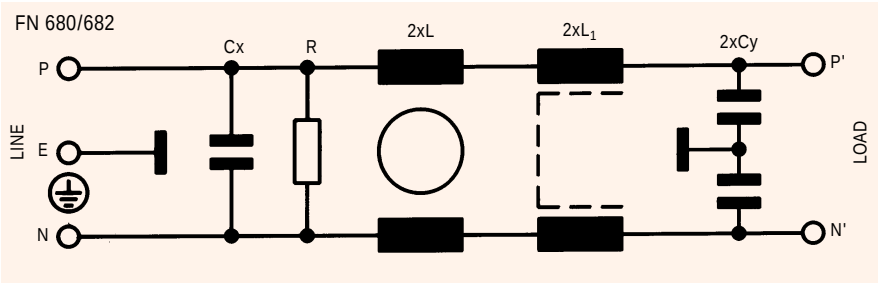
6.5 amp types



10 amp types



Electrical schematics



See tables for component values.

SCHAFFNER

High-power performance filter

FN 685

Like the FN 680, but with even higher inductance values for excellent common- and differential- mode attenuation especially at high frequencies, this family is designed to provide a solution for broadband filtering requirements. Available in 12 versions, with current ratings to 36A, the filters are ideal for use with switched-mode power supplies, computers and other digital systems.

- **current ratings from 10 to 36A**
- **excellent attenuation characteristics**

See Mechanical Data (pages 55 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 685-10/06 is a 10A filter with fast-on connections.

Approvals

Family	Connections			Current ratings		Inductance	Housing	Weight
	⊘	⏚	⊘	A at 40°C	(25°)	L/L_1 mH		g
FN 685 -10 /??	/03	/06	-	10	(12)	4.2/40	B7A	1200
FN 685 -16 /??	/03	/06	-	16	(19.2)	2.3/0.04	B7A	1350
FN 686 -25 /??	-	-	/23	25	(30)	1.35/0.04	B23	2350
FN 686 -36 /??	-	-	/23	36	(43.2)	0.8/0.03	B23	2850

Additional specifications

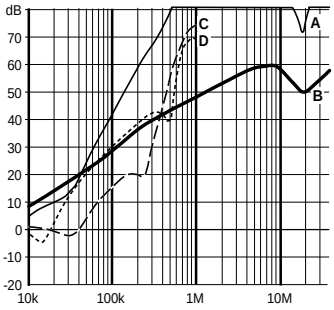
Filter type	Capacitance		Res.	Maximum leakage	Maximum operating voltage		Operating frequency	Hipot test voltage	
	Cx/Cx_1 nF	Cy nF	R MΩ	µA/phase	VAC	Hz	Hz	PN→E VAC	P→N VDC
FN 685 types	470/220	4.7	0.33	410	250	50/60	DC to 400	2000	1700
FN 686 types	470/220	22	0.33	1900	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 400,000 hours.

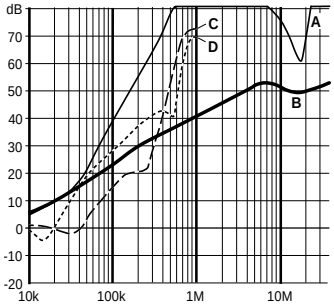
Insertion loss

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

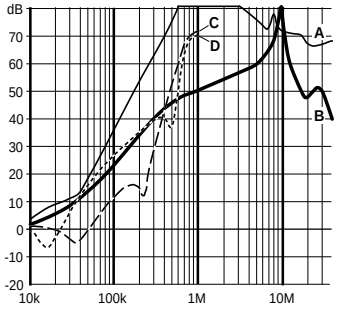
10 amp types



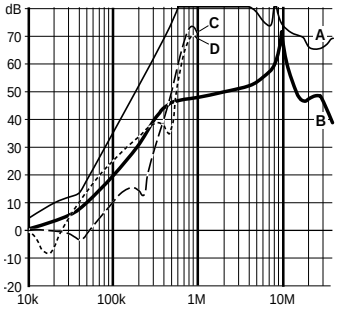
16 amp types



25 amp types

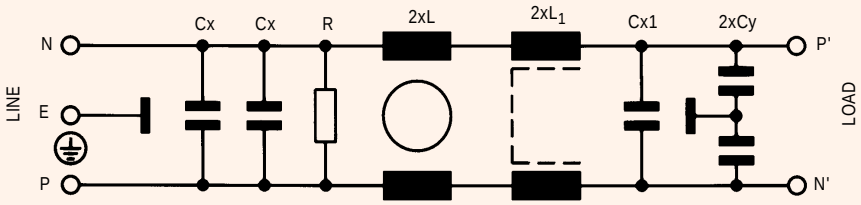


36 amp types



Electrical schematics

FN 685/686



See tables for component values.

SCHAFFNER

Three-stage filter

FN 700Z

Offering outstanding noise suppression at frequencies up to 3GHz, together with protection against nuclear electromagnetic pulses and very high surge voltages, this filter provides a ready-to-use option for high-integrity equipment designs. Applications include systems requiring TEMPEST and NEMP protection, and overcoming sensitive interference problems with commercial equipment.

- **current ratings from 6 to 20A (6 and 10A options with IEC inlets)**
- **TEMPEST**
- **NEMP**
- **attenuation to 3GHz**
- **protection against high surge voltages**

See Mechanical Data (pages 56 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 700Z-20/03 is a 20A filter with M4 screw clamp connections.

Approvals

Family	Connections		Current ratings A at 40°C (25°)		Res R MΩ	Inductance L µH	Inductance L_1 mH	Housing	Weight g
FN 700Z -6 /??	-	/06	6	(6.9)	0.33	50	17.1	B24	2000
FN 700Z -10 /??	-	/06	10	(11.6)	0.33	50	9.4	B25	2300
FN 700Z -20 /??	/03	-	20	(23)	0.33	60	5.5	B26	3500

Additional specifications

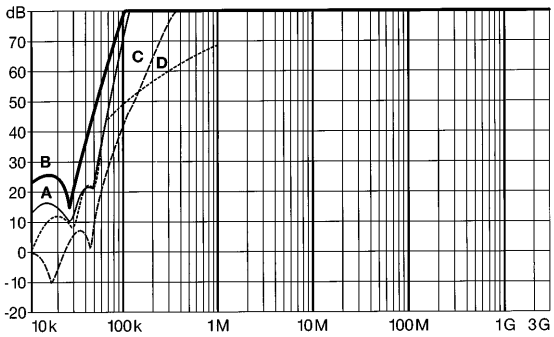
Filter type	Capacitance Cx/Cx_1 µF	Capacitance Cy/Cy_1 nF	Maximum leakage µA/phase	Maximum operating voltage VAC	Maximum operating voltage Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	Hipot test voltage P→N VAC
6A/10A types	1/-	2.5/-	440	250	50/60	DC to 400	590	590
20A types	1/2.2	5/10	2600	250	50/60	DC to 60	590	590

MTBF at 40°C, 230V, per Mil-HB-217F: 450,000 hours.

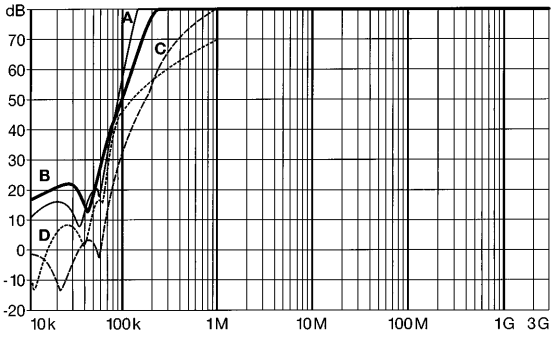
Insertion loss

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

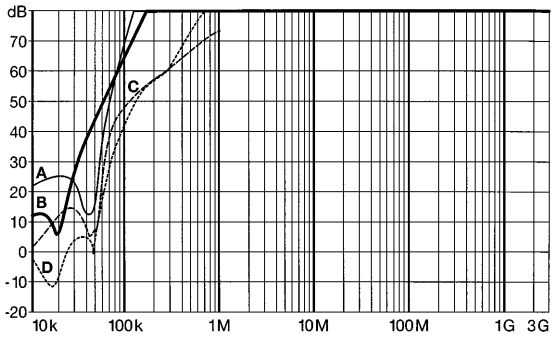
6 amp types



10 amp types

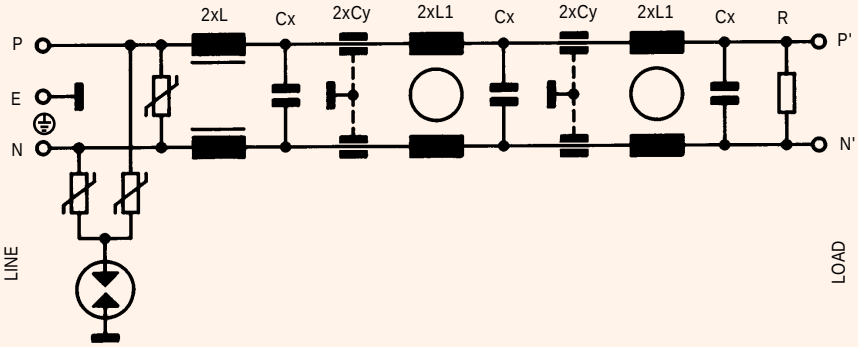


20 amp types

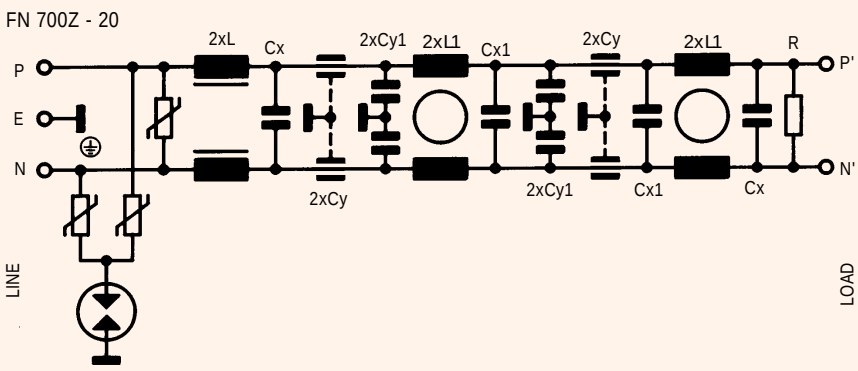


Electrical schematics

FN 700Z-6, FN 700Z-10



FN 700Z - 20



See tables for component values.

SCHAFFNER

Compact performance filter

FN 9675

This one-stage filter is constructed using a novel winding technique, to provide the kind of performance usually found only in more expensive two-stage designs. Consequently, it is an excellent choice for solving more difficult interference problems, where equipment space is at a premium, such as in high-density switched-mode power supplies.

- **current ratings from 3 to 16A**
- **economic high-performance filter**
- **screw or fast-on connections**

See Mechanical Data (pages 58 and 60) for full details of housings and connections.

Filter selection table

Choose the family **FN xxx** with the required current rating and features, and add **/??** to determine input/output (line/load) connection style. Example: FN 9675-3/06 is a 3A filter with fast-on connections.

Approvals

Family	Connections		Current ratings A at 40°C (25°)		Inductance L mH	Capacitance Cx/Cx_1 nF	Housing	Weight g
FN 9675 -3 /??	-	/06	3	(3.5)	18	680/680	K21	270
FN 9675 -6 /??	-	/06	6	(6.9)	3	680/680	K21	270
FN 9675 -16 /??	/03	-	16	(18.4)	10.2	1000/1000	L2	850
FN 9676 -16 /??	/03	-	16	(18.4)	10.2	1000/1000	L2	1050

Additional specifications

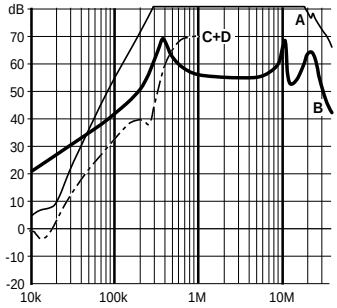
Filter type	Capacitance Cy/Cy_1 nF	Res. R MΩ	Maximum leakage µA/phase	Maximum operating voltage VAC	Hz	Operating frequency Hz	Hipot test voltage PN→E VAC	P→N VDC
FN 9675 types	4.7/-	0.47	410	250	50/60	DC to 400	2000	1700
FN 9676 types	6.8/15	0.47	1900	250	50/60	DC to 400	2000	1700

MTBF at 40°C, 230V, per Mil-HB-217F: 280,000 hours (FN 9675); 400,000 hours (FN 9676).

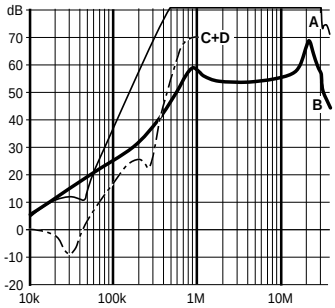
Insertion loss

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

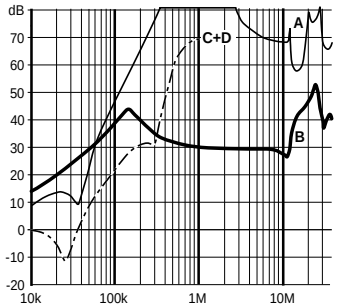
3 amp types



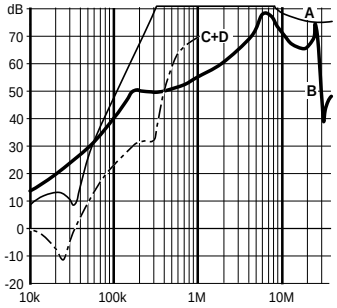
6 amp types



16 amp FN 9675

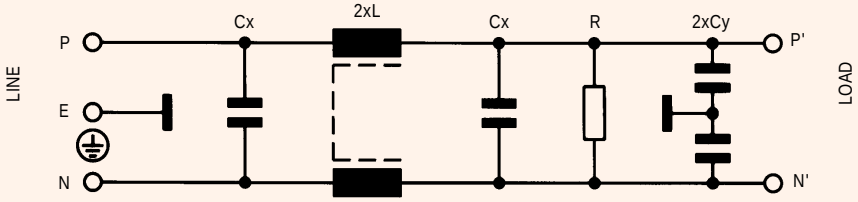


16 amp FN 9676

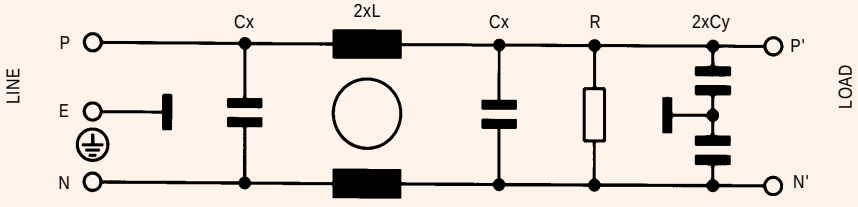


Electrical schematics

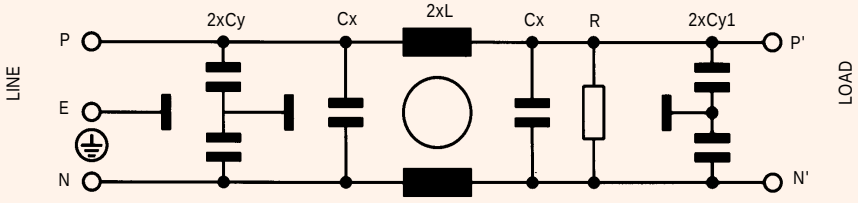
FN 9675 (3 and 6A)



FN 9675 (16A)



FN 9676 (16A)



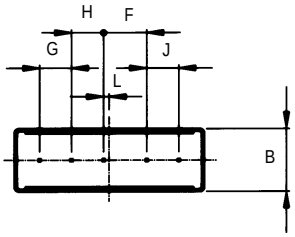
See tables for component values.

SCHAFFNER

	FN 406 **Housing A6**	FN 410 **E1**	FN 421 **A7A**	FN 420, FN 422 **A7B**	Tol.* mm
A	45 ± 0.2	72 ± 0.8	70	83	± 0.5
B	15	33 ± 1	31	41 ± 0.3	± 0.5
C	28	19 ± 0.5	17		± 0.3
D	1.5 ± 0.3		54	65.8	± 0.2
E				31	± 0.5
F	10.16 ± 0.1	60		40	± 0.2
G	7.62	15 ± 0.2		5.5 ± 0.3	± 0.1
H	7.62				± 0.1
J	7.62		15.2 ± 0.3		± 0.1
K				1	± 0.1
L	1.27				-
M				∅5	± 0.1

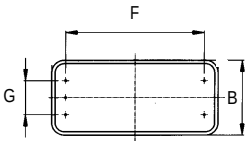
* Measurements share this common tolerance unless otherwise stated.

BOTTOM VIEW



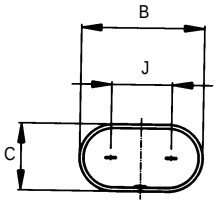
Housing A6

BOTTOM VIEW



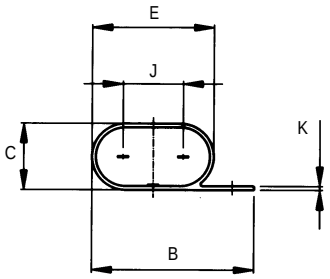
Housing E1

SIDE VIEW



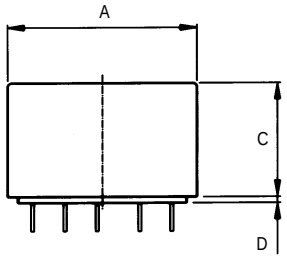
Housing A7A

SIDE VIEW



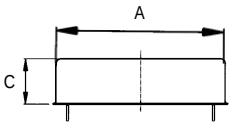
Housing A7B

SIDE VIEW



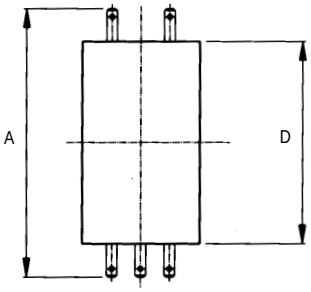
Housing A6

SIDE VIEW



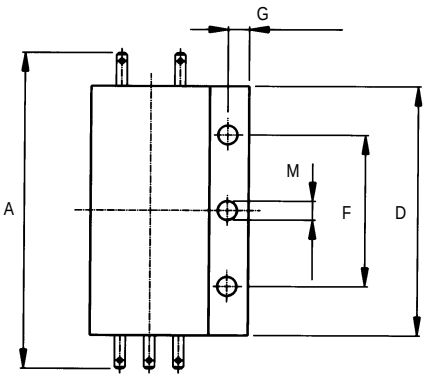
Housing E1

TOP VIEW



Housing A7A

TOP VIEW



Housing A7B

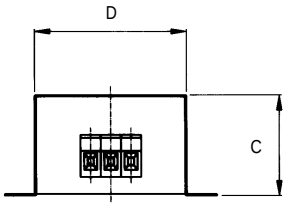
Mechanical Data

SCHAFFNER

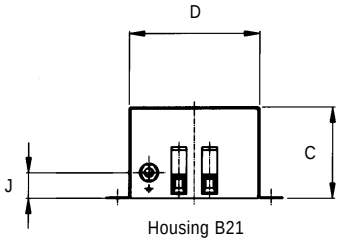
	FN 357-6, -10 FN 685 **Housing B7, B7A**	FN 352Z-10 **B8**	FN 357-16 **B11**	FN 352Z-20 FN 353Z-30 **B13**	FN 350-55 **B21**	FN 352Z-6 **B22**	FN 686 **B23**	Tol.* mm
A	150	150.5	175	200	180	152	170	± 0.5
B	105	126 $^{+0}_{-1}$	130	150	115	51	129 ± 1	± 0.5
C	50	55.25	65		60	45	60	± 0.5
D	75	100.5	100	119.5	85	133	100	± 0.5
E	85	85	90	115	115 ± 0.3	143 ± 0.3	115 ± 0.2	± 0.1
F	90	112 $^{+0}_{-0.4}$	115	135 – 0.6	100		113 ± 0.2	± 0.5
J					17	27		± 0.5
K	11					27	15	± 0.5
L	20					9.5	24	± 0.5
M	6.5		6.5	6.4	6.4	7	6.5	± 0.1
N						5.3		± 0.1

* Measurements share this common tolerance unless otherwise stated.

SIDE VIEW

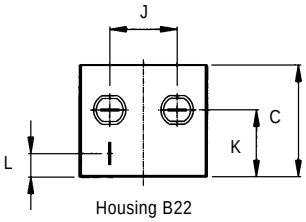


Housing B7, B8, B11
(Connection /29)

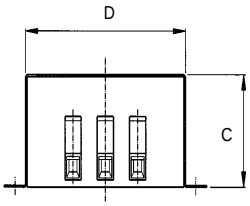


Housing B21
(Connection /33)

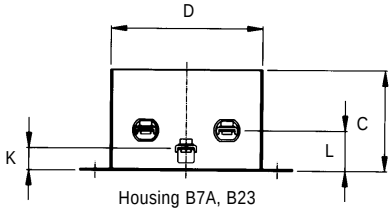
FRONT VIEW



Housing B22

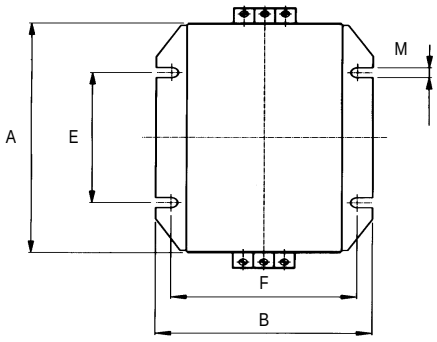


Housing B13
(Connection /33)



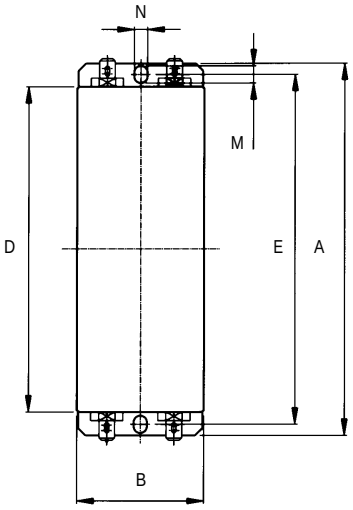
Housing B7A, B23
(Connection /03)

TOP VIEW



Housing B7, B7A, B8, B11,
B13, B21, B23

TOP VIEW



Housing B22

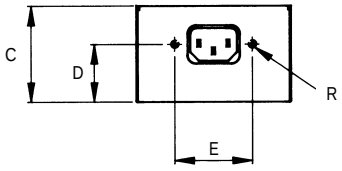
Mechanical Data

SCHAFFNER

	FN 700Z-6 **Housing B24**	FN 700Z-10 **B25**	FN 700Z-20 **B26**	FN 346 **B27**	Tol.* mm
A	200	250	275	75.9 $^{+0}_{-0.3}$	± 0.3
B	80		110	55.6 ± 0.5	± 0.3
C	50			42 ± 0.5	± 0.2
D	30		34 ± 0.2		± 0.3
E	40		94 ± 0.2	40	± 0.1
F	85	100	112.5		± 0.2
G	85	100	112.5		± 0.2
H	15	25	25		± 0.3
J	40		60 ± 0.5	27 ± 0.2	± 0.3
K	30		25 ± 0.3	12	± 0.5
L	20		35 ± 0.5		± 0.3
M	50		94 ± 0.1		± 0.2
R	M4			M3	-
Y				AWG 18	-
Z				140	± 5

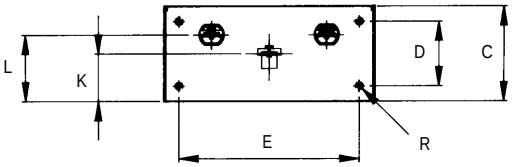
* Measurements share this common tolerance unless otherwise stated.

FRONT VIEW



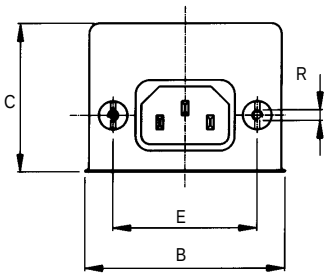
Housing B24, B25

FRONT VIEW



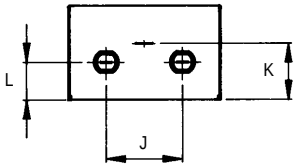
Housing B26

FRONT VIEW



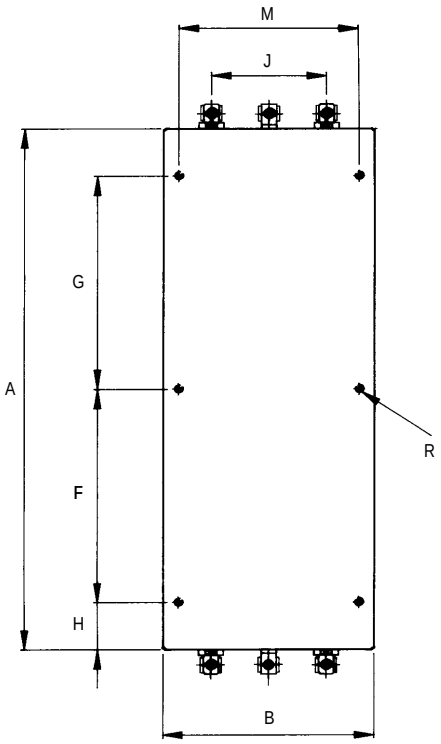
Housing B27

BACK VIEW



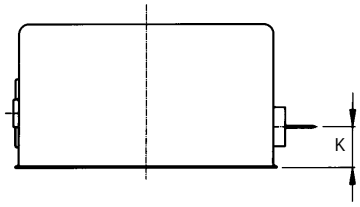
Housing B24, B25

BOTTOM VIEW

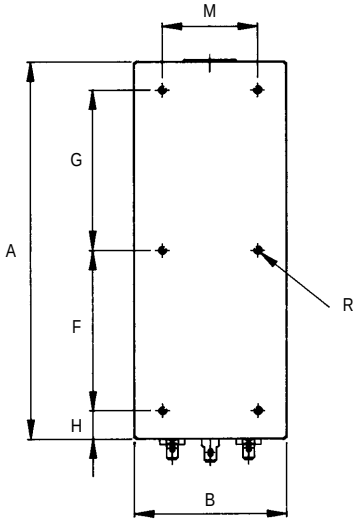


Housing B26

SIDE VIEW

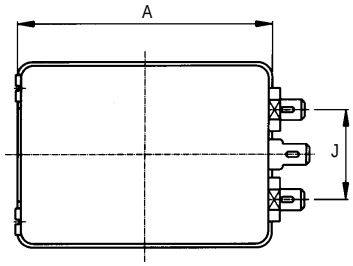


BOTTOM VIEW



Housing B24, B25

TOP VIEW



Housing B27

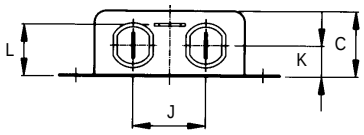
Mechanical Data

SCHAFFNER

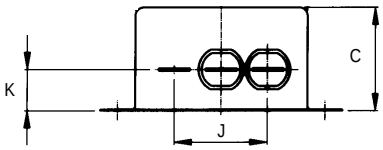
	FN 610 -1-3-6 Housing F1	FN 610-10 F2	FN 332 G1	FN 612-1 H1	FN 612 -3-6-10 H2	FN 612 -20 H2	FN 660-1 H21	FN 610 -20 J1	FN 680-1 J11	FN 343 J2	Tol.* mm
A	64		45	71		85	71			70	± 0.5
B	33		41	46.6 ± 1		54 ± 1	46.6 ± 1	52.6		69	± 0.5
C	19	29	24.8	22 ± 1	29 ± 1	40 ± 1	29 ± 1	29		30 ± 1	± 0.5
D	44		29 ± 0.5	50.5 ± 1		65 ± 1	50.5 ± 1	50.5 ± 1		49.8 ± 1	± 0.3
F	54		37 ± 0.4	61		75	61			60 ± 0.2	± 0.2
J	21		12.5 ± 0.2	21		27	21(J1) 8.5(J2)	21		27	± 0.5
K	9		9.6 ± 0.2	10.5		12	10.5 ± 0.3	14		12	± 0.5
L	15		18.7	16.5	24.5	29.5	19	20			± 0.5
M	5.3		3.5	5.3							± 0.1
N	6.3		3.9	6.3							± 0.1
Y	6			6							± 1
Z	140			140							+ 5

* Measurements share this common tolerance unless otherwise stated.

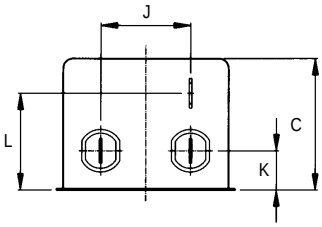
FRONT VIEW



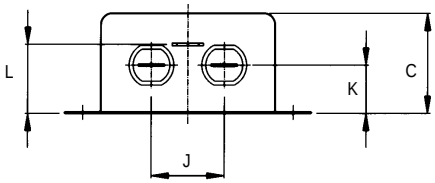
Housing F1, F2, G1
H1, H2, J1, K2



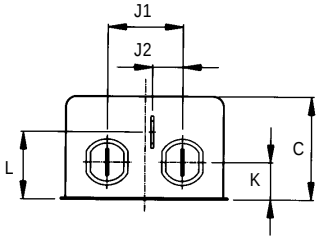
Housing J2



Housing K2

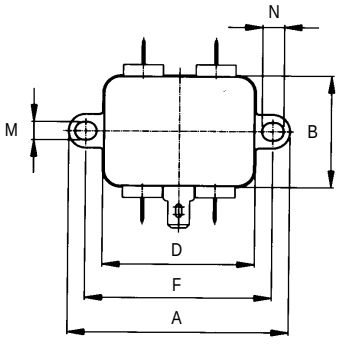


Housing J11

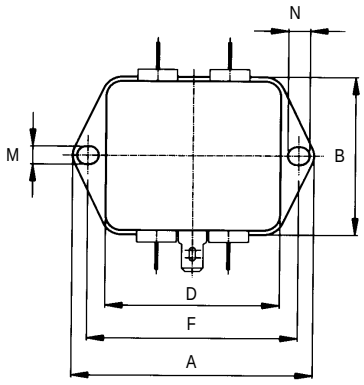


Housing H21, K1

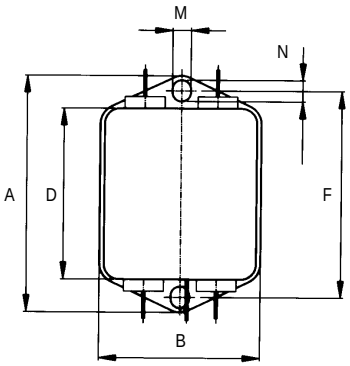
TOP VIEW



Housing F1, F2, G1



Housing H1, H2, J1, J11, J2



Housing H21, K1, K2, K21

Mechanical Data

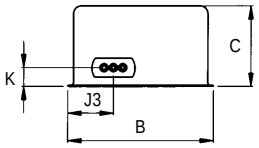
SCHAFFNER

	FN 660-3-6 FN 250-6	FN ‡	FN 250-12	FN §	FN 682-10	FN 9675-16 FN 9676-16	FN 250-20	FN 350 -8-12-20	FN 350-30	Tol.* mm
	K1, K11	**K2, K21**	**K22**	**L1**	**L2**	**L2**	**L4**	**L21**	**L21**	
A	85			105			119	105		± 0.5
B	54			99.5 ± 1			84.5 ± 1	99.5		± 0.5
C	30	40		38	57		38	57		± 1
D	65			84.5			98.5 ± 0.5	84.5		± 1
E				79			66	79		± 0.5
F	75			95			109	95		± 0.2
G				51						± 0.1
J	27(J1) 8.5(J2)17(J3)	27	17 (J3)	40						± 0.5
K	7	12		9.5		11		16	19	± 0.5
L		29.5		19						± 0.5
M	5.3			4.4			4.4			± 0.1
N	6.3			6			7.5	6		± 0.1
W	AWG 16		AWG 16				AWG 14			-
Y	6						6			± 1
Z	300	140 + 5	300				300			+ 10

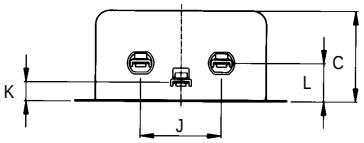
‡ FN 660-10-16, FN 670-1.8-3-6, FN 680-2.5, FN 682-4, FN 9675-3-6
§ FN 610-30, FN 612-30, FN 660-20, FN 670-10, FN 682-6.5

* Measurements share this common tolerance unless otherwise stated.

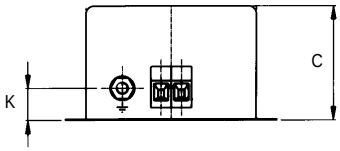
FRONT VIEW



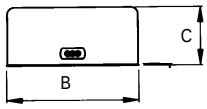
Housing K11, K22



Housing L1, L2

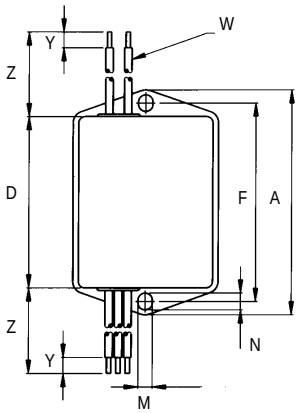


Housing L21

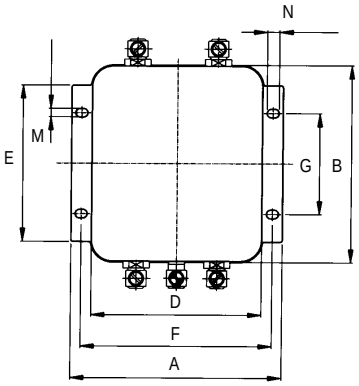


Housing L4

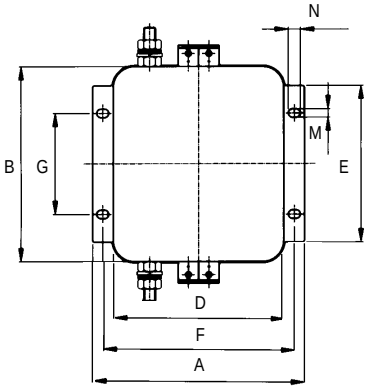
TOP VIEW



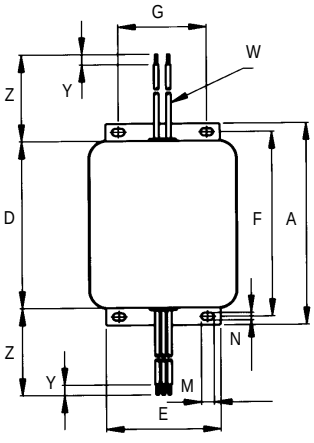
Housing K11, K22



Housing L1, L2



Housing L21



Housing L4

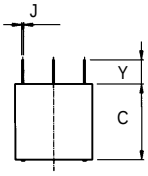
Mechanical Data

SCHAFFNER

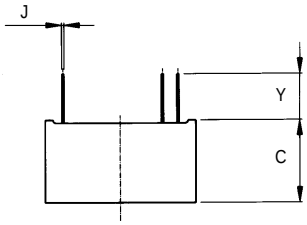
	FN 22 **Housing KA1**	FN 401-0.8 **KA2**	FN 401-1.5 **KA3**	FN 402-A-02 **KA4**	FN 405 **KA4**	FN 402-A-07 **KB1**	FN 402-A-16-38 **KB2**	Tol.* mm
A	25	49		45	36	43.5		± 0.5
B	25	24 ± 0.3	35 ± 0.3	28	31	45		± 0.5
C	25	16	27	16.5	19.5	16.5		± 0.5
D						28		± 0.5
E	15 ± 0.1	15	20	20	15	10 ± 1	7.5 ± 0.5	± 0.2
F	20	22.5	37.5	33	17.5	12 ± 1	7 ± 0.5	± 0.2
G	2.5 ± 0.1	2.5	5	0	0	34		± 0.2
H		6.25	7.5	10	7.5	24 ± 1	23 ± 0.5	± 0.2
J	∅0.6 ± 0.05	∅0.8		∅0.6	∅0.7	AWG 18		± 0.1
K		15	20	10	15	6.5 ± 0.5		± 0.2
M						∅6.5		± 0.1
N						∅3.1		± 0.1
Y	4	15	10	4	5.8	6	10 ± 1	± 0.5
Z						150		+ 5

* Measurements share this common tolerance unless otherwise stated.

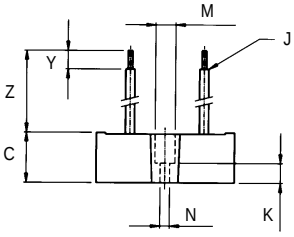
SIDE VIEW



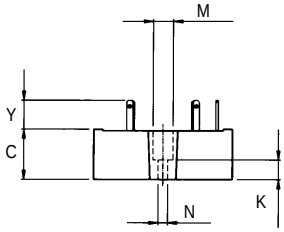
Housing KA1



Housing KA2, KA3, KA4

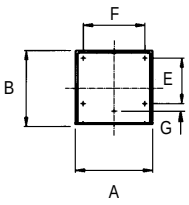


Housing KB1

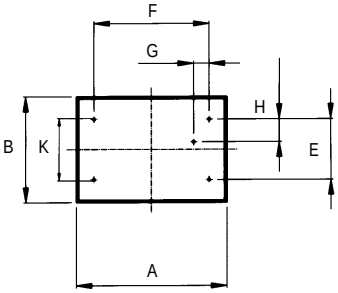


Housing KB2

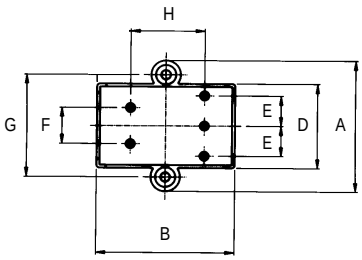
BOTTOM VIEW



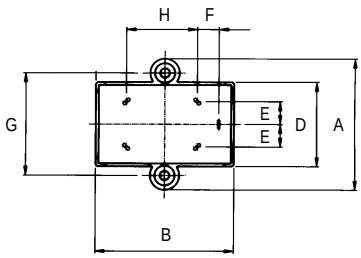
Housing KA1



Housing KA2, KA3, KA4



Housing KB1



Housing KB2

Filter connections

These are the standard types of input and output connections available for Schaffner's range of filter families.

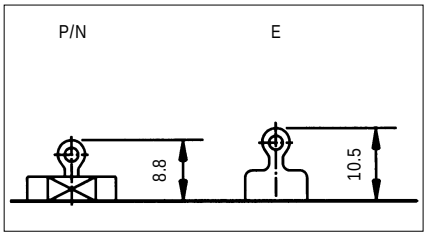
Schaffner can also produce filters with other popular output connectors, or user-specific interfaces, to custom order. Please call your local sales office to discuss any custom requirements.

Cross reference list
AWG to copper area in mm^2

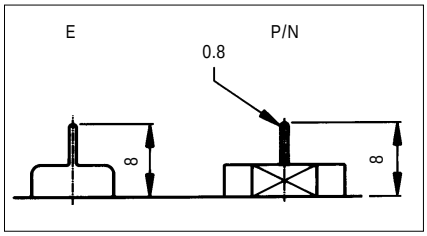
AWG number	Cu mm^2 (approx)
22	0.33
20	0.54
18	0.83
16	1.34
14	2.15
12	3.44

1 inch = 25.4mm

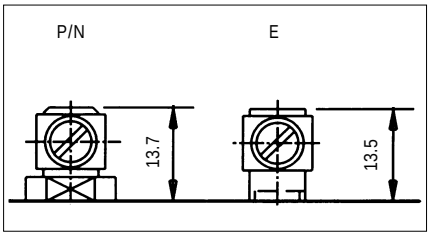
Dimensions in mm



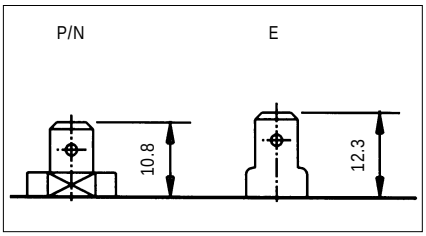
Type /01
Solder lug with a hole capable of accommodating several small wires



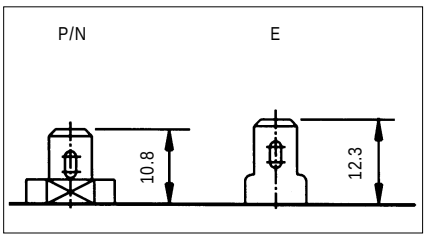
Type /02
Pin suitable for direct assembly onto through-hole printed-circuit boards



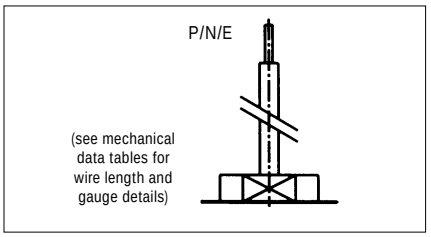
Type /03
Clamp terminal with M4 screw



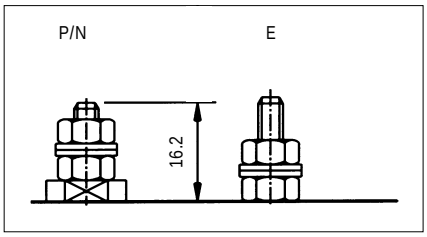
Type /05
Industry-standard size fast-on terminal, 6.3 x 0.8mm



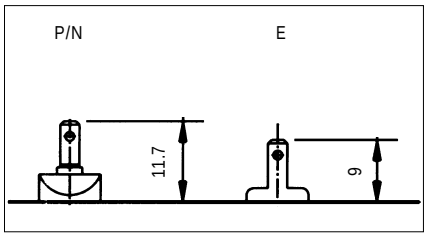
Type /06
Industry-standard size fast-on which may also be used as a solder lug, 6.3 x 0.8mm



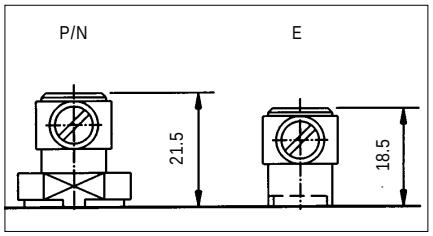
Type /07
Insulated wire, stripped ready for soldering. Wire gauge varies according to filter



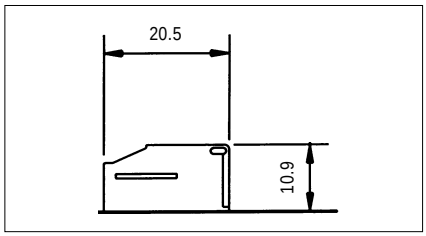
Type /08 = M4 screw
Type /09 = M5 screw
Type /10 = UNC 8-32 screw



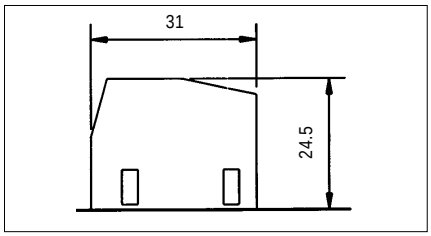
Type /13 = Fast-on, 2.8 x 0.5mm



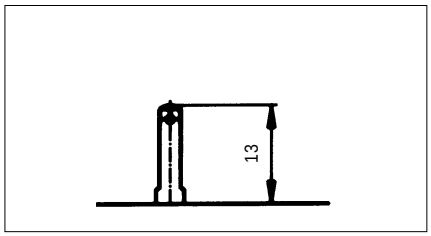
Type /23
Clamp terminal with M5 screw



Type /29
Safety terminal block



Type /33
Safety terminal block



Type /16 = Solder/fast-on, 2.8 x 0.5mm
Type /38 = Fast-on, 2.8 x 0.8mm

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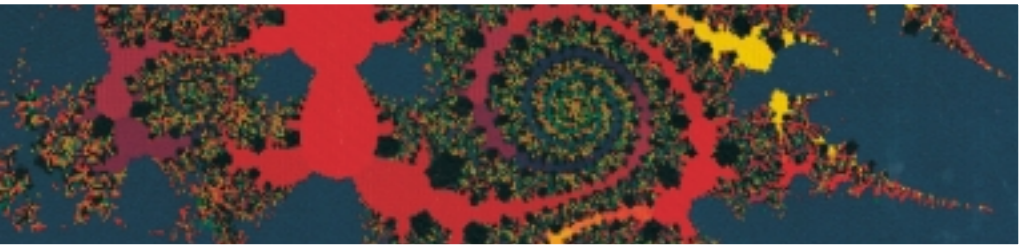

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