

Applications & Cases

EMC components

July 2004

Matching filters all along the line



PROFILE | EMC FILTERS

EPCOS offers EMC filters to eliminate conducted interference on telecom, data and control lines. These filters match every system. Typical stopband attenuation is better than 100 dB. High commonmode suppression can be obtained with current-compensated variants.



Measures to ensure electromagnetic compatibility are essential to smooth and reliable operation of wireline communication and data systems. EPCOS has therefore developed special EMC filters for telecom and control applications.

Filters used for EMC in communications and control electronics must satisfy exacting requirements in terms of passband, impedance of the connected network and coupling of individual lines. Their parameters must match those of the intended application. EPCOS has developed EMC filters of series B84312 to match various wireline applications → 1,2,3.

	B84312-C20-B3	B84312-C10-B3	B84312-C40-B1	B84312-C50-B1	B84312-C60-B1	B84312-C90-B1
Application	Standard telephone system	Telephone system with extended passband	Telephone system RS232 TTY and modem lines up to 50 kHz	Balanced data lines RS485, RS422	Balanced data lines RS485, RS422	Telephone system with increased stopband attenuation from 10 kHz
Passband	0 to 3.4 kHz at 600 Ω	0 to 10 kHz at 600 Ω	0 to 50 kHz at 600 Ω	0 to 120 kHz at 150 Ω	0 to 300 kHz at 150 Ω	0 to 3.4 kHz at 600 Ω

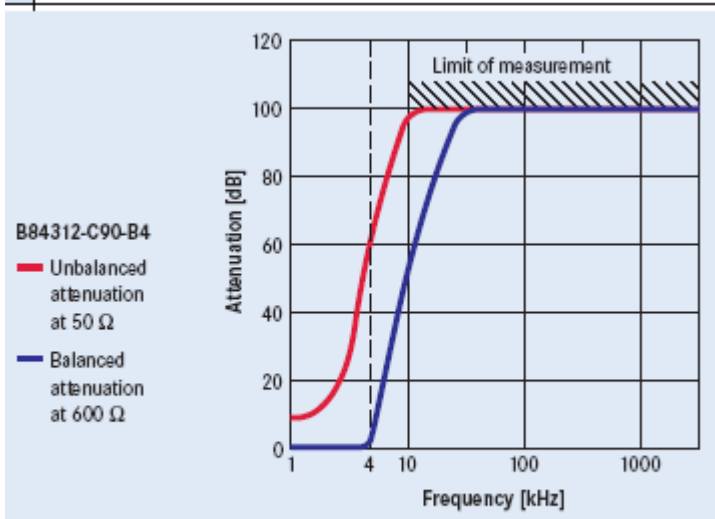
	B84312-C112-E	B84312-C110-E1	B84312-C114-B1	B84312-C60-B1	B84312-C60-B1	B84312-C114-B1
Standard	CCITT G. 703	CCITT L430 ETS 300012	Up0 8/89	ANSI T 1.601-1988	FTZ 1 TR 220	HICOM
Number of twisted pairs	2	2 or 4	1	1	1	1
Transmission rate	2.048 Mbit/s	144 kbit/s	304 kbit/s; 152 kbit/s per direction; 384 kBd	144 kbit/s	320 kbit/s; 160 kbit/s per direction; 120 kBd	160 kbit/s; 80 kbit/s per direction; 256 kBd
Passband	0 to 10 MHz at 50 Ω	0 to 4 MHz at 100 Ω	0 to 4 MHz at 100 Ω	0 to 300 kHz at 150 Ω	0 to 300 kHz at 150 Ω	0 to 4 MHz at 100 Ω
Rated voltage	80 V DC	80 V DC	80 V DC	100 V DC	100 V DC	80 V DC

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	B84312-C30-B3	B84312-C30-H3	B84312-C100-B3	B84312-C100-H3	B84312-C60-B1	B84312-C140-S1
Lines	2	20	2	20	2	20
Stopband	100 dB/200 kHz	100 dB/200 kHz	100 dB/30 kHz	100 dB/30 kHz	100 dB/300 kHz	100 dB/300 kHz
Rated current	1 A per line	1 A per line	1 A per line	1 A per line	100 mA per line	300 mA per line

EMC filters are designed as low-pass filters. Their passband width largely depends on the required transmission rate. The stop band should start at the lowest possible frequency. This requirement is favored by the fact that the useful signal is balanced, whereas interference signals tend to be unbalanced. So filters with current-compensated chokes can already suppress interference signals effectively at lower frequencies despite the large bandwidth required for the useful signal. This characteristic is illustrated in → 4 by the example of a B84312-C90-B4 filter for telephone lines. The useful signal can thus pass unhindered up to 4 kHz (balanced attenuation). In contrast, interference is already suppressed by 60 dB at this frequency (unbalanced attenuation).

4 | Balanced and unbalanced attenuation



4 The use of current-compensated chokes already provides effective attenuation of differential-mode noise in the passband.

Filters for telephone lines

Standard telephone lines are designed for voice transmission in the range from 300 to 3400 Hz. Both the B84312-C20-B3 filters containing chokes without current compensation (discrete chokes) and the B84312-C90-B4 types with current-compensated chokes are suitable for these systems. The main difference is that the filters with current-compensated chokes already attain an unbalanced insertion loss of 100 dB at a frequency of 10 kHz. Airborne interference can thus be effectively suppressed.

In carrier frequency systems, signals from several telephone lines are multiplexed in a multistage modulation procedure. Filters suitable for standard applications in the most common CF systems are listed in 5. Suitable shielded feedthroughs with and without electromagnetic pulse (EMP) protection are also available for V300 systems that multiplex voice signals from 300 lines and transmit the composite signal via coaxial cable.

5 | Common carrier frequency systems and matching filters

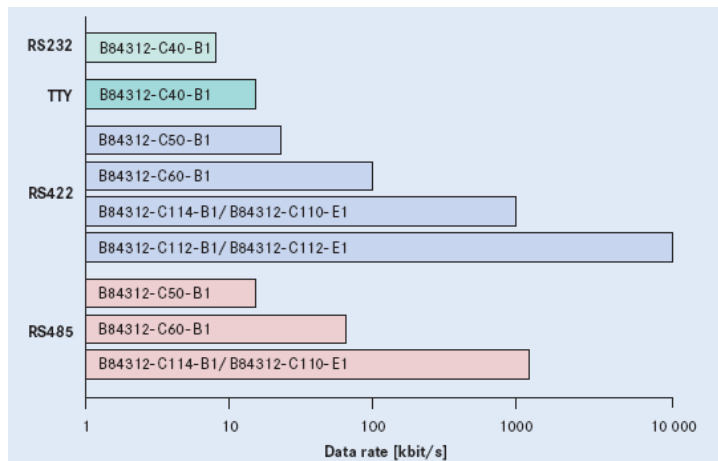
CF system	Frequency range	Filter
Z12	6 to 108 kHz	B84312-C50-B1
V60	12 to 252 kHz	B84312-C60-B1
V120	12 to 525 kHz	B84312-C114-B1

5 EPCOS offers EMC filters for V300 systems (and carrier systems with even more channels) as well as the filters listed on the left.

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Filters for serial data interfaces

Unlike other data transfer interfaces, the RS232 interface operates asymmetrically. A wide variety of impedance patterns are obtained, depending on the technology of the source and drain of interference (TTL, CMOS, etc.). These in turn affect matching of the filter and thus the data transmission rate that can be obtained. In general, data rates up to 4.8 kbit/s can be obtained with the B84312-C40-B1 filter, and even up to 9.6 kbit/s with appropriate design of the source and drain. A significantly higher transmission rate can be obtained by combining a TTY interface - a current interface - with a B84312-C40-B1 filter → 6.



The RS422 interface is configured with eight lines or four twisted pairs as standard. Each pair must run through a separate filter. Depending on application, this interface can support data transmission rates up to 10 Mbit/s. It comes in several variants, but their electrical properties are similar. Distinctions are made between a standard two-wire interface (twisted pair), the bit bus (two-wire interface and another twisted pair for the repeater) and the RS485 interface in four-wire technology (one twisted pair for transmitting and another for receiving). As in the RS422 interface, each twisted pair must run through a separate filter.

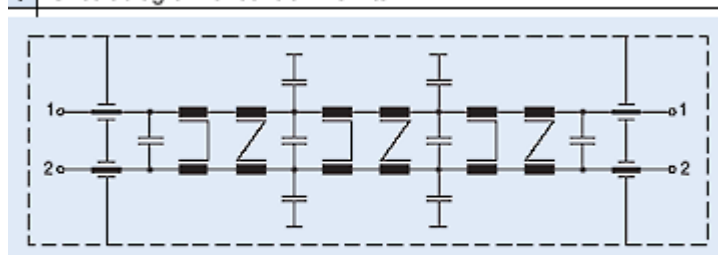
Filters for ISDN applications

Matching filters for the various ISDN interfaces are listed in 2. Filters matching a large passband were developed so as not to reduce the range of the ISDN interfaces significantly. Use of a B84312-C110-E1 filter only reduces the range of an S0 interface from 1280 to 1190 meters. This range reduction of 90 meters or 7% is virtually negligible in practice.

Filters for control lines

For standard control line applications (1 A and 100 V AC or 100 V DC), two filters are used: the B84312-C30-B3 containing chokes without current compensation and the B84312-C100-B3 filter → 7 with current-compensated chokes.

7 | Circuit diagram of control line filter



7 The type of serial interface and the filter used determine the transmission rate attainable.

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The various branches of the B84312-C30-B3 can be used as forward or return lines as desired. On the other hand, care should be taken with the B84312-C100-B3 that the forward and return lines always run through the same filter. The B84312-C100-B3 has better stopband attenuation than the B84312-C30-B3 3. In fire alarm and air conditioning systems, signals must often be transmitted from a sensor inside a shielded casing to a control unit outside. Both the B84312-C40-B1 and B84312-C140-S1 filters have proved ideal for this purpose. Their capacitance of only 64 nF between conductor and ground allows signals with steep edges or from a high-impedance signal source to pass through the shielding.

Accessories and service

A wide range of accessories is available to ensure optimum deployment of these filters. It extends from EMP protection and adapters for special assemblies to cabinets in which several filters may be combined into a unit. The mechanical and electrical properties of every filter are examined, and the filter is then date-stamped and provided with a serial number. As EMC filters in particular must be matched to the application, customers can use the consulting service provided by EPCOS: [✉ emv.labor@epcos.com](mailto:emv.labor@epcos.com)