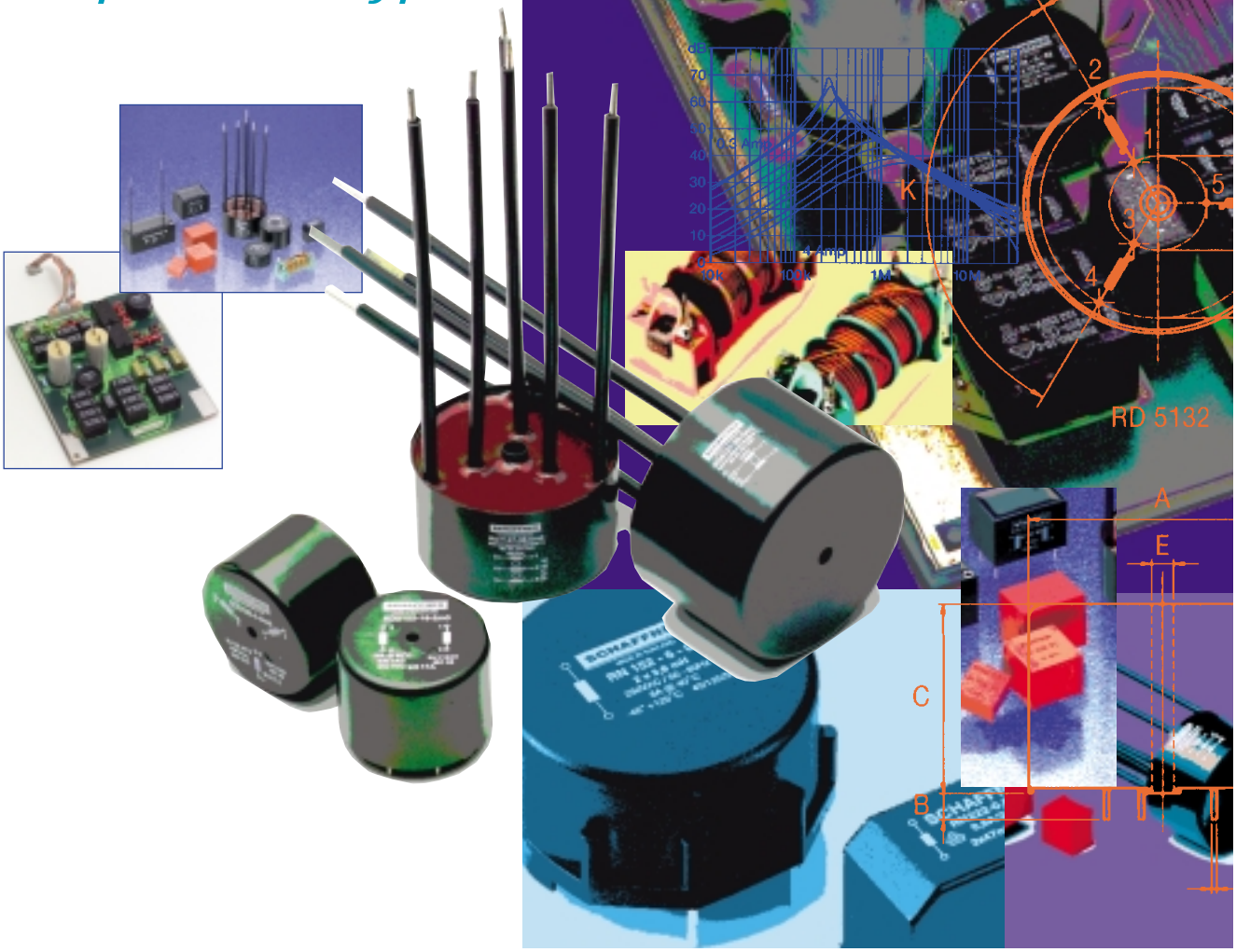
RFI SUPPRESSION CHOKES

rod-cored, saturating and current compensated types



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Your number one name for EMC

RFI suppression chokes

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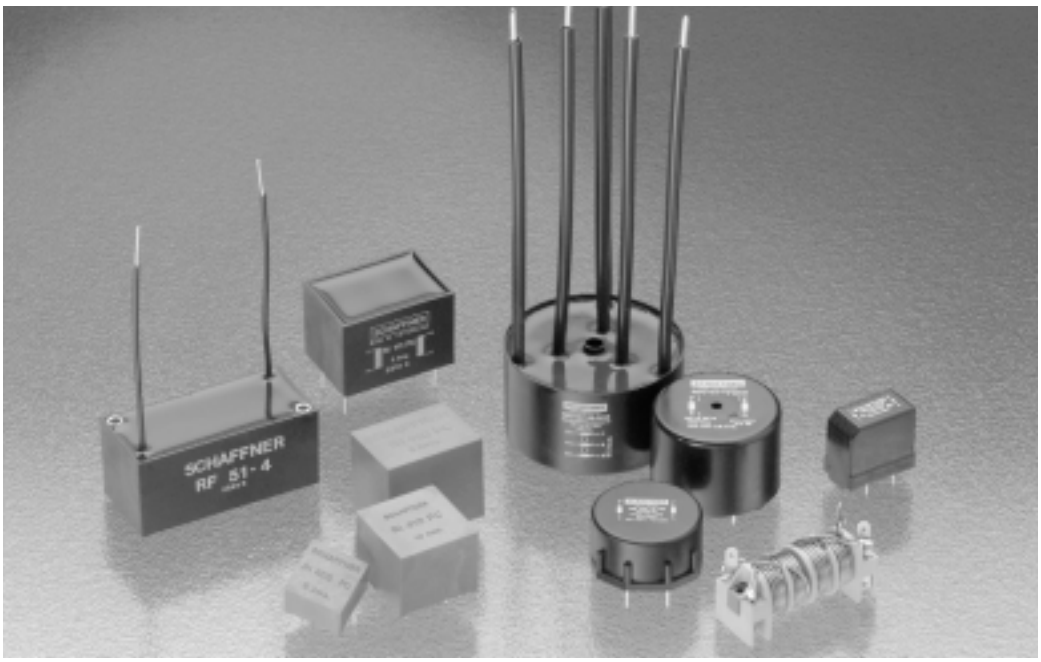

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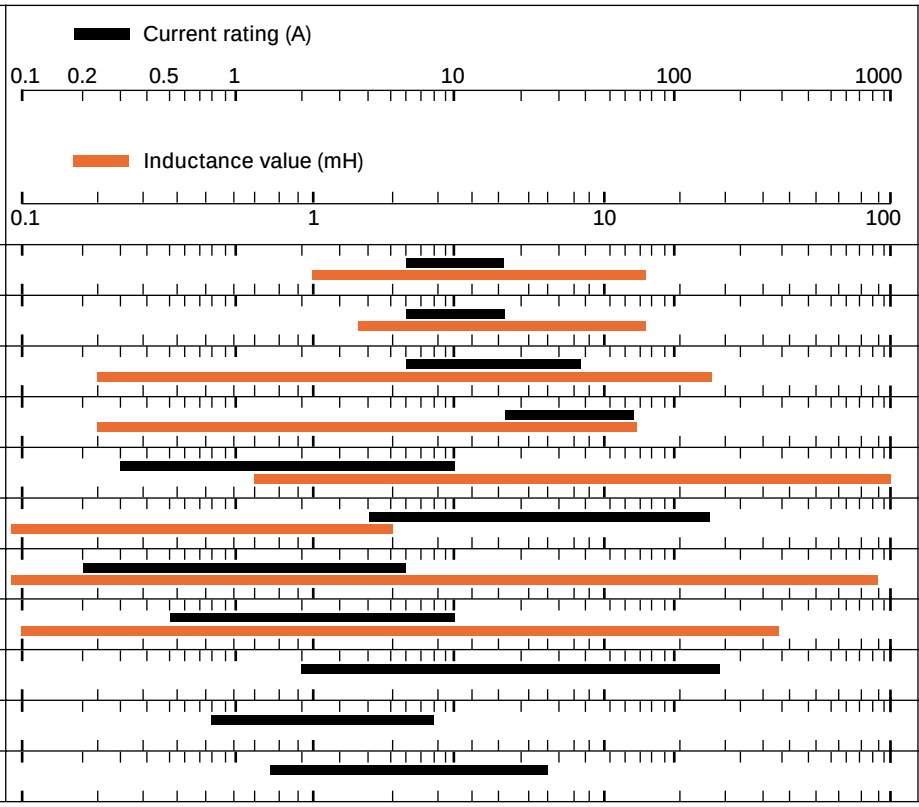
RFI suppression chokes

EMC compliance: a comprehensive choke range

Schaffner offers an exceptionally broad range of discrete chokes for suppressing radio frequency interference (RFI), allowing optimized circuitry for EMC compliance to be designed easily and economically. This catalog details current-compensated, saturating and non-saturating choke types, providing the ideal components to suppress any form or combination of common-mode and differential-mode noise. With around 150 standard products, spanning a broad spread of inductance values and current ratings up to 150A (up to 500A on request), and available in a variety of packaging styles and circuit configurations suitable for single- or three-phase systems, designers can quickly create optimum filtering solutions for almost every application.

Rapid choke selector

This chart provides an overview of our standard families of chokes, allowing you to quickly identify suitable components for your application, and go directly to the relevant technical data. Further general introductory information on filter design using discrete chokes is provided on the following pages.



Choke family	For common mode noise	For differential mode noise	Saturating chokes	For 3-phase/3-phase+neut.	PCB mounting	With flying leads	Catalog page
RD Series (5000)	✓			✓	✓		7
(6000)	✓			✓		✓	7
(7000)	✓			✓		✓	7
(8000)	✓			✓		✓	7
RN Series	✓				✓		10
RF Series (51-101)		✓				✓	12
(201)		✓			✓		12
(211)		✓			✓		12
RI Series (100)			✓		✓	✓	14
(200)			✓		✓	✓	14
(400)			✓		✓	✓	14

General information on EMC and filter design using discrete chokes

EMC compliance is now a fundamental element of the electrical/electronics equipment design process, with legislation in Europe to make compliance obligatory. This section provides an introduction to interference and noise limits - using the influential European standards as an example - with an introduction to the three main forms of choke components and their application.

Permissible noise limits

The various standards set down limits for conducted EMI emissions. These limits are measured in voltage and given in dBµV where 0dB is 1µV. The interference is measured using a measurement receiver which has defined bandwidths and receivers. The two receivers used are a quasi-peak detector, and an average detector. To ensure repeatability of the measurements, the impedance of the mains supply must be constant. The standards calls for a defined artificial mains network - sometimes called a line impedance stabilization network (LISN) - which gives a defined impedance to the noise and also helps filter any noise on the mains which may affect the measurements.

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

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

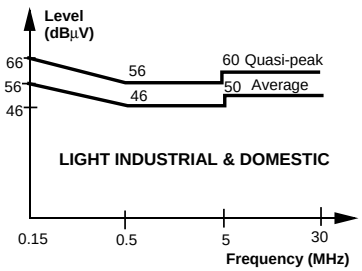


Figure 1. *Permissible interference limits for EN 50081-1*

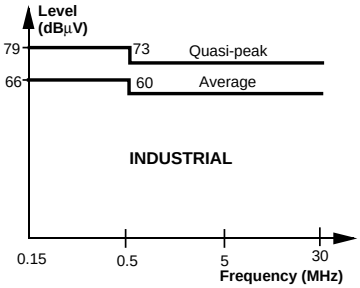


Figure 2. *Permissible interference limits for EN 50081-2*

Interference sources and spectrums

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

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

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

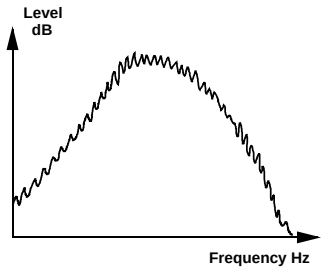


Figure 3. *Continuous spectrum*

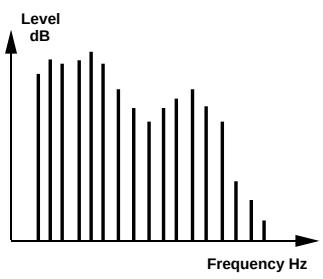


Figure 4. *Discrete spectrum*

Interference propagation

EMI can propagate by two means:

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

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

Below about 100-200MHz, the most efficient radiators in a system are usually the power supply and data cables. Proper filtering of these cables will reduce radiation due to the cables as well as conducted interference.

Above about 100-200MHz, PCB tracks and short internal cables will start to become efficient radiators. To reduce this radiation PCBs should be laid out to reduce track length and loop areas; ground planes should be used if possible. Decoupling of digital ICs is very important and shielding may be necessary.

Interference types

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

Common mode noise appears as a voltage between each phase and earth. The common mode currents flow from the noise source to earth (usually via a

parasitic capacitance) along the earth path and return along the phases (Figure 6).

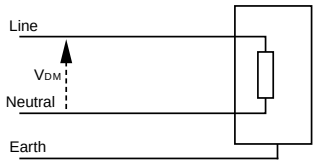


Figure 5. *Differential mode interference (V_{DM})*

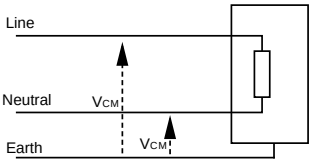


Figure 6. *Common mode interference (V_{CM})*

Suppressing interference

Interference can be reflected towards its source by incorporating an LC network in the noise path. This prevents interference energy from leaving a suppressed device and entering the power supply line. An efficient inductor-capacitor combination to protect against line-conducted interference consists of:

- series inductances in the interference paths
- Cx capacitors between phase and neutral
- Cy capacitors between phases and earth

Three main types of chokes may be used for this purpose:

- current-compensated - with multiple windings to avoid saturation (loss of effective inductance) of the core material
- saturating chokes - which are ideal for reducing fast current changes
- rod-cored chokes - which present a constant inductance even at high currents

Current-compensated chokes *(RN & RD Series)*

This type of component consists of a ring core with two or more windings, potted in a plastic housing. It is used to attenuate common-mode or asymmetric (P/N→E) interference signals, by being connected in series with the phase and neutral lines of an AC powerline input. The magnetic fields produced by this winding technique cancel each other out. Full inductance is only presented to interference signals which flow asymmetrically from phase/neutral to earth. Symmetrical components of the noise are also attenuated by the leakage inductance of the windings. The impedance of the choke at powerline frequencies is therefore negligible, resulting in practically zero voltage drop. These chokes are typically used in conjunction with suppression capacitors as follows:

- in phase-angle control circuits where the desired degree of suppression cannot be achieved by saturating chokes alone
- for suppressing high interference levels from ultrasonic generators, fast rectifiers, switched mains equipment etc
- for suppressing equipment with no earth connection
- for input filters to protect digital circuitry from mains-borne interference

Saturating chokes *(RI Series)*

Saturating-type chokes change impedance at the moment of switching, and can be used to attenuate differential-mode or symmetrical (P→N) interference, as generated by phase angle control devices such as thyristors and triacs. Interference levels can be brought within the limits of national and international regulations by using these chokes in conjunction with appropriate suppression capacitors. For optimum attenuation, chokes must be connected as close as possible to the semiconductor switching device. A simple single-stage suppression circuit is shown in Figure 7; this can be made into a dual-stage filter by the load itself and one additional capacitor.

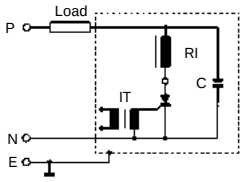


Figure 7. *Saturating choke in series with a thyristor*

Rod-cored chokes *(RF Series)*

In contrast to saturating types, rod-cored chokes present a constant inductance. They are also suitable for attenuating differential-mode or symmetrical (P→N) interference, particularly lower frequency interference up to around 500kHz. Single and dual rod-cored chokes are ideal for the construction of RFI suppression filters for the 150kHz frequency region of EN 50081.

Operating current

The maximum operating current for components in this catalogue is specified at an ambient temperature of 40˚C (Fig 8).

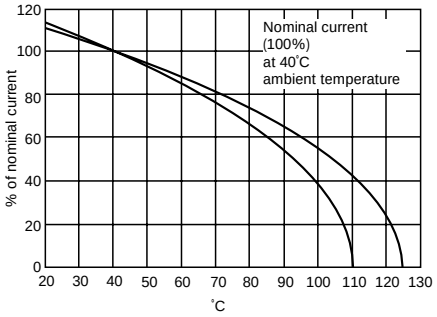


Figure 8. *Maximum permissible current as a function of ambient temperature*

Because Schaffner chokes are manufactured to meet the IEC 68 climate class (HMF, HFK, GFK and GLF classes), the maximum internal temperature reached in the choke is in the region of 100 to 125˚C. (Maximum ambient temperature is 100 to 125˚C.) The formula below provides the relationship between ambient temperature and permissible current loading:

$$I_{perm} = I_{nom.} \sqrt{\frac{\vartheta_{max.} - \vartheta_{ambient}}{\vartheta_{max.} - 40}}$$

Some typical noise suppression circuit designs

The following diagrams illustrate some commonly-used noise suppression circuit designs. Application engineers are available throughout Schaffner's worldwide network of support centres to help customers choose and design optimal circuits for specific EMC problems.

Single-phase power control. The circuit in Figure 9 controls the amount of power delivered to the load. The use of a filter based on a saturating-type choke (from the RI Series) - sited as close as possible to the switching element - provides short-duration impedance to suppress the noise precisely at the times of switching.

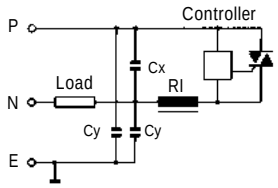


Figure 9. *Application of a saturating choke in a single-phase system*

Three-phase power control. The circuit in Figure 10 illustrates the use of a filter based on saturating-type chokes (from the RI Series) in a three-phase rectifier with a resistive load. Sited as close as possible to the thyristor switching elements, the chokes provide short-duration impedance to suppress noise precisely at the times of switching.

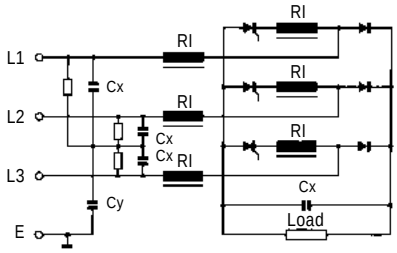


Figure 10. *Application of saturating chokes in a three-phase system*

Suppressing common-mode interference. The circuit in Figure 11 illustrates the use of a current-compensated type choke (from the RN Series) in conjunction with a few discrete components, to provide an economic filter to suppress common-mode interference between the AC mains and a switched-mode power supply.

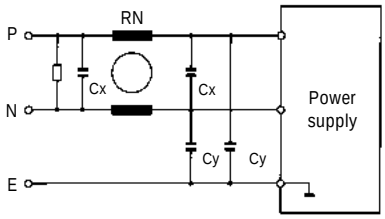


Figure 11. *Simple powerline filer to remove common-mode noise, based on a current-compensated choke*

Suppressing differential and common-mode noise. The circuit in Figure 12 adds another stage to the previous circuit to combat differential-mode interference. This is achieved by means of a filter based on non-saturating rod-cored chokes from the RF Series, which are ideal for removing lower frequency noise such as that generated at typical power supply switching frequencies.

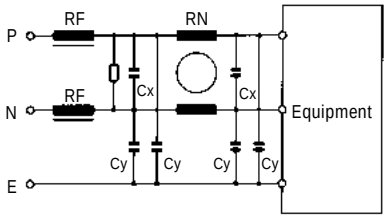


Figure 12. *Two-stage powerline filter with differential- and common-mode suppression*

Further publications available

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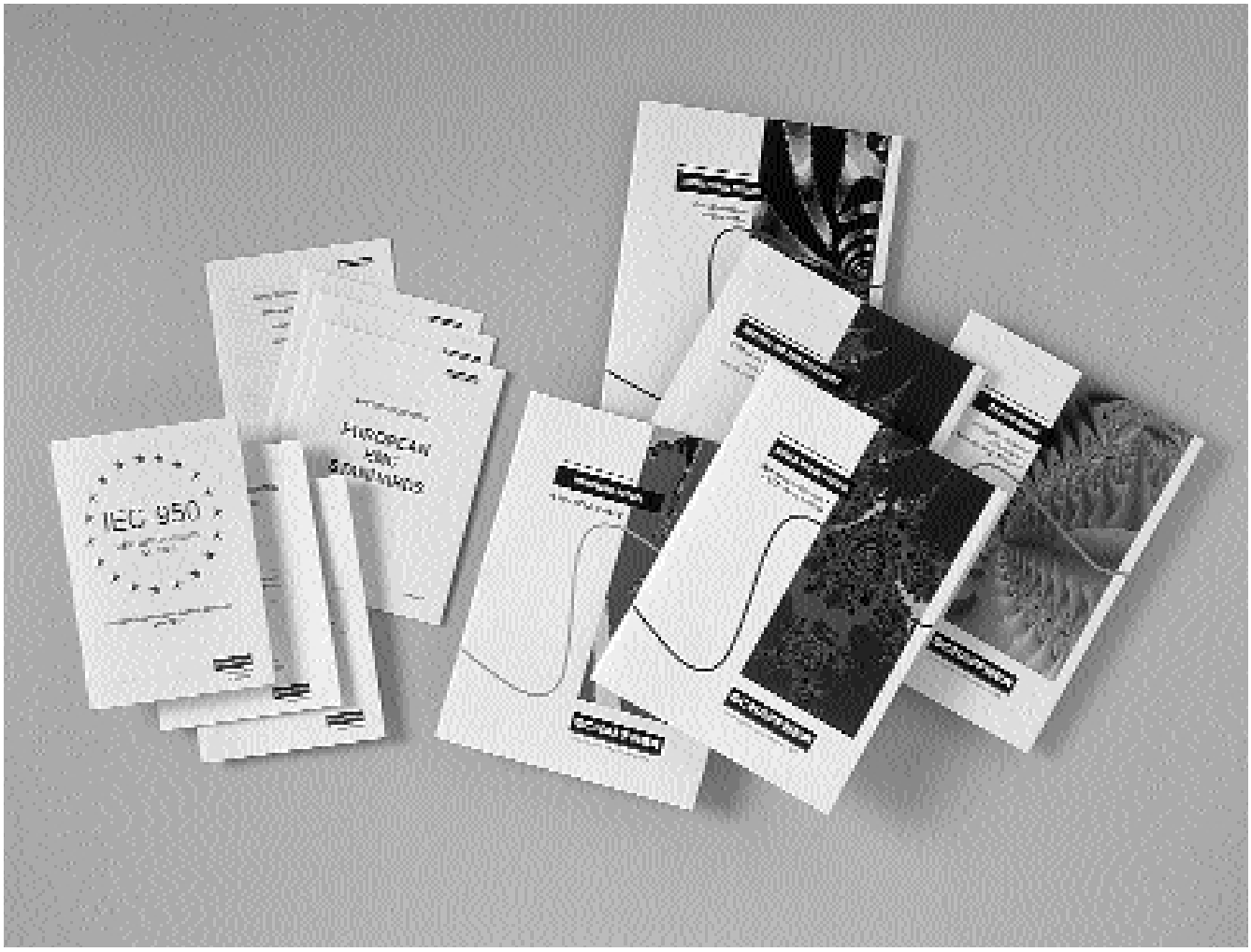

Schaffner offers a comprehensive range of power components, and publishes further catalogues on:

- powerline filters with IEC inlets
- single-phase filters
- three-phase filters
- pulse transformers

Numerous application notes are also available to help designers understand and apply these components. Schaffner also offers a comprehensive range of stimulus and measurement instrumentation for EMC conformance.

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Current-compensated chokes

RD Series

These chokes employ current-compensated windings to present a large inductance to common-mode noise signals and handle peak currents without saturating, utilizing toroidal ferrite cores to pack high inductance values into compact housings. The family is ideal for interference suppression in medium-to-high current applications such as uninterruptible and switched-mode power supplies, and DC stages of inverters. With a choice of over 40 versions, in a range of package styles, designers can quickly create optimal filter solutions for any application.

- **6 to 64A ratings**
- **0.2 to 25mH inductances**
- **up to 600VAC or 850VDC**
- **DC to 400Hz frequencies**
- **PCB-mount or flying-lead versions**
- **dual, triple and quad choke configurations**

Choke selection table Choose the choke **RD xxxx** offering the required current rating and inductance characteristics. The name provides a verification of selection: in RD wxyz-??-??, w = diameter of housing in cm; x = housing height (1 denoting standard); y = number of lines (2 = phase+neut., 3 = 3-phase, 4 = 3-phase+neut.), and z = connection type (2 = PCB pins, 7 = wire); -??-?? indicates current and inductance ratings.

Choke type	Nominal current A@40ºC	Inductance L* mH/path	Circuit symbol	R† mΩ/ path	Weight approx. g
RD 5122-6-9m6	6	9.6		52.55	160
RD 5122-10-6m0	10	6		24.25	160
RD 5122-16-2m0	16	2		9.50	160
RD 5132-6-5m0	6	5		38	160
RD 5132-10-3m0	10	3		17.60	160
RD 5132-16-1m0	16	1		6.90	160
RD 6127-6-15m0	6	15		66.65	235
RD 6127-10-9m0	10	9		25.90	235
RD 6127-16-3m0	16	3		10.90	235
RD 6137-6-7m5	6	7.5		49	235
RD 6137-10-4m5	10	4.5		18.35	235
RD 6137-16-1m5	16	1.5		8.30	235
RD 7127-6-25m0	6	25		84.20	320
RD 7127-10-14m0	10	14		33.50	350
RD 7127-16-5m7	16	5.7		14.10	370
RD 7127-25-2m8	25	2.8		6.40	400
RD 7127-36-1m0	36	1		3.30	380
RD 7137-6-12m0	6	12		60.60	340
RD 7137-10-6m6	10	6.6		21.90	380
RD 7137-16-2m8	16	2.8		10.70	380
RD 7137-25-1m3	25	1.3		4.45	440
RD 7137-36-0m5	36	0.5		2.75	400

Choke type	Nominal current A@40ºC	Inductance L* mH/path	Circuit symbol	R† mΩ/ path	Weight approx. g
RD 7147-6-6m0	6	6		45.10	320
RD 7147-10-3m5	10	3.5		19.10	370
RD 7147-16-1m5	16	1.5		8.50	390
RD 7147-25-0m7	25	0.7		3.65	430
RD 7147-36-0m2	36	0.2		2.30	400
RD 8127-16-12m0	16	12		20.05	590
RD 8127-25-5m0	25	5		8.45	630
RD 8127-36-3m0	36	3		4.55	690
RD 8127-50-1m0	50	1		2.50	640
RD 8127-64-0m8	64	0.8		1.60	710
RD 8137-16-5m0	16	5		11.60	630
RD 8137-25-2m5	25	2.5		6.40	650
RD 8137-36-1m5	36	1.5		3.65	720
RD 8137-50-0m6	50	0.6		2.15	700
RD 8137-64-0m5	64	0.5		1.35	780
RD 8147-16-3m0	16	3		9.25	650
RD 8147-25-1m3	25	1.3		5.05	650
RD 8147-36-0m8	36	0.8		3.00	760
RD 8147-50-0m3	50	0.3		1.75	740
RD 8147-64-0m2	64	0.2		1.10	820

Test conditions

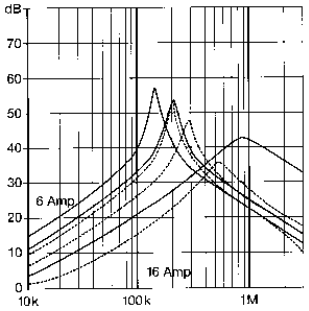
* Measuring frequency: 1kHz; 500µA > 0.16mH < 1.6mH; 50µA > 1.6mH < 160mH; inductance tolerance +50%, -30%
† Resistance: tolerance max. ±15% at 25°C; < 200mΩ 100mA
Electrical characteristics at 25°C ±2°C

Environmental ratings

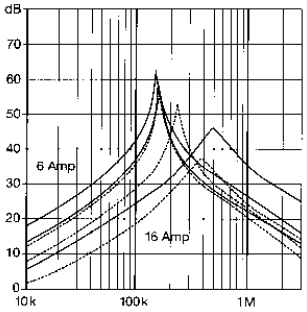
Maximum operating voltage:	600VAC/850VDC at 40˚C
High potential test voltage	
winding-to-winding at 25˚C:	2500VAC, 1 minute, guaranteed 2500V, 50Hz, 2 sec, factory test
winding-to-housing at 25˚C:	4000VAC, 1 minute, guaranteed
Surge current at 10msec:	20 x $I_{nominal}$ at 25˚C
Power operating frequency:	DC to 400Hz at 40°C
Operating/storage temp:	-25ºC to +110˚C
Climatic class per IEC 68:	25/110/21
Flammability:	UL94V0 (insulating tubes UL94V2)

Typical attenuation/resonance frequency characteristics

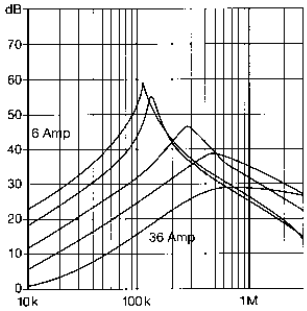
RD 5122–/5132...



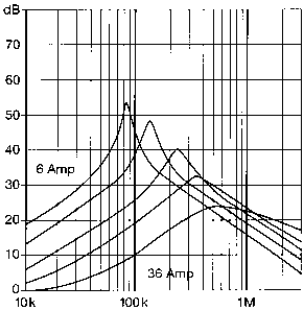
RD 6127–/6137...



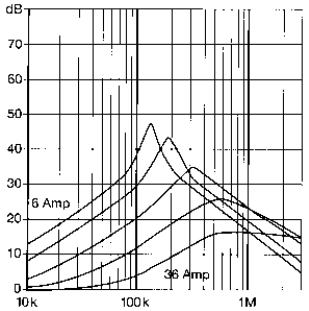
RD 7127



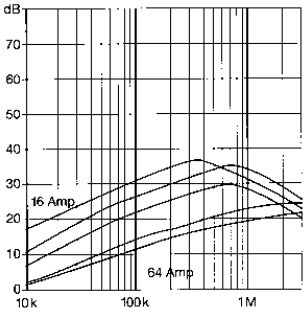
RD 7137



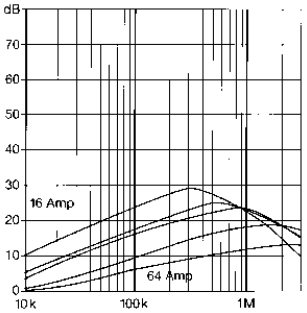
RD 7147



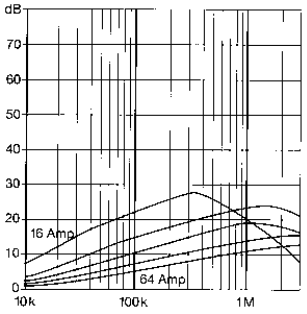
RD 8127



RD 8137



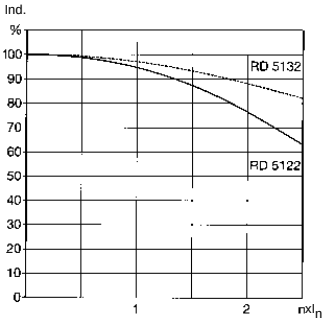
RD 8147



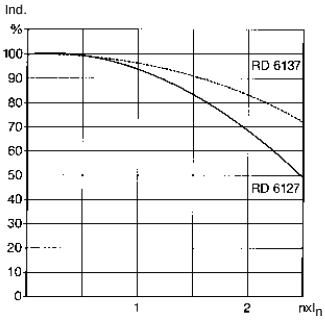
Typical saturation characteristics

Inductance (typical value in %) vs. nominal current (A DC)

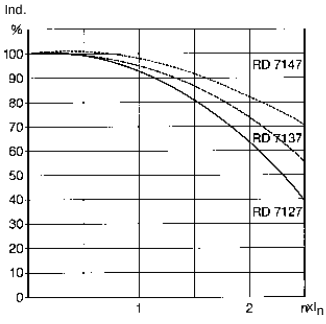
RD 5122 and 5132



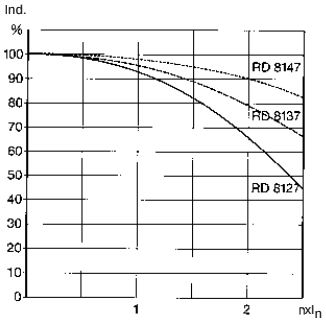
RD 6127 and 6137



RD 7127, 7137, 7147



RD 8127, 8137, 8147



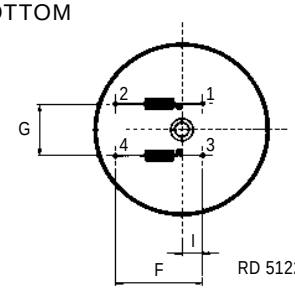
Mechanical data

Choke	RD 5122	RD 5132	RD 6127	RD 6137	RD 7127	RD 7137	RD 7147	RD 8127	RD 8137	RD 8147	Tol.* mm
A	50		60		70			80			± 0.5
B	5		150 $^{+5}_{-0}$					200 $^{+5}_{-0}$			± 0.5
C	35				40			50			± 0.5
D			10					20			± 1
E	4.1 $^{+0.3}_{-0}$				6.1						$^{+6}_{-0}$
F	25	20									± 0.3
G	15	∅40 ± 0.4									± 0.3
H	Sizes vary according to ratings - see separate table below										-
I	5										-
K		120º									-

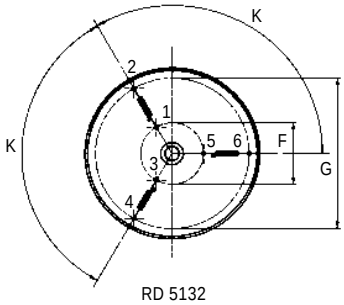
Dimensions in mm; 1 inch = 25.4mm

* Measurements share this common tolerance unless otherwise stated

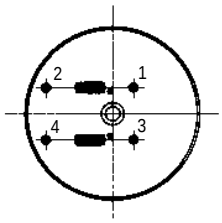
BOTTOM



RD 5122

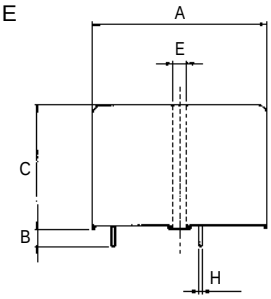


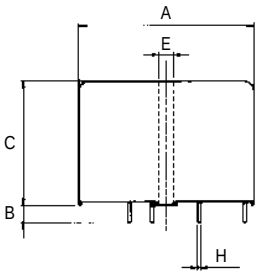
RD 5132

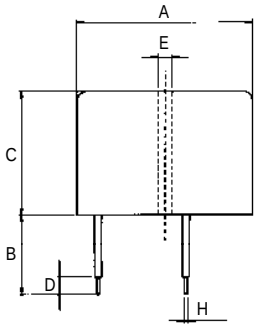


RD 6127, 7127, 8127

SIDE







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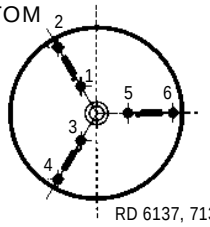
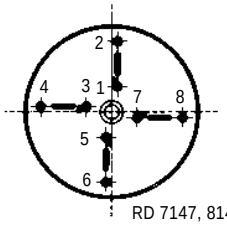


RD 6137, 7137, 8137



RD 7147, 8147

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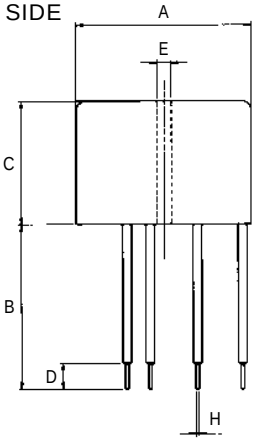
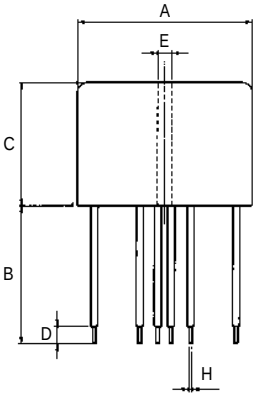




Pin diameter/section sizes (dimension H)

Choke	H	Choke	H
RD 5122-6-9m6	∅1	RD 7147-6-6m0	∅1
-10-6m0	∅1.3	-10-3m5	∅1.4
-16-2m0	∅1.6	-16-1m5	∅1.8
		-25-0m7	∅2.4
RD 5132-6-5m0	∅1	-36-0m2	∅2.5
-10-3m0	∅1.3		
-16-1m0	∅1.6	RD 8127-16-12m0	∅2
		-25-5m0	∅2.4
RD 6127-6-15m0	∅1	-36-3m0	⍁1.5 x 4.5
-10-9m0	∅1.5	-50-1m0	⍁1.7 x 5
-16-3m0	∅1.8	-64-0m8	⍁2.5 x 5
RD 6137-6-7m5	∅1	RD 8137-16-5m0	∅2
-10-4m5	∅1.5	-25-2m5	∅2.4
-16-1m5	∅1.8	-36-1m5	⍁1.5 x 4.5
		-50-0m6	⍁1.7 x 5
RD 7127-6-25m0	∅1	-64-0m5	⍁2.5 x 5
-10-14m0	∅1.4		
-16-5m7	∅1.8	RD 8147-16-3m0	∅2
-25-2m8	∅2.4	-25-1m3	∅2.4
-36-1m0	∅2.7	-36-0m8	⍁1.5 x 4.5
		-50-0m3	⍁1.7 x 5
RD 7137-6-12m0	∅1	-64-0m2	⍁2.5 x 5
-10-6m6	∅1.5		
-16-2m8	∅1.8		
-25-1m3	∅2.5		
-36-0m5	∅2.7		

SCHAFFNER

Current-compensated chokes

RN Series

These chokes employ current-compensated windings to present a large inductance to common-mode noise signals and handle peak currents without saturating, utilizing toroidal ferrite cores to pack high inductance values into compact form-factors. The dual-configuration component family offers an ideal basis for building multi-stage interference suppression circuits for low-to-medium current applications such as uninterruptible and switched-mode power supplies, regulators, DC-DC converters, and frequency inverters. With a choice of 48 versions, in eleven different packages, designers can quickly create optimized filtering solutions for any particular requirement.

- **0.3 to 10A ratings**
- **0.7 to 100mH inductances (dual choke configurations)**
- **100kHz-3MHz common-mode resonance frequencies**
- **11 different PCB-mount housing sizes**

(RN 142/242/143/152 pending)

Choke selection table Choose the choke **RN ?xx** offering the required current rating and inductance characteristics. ? determines package style: insert 1 for a lower profile, 2 for a taller component with a smaller footprint. Example: RN 122-1/02 is a lower profile choke.

Choke type ? (1 = 2 =)	Nominal current A@40ºC	Inductance L* mH/path	Circuit symbol	R† mΩ/path	Weight approx.g /
RN ?02-0.3/02	0.3	12		1275	2/3
RN ?02-0.6/02	0.6	4.4		385	2/3
RN ?02-1/02	1	3		205	2/3
RN ?02-1.5/02	1.5	1.6		100	2/3
RN ?02-2/02	2	1.1		70	2/3
RN ?12-0.4/02	0.4	39		1460	5/6
RN ?12-0.5/02	0.5	27		1250	5/6
RN ?12-0.6/02	0.6	15		465	5/6
RN ?12-0.8/02	0.8	10		370	5/6
RN ?12-1.2/02	1.2	6.8		245	5/6
RN ?12-1.5/02	1.5	3.3		135	5/6
RN ?12-2/02	2	1.8		75	5/6
RN ?12-4/02	4	0.7		27	5/6
RN ?14-0.3/02	0.3	47		1750	9/12
RN ?14-0.5/02	0.5	39		810	9/12
RN ?14-0.8/02	0.8	27		500	9/12
RN ?14-1/02	1	15		375	9/12
RN ?14-1.2/02	1.2	10		200	9/12
RN ?14-1.5/02	1.5	6.8		130	9/12
RN ?14-2/02	2	4.2		102	9/12
RN ?14-2.5/02	2.5	3.3		72	9/12
RN ?14-3/02	3	2		55	9/12
RN ?14-4/02	4	1.5		35	9/12

Choke type ? (1 = 2 =)	Nominal current A@40ºC	Inductance L* mH/path	Circuit symbol	R† mΩ/path	Weight approx.g /
RN ?22-0.6/02	0.6	47		1180	17/21
RN ?22-0.8/02	0.8	39		1000	17/21
RN ?22-1/02	1	18		610	17/21
RN ?22-1.5/02	1.5	10		220	17/21
RN ?22-2/02	2	6.8		147	17/21
RN ?22-2.5/02	2.5	5.6		105	17/21
RN ?22-3/02	3	4.5		80	17/21
RN ?22-4/02	4	3.3		45	17/21
RN ?42-0.5/02	0.5	82		2700	32
RN ?42-1/02	1	33		810	32
RN ?42-1.4/02	1.4	27		500	32
RN ?42-2/02	2	6.8		190	32
RN ?42-4/02	4	3.3		66	32
RN ?42-6/02	6	1.8		20	32
RN 143-0.5/02	0.5	100		2900	33
RN 143-1/02	1	47		880	33
RN 143-2/02	2	10		230	33
RN 143-4/02	4	3.9		58	33
RN 143-6/02	6	1.8		20	33
RN 152-1/02	1	68		1300	54
RN 152-2/02	2	18		350	54
RN 152-4/02	4	6.8		87	54
RN 152-6/02	6	3.9		41	54
RN 152-8/02	8	2.7		22	54
RN 152-10/02	10	1.8		14	54

Environmental ratings

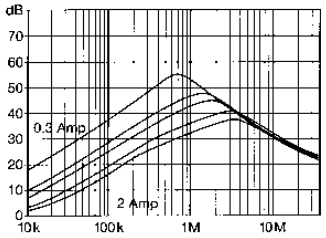
Maximum operating voltage:	250V at 40˚C
High potential test voltage	
winding-to-winding at 25˚C:	1500VAC, 1 minute, guaranteed 1500V, 50Hz, 2 sec, factory test
winding-to-housing at 25˚C:	4000VAC, 1 minute, guaranteed
Surge current at 10msec:	20 x $I_{nominal}$ at 25˚C
Power operating frequency:	DC to 1kHz at 40°C
Operating temperature:	-40ºC to +125˚C
Storage temperature:	-40ºC to +125˚C
Climatic class per IEC 68:	40/125/56
Flammability:	UL94V0

Test conditions

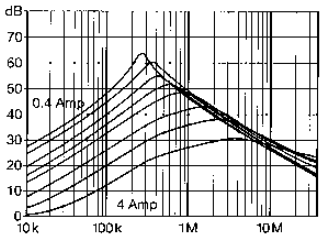
* Measuring frequency: 10kHz; 5mA < 16µH;
500µA > 16µH < 160µH; 50µA > 160µH < 16mH;
50mV > 16mH < 160mH; inductance tolerance +50%, -30%
† Resistance: tolerance max. ±15% at 25°C;
≤ 20mΩ 1A; > 20mΩ ≤ 200mΩ 100mA; > 200mΩ ≤ 2Ω 10mA
Electrical characteristics at 25ºC ±2ºC

Typical attenuation/resonance frequency characteristics

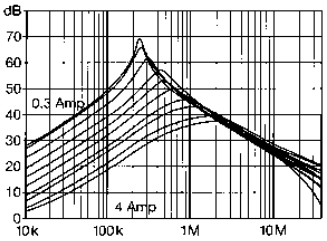
RN ?02



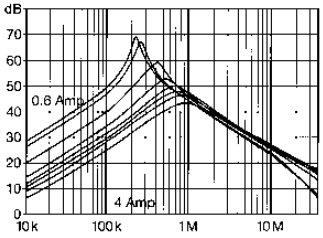
RN ?12



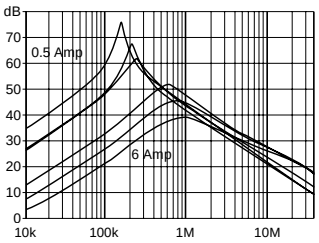
RN ?14



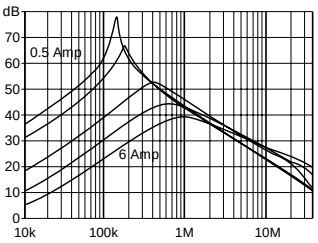
RN ?22



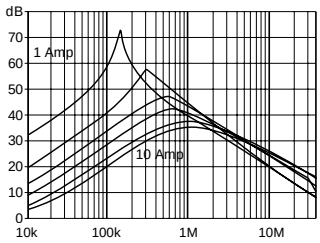
RN ?42



RN 143



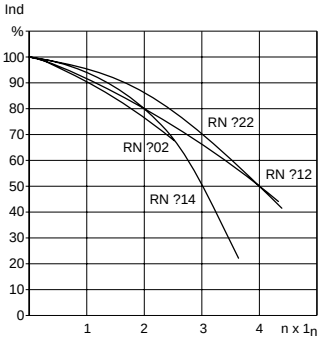
RN 152



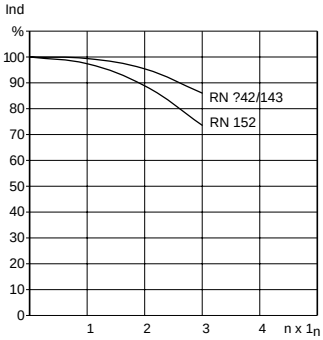
Typical saturation characteristics

Inductance (typical value in %) vs. nominal current (A DC)

RN ?02/?12/?14/?22



RN ?42/143/152



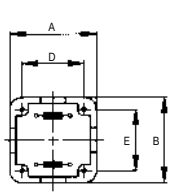
Mechanical data

Choke	RN 102	RN 112	RN 114	RN 122	RN 202	RN 212	RN 214	RN 222	RN 142 RN 143	RN 242	RN 152	Tol.* mm
A	14	17.7	22.5	28	18.2	18	23	31	33.1	31	43	± 0.3
B	14	17.1	21.5	27	8.8	12.5	15.5	18	32.5	18	41.8	± 0.3
C	9	12.6	13.2	16.5	13.5	20	25	29.3	19.7	34.3	25	± 0.3
D	10	15	20.1	25	15.21	15	10	12.5	30	12.5	40	± 0.2
E	10		12.5	15	5.08	10	12.5	15	20	15	15	± 0.2
F	4 ± 0.6				4.5	4			4.3	4.2	4.5	± 0.5
G	0.6	0.8									1.2	± 0.1

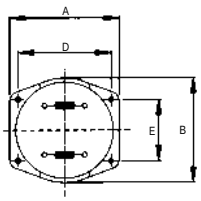
Dimensions in mm; 1 inch = 25.4mm

* Measurements share this common tolerance unless otherwise stated

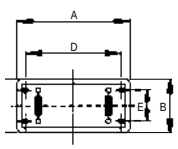
BOTTOM



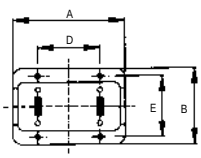
RN 102



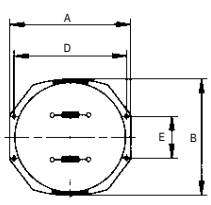
RN 112, 114, 122, 142, 143



RN 202

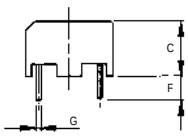


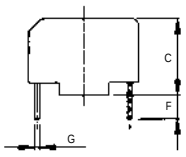
RN 212, 214, 222, 242

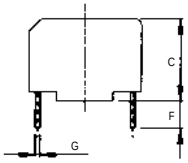


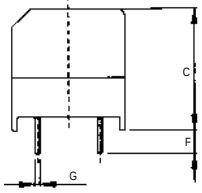
RN 152

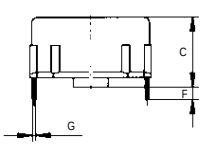
SIDE











SCHAFFNER

Rod-cored chokes

RF Series

These chokes present a constant inductance, and are ideal for attenuating differential-mode or symmetrical interference problems, particularly at lower frequencies up to around 500kHz. They are suitable for replacing saturating or current-compensated chokes in higher power three-phase systems handling currents in 100A+ range.

- **0.2 to 150A ratings (higher currents on request)**
- **0.1mH to 92mH inductances**
- **fast-on or PCB-mount versions**

(RF 201/RF 211)

Choke selection table

Choke type	Nominal current A@40ºC	Inductance L* mH	Circuit symbol	R† mΩ	Weight approx. g
RF 51-4	4	2.4 (2)		310	250
RF 61-16	16	1.2 (1.2)		40	1300
RF 71-35	35	0.58 (0.35)		12	2720
RF 71-75	75	0.1 (0.06)		2	2800
RF 81-75	75	0.42 (0.3)		3.7	9060
RF 81-150	150	0.1 (0.08)		0.95	9400
RF 101-150	150	0.28 (0.22)		2.25	22000
RF 201-0.2/02	0.2	92 (90)		34000	30
RF 201-0.5/02	0.5	18.5 (18)		6300	32
RF 201-1/02	1	4.6 (4.4)		1900	35
RF 201-2/02	2	1.3 (0.84)		500	27
RF 201-0.2/07	0.2	92 (90)		34000	32
RF 201-0.5/07	0.5	18.5 (18)		6300	34
RF 201-1/07	1	4.6 (4.4)		1900	30
RF 201-2/07	2	1.3 (0.84)		520	30
RF 201-6/07	6	0.13 (0.08)		68	29

Choke type	Nominal current A@40ºC	Inductance L* mH	Circuit symbol	R† mΩ	Weight approx. g
RF 211-0.5/02	0.5	50 (47)		10200	75
RF 211-1/02	1	13.6 (12.5)		3000	70
RF 211-2/02	2	3.8 (3.3)		820	70
RF 211-4/02	4	0.92 (0.68)		202	74
RF 211-6/02	6	0.39 (0.33)		100	75
RF 211-10/02	10	0.15 (0.1)		42	70
RF 211-0.5/14	0.5	50 (47)		10200	72
RF 211-1/14	1	13.6 (12.5)		3000	71
RF 211-2/14	2	3.8 (3.3)		820	74
RF 211-4/14	4	0.92 (0.68)		202	74
RF 211-6/14	6	0.39 (0.33)		90	76
RF 211-10/14	10	0.15 (0.1)		33	73

Test conditions

* Measuring frequency: 1kHz; 500µA > 0.16mH < 1.6mH; 50µA > 1.6mH < 160mH; inductance tolerance +50%, -30% (values in brackets according to VDE 0565-2)

† Resistance: tolerance max. ±15% at 25°C; < 200mΩ 100mA; > 200mΩ ≤ 2Ω 10mA; > 2Ω ≤ 20Ω 1mA

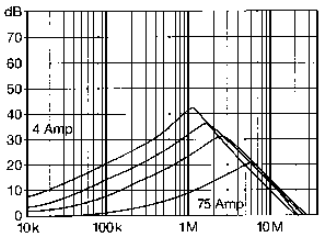
Electrical characteristics at 25ºC ± 2ºC

Environmental ratings

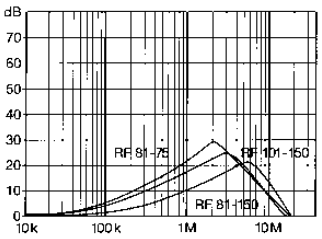
Maximum operating voltage:	380/500V at 40˚C
High potential test voltage	
RF 201 / RF 211	
winding-to-rod core at 25˚C:	2500VAC, 1 minute, guaranteed 2500V, 50Hz, 2 sec, factory test
RF 51 - RF 101	
winding-to-inserts at 25˚C:	3000VAC, 1 minute, guaranteed 3000V, 50Hz, 2 sec, factory test
Surge current at 10msec:	20 x $I_{nominal}$ at 25˚C
Power operating frequency:	DC to 1kHz at 40°C
Operating/storage temp:	
RF 201 / RF 211	-40˚C to +110˚C
RF 51 - RF 101	-25˚C to +110˚C
Climatic class per IEC 68:	
RF 201 / RF 211	40/110/21
RF 51 - RF 101	25/110/21

Typical attenuation/resonance frequency characteristics

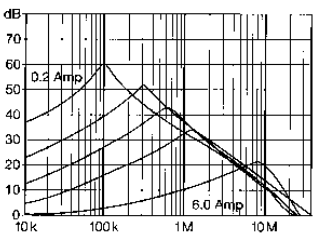
RF 51/61/71



RF 81/101



RF 201



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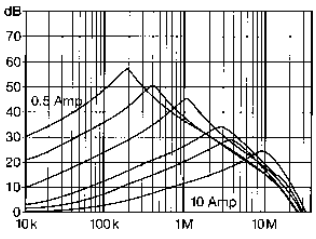


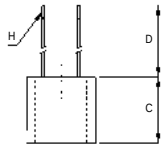
Mechanical data

Choke	RF 51	RF 61	RF 71	RF 81	RF 101	Tol.* mm
A	75 ± 0.5	145	191.5 ± 1	270 ± 10	425 ± 2	$^{+0.2}_{-0}$
B	35	50	61 ± 0.5	90	130 ± 2	± 0.3
C	34	55	65 ± 0.5	95 ± 3	130 $^{+10}_{-0}$	± 0.3
D	100 $^{+10}_{-0}$	15 ± 2		45	60	± 3
E	66	131	177.5	226	140	± 0.25
F	26	37	47 ± 0.5	60	90	± 0.25
G	∅4.2	∅6.5		M6	M8	± 0.1
H	∅1.06					-
I		∅5				± 0.3
K				9	15	$^{+0}_{-1}$

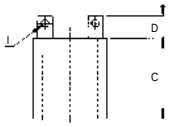
Dimensions in mm; 1 inch = 25.4mm

* Measurements share this common tolerance unless otherwise stated

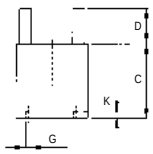
SIDE



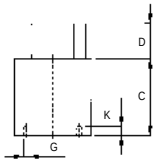
RF 51



RF 61, 71

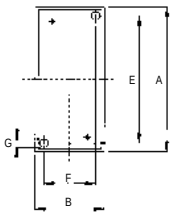


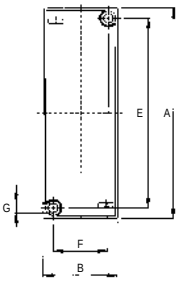
RF 81

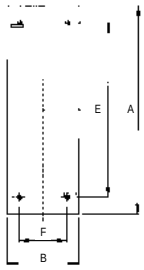


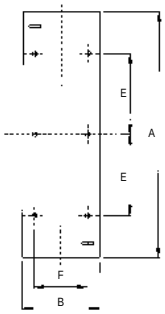
RF 101

BOTTOM







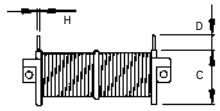


Choke	RF 201 -xx/02	RF 201 -0.2/07	RF 201 -0.5/07	RF 201 -1/07	RF 201 -2/07	RF 201 -6/07	RF 211 -xx/02	RF 211 -xx/14	Tol.* mm
A	48	52.5					58		± 0.3
B	16	19					23		± 0.2
C	18	23.5		18.5			25.5		± 0.3
D	5.1	110 ± 5					6	6.5	± 0.5
E		47					51 ± 0.15		± 0.2
F		8.6							± 0.2
G		∅2.8					3.6		$^{+0.2}_{-0}$
H	0.8						0.8		± 0.1
I							∅2		± 0.1
K		48						17.5	± 0.2
L							7.2		± 0.1

Dimensions in mm; 1 inch = 25.4mm

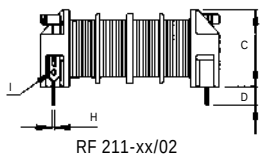
* Measurements share this common tolerance unless otherwise stated

SIDE

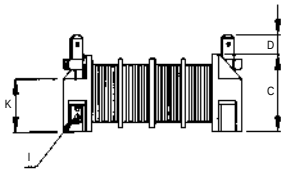


RF 201-xx/02

RF 201-xx/07

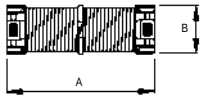


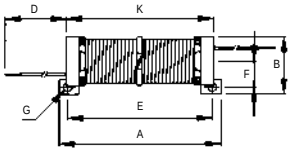
RF 211-xx/02

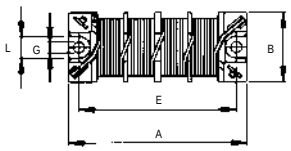


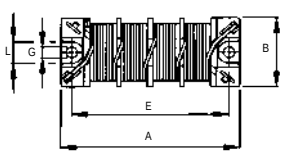
RF 211-xx/14

BOTTOM

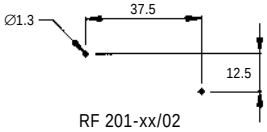




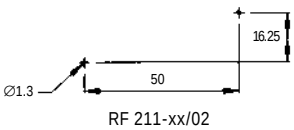




DRILLINGS FOR PCB MOUNTING



RF 201-xx/02



RF 211-xx/02

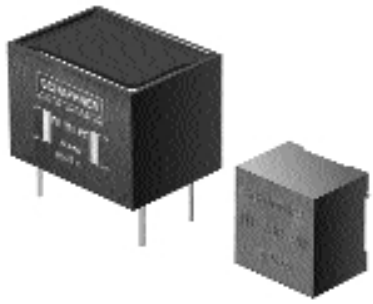
SCHAFFNER

Saturating chokes

RI Series

The inductance of saturating-type chokes reduces as load current increases, and is ideal for attenuating the differential-mode or symmetrical interference generated by fast-switching thyristors, triacs, transistors and phase angle control devices. Inductance values are not shown because the leakage inductance is relatively high.

- **0.8 to 25A ratings**
- **single or dual choke configurations**
- **flying lead or PCB-mount versions**



Choke selection table Choose the choke **RI xxx** offering the required current rating and component configuration.
Types with the letters PC in the name have pins for PCB mounting; others have flying lead wire connections.

Choke type	Nominal current A@40ºC	Circuit symbol	R† mΩ/path	Weight approx. g
RI 109 PC	2		280	65
RI 110 PC	3		148	120
RI 111 PC	6		42	170
RI 13	25		10	1320
RI 207 PC	0.8		1325	50
RI 209 PC	2		275	40
RI 229 PC	2		265	30
RI 230 PC	3		160	50
RI 210 PC	3		160	65
RI 231 PC	5		62	80

Choke type	Nominal current A@40ºC	Circuit symbol	R† mΩ	Weight approx. g
RI 211 PC	6		43	70
RI 221 PC	8		34	175
RI 401 PC	1.5		620	15
RI 403 PC	3		105	30
RI 406 PC	6		53	55
RI 410 PC	10		28	95
RI 222	15		21	330
RI 415	15		8	205
RI 425	25		3.5	325

Environmental ratings

Maximum operating voltage:	500V at 40˚C
High potential test voltage winding-to-winding at 25˚C and/or winding-to-inserts:	2500VAC, 1 minute, guaranteed 2500V, 50Hz, 2 sec, factory test
Surge current at 10msec:	20 x $I_{nominal}$ at 25˚C
Power operating frequency:	DC to 1kHz at 40°C
Operating temperature:	-25°C to +110˚C
Storage temperature:	-25°C to +110˚C
Climatic class per IEC 68:	25/110/21
Flammability:	UL94V0

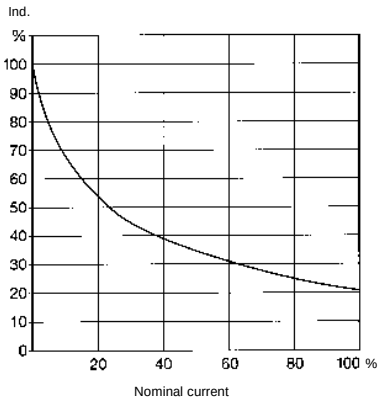
Test conditions

† Resistance: tolerance max. ±15% at 25°C; < 200mΩ 100mA; > 200mΩ ≤ 2Ω 10mA
Electrical characteristics at 25ºC ± 2ºC

Typical saturation characteristics

Inductance (typical value in %) vs. nominal current in %

RI series typical



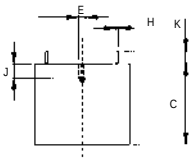
Mechanical data
PCB Mounting

Choke	RI 109	RI 110	RI 111/ RI 221	RI 207/ RI 401	RI 209	RI 210	RI 211	RI 229/ RI 403	RI 230/ RI 406	RI 231	RI 410	Tol.* mm
A	32	40	49	$19.5^{+0.55}_{-0}$	25	32		23.3	28.5	$32.5^{+0.5}_{-0}$	33	± 0.3
B	24	30	35	$19.5^{+0.55}_{-0}$	25	24		23.3	28.5	$32.5^{+0.5}_{-0}$	33	± 0.3
C	30	35	34	$15^{+0}_{-0.6}$/$15^{+0.3}$	25	30		18	21.5	25	28	± 0.3
D	17	18	21			17						± 0.25
E	M3		M4			M3						-
F	25	30	40/20	12.5		15	25	15	20	17.5		± 0.2
G	10	12.5	20	7.5	12.5		17.5	10		15		± 0.2
H	0.6 x 0.88		∅1.15/1.13	0.6 x 0.88	∅1		∅1.13	∅0.8/0.9	0.6 x 0.88	0.75 x 1.1		± 0.1
J	4		6			4						$^{+0}_{-0.5}$
K	~6.5	~5.5	~15	~4	~15	~11	~15	~4/~6	~4/~4.5	~6		-

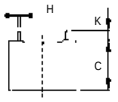
Dimensions in mm; 1 inch = 25.4mm

* Measurements share this common tolerance unless otherwise stated

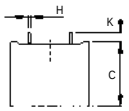
SIDE



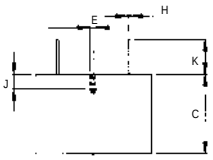
RI 109, 110, 111



RI 207, 209, 229, 230, 401, 403, 406

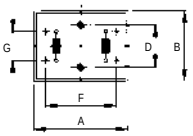


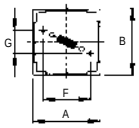
RI 231, 410

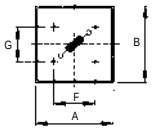


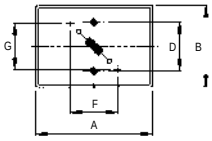
RI 210, 211, 221

BOTTOM









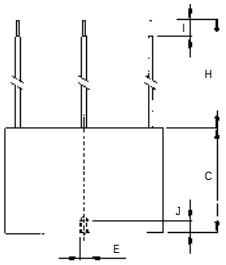
Flying lead types

Choke	RI 13	RI 222	RI 415	RI 425	Tol.* mm
A	95	$48^{+0.3}_{-1.2}$	$35^{+0}_{-0.5}$	$48^{+0.3}_{-1.2}$	± 0.3
B	$60^{+1.3}_{-0}$	48	$49^{+0}_{-0.5}$	48	$^{+0.3}_{-1.2}$
C	65	43	34	43	± 0.3
D	37	30			± 0.25
E	M5	M4			-
F	~80	~35	~22	~39	-
G	~40	~35	~36	~35	-
I	10				± 1
J	7^{+1}_{-0}	6			$^{+0}_{-0.5}$
K	200				± 10

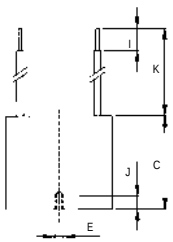
Dimensions in mm; 1 inch = 25.4mm

* Measurements share this common tolerance unless otherwise stated

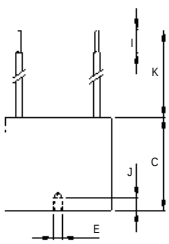
SIDE



RI 13

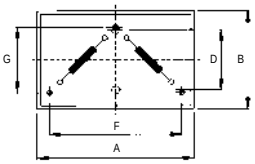


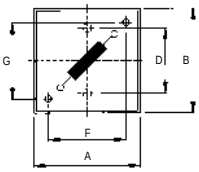
RI 222

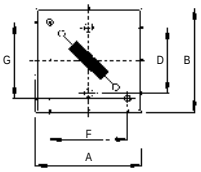


RI 415, 425

BOTTOM







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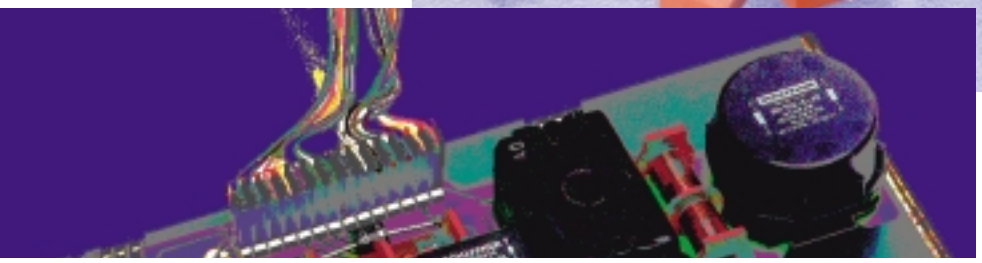

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