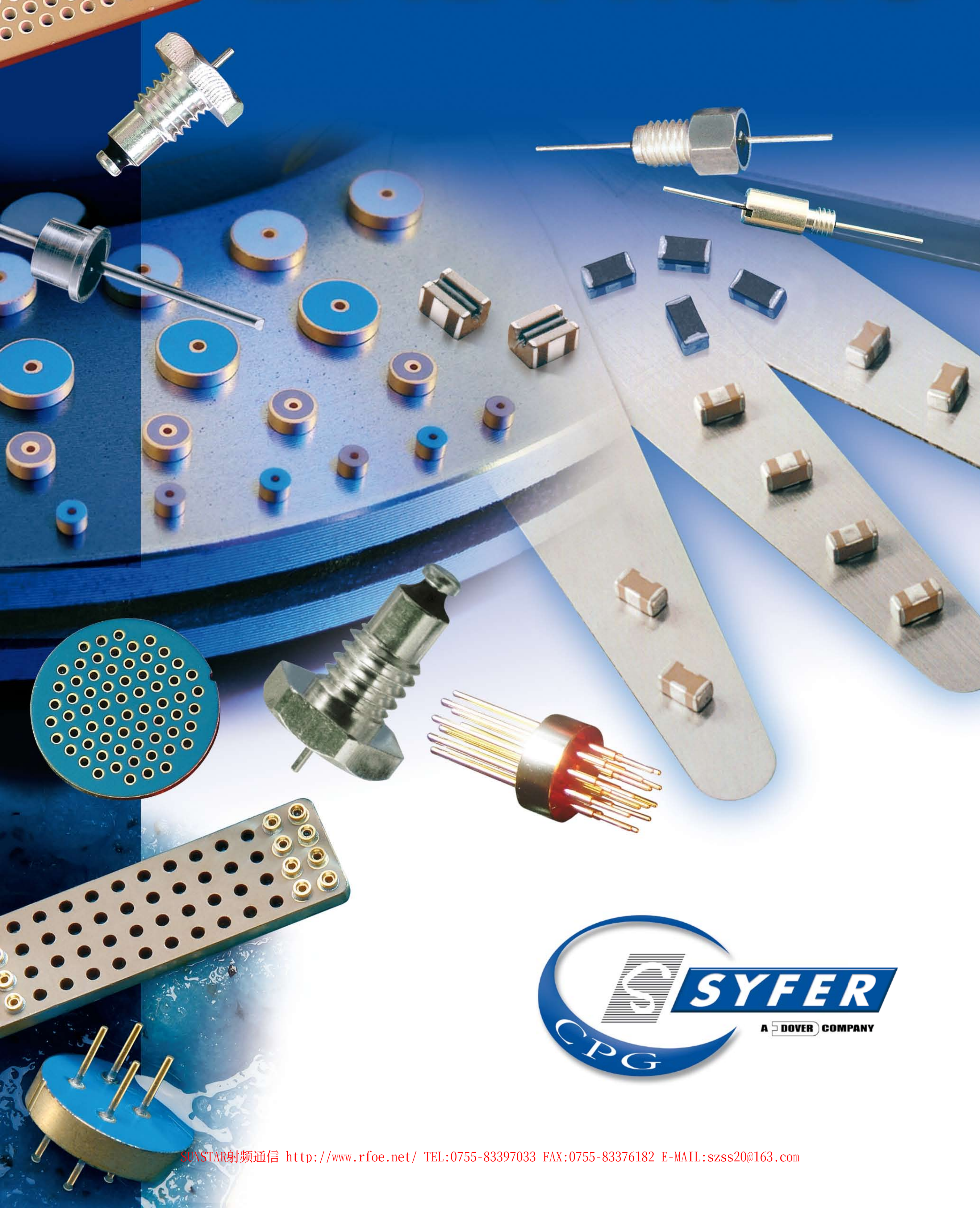
EMI Filters



Introduction to Syfer Technology

Syfer Technology Limited is a UK company dedicated to the manufacture of ceramic based electronic components. Syfer has been producing Multilayer Ceramic Capacitors for over 30 years and its employees are committed to providing customers with high quality products together with a fast, friendly and flexible service from a state-of-the-art facility.

Production process

At the core of Syfer's ceramic manufacturing technology is the 'Wet Process'. This fully integrated computer-controlled manufacturing operation is in a clean room environment, and offers unique advantages in the manufacture of filter products. This has resulted in Syfer being a world leader in the manufacture of EMI filters, discoidal capacitors and planar arrays. Our multilayer ceramic manufacturing facility and filter assembly facility holds a number of internationally recognised approvals including ISO 9001:2000, IS0 14001:2004 and OHSAS 18001:1999. Syfer is also an ESA (European Space Agency) and NASA approved source. Specific product approvals include IECQ CECC, UL, TÜV and AEC-Q200.

Products

Syfer's excellence in ceramic materials technology, combined with EMI filter expertise, has enabled us to offer an unrivalled range of EMI filters products including:

- 3 terminal EMI chips
- Surface mount Pi filters
- X2Y Integrated Passive Components
- Panel mount threaded filters
- Panel mount solder-in filters
- Custom filter assembly capability
- Varistor filters
- Discoidal capacitors
- Planar capacitor and planar varistor arrays

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Benefits

Panel mount filters

- Use of X7R and C0G/NP0 ceramics - no Z5U
- High capacitance values, high voltage

Surface mount EMI filters

- High capacitance, high voltage, high current Pi filters
- FlexiCap™ termination an option
- AEC-Q200 approvals

X2Y

- Available with FlexiCap™ termination
- AEC-Q200 approvals
- Available in surface mount, panel mount and planar array versions

Planar arrays

- Mechanical superiority, tighter mechanical tolerances
- High voltage capability, mixed capacitance values
- NASA approved
- Available in capacitor, varistor, inductor and X2Y formats

Discoidal capacitors

- Small sizes, high capacitance values, high voltage capability
- Custom sizes available
- Varistor discoidal options

Multiway filter assemblies

- Can use either discoidal capacitor elements or planar arrays
- Full custom design facility

Other Syfer products

- Multilayer ceramic chip capacitors
- High voltage MLCCs
- FlexiCap™ capacitors with flexible terminations
- Class 'X' and 'Y' SMD surge and safety capacitors
- Radial leaded capacitors
- AEC-Q200 approved capacitors
- IECQ CECC approved capacitors and radials
- Capacitors for space applications

SYFER
A DOVER COMPANY
CPG

Contents

Syfer - *The EMI Filter Specialist*

The need for EMI filters

The use of electronic equipment is ever-increasing, with greater likelihood of interference from other pieces of equipment. Added to this, circuits with lower power levels that are more easily disturbed means that equipment is increasingly in need of protection from EMI (electromagnetic interference). To meet legislation such as the EU Directive on EMC, in addition to other international regulations such as FCC, EMI filtering is now an essential element of equipment design. Introducing screening measures, eg to the case or cables, may suffice in many instances, but some form of low-pass filtering will often be required.

Faraday Cage

The ideal way of protecting a piece of equipment or circuit from EMI is to totally enclose it in a metal (or conductive) box. This screened enclosure is called a 'Faraday Cage'. Radiated interference is thus prevented from adversely affecting it (Fig 1).

Input/output cabling

In reality however, most pieces of equipment require input and/or output connections, perhaps power cables or signal and control lines. The cables providing these connections can act as antennae, able to pick up interference and also to radiate it (Fig 2). Any cable or wire going in through the equipment case can introduce electrical noise, and also radiate it internally onto other wires and circuits. Similarly, it can provide a path to the outside from any noise generated internally, which can also then be radiated and may in turn adversely affect other equipment.

1. Interference can enter a piece of equipment directly through the cabling (conducted interference).
2. Radiated interference can travel directly to the affected equipment.
3. Interference can exit an EMI source via a cable, subsequently to be radiated from the cable and to the affected equipment.
4. Interference can be radiated from an EMI source and then picked up by a cable entering the affected equipment.

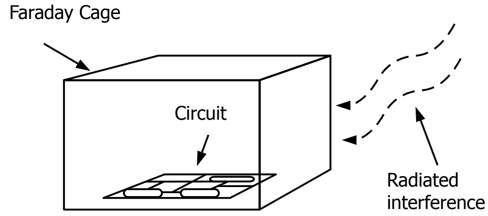
Filter location - panel mount filters

To prevent interference entering or leaving a piece of equipment, feedthrough EMI filters can be mounted in the wall of a shielded case. Any incoming or outgoing cables would then pass through the filters. Power or wanted signals pass through the filters unaffected, whilst higher frequency interference is removed. While the screened case protects against radiated interference, the feedthrough filters protect against conducted interference. The integrity of the equipment is thus assured (Fig 3).

Filter location - surface mount filters

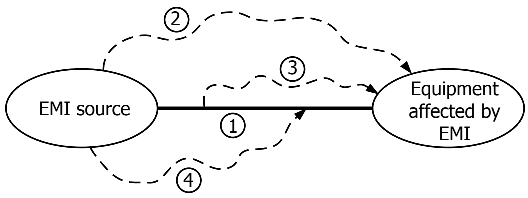
Where there is no suitable bulkhead for mounting the filters, pcb types can be used (Fig 4). While this can be an effective method of filtering, it should be noted that in general the insertion loss performance can be reduced at higher frequencies, unless additional screening measures are taken.

Good design practices such as short tracks, short connections, close proximity to input and good grounding will help improve insertion loss performance.



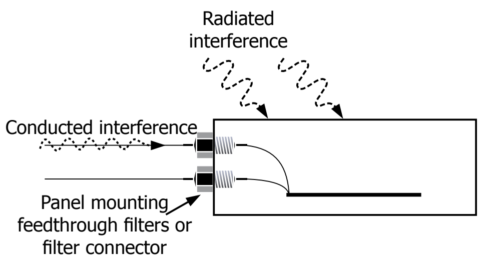
Faraday Cage protects against radiated interference

Fig 1



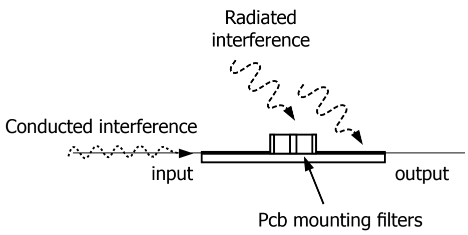
Modes of propagation of EMI

Fig 2



Feedthrough filters remove conducted interference and provide ultimate performance

Fig 3



Surface mount filters remove conducted interference, performance reduced due to radiated interference

Fig 4

Conducted interference
Interference transmitted along a conductor/cable. Protection is provided by a series component. If a feedthrough filter is used to remove conducted interference, and mounted in the wall of a shielded compartment, it provides effective filtering while maintaining the screening integrity. It should be noted that the filter will reduce both emissions and susceptibility.

Cut-off frequency/3dB point
The frequency at which the filter starts to become effective - generally taken to be the 3dB point of the attenuation curve. Anything on the line below this frequency will be unaffected. The higher the capacitance of the filter the lower the cut-off, and vice versa. It will also vary depending on source and load impedances.

EMC
ElectroMagnetic compatibility. A situation wherein two pieces of electrical or electronic equipment are able to function in the same environment without adversely affecting, or being affected by, each other.

EMI
ElectroMagnetic interference. A broad term covering a wide range of electrical disturbances, natural and man-made, from dc to GHz frequencies and beyond. Sources of disturbance may include radar transmitters, motors, computer clocks, lightning, electrostatic discharge and many other phenomena.

Emissions
Signals, unwanted (interference) or otherwise from a piece of equipment.

ESD
Electrostatic discharge, which can result in damage through excessive voltage spikes. We can offer assistance on whether our products can meet specific ESD test requirements.

Insertion loss
At a given frequency, the insertion loss of a feed though suppression capacitor or filter connected into a given transmission system is defined as the ratio of voltages appearing across the line immediately beyond the point of insertion, before and after insertion. As measured herein, insertion loss is represented as the ratio of input voltage required to obtain constant output voltage, with and without the component, in the specified 50Ω system. This ratio is expressed in decibels (dB) as follows:

$$\text{Insertion loss} = 20 \log \frac{E_1}{E_2}$$

Where:

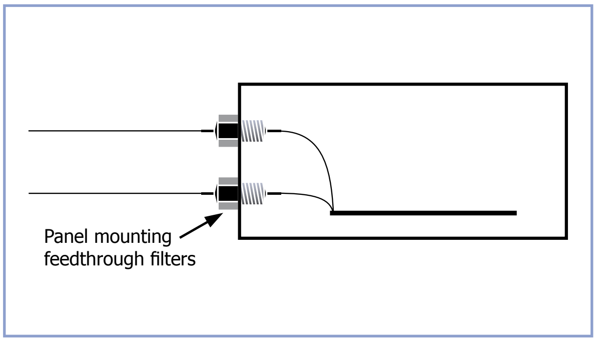
E_1 = The output voltage of the signal generator with the component in the circuit.

E_2 = The output voltage of the signal generator with the component not in the circuit.

When testing is conducted with a network/spectrum analyzer, the equipment usually maintains a constant output voltage and can be set to record the output to input voltage ratio in decibels.

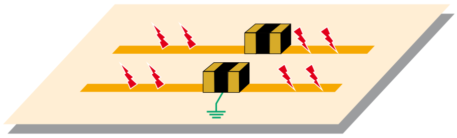
Low-pass filter
A filter that lets through dc and low frequency signals, while attenuating (unwanted) high frequency noise.

Panel mount filter
A panel mounted filter that will pass the signal from one side of the wall of a shielded box (or 'Faraday Cage') to the other (it feeds the signal through the panel). For effective operation, the filter input and output should be screened from each other, ie there should ideally be no apertures in the panel.



Radiated interference
Interference transmitted in free air. Protection is provided by shielding.

Surface mount filter
A filter that is suitable for surface mounting on Pcbs. It offers improved filtering compared to standard MLCCs, ease of assembly and savings on board space compared to a combination of descreet filter elements. Filter performance at higher frequencies is reduced compared to panel mount types, unless additional shielding measures are taken (see page 10).

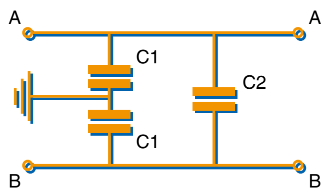


Susceptibility
The extent to which a piece of equipment is vulnerable to interference emitted from another piece of equipment.

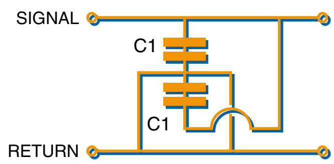
Working voltage
Continuous operating voltage. This can potentially be across the entire operating temperature range.

X2Y filter
Integrated passive component with extremely low self inductance for filtering and de-coupling.

For filtering applications:



For de-coupling applications:



Factors affecting insertion loss

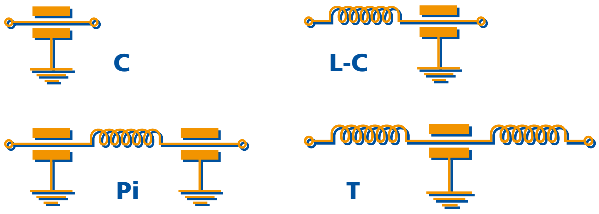
Insertion loss varies with frequency. It is determined by:

- Electrical configuration
- Source/load impedances
- Ceramic dielectric materials. The capacitance change will be affected by applied voltage, temperature and the age of the part
- The load current which can cause ferrite saturation
- Mounting styles ie. panel mount or surface mount

Detailed information can be found on the following two pages.

Electrical configuration

A number of different electrical configurations are available in feedthrough filters, including the common types shown opposite. A single element filter (a capacitor or an inductor) theoretically provides an insertion loss characteristic of 20dB per decade, a dual element filter (capacitor/inductor) 40dB per decade whilst a triple element filter (Pi or T configuration) theoretically yields 60dB per decade. In practise, the insertion loss curves do not exactly match the predictions, and the data sheets should be consulted for the realistic figure. The choice of electrical configuration is made primarily on the source and load impedances and may also be influenced by the level of attenuation required at various frequencies.



C filter

This is a feedthrough capacitor with low self inductance. It shunts high frequency noise to ground and is suitable for use with a high impedance source and load.

L-C filter

This is a feedthrough filter with an inductive element in combination with a capacitor. It is commonly used in a circuit with a low impedance source and a high impedance load (or vice versa). The inductive element should face the low impedance.

Pi filter

This is a feedthrough filter with 2 capacitors and an inductive element between them. Ideally, it should be used where both source and load impedances are high.

T filter

This is a feedthrough filter with 2 series inductive elements separated by one feedthrough capacitor. It is suitable for use where both source and load impedances are low.

Source and load impedances

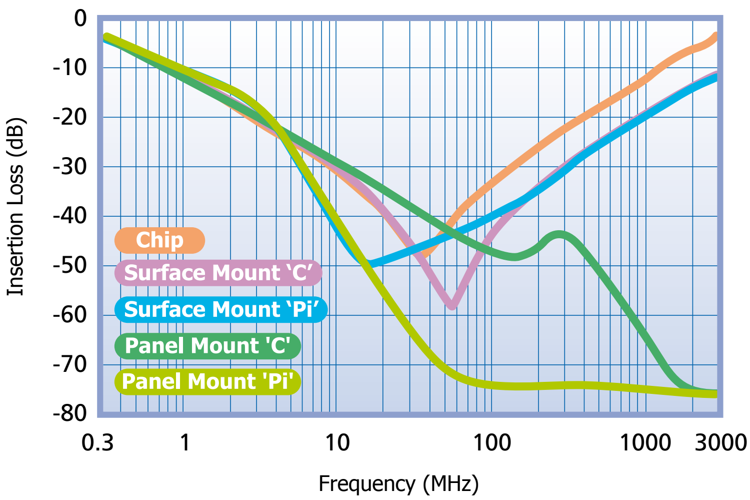
Insertion loss figures are normally published for a 50Ω source and 50Ω load circuit. In practise the impedance values will probably be very different, which could result in either an increase or decrease in insertion loss. The electrical configuration of the filter (the capacitor/inductor combination) should be chosen to optimise the filter performance for that particular source/load impedance situation. An estimate of insertion loss for source and load impedances other than 50Ω can be supplied. Please contact our Sales Office.

Load current

For filters which include ferrite inductors, the insertion loss under load current may be less than that with no load. This is because the ferrite material saturates with current. The reduction in insertion loss depends on the current and the characteristics of the particular ferrite material. In extreme cases the ferrite will become ineffective and insertion loss will appear to be the same as for a C filter. For further information contact the Sales Office.

Attenuation curve

A plot of insertion loss versus frequency on a logarithmic scale.



Choice of ceramic dielectric material

When choosing a filter, it is important to be aware of the different performance characteristics that may be available from different categories of ceramic materials employed in their capacitors. Generally, stability of dielectric constant (and therefore filter capacitance value), with respect to some operational and environmental parameters, deteriorates with increasing dielectric constant. Specific factors which affect dielectric constant are temperature, voltage, frequency and time (ageing).

The three main classifications of ceramic dielectric employed in the manufacture of EMI filters are generally referred to as ultra stable (C0G/NP0), stable (X7R) and general purpose (Z5U, Y5V or X7W).

C0G/NP0

Most parameters for materials in this dielectric classification are relatively unaffected by temperature, voltage, frequency or time. Stabilities are measured in terms of parts per million but dielectric constants are relatively low (10 to 100).

X7R

This is a classification for materials which are relatively stable with respect to temperature, voltage, frequency and time. Typical dielectric constants would be of the order 2,000 to 4,000, enabling the achievement of far higher capacitance values for a given size of capacitor than can be gained from C0G/NP0 materials.

If the voltage coefficient (Vc) is critical, Syfer are also able to offer parts with BX (2X1) and BZ (2C1) Vc characteristics. Refer to the factory for further details.

Z5U/Y5V/X7W

These are classifications for materials which are relatively unstable with respect to temperature, voltage, frequency and time. Whilst typical dielectric constants may be of the order 5,000 to 25,000, operating temperature ranges are severely restricted.

A summary of the specifications of these materials follows. Please note that Syfer uses only the higher performance C0G/NP0 and X7R in its standard ranges.

Summary of Ceramic Dielectric Characteristics

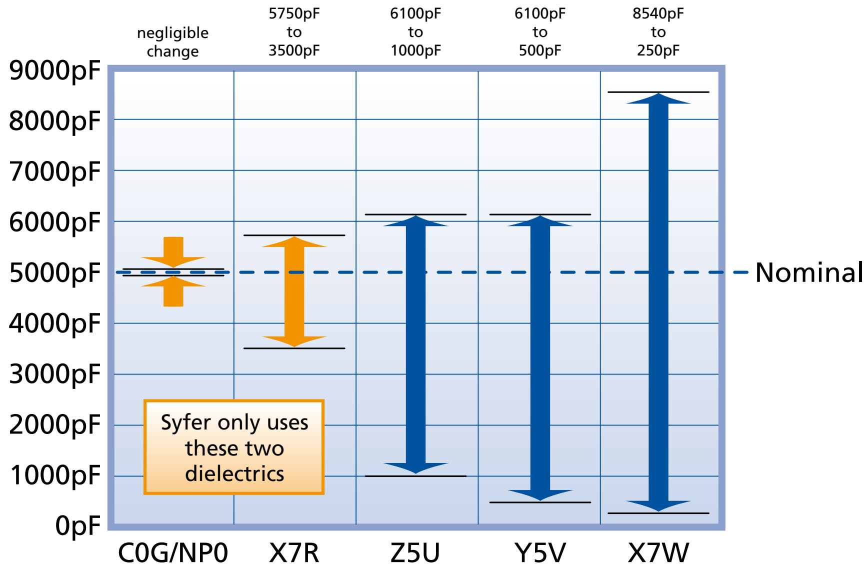
	C0G/NP0	X7R	Z5U	Y5V	X7W
EIA dielectric classification	Ultra stable	Stable	General purpose		
Rated temperature range	-55ºC to +125ºC	-55ºC to +125ºC	-10ºC to +85ºC	-30ºC to +85ºC	-55ºC to +125ºC
Maximum capacitance change over temperature range (no voltage applied)	0 ±30 ppm/°C	±15%	+22-56%	+22-56%	+40-90%
Ageing characteristics	Zero	1% per time decade	6% per time decade	6% per time decade	6% per time decade

Spread of capacitance values

The capacitance of a ceramic capacitor can change as a result of a change in temperature, applied voltage and age. Please note that this potential change can lead to a significant drop in filtering performance.

Example

Consider the typical performance of 5,000pF filter capacitors, offered in standard dielectric classifications, operating at a voltage of 100Vdc at 85°C, at an age of 10,000 hours. The final capacitance value can fall within the range of values (see chart to the right), taking into account the ageing process and effects of temperature and voltage as shown in the chart above.



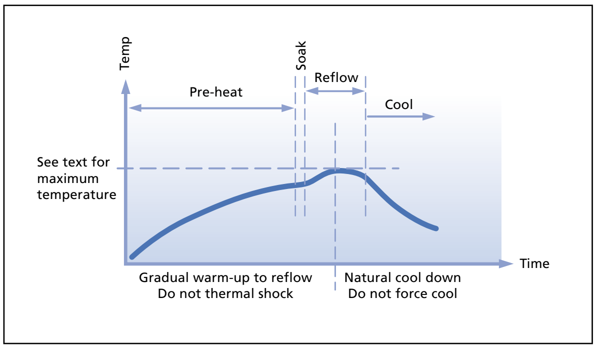
It is clear that the capacitance can change as a result of an increase (or decrease) in temperature, applied voltage and as a result of ageing. If the capacitance has reduced, so too will the insertion loss performance.

Installation of filters

Surface mount and panel mount solder-in filters

Solder pad layouts are included with the detailed information for each part.

Recommended soldering profile



Soldering of filters

The soldering process should be controlled such that the filter does not experience any thermal shocks which may induce thermal cracks in the ceramic dielectric.

The pre-heat temperature rise of the filter should be kept to around 2°C per second. In practice successful temperature rises tend to be in the region of 1.5°C to 4°C per second dependent upon substrate and components.

The introduction of a soak after pre-heat can be useful as it allows temperature uniformity to be established across the substrate thus preventing substrate warping. The magnitude or direction of any warping may change on cooling imposing damaging stresses upon the filter.

E01, E03, E07 SBSP ranges are compatible with all standard solder types including lead-free, maximum temperature 260°C. For SBSG, SBSM and SFSS ranges, solder time should be minimised, and the temperature controlled to a maximum of 220°C. For SFSR, SFST and SFSU ranges the maximum temperature is 250°C.

Cooling to ambient temperature should be allowed to occur naturally. Natural cooling allows a gradual relaxation of thermal mismatch stresses in the solder joints. Draughts should be avoided. Forced air cooling can induce thermal breakage, and cleaning with cold fluids immediately after a soldering process may result in cracked filters.

Note: The use of FlexiCap™ terminations is strongly recommended to reduce the risk of mechanical cracking.

Soldering to axial wire leads

Soldering temperature

The tip temperature of the iron should not exceed 300°C.

Dwell time

Dwell time should be 3-5 seconds maximum to minimise the risk of cracking the capacitor due to thermal shock.

Heat sink

Where possible, a heat sink should be used between the solder joint and the body, especially if longer dwell times are required.

Bending or cropping of wire leads

Bending or cropping of the filter terminations should not be carried out within 4mm (0.157”) of the epoxy encapsulation, the wire should be supported when cropping.

Panel mount screw-in filters

General

The ceramic capacitor, which is the heart of the filter, can be damaged by thermal and mechanical shock, as well as by over-voltage. Care should be taken to minimise the risk of stress when mounting the filter to a panel and when soldering wire to the filter terminations.

Mounting to chassis

Mounting torque

It is important to mount the filter to the bulkhead or panel using the recommended mounting torque, otherwise damage may be caused to the capacitor due to distortion of the case. When a threaded hole is to be utilised, the maximum mounting torque should be 50% of the specified figure which relates to unthreaded holes. For details of torque figures for each filter range, please see below.

	Torque (max.)	
Thread	With nut	Into tapped hole
M2.5 & 4-40 UNC	-	0.15Nm (1.7lbf in)
M3	0.25Nm (2.8lbf in)	0.15Nm (1.7lbf in)
6-32 UNC	0.3Nm (3.4lbf in)	0.15Nm (1.7lbf in)
M3.5	0.35Nm (4lbf in)	0.18Nm (2lbf in)
M4 & 8-32 UNC	0.5Nm (5.6lbf in)	0.25Nm (2.8lbf in)
M5, 12-32 UNEF & 2BA	0.6Nm (6.8lbf in)	0.3Nm (3.4lbf in)
M6 & 1/4-28 UNF	0.9Nm (10.2lbf in)	-

Tools

Hexagonal devices should be assembled using a suitable socket. Round bodied filters may be fitted to the panel in one of two ways (and should not be fitted using pliers or other similar tools which may damage them):

- Round bodies with slotted tops are designed to be screwed in using a simple purpose-designed tool.
- Round bodies without slotted tops are intended to be inserted into slotted holes and retained with a nut.

Grounding

To ensure the proper operation of the filters, the filter body should be adequately grounded to the panel to allow an effective path for the interference. The use of locking adhesives is not recommended, but if used should be applied after the filter has been fitted.

Minimum plate thickness

Users should be aware that the majority of filters in this catalogue have an undercut between the thread and the mounting flange of the body, equal to 1.5 x the pitch of the thread. Mounting into a panel thinner than this undercut length may result in problems with thread mating and filter position. It is recommended that a panel thicker than this undercut length be used wherever possible.

Maximum plate thickness

This is specified for each filter in order that the nut can be fully engaged even when using a washer.

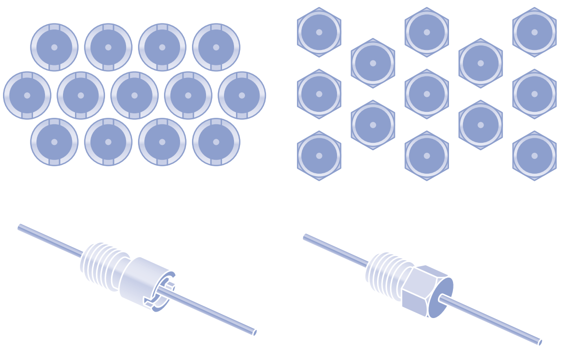
Soldering to wire leads and bending or cropping of wire leads. See section above for full details.

Thread size or head size? What's the crucial factor in spacing

The thread size has no relevance to the mounting pitch, but can influence cost. Very small threads are harder to work with, but offer little or no gain over larger thread sizes.

If close mounting pitch is important, change instead to a round body style. Mounted using modified screwdriver blades, this style of component removes the need to allow space for mounting sockets and allow components to be mounted almost touching each other.

Syfer offer a full range of round head filter types - SFNO, SFKB, SFKK, SFLM, SFMD and SFUM. Special requirements can also be considered.



Schematic showing the pitch improvement that can be gained with round head filters compared to traditional hexagon heads

Hermetic seals vs resin seals

Resin sealed filters have epoxy encapsulants injected into the cavities either side of the filter elements. The purpose of the resin is to 'ruggedise' the assembly, supporting the pins and sealing the ceramic to prevent reliability issues such as moisture ingress. Poor encapsulants can be susceptible to cracking away from the metalwork due to temperature change. This can then allow moisture penetration which can result in reliability concerns. They can also exert a force on the ceramic which can result in cracking causing electrical failure.

Screw mount 'hermetic' filters generally have glass to metal seals soldered into place instead of conventional resin seals. Unless fitted with sealing rings, they will not normally provide a gas seal between either side of the mounting bulkhead. The act of soldering the hermetic seal into place can result in problems due to multiple soldering operations. Care must be taken when using the filters, as the exposed solder joints can be prone to reflowing, compromising the seal effectiveness.

Solder mount hermetic filters may create a gas seal between either side of the bulkhead, but this is generally dependent on the sealing capabilities of the solder joint rather than the filter seal. Usually, solder mount filters only have a glass seal on one side of the filter body.

Syfer filters are all resin sealed, but use a very high purity, highly filled, epoxy encapsulant with a very low co-efficient of thermal expansion - very closely matched to the expansion co-efficient of the ceramic and other materials used in the construction. These characteristics enable Syfer filters to be thermally cycled with very little stress being applied to the ceramic elements, and with reduced risk of cracking ensuring no moisture ingress.

Discoidal capacitor vs tubular capacitor

The original panel mount filters used single layer tubular capacitors. There is one major advantage of this type of capacitor - it lends itself to very easy Pi filter construction. For this reason, Pi filters have tended to be considered the optimum filter configuration.

As performance demands increased, higher capacitance values were required. High K, unstable (Z5U / Y5V see page 7) dielectrics and multilayer tubes began to be used. These use buried layer electrodes within the tube walls, but the reduced dielectric thickness resulted in lower voltage withstand capability. The unstable dielectrics result in poor performance over the voltage and temperature ranges.

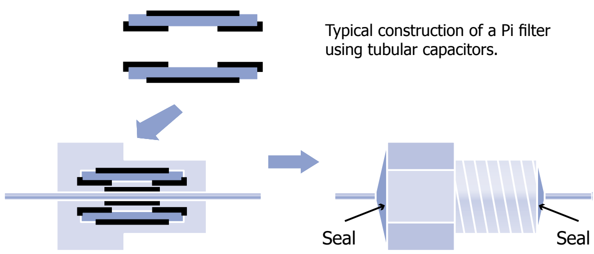
Tubular capacitors have one major flaw - the thin ceramic walls make them very prone to cracking causing electrical failures.

As MLCC chip capabilities developed, the discoidal capacitor appeared in filters. These devices use MLCC chip technology to produce a very low inductance (low ESL / low ESR) capacitor giving improved performance and higher capacitance and voltage ranges (higher capacitance per unit voltage). They are physically much stronger and robust than tubes.

All Syfer panel mount filters use discoidal capacitors for optimum mechanical strength and high quality X7R or C0G/NP0 dielectric materials for optimum electrical performance.

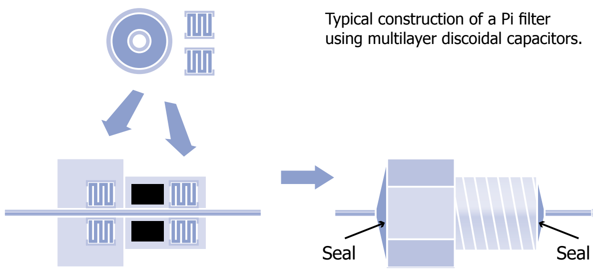
	Advantages	Disadvantages
Tube based filters	Cheap. Suited to Pi filter manufacture.	Low capacitance only, not robust – easily cracked multilayer tubes = higher capacitance but low voltage.
Disc based filters	Robust. High capacitance. C, L-C, & T circuits easy. Very high capacitance Pi filters possible. Tight tolerance possible. Vc characteristics possible.	Low capacitance Pi filters, relatively expensive.

Tubular capacitor



Typical construction of a Pi filter using tubular capacitors.

Multilayer discoidal capacitor



Typical construction of a Pi filter using multilayer discoidal capacitors.

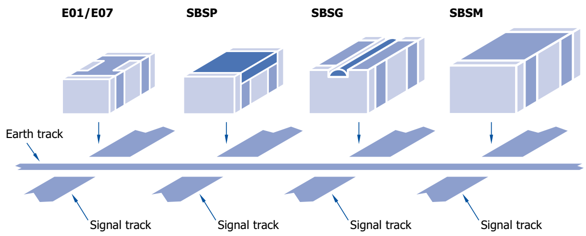
Notes: 1) For dimensions and pad sizes see page 12.
2) For ordering information see page 13.

Type		E01			E07			SBSGC	SBSMC
Chip Size		0805	1206	1806	0805	1206	1806	1812	2220
Max Current		300mA	300mA	300mA	1A	2A	2A	10A	20A
Rated Voltage	Dielectric	Minimum and maximum capacitance values							
50Vdc	C0G/NP0	680pF-820pF	-	-	-	-	-	-	-
	X7R	22nF-47nF	22nF-100nF	100nF-200nF	4.7nF-47nF	33nF-100nF	47nF-200nF	220nF	470nF
100Vdc	C0G/NP0	22pF-560pF	22pF-1nF	22pF-2.2nF	-	-	-	-	-
	X7R	1nF-15nF	1.5nF-15nF	3.3nF-68nF	1nF-3.3nF	10nF-22nF	22nF-33nF	100nF-150nF	220nF-330nF
200Vdc	C0G/NP0	-	-	-	-	-	-	-	-
	X7R	-	-	-	-	-	-	68nF	100nF-150nF
500Vdc	C0G/NP0	-	-	-	-	-	-	-	-
	X7R	-	-	-	-	-	-	1nF-47nF	1nF-68nF

Effects of mounting method on insertion loss

C and Pi filters are mounted to pcbs and soldered in identical manner to chip capacitors. Solder connections made to each end (signal lines) and each side band (earth track).

Whilst SBSG, SBSM and SBSP filters can be mounted conventionally on pcbs, they are also suitable for mounting in a wall or partition on a board. This greatly improves the screening between filter input and output, thereby enhancing the high frequency response.



The following insertion loss curves (for SBSP, SBSG, SBSM Pi filters), based on actual measurements, show the effect. It can be seen that the filters conventionally mounted (Fig. 1) exhibit a drop in attenuation at higher frequencies. Improved shielding methods (Fig. 2), maintain excellent suppression characteristics to 1GHz and above. See below for application example.

Figure 1. Filters mounted on open pcb

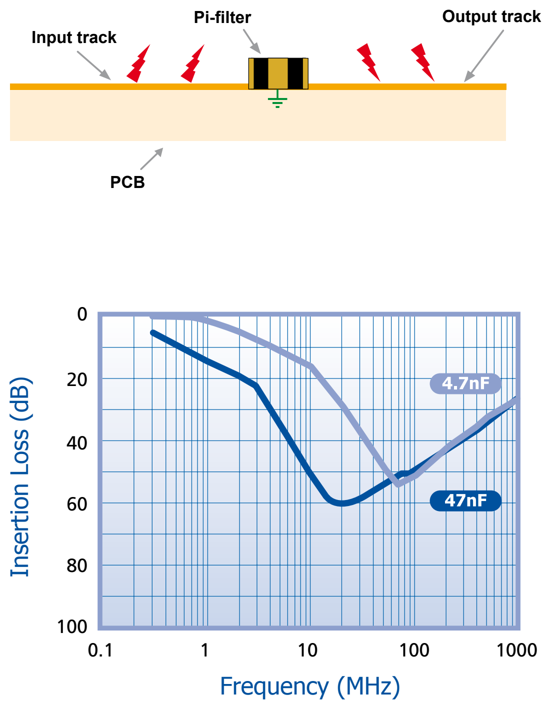
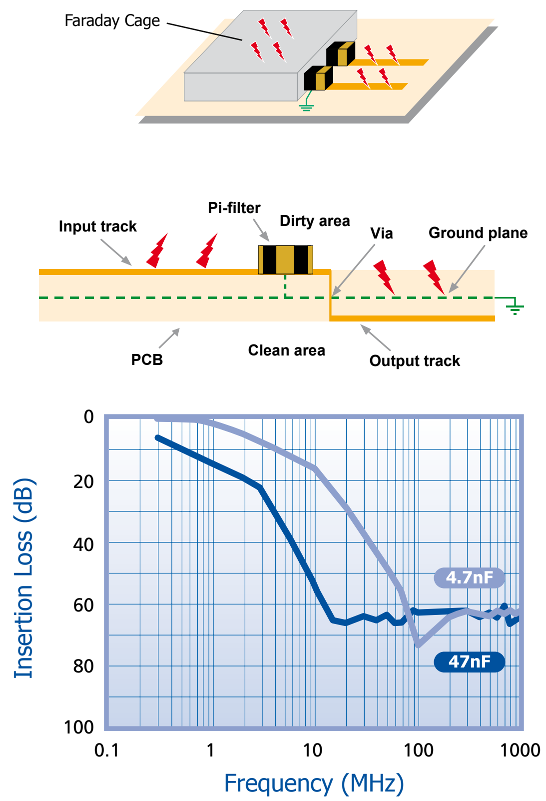


Figure 2. Improved shielding



Notes: 1) For dimensions and pad sizes see page 12.
2) For ordering information see page 13.

Type		SBSPP	SBSGP	SBSMP
Chip Size		1206	1812	2220
Max Current		1A	5A	10A
Rated Voltage	Dielectric	Minimum and maximum capacitance values		
25Vdc	C0G/NP0	-	-	-
	X7R	100nF-150nF	-	-
50Vdc	C0G/NP0	-	-	-
	X7R	22nF-68nF	220nF	470nF
100Vdc	C0G/NP0	22pF-470pF	-	-
	X7R	1nF-15nF	100nF-150nF	220nF-330nF
200Vdc	C0G/NP0	-	-	-
	X7R	-	68nF	100nF-150nF
500Vdc	C0G/NP0	-	-	-
	X7R	-	1nF-47nF	1nF-68nF

Insertion loss tables for surface mount EMI filters - C filter

	Open Board Performance						Feedthrough or Shielded Performance				
Capacitance	0.1MHz	1MHz	10MHz	100MHz	1GHz	Resonance Freq (MHz) approx.	0.1MHz	1MHz	10MHz	100MHz	1GHz
22pF	0	0	0	0	28	1100	0	0	0	0	10
33pF	0	0	0	1	24	790	0	0	0	0	12
47pF	0	0	0	2	20	640	0	0	0	1	15
68pF	0	0	0	4	17	500	0	0	0	2	18
100pF	0	0	0	5	15	405	0	0	0	4	22
150pF	0	0	0	8	14	330	0	0	0	7	25
220pF	0	0	1	12	13	260	0	0	0	10	29
330pF	0	0	1	13	13	200	0	0	0	13	33
470pF	0	0	2	19	12	160	0	0	1	16	35
560pF	0	0	3	21	12	150	0	0	1	17	37
680pF	0	0	4	24	12	130	0	0	2	19	39
820pF	0	0	5	25	12	120	0	0	3	21	40
1nF	0	0	6	28	12	100	0	0	4	23	41
1.5nF	0	0	8	35	12	80	0	0	7	26	45
2.2nF	0	0	12	47	12	60	0	0	10	30	50
3.3nF	0	1	15	43	12	50	0	0	13	33	52
4.7nF	0	2	18	39	12	40	0	1	16	36	55
6.8nF	0	4	21	37	12	32	0	2	19	39	57
10nF	0	5	25	35	12	25	0	4	22	41	60+
15nF	0	8	28	34	12	20	0	7	25	44	60+
22nF	0	12	31	34	12	15	0	10	29	46	60+
33nF	1	15	35	33	12	12	0	13	33	48	60+
47nF	2	18	39	32	12	10	1	16	35	50	60+
68nF	3	21	43	32	12	8.5	2	19	39	54	60+
100nF	6	24	49	32	12	7	4	22	41	57	60+
150nF	8	27	55	32	12	5.5	7	25	45	60+	60+
220nF	11	31	65	32	12	4.2	10	29	49	60+	60+
330nF	14	34	60	32	12	3.5	13	33	52	60+	60+
470nF	17	37	60	32	12	2.8	16	35	55	60+	60+

Insertion loss tables for surface mount EMI filters - Pi filter

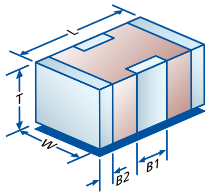
	Open Board Performance						Feedthrough or Shielded Performance				
Capacitance	0.1MHz	1MHz	10MHz	100MHz	1GHz	Resonance Freq (MHz) approx.	0.1MHz	1MHz	10MHz	100MHz	1GHz
22pF	0	0	0	2	22	1100	0	0	0	1	12
47pF	0	0	0	3	15	640	0	0	0	3	21
100pF	0	0	0	7	14	405	0	0	0	7	32
220pF	0	0	1	14	12	260	0	0	1	13	45
470pF	0	0	3	23	12	160	0	0	2	22	58
1nF	0	0	6	31	12	100	0	0	5	33	60+
1.5nF	0	0	8	32	12	80	0	0	9	40	60+
2.2nF	0	0	12	32	12	60	0	0	11	47	60+
3.3nF	0	1	15	32	12	50	0	0	14	54	60+
4.7nF	0	2	19	32	12	40	0	1	19	57	60+
6.8nF	0	4	24	32	12	32	0	2	24	60+	60+
10nF	0	5	29	32	12	25	0	5	29	60+	60+
15nF	0	8	35	32	12	20	0	7	36	60+	60+
22nF	0	11	41	32	12	15	0	11	42	60+	60+
33nF	1	13	46	32	12	12	0	14	51	60+	60+
47nF	2	15	49	32	12	10	1	16	57	60+	60+
68nF	3	18	51	32	12	8.5	3	19	60+	60+	60+
100nF	6	19	52	32	12	7.5	5	21	60+	60+	60+
150nF	8	20	52	32	12	5.5	8	23	60+	60+	60+
220nF	11	25	52	32	12	4.2	11	27	60+	60+	60+
330nF	14	34	52	32	12	3.5	14	35	60+	60+	60+
470nF	17	41	52	32	12	2.8	17	41	60+	60+	60+

Notes: 1) All dimensions mm (inches).
2) Pad widths less than chip width gives improved mechanical performance.
3) Insulating the earth track underneath the filters is acceptable and can help avoid displacement of filter during soldering.

E01

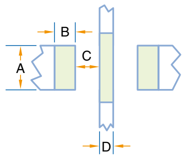
300mA

C



	0805	1206	1806
L	2.0 ± 0.3 (0.079 ± 0.012)	3.2 ± 0.3 (0.126 ± 0.012)	4.5 ± 0.35 (0.177 ± 0.014)
W	1.25 ± 0.2 (0.049 ± 0.008)	1.6 ± 0.2 (0.063 ± 0.008)	1.6 ± 0.2 (0.063 ± 0.008)
T	1.0 ± 0.15 (0.039 ± 0.006)	1.1 ± 0.2 (0.043 ± 0.008)	1.1 ± 0.2 (0.043 ± 0.008)
B1	0.60 ± 0.2 (0.024 ± 0.008)	0.95 ± 0.3 (0.037 ± 0.012)	1.4 ± 0.3 (0.055 ± 0.012)
B2	0.3 ± 0.15 (0.012 ± 0.006)	0.5 ± 0.25 (0.02 ± 0.01)	0.5 ± 0.25 (0.02 ± 0.01)

Recommended solder lands

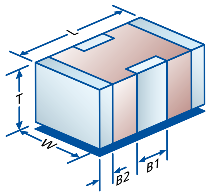


	0805	1206	1806
A	0.95 (0.037)	1.2 (0.047)	1.2 (0.047)
B	0.9 (0.035)	0.9 (0.035)	1.4 (0.055)
C	0.3 (0.012)	0.6 (0.024)	0.8 (0.03)
D	0.4 (0.016)	0.8 (0.03)	1.4 (0.055)

E07

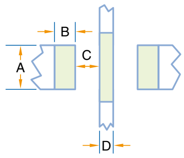
1Amp / 2Amp

C



	0805	1206	1806
L	2.0 ± 0.3 (0.079 ± 0.012)	3.2 ± 0.3 (0.126 ± 0.012)	4.5 ± 0.35 (0.177 ± 0.014)
W	1.25 ± 0.2 (0.049 ± 0.008)	1.6 ± 0.2 (0.063 ± 0.008)	1.6 ± 0.2 (0.063 ± 0.008)
T	1.0 ± 0.15 (0.039 ± 0.006)	1.1 ± 0.2 (0.043 ± 0.008)	1.1 ± 0.2 (0.043 ± 0.008)
B1	0.60 ± 0.2 (0.024 ± 0.008)	0.95 ± 0.3 (0.037 ± 0.012)	1.4 ± 0.3 (0.055 ± 0.012)
B2	0.3 ± 0.15 (0.012 ± 0.006)	0.5 ± 0.25 (0.02 ± 0.01)	0.5 ± 0.25 (0.02 ± 0.01)

Recommended solder lands

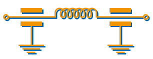


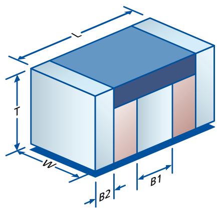
	0805	1206	1806
A	0.95 (0.037)	1.2 (0.047)	1.2 (0.047)
B	0.9 (0.035)	0.9 (0.035)	1.4 (0.055)
C	0.3 (0.012)	0.6 (0.024)	0.8 (0.03)
D	0.4 (0.016)	0.8 (0.03)	1.4 (0.055)

SBSP

1Amp

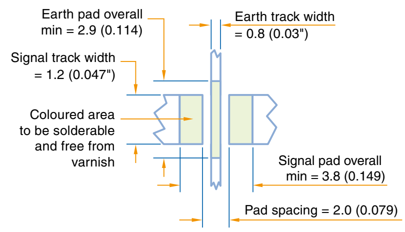
Pi





	1206
L	3.2 ± 0.3 (0.126 ± 0.012)
W	1.6 ± 0.3 (0.063 ± 0.008)
T	1.6 ± 0.2 (0.063 ± 0.008)
B1	0.95 ± 0.3 (0.037 ± 0.012)
B2	0.5 ± 0.25 (0.02 ± 0.01)

Recommended pad/track details

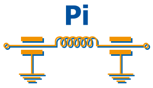


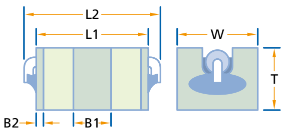
SBSG

5Amp / 10Amp

C

Pi

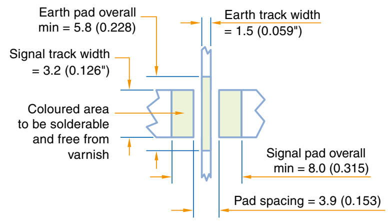




Tin plated solderable termination area
Solder joint from filter manufacture

	1812
L1	4.55 ± 0.25 (0.179 ± 0.010)
L2	5.25 ± 0.4 (0.207 ± 0.015)
W	3.20 ± 0.2 (0.126 ± 0.008)
T	2.50 ± 0.15 (0.098 ± 0.006)
B1	1.50 ± 0.4 (0.059 ± 0.015)
B2	0.30 ± 0.25 (0.012 ± 0.010)

Recommended pad/track details

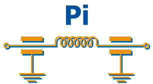


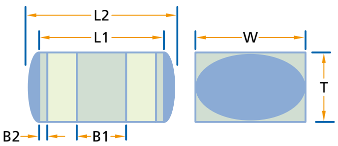
SBSM

10Amp / 20Amp

C

Pi



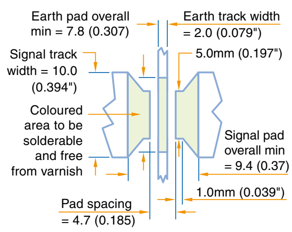


Tin plated solderable termination area
Solder joint from filter manufacture

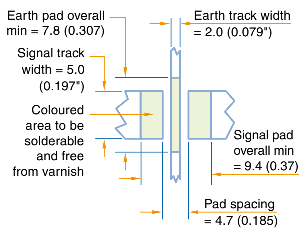
	2220
L1	5.7 ± 0.4 (0.224 ± 0.015)
L2	6.6 ± 0.4 (0.260 ± 0.015)
W	5.0 ± 0.4 (0.197 ± 0.015)
T	3.18 ± 0.2 (0.125 ± 0.008)
B1	2.25 ± 0.4 (0.088 ± 0.015)
B2	0.30 ± 0.25 (0.012 ± 0.010)

Recommended pad/track details

C Filter



Pi filter



Ordering Information

1206	Y	100	0222	M	X	T	E01
Chip Size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Tolerance**	**Dielectric**	**Packaging**	**Type**
0805 1206 1806	J = Nickel Barrier (Tin) Y = FlexiCap™ (Tin) A = (Tin/Lead) H = FlexiCap™ (Tin/Lead)	50 = 50Vdc 100 = 100Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0222=2200pF.	M = ±20%	C = C0G/ NP0 X = X7R	T=178mm (7”) reel R=330mm (13”) reel B = Bulk	

Reeled quantities

178mm (7”) reel	0805	1206	1806
	3000	2500	2500

330mm (13”) reel	0805	1206	1806
	12000	10000	10000

Ordering Information

1206	Y	100	0103	M	X	T	E07
Chip Size	**Termination**	**Voltage**	**Capacitance in picofarads (pF)**	**Tolerance**	**Dielectric**	**Packaging**	**Type**
0805 1206 1806	J = Nickel Barrier (Tin) Y = FlexiCap™ (Tin) A = (Tin/Lead) H = FlexiCap™ (Tin/Lead)	50 = 50Vdc 100 = 100Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0103=10nF.	M = ±20%	X = X7R	T=178mm (7”) reel R=330mm (13”) reel B = Bulk	

Reeled quantities

178mm (7”) reel	0805	1206	1806
	3000	2500	2500

330mm (13”) reel	0805	1206	1806
	12000	10000	10000

Ordering Information

SBS	P	P	100	0153	M	X	T
Type	**Size**	**Configuration**	**Voltage**	**Capacitance in picofarads (pF)**	**Tolerance**	**Dielectric**	**Packaging**
Surface mount board filter	P = 1206	P = Pi Section	025 = 25Vdc 050 = 50Vdc 100 = 100Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0153=15nF.	M = ±20%	C=C0G/ NP0 X=X7R	T=178mm (7”) reel R=330mm (13”) reel B = Bulk

Reeled quantities

178mm (7”) reel	1206
	1500

330mm (13”) reel	1206
	6000

Ordering Information

SBS	G	P	500	0473	M	X	T
Type	**Size**	**Configuration**	**Voltage**	**Capacitance in picofarads (pF)**	**Tolerance**	**Dielectric**	**Packaging**
Surface mount board filter	G = 1812	C = C Section P = Pi Section	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 500 = 500Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0473=47nF.	M = ±20%	X=X7R	T=178mm (7”) reel R=330mm (13”) reel B = Bulk

Reeled quantities

178mm (7”) reel	1812
	500

330mm (13”) reel	1812
	2000

Ordering Information

SBS	M	P	050	0474	M	X	T
Type	**Size**	**Configuration**	**Voltage**	**Capacitance in picofarads (pF)**	**Tolerance**	**Dielectric**	**Packaging**
Surface mount board filter	M = 2220	C = C Section P = Pi Section	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 500 = 500Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0474=470nF.	M = ±20%	X=X7R	T=178mm (7”) reel R=330mm (13”) reel B = Bulk

Reeled quantities

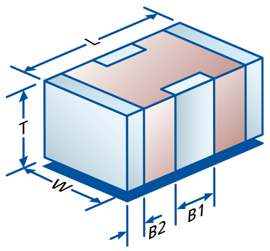
178mm (7”) reel	2220
	500

330mm (13”) reel	2220
	2000

X2Y

Type		E03					
Chip size		0603	0805	1206	1410	1812	2220
Rated voltage	Dielectric	Minimum and maximum capacitance values					
16Vdc	C0G/NP0	150pF	-	-	-	-	-
	X7R	15nF	-	-	-	-	-
25Vdc	C0G/NP0	120pF	560pF-820pF	1.8nF-3.3nF	6.8nF-8.2nF	12nF-15nF	22nF-33nF
	X7R	12nF	56nF-68nF	-	470nF	820nF	1.2µF
50Vdc	C0G/NP0	10pF-100pF	390pF-470pF	1.2nF-1.5nF	4.7nF-5.6nF	8.2nF-10nF	18nF
	X7R	150pF-10nF	18nF-47nF	56nF-220nF	180nF-400nF	390nF-680nF	560nF-1.0µF
100Vdc	C0G/NP0	-	10pF-330pF	22pF-1.0nF	100pF-3.9nF	820pF-6.8nF	1.0nF-15nF
	X7R	-	470pF-15nF	1.5nF-47nF	4.7nF-150nF	8.2nF-330nF	10nF-470nF

Note: For some lower capacitance parts, higher voltage rated parts may be supplied.



	0603	0805	1206	1410	1812	2220
L	1.6±0.2 (0.063±0.008)	2.0±0.3 (0.08±0.012)	3.2±0.3 (0.126±0.012)	3.6±0.3 (0.14±0.012)	4.5±0.35 (0.18±0.014)	5.7±0.4 (0.22±0.016)
W	0.8±0.2 (0.03±0.008)	1.25±0.2 (0.05±0.008)	1.60±0.2 (0.063±0.008)	2.5±0.3 (0.1±0.012)	3.2±0.3 (0.126±0.012)	5.0±0.4 (0.2±0.016)
T	0.5±0.15 (0.02±0.006)	1.0±0.15 (0.04±0.006)	1.1±0.2 (0.043±0.008)	2 max. (0.08 max.)	2 max. (0.08 max.)	2.5 max. (0.1 max.)
B1	0.4±0.15 (0.016±0.006)	0.5±0.25 (0.02±0.01)	0.95±0.3 (0.037±0.012)	1.20±0.3 (0.047±0.012)	1.4±0.35 (0.06±0.014)	2.25±0.4 (0.09±0.016)
B2	0.25±0.15 (0.010±0.006)	0.3±0.15 (0.012±0.006)	0.5±0.25 (0.02±0.01)	0.5±0.25 (0.02±0.01)	0.75±0.25 (0.03±0.01)	0.75±0.25 (0.03±0.01)

Note 1: All dimensions mm (inches).
Note 2: Pad widths less than chip width gives improved mechanical performance.
Note 3: Insulating the earth track underneath the filters is acceptable and can help avoid displacement of filter during soldering.

The Syfer X2Y Integrated Passive Component is a 3 terminal EMI chip device.

When used in balanced line applications, the revolutionary design provides simultaneous line-to-line and line-to-ground filtering, using a single ceramic chip. In this way, differential and common mode filtering are provided in one device.

For unbalanced applications, it provides ultra low ESL (equivalent series inductance). Capable of replacing 2 or more conventional devices, it is ideal for balanced and unbalanced lines, twisted pairs and dc motors, in automotive, audio, sensor and other applications.

Available in sizes from 0603 to 2220, these filters can prove invaluable in meeting stringent EMC demands.

Manufactured in the UK by Syfer Technology Limited under licence from X2Y attenuators LLC.

Advantages

- Replaces 2 or 3 capacitors with one device
- Ultra low inductance due to cancellation effect
- For balanced lines: Matched capacitance line to ground on both lines
- Differential and common mode attenuation
- Effects of temperature and voltage variation eliminated
- Effect of ageing equal on both lines
- High current capability

Applications

- Single ended/unbalanced lines
- Balanced lines and twisted pairs
- EMI Suppression on dc motors
- Sensor/transducer applications
- Wireless communications
- Audio amplifiers
- CANBUS systems

Dielectric
X7R or C0G/NP0

Electrical configuration
Multiple capacitance

Capacitance measurement
At 1000hr point

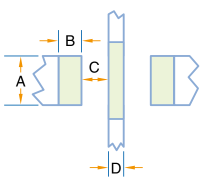
Typical capacitance matching
Better than 5%

Temperature rating
-55°C to 125°C

Dielectric withstand voltage
2.5 x Rated Volts for 5 secs. Charging current limited to 50mA Max.

Insulation resistance
100Gohms or 1000s (whichever is the less)

Recommended solder lands



	0603	0805	1206	1410	1812	2220
A	0.6 (0.024)	0.95 (0.037)	1.2 (0.047)	2.05 (0.08)	2.65 (0.104)	4.15 (0.163)
B	0.6 (0.024)	0.9 (0.035)	0.9 (0.035)	1.0 (0.04)	1.4 (0.055)	1.4 (0.055)
C	0.4 (0.016)	0.3 (0.012)	0.6 (0.024)	0.7 (0.028)	0.8 (0.03)	1.2 (0.047)
D	0.2 (0.008)	0.4 (0.016)	0.8 (0.03)	0.9 (0.035)	1.4 (0.055)	1.8 (0.071)

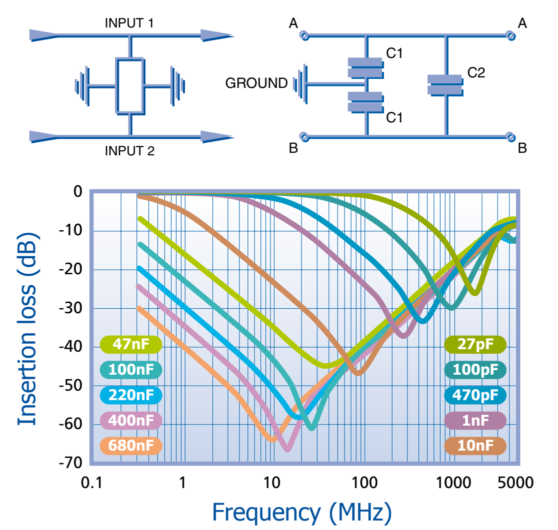
The internal structure furnishes a reduced inductance when compared to that of a conventional capacitor. This is a result of the novel internal electrode structure which inherently reduces the inductance by the cancellation effect of opposing currents in close proximity. The capacitance line to ground (common mode) is closely matched due to the symmetry within the design. As the device includes line to ground capacitance for both lines, any temperature, ageing and voltage effects will have an equal influence on both lines therefore maintaining balanced decoupling.

Because the part acts as a de-coupling device, the current limitations of a standard 3 terminal chip do not apply. The single line 3 terminal feedthrough chip carries the signal current through the very thin feedthrough electrodes within the device which have limited dc resistance and so can cause excessive heating, hence the maximum permissible current is often limited to around 300mA for a 1206 device. The Integrated Passive Component is in by-pass across two lines and so is unaffected by high signal currents.

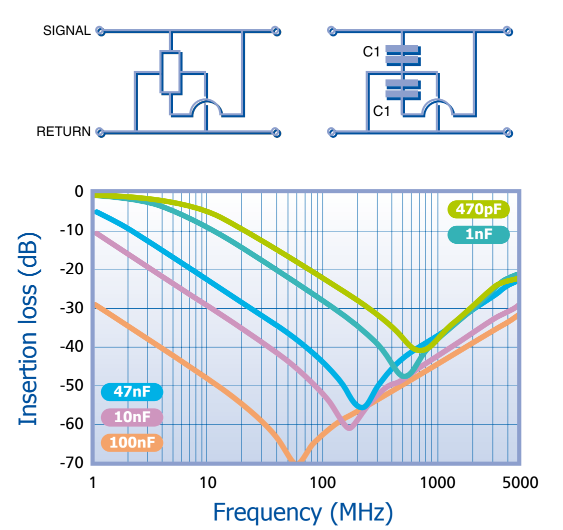
The table below offers a comparison of de-coupling devices and demonstrates how the Integrated Passive Component extends the options for EMC circuit protection.

Component	Advantages	Disadvantages	Applications
Chip capacitor	Industry standard	Requires 1 per line High inductance Capacitance matching problems	By-pass Low frequency
3 terminal feedthrough	Feedthrough Lower inductance	Current limited	Feedthrough Unbalanced lines High frequency
Syfer X2Y Integrated Passive Component	Very low inductance Replaces 2 (or 3) components Negates the effects of temperature, voltage and ageing Provides both common mode and differential mode attenuation Can be used on balanced & unbalanced lines	Care must be taken to optimise circuit design	By-pass Balanced lines High frequency dc electric motors Unbalanced lines Audio amplifiers CANBUS

Filtering application



Decoupling application



Ordering information

1812	Y	100	0334	M	X	T	E03
Chip Size	**Termination**	**Voltage**	**Capacitance in picofarads (pF) C_1**	**Tolerance**	**Dielectric**	**Packaging**	**Type**
0603 0805 1206 1410 1812 2220	J = Nickel barrier Y = FlexiCap™ A = (Tin/lead) H = FlexiCap™ (Tin/lead)	16 = 16Vdc 25 = 25Vdc 50 = 50Vdc 100 = 100Vdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0334=330nF. Note: $C_1 = 2C_2$	M = ±20%	C = C0G/NP0 X = X7R	T=178mm (7”) reel R=330mm (13”) reel B = Bulk	Syfer X2Y Integrated Passive Component

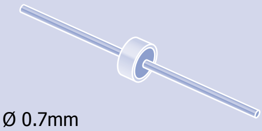
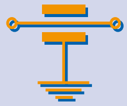
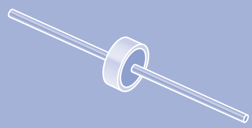
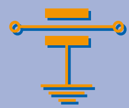
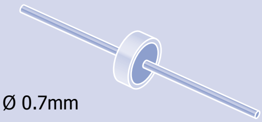
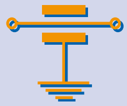
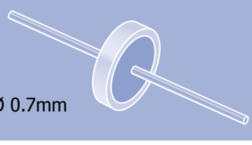
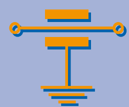
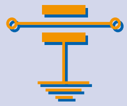
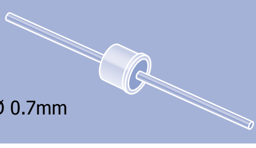
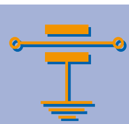
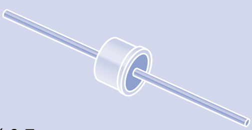
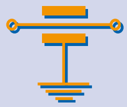
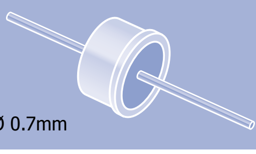
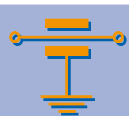
Reeled quantities

178mm (7”) reel	0603	0805	1206	1410	1812	2220
	4000	3000	2500	2000	1000	1000

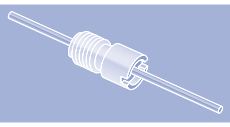
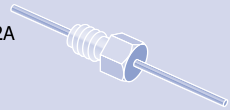
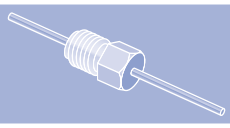
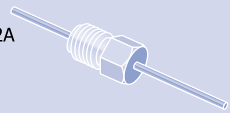
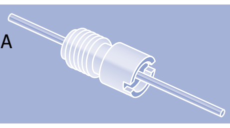
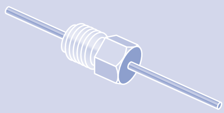
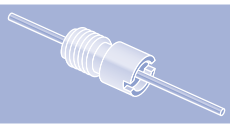
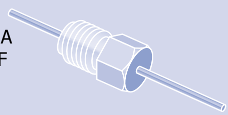
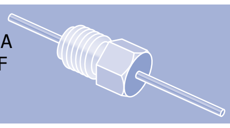
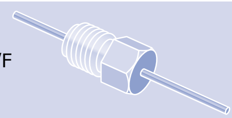
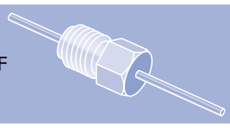
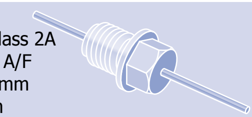
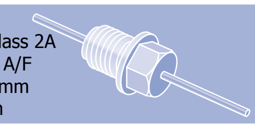
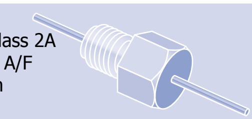
330mm (13”) reel	0603	0805	1206	1410	1812	2220
	16000	12000	10000	8000	4000	4000

Solder-in panel mount EMI filters

Notes:
1) For insertion loss information see p19
2) For ordering information see p20
3) For assembly and soldering information see p8

	Rated voltage dc	Min. - Max. capacitance C0G/NP0	Min. - Max. capacitance X7R	Circuit configuration	Max current
SFSSC 2.3mm Ø discoidal  Lead Ø 0.7mm	50	-	47nF	C 	10A
	100	-	22nF		
	200	-	10nF		
	500	10pF - 220pF	470pF - 4.7nF		
SFSSC 2.8mm Ø discoidal  Lead Ø 0.7mm	50	-	100nF	C 	10A
	100	-	68nF		
	200	-	47nF		
	300	-	33nF		
	500	10pF - 680pF	1nF - 22nF		
SFSSC 3.0mm Ø discoidal  Lead Ø 0.7mm	50	-	150nF	C 	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFSSC 5.0mm Ø discoidal  Lead Ø 0.7mm	50	-	680nF	C 	10A
	100	-	330nF - 470nF		
	200	-	220nF		
	500	-	47nF - 150nF		
SFSSC 8.75mm Ø discoidal  Lead Ø 1.0mm	50	-	3.3µF	C 	15A
	100	-	1.5µF - 2.2µF		
	200	-	1µF		
	300	-	680nF		
	500	-	100nF - 470nF		
	1000	-	15nF - 68nF		
	2000	330pF - 1nF	1.5nF - 10nF		
	3000	100pF - 220pF	-		
SFSRC 2.8mm body Ø  Lead Ø 0.7mm	50	-	47nF	C 	10A
	100	-	22nF		
	200	-	10nF		
	500	10pF - 220pF	470pF - 4.7nF		
SFSTC 3.25mm body Ø  Lead Ø 0.7mm	50	-	100nF	C 	10A
	100	-	68nF		
	200	-	47nF		
	300	-	33nF		
	500	10pF - 680pF	1nF - 22nF		
SFSUC 5.6mm body Ø  Lead Ø 0.7mm	50	-	680nF	C 	10A
	100	-	330nF - 470nF		
	200	-	220nF		
	500	10pF - 680pF	1nF - 150nF		

Notes:
1) For insertion loss information see p19
2) For ordering information see p20
3) For assembly and soldering information see p8

Type	Rated voltage dc	Min. - Max. capacitance C0G/NP0	Min. - Max. capacitance X7R	Circuit configuration	Max current
SFNOC M2.5 x 0.45 - 6g, Head Ø 3.5mm, Lead Ø 0.7mm 	50	-	47nF	C	10A
	100	10pF - 220pF	470pF - 22nF		
SFAA 4-40 UNC Class 2A, Head 4.0mm A/F, Lead Ø 0.7mm 	50	-	150nF	C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFAJ M3 x 0.5 - 6g, Head 4.0mm A/F, Lead Ø 0.7mm 	50	-	150nF	C, L-C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFAB 6-32 UNC Class 2A, Head 4.0mm A/F, Lead Ø 0.7mm 	50	-	150nF	C, L-C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFKB 6-32 UNC Class 2A, Head Ø 4.4mm, Lead Ø 0.7mm 	50	-	150nF	C, L-C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFAK M3.5 x 0.6 - 6g, Head 4.0mm A/F, Lead Ø 0.7mm 	50	-	150nF	C, L-C, T	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFKK M3.5 x 0.6 - 6g, Head Ø 4.4mm, Lead Ø 0.7mm 	50	-	150nF	C, L-C, T	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFBC 8-32 UNC Class 2A, Head 4.75mm A/F, Lead Ø 0.7mm 	50	-	150nF	C, L-C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFBC 8-32 UNC Class 2A, Head 4.75mm A/F, Lead Ø 0.7mm 	50	-	94nF	Pi	10A
	100	-	44nF		
	200	-	20nF		
	500	20pF - 440pF	940pF - 9.4nF		
SFBL M4 x 0.7 - 6g, Head 4.75mm A/F, Lead Ø 0.7mm 	50	-	150nF	C, L-C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFBL M4 x 0.7 - 6g, Head 4.75mm A/F, Lead Ø 0.7mm 	50	-	94nF	Pi	10A
	100	-	44nF		
	200	-	20nF		
	500	20pF - 440pF	940pF - 9.4nF		
SFBD 12-32 UNEF Class 2A, Head 4.75mm A/F, Flange Ø 6.35mm, Lead Ø 0.7mm 	50	-	150nF	C, L-C, T	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFBD 12-32 UNEF Class 2A, Head 4.75mm A/F, Flange Ø 6.35mm, Lead Ø 0.7mm 	50	-	300nF	Pi	10A
	100	-	200nF		
	200	-	94nF - 136nF		
	500	20pF - 1.36nF	2nF - 66nF		
SFCD 12-32 UNEF Class 2A, Head 6.35mm A/F, Lead Ø 0.7mm 	50	-	680nF	C, L-C	10A
	100	-	330nF - 470nF		
	200	-	220nF		
	500	10pF - 680pF	1nF - 150nF		

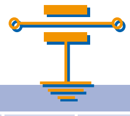
Screw mounted EMI filters

Notes:
1) For insertion loss information see p19
2) For ordering information see p20
3) For assembly and soldering information see p8

	Rated voltage dc	Min. - Max. capacitance		Circuit configuration	Max current
		C0G/NP0	X7R		
SFCD 12-32 UNEF Class 2A, Head 6.35mm A/F, Lead Ø 0.7mm	50	-	300nF	Pi	10A
	100	-	200nF		
	200	-	94nF - 136nF		
	500	20pF - 1.36nF	2nF - 66nF		
SFCI 2BA, Head 6.35mm A/F, Lead Ø 0.7mm	50	-	680nF	C, L-C	10A
	100	-	330nF - 470nF		
	200	-	220nF		
	500	10pF - 680pF	1nF - 150nF		
SFBM M5 x 0.8 - 6g, Head 4.75mm A/F, Flange Ø 6.35mm, Lead Ø 0.7mm	50	-	150nF	C, L-C, T	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFBM M5 x 0.8 - 6g, Head 4.75mm A/F, Flange Ø 6.35mm, Lead Ø 0.7mm	50	-	300nF	Pi	10A
	100	-	200nF		
	200	-	94nF - 136nF		
	500	20pF - 1.36nF	2nF - 66nF		
SFCM M5 x 0.8 - 6g, Head 6.35mm A/F, Lead Ø 0.7mm	50	-	680nF	C, L-C	10A
	100	-	330nF - 470nF		
	200	-	220nF		
	500	10pF - 680pF	1nF - 150nF		
SFLM M5 x 0.8 - 6g, Head Ø 6.0mm, Lead Ø 0.7mm	50	-	150nF	C, L-C, T	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFLM M5 x 0.8 - 6g, Head Ø 6.0mm, Lead Ø 0.7mm	50	-	300nF	Pi	10A
	100	-	200nF		
	200	-	94nF - 136nF		
	500	20pF - 1.36nF	2nF - 66nF		
SFTM low profile, M5 x 0.8 - 6g, Head 6.35mm A/F, Lead Ø 0.7mm	50	-	150nF	C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFUM low profile, M5 x 0.8 - 6g, Head Ø 6.0mm, Lead Ø 0.7mm	50	-	150nF	C	10A
	100	-	100nF		
	200	-	47nF - 68nF		
	500	10pF - 680pF	1nF - 33nF		
SFJE ¼-28 UNF Class 2A, Head Ø 9.8mm, Lead Ø 1.0mm	50	-	3.3µF	C, L-C	15A
	100	-	2.2µF		
	200	-	1µF		
	300	-	680nF		
	500	-	100nF - 470nF		
	1000	-	15nF - 68nF		
	2000	330pF - 1nF	1.5nF - 10nF		
	3000	100pF - 220pF	-		
SFJN M6 x 0.75 - 6g, Head Ø 9.8mm, Lead Ø 1.0mm	50	-	3.3µF	C, L-C	15A
	100	-	2.2µF		
	200	-	1µF		
	300	-	680nF		
	500	-	100nF - 470nF		
	1000	-	15nF - 68nF		
	2000	330pF - 1nF	1.5nF - 10nF		
	3000	100pF - 220pF	-		

Typical insertion loss (dB) for panel mount EMI filters. No load. 50Ω system

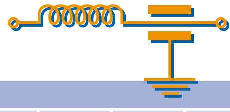
C



C - section filters							
SFAAC	SFABC	SFAJC	SFAKC	SFBCC	SFBDC	SFBLC	SFBMC
SFCDC	SFCIC	SFCMC	SFJEB	SFJEC	SFJNC	SFKBC	SFKKC
SFLMC	SFNOC	SFSRC	SFSSC	SFSTC	SFSUC	SFTMC	SFUMC

Capacitance	0.01MHz	0.1MHz	1MHz	10MHz	100MHz	1GHz
10pF						4
15pF						7
22pF						10
33pF						12
47pF					1	15
68pF					2	18
100pF					4	22
150pF					7	25
220pF					10	29
330pF					13	33
470pF				1	16	35
680pF				2	19	39
1nF				4	23	41
1.5nF				7	26	45
2.2nF				10	30	50
3.3nF				13	33	52
4.7nF			1	16	36	55
6.8nF			2	19	39	57
10nF			4	22	41	60
15nF			7	25	44	62
22nF			10	29	46	65
33nF			13	33	48	68
47nF		1	16	35	50	70
68nF		2	19	39	54	70
100nF		4	22	41	57	70
150nF		7	25	45	60	70
220nF		10	29	49	62	70
330nF		13	33	52	66	70
470nF	1	16	35	55	68	70
680nF	2	19	38	58	70	70
1µF	4	22	41	61	70	70
1.5µF	7	25	45	64	70	70
2.2µF	10	29	48	66	70	70
3.3µF	14	34	52	70	70	70

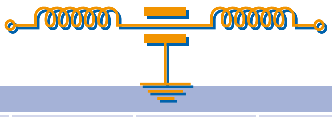
L-C



L-C - section filters							
SFABL	SFAJL	SFAKL	SFBCL	SFBDL	SFBLL	SFBML	SFCDL
SFCIL	SFCML	SFJEL	SFJNL	SFKBL	SFKKL	SFLML	

Capacitance	0.01MHz	0.1MHz	1MHz	10MHz	100MHz	1GHz
10pF						6
15pF						9
22pF						12
33pF					1	15
47pF					2	19
68pF					4	20
100pF					7	24
150pF					10	27
220pF					12	30
330pF				1	16	34
470pF				2	19	38
680pF				3	22	41
1nF				6	25	44
1.5nF				9	29	48
2.2nF				12	31	51
3.3nF				15	35	54
4.7nF			1	18	39	57
6.8nF			2	21	41	60
10nF			4	23	43	63
15nF			7	27	46	66
22nF			10	30	48	68
33nF			13	34	50	70
47nF		1	17	37	51	70
68nF		2	20	40	55	70
100nF		4	22	44	60	70
150nF		7	25	47	62	70
220nF		10	29	49	66	70
330nF		13	33	53	68	70
470nF	1	16	35	56	70	70
680nF	2	19	38	58	70	70
1µF	4	22	41	61	70	70
1.5µF	7	25	45	64	70	70
2.2µF	10	29	49	66	70	70
3.3µF	14	34	53	70	70	70

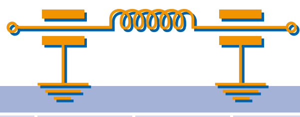
T



T - section filters				
SFBDT	SFBMT	SFLMT	SFAKT	SFKKT

Capacitance	0.1MHz	1MHz	10MHz	100MHz	1GHz
10pF					9
15pF					11
22pF				1	14
33pF				2	18
47pF				4	20
68pF				6	23
100pF				9	27
150pF				12	30
220pF				15	33
330pF			1	19	36
470pF			2	21	40
680pF			4	24	43
1nF			7	28	47
1.5nF			10	30	50
2.2nF			13	34	53
3.3nF			17	38	57
4.7nF			19	40	59
6.8nF		1	23	43	63
10nF		4	26	45	66
15nF		7	29	47	68
22nF		10	33	49	70
33nF		14	36	50	70
47nF	1	17	39	52	70
68nF	2	20	42	57	70
100nF	4	22	46	62	70
150nF	7	25	49	68	70

Pi



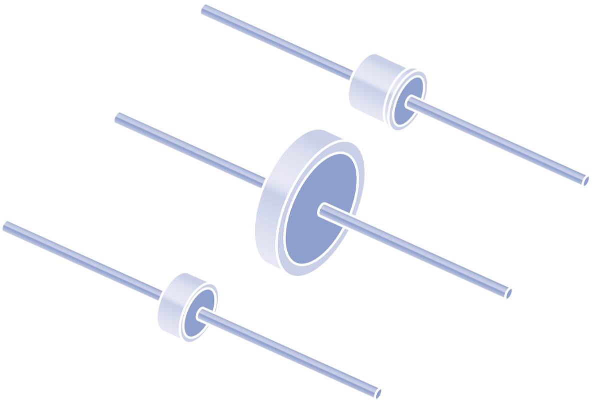
Pi - section filters					
SFBCP	SFBDP	SFBLP	SFBMP	SFCDP	SFLMP

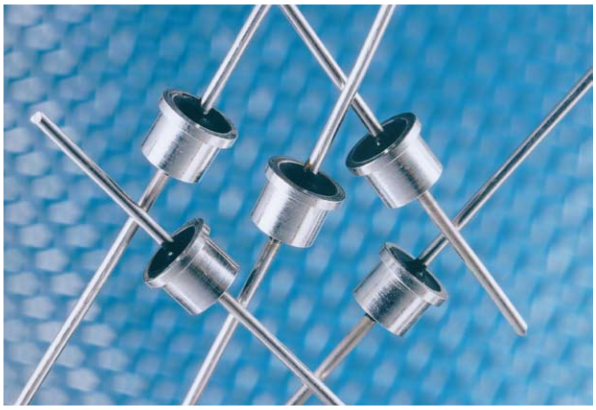
Capacitance	0.1MHz	1MHz	10MHz	100MHz	1GHz
20pF				1	11
30pF				2	15
44pF				3	19
66pF				4	23
94pF				6	29
136pF				8	35
200pF				11	41
300pF			1	15	50
440pF			2	20	57
660pF			3	25	65
940pF			5	31	68
1.36nF			7	37	70
2nF			10	44	70
3nF			13	51	70
4.4nF		1	17	59	70
6.6nF		2	21	64	70
9.4nF		4	27	68	70
13.6nF		6	34	70	70
20nF		9	40	70	70
30nF		12	48	70	70
44nF	1	14	54	70	70
66nF	2	17	63	70	70
94nF	4	18	68	70	70
136nF	8	25	70	70	70
200nF	10	27	70	70	70
300nF	13	30	70	70	70

Ordering information

Solder-in types *Note: Ordering code can have up to 4 additional digits on the end to denote special requirements.*

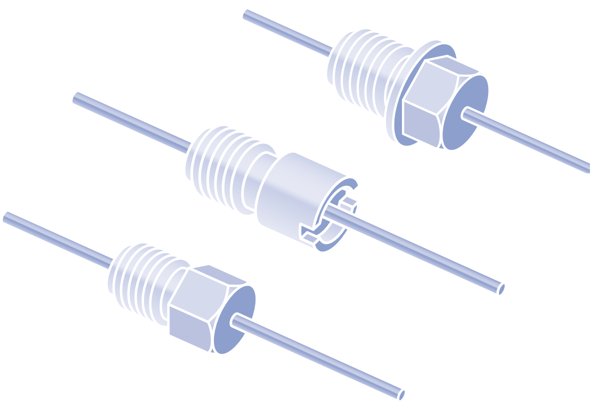
SFS	T	C	500	0223	M	X	0
Type	**Case dia.**	**Electrical configuration**	**Voltage**	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric**	**Nuts & washers**
Solder-in panel mount filter	S = Special (no case) Contact Sales Office for full part number R = 2.8mm T = 3.25mm U = 5.6mm	C = C section	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 300 = 300Vdc 500 = 500Vdc 1K0 = 1kVdc 2K0 = 2kVdc 3K0 = 3kVdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0223=22nF	M = ±20% (Standard) P = -0 +100% S = -20%+50% Z = -20%+80%	C = C0G/ NP0 X = X7R	0 = Without





Threaded types *Note: Ordering code can have up to 4 additional digits on the end to denote special requirements.*

SF	J	E	L	050	0335	M	X	1
Type	**Case style** ** = Low Profile*	**Thread**	**Electrical configuration**	**Voltage** *or varistor maximum continuous working voltage*	**Capacitance in picofarads (pF)**	**Capacitance tolerance**	**Dielectric**	**Nuts & washers**
Screw mount filter	A = 4mm A/F B = 4.75mm A/F C = 6.35mm A/F D = 10mm A/F J = 9.8mm O.D. K = 4.4mm O.D. L = 6mm O.D. M = 6.35mm O.D. N = 3.5mm O.D. T = 6.35mm A/F * U = 6mm O.D. *	A = 4-40 UNC B = 6-32 UNC C = 8-32 UNC D = 12-32 UNEF E = 1/4-28 UNF I = 2BA J = M3 K = M3.5 L = M4 M = M5 N = M6 O = M2.5	C = C section L = L-C section P = Pi section T = T section B = Balanced line filter V = Varistor EMI filter	050 = 50Vdc 100 = 100Vdc 200 = 200Vdc 300 = 300Vdc 500 = 500Vdc 1K0 = 1kVdc 2K0 = 2kVdc 3K0 = 3kVdc	First digit is 0. Second and third digits are significant figures of capacitance code. The fourth digit is number of zeros following Example: 0335=3.3µF 13N6=13.6nF	M = ±20% (Standard) P = -0 +100% S = -20%+50% Z = -20%+80%	C = C0G/ NP0 X = X7R M = MOV (varistor material)	0 = Without 1 = With



The Syfer range of varistor filters provides both transient voltage protection and EMI filtering in one device. The heart of this unique device is a multilayer varistor discoidal, which provides a dual function. The use of metal oxide based ceramic (MOV) provides the voltage protection, with bi-directional clamping, while the inherent capacitance, due to the multilayer construction, ensures effective lowpass EMI filtering up to at least 1GHz.

Maximum continuous dc working voltage

This is the maximum continuous dc working voltage which may be applied up to the maximum operating temperature of the varistor.

Nominal voltage

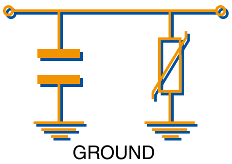
This is the voltage across the varistor when drawing a dc current of 1mA. It is this point that is notionally the start of the region of normal varistor operation.

Maximum clamping voltage

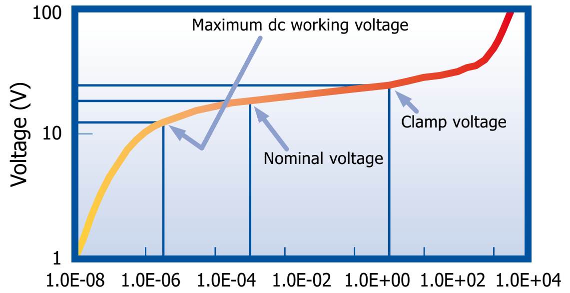
As a varistor is designed for handling transient voltages, all tests requiring currents in excess of 1mA are conducted as pulse tests.

The clamping voltage of a varistor is the peak voltage appearing across the device when measured under the conditions of a specified pulse current and a specified waveform.

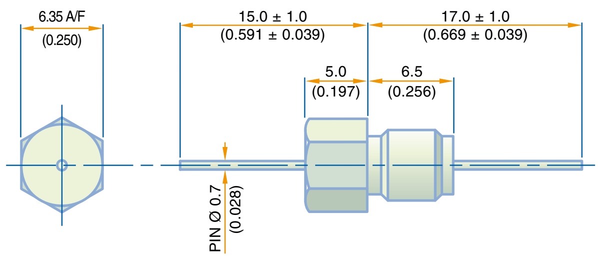
Circuit configuration



Varistor V-I characteristics



Current (A) typical varistor V-I curve



Electrical details	
Electrical configuration	See circuit configuration
Capacitance measurement	At 1000hr point at 1MHz
Temperature rating	-55°C to 125°C
Working voltages, Vdc	5, 14, 18, 26, 42
Capacitance range, nF	1, 2.2, 4.7, 10, *
Leakage current	100µA max @ 20°C
Maximum dc current	10A

*(Other values can be supplied, consult Sales Office for details).

Mechanical details	
Nut A/F	6mm (0.236”)
Head diameter	6.35mm (0.25”)
Washer diameter	9.1mm (0.358”)
Mounting torque	0.6Nm (6.8lbf in) max. if using nut 0.3Nm (3.4lbf in) max. if into tapped hole
Mounting hole dia.	5.2mm ± 0.1 (0.205” ± 0.004”)
Max panel thickness	3.4mm (0.134”)
Weight	1.8g typical (0.06oz)
Finish	Silver plate on copper undercoat

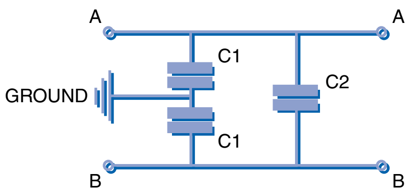
Type No.	Capacitance -20% +80% @1V, 1MHz	Typical insertion loss (dB) 50Ω system No load				Maximum continuous working voltage	Nominal voltage at 1mA dc		Max clamp voltage at 10A (8/20µs)	Maximum non-repetitive surge energy (10/1000µs)	Maximum non-repetitive surge current (8/20µs)
		1MHz	10MHz	100MHz	1GHz		Min.	Max.			
						V	V	V	V	J	A
SFCMV0260102ZM1	1000pF	0	4	23	41	26	29.5	38.5	56	1.5	300
SFCMV0420102ZM1						42	46	56	86	3	300
SFCMV0140222ZM1	2200pF	0	10	30	50	14	15.9	20.3	30	2	300
SFCMV0180222ZM1						18	22	28	40	2	300
SFCMV0260222ZM1						26	29.5	38.5	56	3	300
SFCMV0420222ZM1						42	46	56	86	3	300
SFCMV0050472ZM1	4700pF	1	16	36	55	5	7.1	9.3	17.5	1	300
SFCMV0140472ZM1						14	15.9	20.3	30	2	300
SFCMV0180472ZM1						18	22	28	40	2	300
SFCMV0260472ZM1						26	29.5	38.5	56	3	300
SFCMV0050103ZM1	10000pF	4	22	41	60	5	7.1	9.3	17.5	1	300
SFCMV0140103ZM1						14	15.9	20.3	30	2	300
SFCMV0180103ZM1						18	22	28	40	2	300

Note: 1) For ordering information see p20

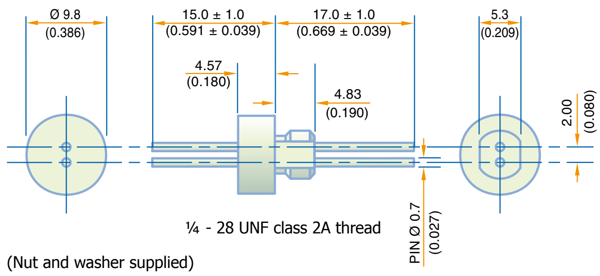
Panel mount EMI filter - X2Y Integrated Passive Components

The Syfer balanced line filter is a 2-pin panel mounting device suitable for balanced lines and twisted pairs. It is ideal for passing lines through a bulkhead, and the feedthrough construction offers insertion loss performance up to 1GHz and above. The filter also incorporates capacitance line-to-line as well as line-to-ground, and therefore both differential and common mode filtering are offered in the same package. In this way one single device can replace three separate components.

Circuit Configuration



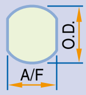
Dimensions mm (inches)



(Nut and washer supplied)

Electrical details		
Electrical configuration	See circuit configuration	
Capacitance measurement	At 1000hr point	
Temperature rating	-55°C to 125°C	
Dielectric withstand voltage	500Vdc	
Capacitance range, nF	Line to Ground (C1) 4.7, 10, 22, 47, 100	Line to Line (C2) 2.35, 5, 11, 23.5, 50

*(Other values can be supplied, consult Sales Office for details).

Mechanical details	
Nut A/F	7.92mm (5/16”)
Head diameter	9.8mm (0.386”)
Washer diameter	11.35mm (0.447”)
Mounting torque	0.9Nm (10.2 lbf in) max.
Mounting hole dia.	 O.D. A/F 6.7mm O.D., 5.5mm A/F (0.264@ O.D., 0.217” A/F)
Max panel thickness	2.3mm (0.091”)
Weight	3.0g typical (0.11oz)
Finish	Silver plate on copper undercoat

Type No.	Capacitance (C1) (±20%)	Dielectric code	Rated voltage (dc)	Current amps
SFJEB2000472MX1	4.7nF	X7R	200	10
SFJEB2000103MX1	10nF	X7R	200	10
SFJEB2000223MX1	22nF	X7R	200	10
SFJEB2000473MX1	47nF	X7R	200	10
SFJEB2000104MX1	100nF	X7R	200	10

Ceramic filter element manufactured in the UK by Syfer Technology Limited under licence from X2Y attenuators LLC.

Note: 1) For ordering information see p20.

Special filters and assemblies

Manufacturing to customer designs or working together with the customer to develop a solution to a problem, Syfer offer the ability to modify standard filter designs or develop custom designs to suit your application.

Modifications to standard filters

Special mechanical outline

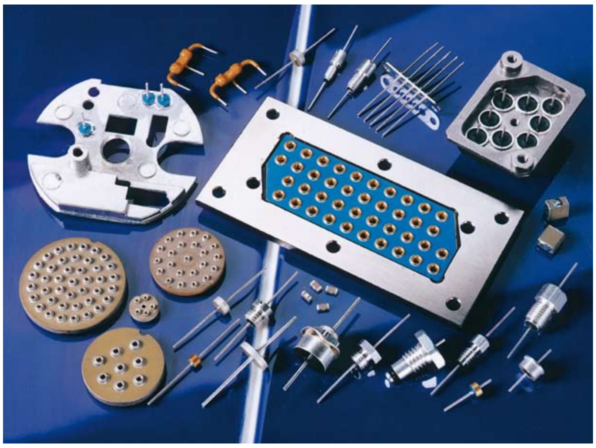
Typical Examples

- Lead lengths to suit
- Special thread options – e.g. M5 x 0.5 – 6g
- Special lead forms – e.g. headed pin / threaded contact
- Larger pin diameters
- Special body or pin finishes

Special electrical testing

Typical Examples

- Special test voltages – e.g. 500Vac 50Hz DWV test
- Special capacitance values
- 100% burn-in
- Higher current ratings possible



Special discrete filters to match your specific requirements

Manufactured to fit the customers specific requirements, electrical characteristics and space envelope. We can offer design solutions to meet your requirement or develop customer designs into production reality.

- **Example 1** - battery terminal filter to meet precise environmental requirements and provide flat pin contact surface for connection to spring contacts on clip-on batteries. Designed to fit customers space envelope and meet specific electrical parameters.

- **Example 2** - special SFSSC disc-on-pin decoupling stub filter for military application. Contact pin terminating inside discoidal and insulated from non pin side. Assembled with high melting point solder to allow customer to solder into panel.

Multiway filter assemblies

From a simple panel fitted with our single line discrete filters to a complex custom designed Pi filter assembly, we offer a full design and manufacture service. Assemblies can be based around discoidal capacitors for maximum flexibility or planar arrays for optimum space utilisation.
As an extension to our planar array range, we can offer soldered-in spring retaining clips for easy assembly into difficult applications such as hermetic sealed connectors and our extensive experience with filter connectors allows us to offer sub contract manufacturing to this industry sector.

- **Example 1** - 4 way 22nF C section planar based filter assembly. DWV 2500Vdc, 100% tested. Supplied to sensor manufacturer for installation into commercial aerospace application.

- **Example 2** - 85 way 1800pF L-C section planar based filter assembly, fitted into mounting plate for easy assembly. Designed to fit specific space envelope for military aerospace application

Please contact our sales office to discuss your specific filtering requirement. We would be pleased to provide a technical and commercial proposal.

Planar arrays

The multilayer planar array is an application specific multi capacitor array designed for use in multiway EMI filter circuits. Derived from discoidal capacitor theory, it provides capacitance between the outside perimeter and the internal through holes.

The most common use of planar arrays is as the capacitor element in filter connectors, although they are also suitable in many other applications.

Syfer's core wet manufacturing process and ceramic handling expertise allows components to be produced with mechanical precision and electrical accuracy, enabling a filter assembly to withstand the most rigorous of electrical specifications. This has resulted in Syfer's position as the manufacturer of choice for the filter connector industry. To date, Syfer have delivered in excess of 3,000 different designs of planar array.

The quality and reliability of Syfer's planar arrays has been uniquely recognised by the approval of NASA for their use in the International Space Station.

Mechanical

With many years experience, Syfer have developed a comprehensive range of designs, including planform designs for the following connectors:

- Circular (MIL-C-38999, MIL-C-26482 and similar)
- Arinc 404 and 600
- 'D' sub
- High Density 'D' sub
- µD (MIL-C-83513)
- Nano 'D'

Special custom shapes and layouts can also be accommodated. Complex shapes including internal and external radii, multiple hole diameters and alignment guides can be considered.

As a guide, Syfer can manufacture planars to a maximum of 3.18mm (0.125") thick and to a maximum of 100mm (4.0") diameter or square.

Standard termination finish is gold plate over nickel for maximum electrical and mechanical performance. Options include conventional silver-palladium (AgPd) or silver-platinum (AgPt) fired terminations.

Solderless assembly/compliant spring clip

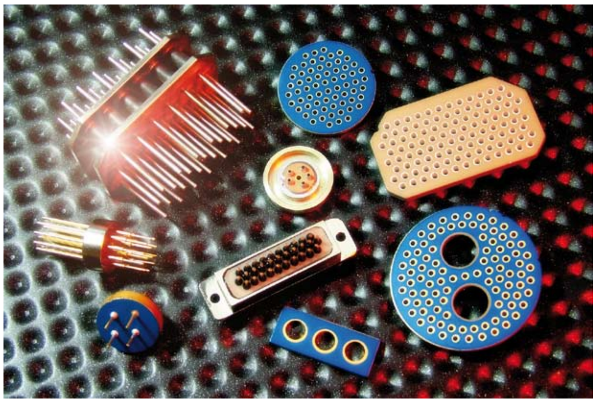
Solderless assembly of planars can be accommodated by the inclusion of compliant spring clips into the holes, allowing the array to be push fitted to through contact pins.

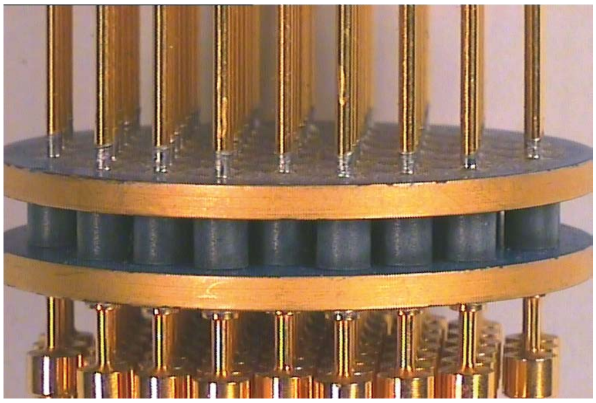
Syfer can supply a standard range of solder-in spring clips, or fit customer supplied compliant clips before shipping the finished connector.

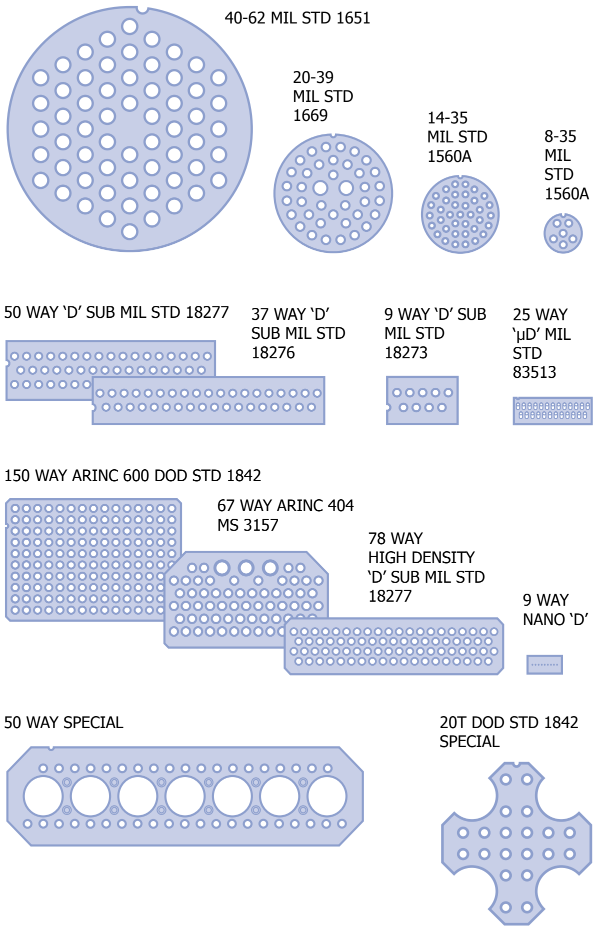
Contract assembly and Technical back-up

Having an EMI filter assembly line alongside the ceramic manufacturing area allows Syfer to offer unprecedented technical back-up and advice to planar array and discoidal customers. This can include design and handling advice and forensic analysis assistance. Syfer personnel have many years experience in the use of planar arrays, having been involved directly in the development of the technology from its inception.

Syfer are also able to offer sub contract and prototype manufacturing services to planar customers and connector companies.







Electrical

- Only stable X7R and ultra stable C0G/NP0 dielectrics used
- Capacitance values from pF to µF
- High voltage capability - DWV (Dielectric Withstand Voltage) to 10kV
- Feedthrough low capacitance unterminated lines
- Grounded earth lines - maximum ground plane resistance specifications included
- Mix of capacitance values within planar – up to a ratio of 400:1 within individual planar possible
- Mixed capacitance lines / no cap feedthrough lines / grounded earth lines available within single planar

Quality

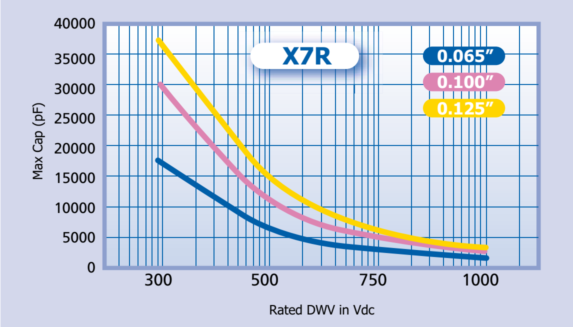
All planars are 100% tested for the following:

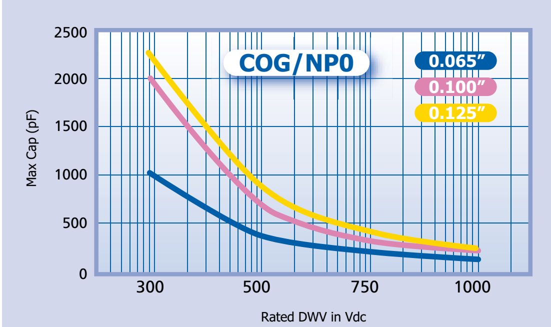
- Capacitance
- Dissipation factor
- DWV (Dielectric Withstand Voltage)
- Insulation resistance
- Visual inspection
- Sample solderability and dimensional check

100% SAM (Scanning Acoustic Microscopy) testing is offered as an option on all planars intended for more severe applications.

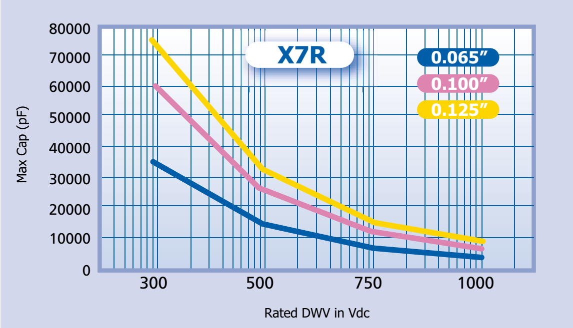
Graphs of typical maximum capacitance values against voltage for array thicknesses of 0.065″ (1.65mm), 0.100″ (2.54mm) and 0.125″ (3.18mm).

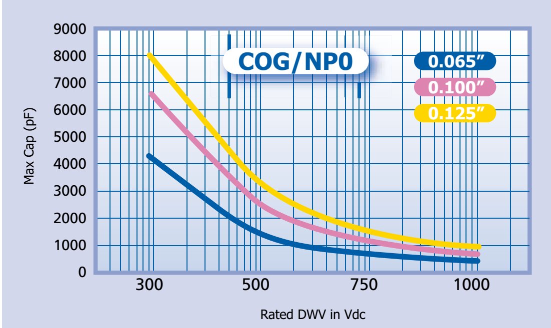
µD planforms



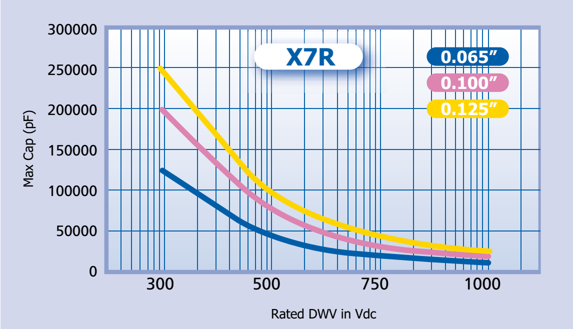


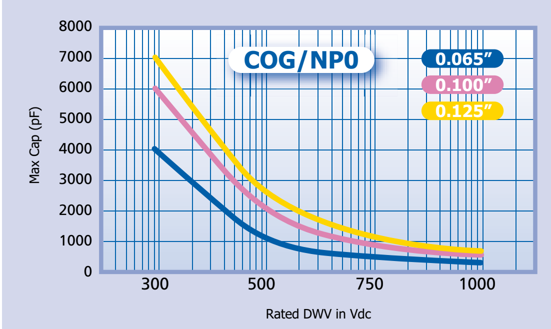
D-Sub planforms



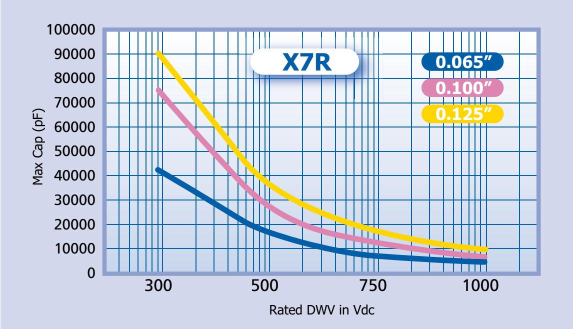


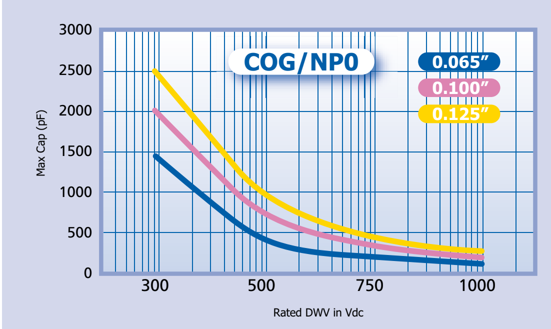
Low density circular planforms





High density circular planforms

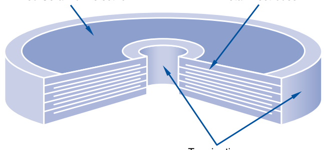




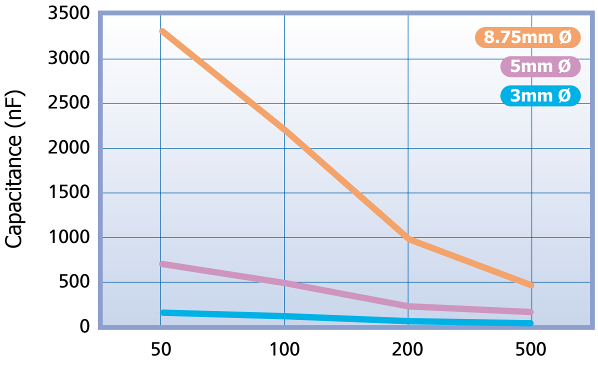
Discoidal multilayer capacitors

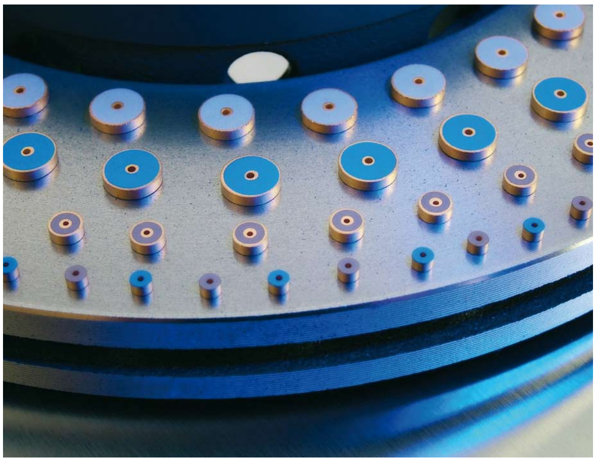
Discoidal capacitors are at the heart of many EMI filters. More robust and reliable than tubular capacitors, they offer higher capacitance options, with values up to several microfarads. In addition to standard configurations, Syfer is able to meet customers' specific drawings in terms of electrical performance and mechanical design.

Discoidal multilayer ceramic capacitors are of a configuration suitable for direct mounting into filters, onto bulkheads and hybrid circuits. Due to their geometry, they have excellent RF performance characteristics as well as very high self resonant frequencies. They are offered with a choice of C0G/NP0 or X7R ceramic, or in MOV (metal oxide varistor) material for voltage protection applications.



Typical capacitance vs disc size vs voltage
Based on typical hole diameter of 0.8mm, and X7R dielectric.





General Specification

Dielectrics:
C0G/NP0, X7R, MOV

Mechanical:
Outer diameter 2.0mm minimum
Inner diameter 0.5mm minimum
Minimum wall thickness requirements apply
Refer to factory

Capacitance range:
pF to µF

Capacitance tolerance:
±5%, ±10%, ±20%, -0%+100%

Voltage:
50V to 3kVdc or higher

Operating temperature range:
C0G/NP0, X7R, MOV, -55°C to +125°C

Termination options:
Silver-palladium (AgPd), silver-platinum (AgPt), gold over nickel

Varistor planar arrays and varistor discoidals

Varistor planar arrays and varistor discoidals provide a dual function. The use of metal oxide based ceramic (MOV) provides the voltage protection, with bi-directional clamping, while the inherent capacitance, due to the multilayer construction, ensures effective lowpass EMI filtering up to at least 1GHz.

Maximum continuous dc working voltage

This is the maximum continuous dc working voltage which may be applied up to the maximum operating temperature of the varistor.

Nominal voltage

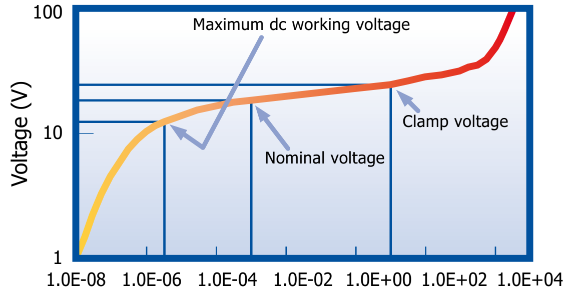
This is the voltage across the varistor when drawing a dc current of 1mA. It is this point that is notionally the start of the region of normal varistor operation.

Maximum clamping voltage

As a varistor is designed for handling transient voltages, all tests requiring currents in excess of 1mA are conducted as pulse tests.

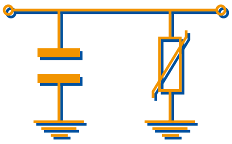
The clamping voltage of a varistor is the peak voltage appearing across the device when measured under the conditions of a specified pulse current and a specified waveform.

Varistor V-I characteristics



Current (A) typical varistor V-I curve

Circuit configuration



To reflect the unique custom nature of discoidals and planar arrays, we do not list a standard range, but ask you to contact the sales office to discuss your specific requirement.

Introduction

Syfer is experienced at providing products for the most demanding applications:

- Space - ESA and NASA projects
- Automotive - AEC-Q200 qualified
- Military and Civil aviation
- Motorsports - F1 and World Rally
- Oil / Downhole / Industrial
- Rail

Syfer product qualifications include AEC-Q200, ESA vendor approval, and Space qualified planar arrays.

RoHS compliance

The full range of Syfer EMI filters is EU RoHS compliant to 2002/95/EC. Special finishes (eg. Sn/Pb) are available for exempt applications such as military and space.

Surface mount

The surface mount C filter (E01, E07), Pi filter (SBSPP) and X2Y Integrated Passive Components (E03) are all available with Syfer FlexiCap™ (standard solderable proprietary flexible epoxy polymer termination material).

FlexiCap™ advantages

- Solves cracking problems caused by excessive mechanical stress
- The polymer allows greater degrees of Pcb deflection during de-panelisation, typically twice that of standard capacitors
- Permits more stress to be placed on components when using large through hole parts, eg transformers, connectors, heatsinks
- More resistant to cracking due to temperature cycling
- No degradation in electrical performance
- Capacitors with tin-lead termination are also available with FlexiCap™ technology

The following are qualified to AEC-Q200:

- Surface mount C filter (E01 range)
- Integrated Passive Component (E03 range)

Panel mount filters

Designed and manufactured to meet or exceed the requirements of MIL C 15733 and MIL C 28861. The test methods are in accordance with Mil Std 220 and Mil Std 202:

- Insertion loss
- Solderability
- Bump and vibration
- Temperature cycling
- Humidity
- Temperature rise under dc load

Special test requirements can be accommodated e.g. 100% burn-in.

Planar arrays and discoidals

Syfer were instrumental in delivering the standard for space approved planar arrays which includes Scanning Acoustic Microscopy (SAM) testing.

Worldwide field sales of Syfer products are handled by the CPG global sales team.

CERAMIC PRODUCTS GROUP
Specialists in Electronic Passives
A DOVER COMPANY

CPG sales offices

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26/07

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DIELECTRIC LABORATORIES · NOVACAP · Voltronics