

REACTORS FOR FILTERING





CONTENTS

| | PAGE |
|--|-------|
| Reactors for filtering in power factor correction | 3 |
| R / RE | 4-6 |
| Reactors for power converters | 7 |
| FILTERS FOR POWER CONVERTERS: MAINS SIDE, L_{RED} AND MOTOR SIDE L_{MOT} | 8 |
| LM, THREE-PHASE REACTORS FOR RIPPLE REDUCTION (MOTOR SIDE) | 9 |
| Chokes reactors | 10 |
| Dimensions | 11-12 |

FILTER REACTORS



Many of the disturbance problems in LV systems may be solved by adequate filtering techniques. CIRCUTOR has developed a complete range of filtering reactors for the following typical applications:

- Avoid resonances and protect capacitors in power factor correction equipment
- Absorb (reduce) harmonics, improving THD (total harmonic distortion)
- Improve short circuit power
- Filtering the disturbed current caused by power converter equipment (variable speed drives,...) at D.C. or A.C. side.

Reactors for absorption filters

These filters are formed by as many L-C branches as harmonics to be filtered. The resonance frequencies of the different branches coincide with those of the harmonics to be filtered.

The constructive form of each branch is similar to that of the detuned filters, (see fig.2 in next page) but in this case the key data is the current to be filtered. This will define the size of the reactor and the capacitor. There are many possible values of current ratings and reactive energy for the filter. **CIRCUTOR** may offer the adequate reactors for all the cases.

Fig. 1.A and 1.B show the response in two typical branches provided for 5th and 7th harmonic filtering. Fig. 1.C shows the typical response of a filter bank including branches for the 5th, 7th, 11th and 13th, plus a high pass filter for $n > 15$.

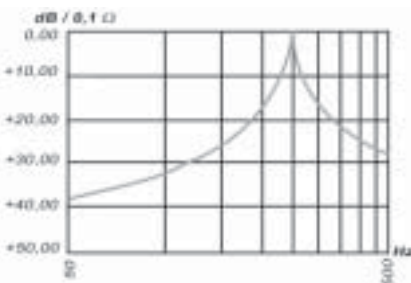


Fig. 1A - Frequency response for n = 5 branch

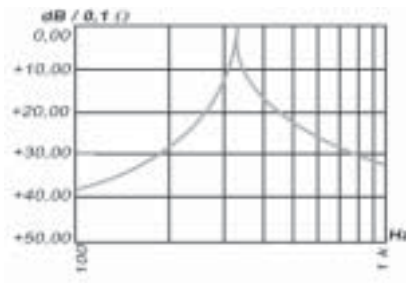


Fig. 1B - Frequency response for n = 7 branch

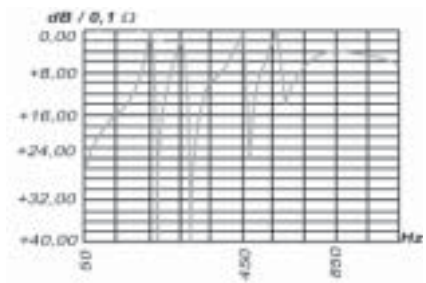
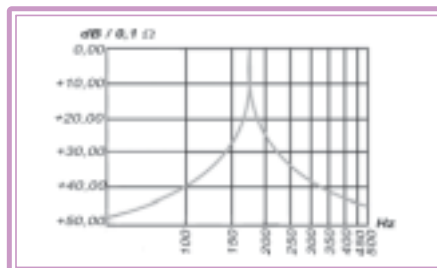


Fig. 1C - Frequency response of filter with n = 5, 7, 11, 13, >15

The impedance of filters is usually given in logarithmic graphs, where the impedances are represented in the Y axis, referred to a standard value (0,1 Ω in our case) as a function of frequency (X axis). The impedance unit is then the (dB/0,1Ω), defined as:

$$Z \text{ (dB / 0,1}\Omega) = 20 \cdot \log [Z \text{ (filter) / 0,1}\Omega]$$



Typical frequency response

| dB / 0,1 Ω to Ω direct conversion | | | |
|-----------------------------------|--------|--------------|--------|
| Z | Z | Z | Z |
| (dB / 0,1 Ω) | Filter | (dB / 0,1 Ω) | Filter |
| 0 | 0,100 | 20 | 1,00 |
| 2 | 0,125 | 22 | 1,25 |
| 4 | 0,158 | 24 | 1,58 |
| 6 | 0,199 | 26 | 1,99 |
| 8 | 0,251 | 28 | 2,51 |
| 10 | 0,316 | 30 | 3,16 |
| 12 | 0,398 | 32 | 3,98 |
| 14 | 0,501 | 34 | 5,01 |
| 16 | 0,630 | 36 | 6,30 |
| 18 | 0,794 | 38 | 7,94 |

Table 1



R / RE, FILTER REACTORS FOR POWER FACTOR CORRECTION

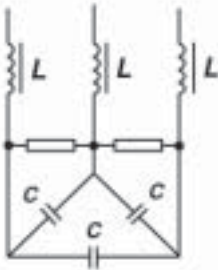
Reactors with detuned filters

The objective of a detuned filter is to avoid the resonance between the inductive impedance of the supply transformer plus the line cabling and the capacitors installed for the PF correction. Such resonance might cause large overloads in the distribution lines and in the capacitors themselves. The filter consists of several L-C branches, which configuration and response curves are like those shown in Fig. 2. The complete filter is formed by as many branches as necessary to obtain the compensation of the reactive energy.

The reactors for this type of filters are specified by the p% factor, which gives the relationship between the voltages across the reactor and the capacitor. The p% factor fixes also the series resonance frequency of the L-C branch.

$$p \% = 100 \cdot \frac{U_L}{U_C} = 100 \cdot \left(\frac{w_L}{w_r} \right)^2$$

Fig. 2



CIRCUTOR has a standard range of reactors, with $p = 7\%$, which means a resonance frequency of 189 Hz for 50 Hz networks or 227 Hz for 60 Hz networks.

This is the most commonly used value in balanced three-phase lines, to avoid resonances to 5th harmonic and above.

In certain installations other p % values must be used. CIRCUTOR may supply reactors adapted to any situation (p % 5.67%, 12.5%, 14% value) on request.

CONSTRUCTIVE CHARACTERISTICS OF FILTER REACTORS

Reactors for low power ratings, type R are built with oriented grain iron sheet and copper windings. The input / output connections use clamp terminals for cable connection.

For higher power ratings RB reactor types are used, which have a core made of oriented grain iron sheet with split air gaps. That gives excellent anti saturation characteristics and very low losses. The RB coils are made of aluminium foil (or copper foil on request).

The input / output connections are made through bars.

Both types, R and RB are vacuum impregnated with a varnish having high insulation properties.

REACTORS III SERIES R / RB / RX / RBX

400 V a.c., 50 Hz, P = 7 % (*)



| Type | Code | kvar | For capacitor | I_n | L (mH) | Losses |
|------------|--------|------|-----------------|-------|--------|--------|
| R-5-400 | P70110 | 5 | CF 46 / 6 | 7,5 A | 7,66 | 25 W |
| R-10-400 | P70115 | 10 | CF 46 / 12,5 | 15 A | 3,83 | 50 W |
| R-15-400 | P70117 | 15 | CF 46 / 19 | 22 A | 2,55 | 57 W |
| RB-20-400 | P70125 | 20 | CF 46 / 25 | 30 A | 1,92 | 76 W |
| RB-25-400 | P70130 | 25 | CF 46 / 30 | 37 A | 1,53 | 90 W |
| RB-30-400 | P70135 | 30 | CF 46 / 37 | 45 A | 1,27 | 120 W |
| RB-40-400 | P70140 | 40 | CF 46 / 50 | 60 A | 0,95 | 145 W |
| RB-50-400 | P70145 | 50 | CF 46 / 62 | 75 A | 0,76 | 185 W |
| RB-60-400 | P70150 | 60 | CF 46 / 74 | 90 A | 0,63 | 205 W |
| RB-80-400 | P70155 | 80 | CF 46 / 100 | 120 A | 0,47 | 235 W |
| RB-100-400 | P70160 | 100 | CF 46 / 62 (x2) | 145 A | 0,38 | 250 W |
| RB-120-400 | P70165 | 120 | CF 46 / 74 (x2) | 175 A | 0,32 | 295 W |

| Type | Code | kvar | For capacitor | I_n | L (mH) | Losses |
|-------------|--------|------|---------------|-------|--------|--------|
| RX-6,25-400 | P7101F | 6,25 | CF 46 / 7,5 | 9 | 6,12 | 36 |
| RX-12,5-400 | P70013 | 12,5 | CF 46 / 15 | 18 | 3,06 | 53 |
| RX-25-400 | P70016 | 25 | CF 46 / 30 | 37 | 1,53 | 92 |
| RBX-50-400 | P70019 | 50 | CF 46 / 63 | 75 | 0,76 | 187 |

(*) Other upon request

REACTORS III SERIE R/ RBC

400 V a.c., 50 Hz, P = 14 % (Fr = 134 Hz)



| Type | Code | kvar | I_n | L (mH) | Losses |
|----------------|---------------|------|-------|--------|--------|
| R-5-400-14% | P70110 00 003 | 5 | 7,5 A | 16,31 | 31 W |
| R-10-400-14% | P70115 00 003 | 10 | 15 A | 8,152 | 61 W |
| R-12,5-400-14% | P70117 00 003 | 12,5 | 18 A | 6,52 | 65 W |
| R-15-400-14% | P70120 00 003 | 15 | 22 A | 5,43 | 71 W |
| R-20-400-14% | P70125 00 003 | 20 | 30 A | 4,07 | 110 W |
| R-25-400-14% | P70130 00 003 | 25 | 37 A | 3,26 | 112 W |
| RBC-30-400-14% | P70135 00 003 | 30 | 45 A | 2,71 | 146 W |
| RBC-40-400-14% | P70140 00 003 | 40 | 60 A | 2,03 | 181 W |
| RBC-50-400-14% | P70145 00 003 | 50 | 75 A | 1,63 | 225 W |
| RBC-60-400-14% | P70150 00 003 | 60 | 90 A | 1,35 | 254 W |

Type R reactors: Cu wire conductor

Type RBC reactors: Cu band conductors

FEATURES

| | R / RB | RX / RBX | R-14% / RBC |
|-----------------------------|-------------------|----------|-------------|
| Insulation voltage | 4 kV | | |
| Tolerance of L | 3 % | | |
| Linearity (5 % of L) to | $1,8 I_n$ | | |
| Maximum ambient temperature | 45 °C | | |
| Internal insulation | Class F (155 °C)* | | |

| | R / RB | RX / RBX | R-14% / RBC |
|-----------------------|-------------------------------|----------|-------------|
| Maximum overload | $\sqrt{\sum (n \cdot I_n)^2}$ | | |
| Permanent | 1,17 I_n | | |
| Transient (1 min) | 2 I_n | | |
| Protection thermostat | 90 °C | | |
| Standards | IEC-289, IEC-076 | | |

* On request, H class (180 °C)

ACCESSORIES

Capacitors
see catalogue R1/2



REACTORS III FOR RE/ RBE SERIES (STATIC)

400 V a.c., 50 Hz, P = 7 % (Fr= 189 Hz)

For static banks with thyristor module based reconnection with reject filters, the RE / RBU reactors have been standardised at 400 V–p=7% especially for this application. These reactors are connected within a triangle forming the capacitor set for improved operation.



| Type | Code | kvar | For capacitor | I_n | L (mH) | Losses |
|------------|--------|------|-----------------|-------|--------|--------|
| RE-5-400 | P70210 | 5 | CF 46 / 6-6B | 5 A | 23,67 | 25 W |
| RE-10-400 | P70215 | 10 | CF 46 / 12,5-6B | 9 A | 11,27 | 50 W |
| RE-15-400 | P70220 | 15 | CF 46 / 19-6B | 13 A | 7,50 | 57 W |
| RE-20-400 | P70225 | 20 | CF 46 / 25-6B | 17 A | 5,68 | 76 W |
| RE-25-400 | P70230 | 25 | CF 46 / 30-6B | 21 A | 4,68 | 90 W |
| RE-30-400 | P70235 | 30 | CF 46 / 37-6B | 26 A | 3,84 | 120 W |
| RE-40-400 | P70240 | 40 | CF 46 / 50-6B | 35 A | 2,84 | 145 W |
| RBE-50-400 | P70245 | 50 | CF 46 / 62-6B | 42 A | 2,29 | 185 W |
| RBE-60-400 | P70250 | 60 | CF 46 / 74-6B | 51 A | 1,89 | 205 W |
| RBE-80-400 | P70255 | 80 | CF 46 / 100-6B | 68 A | 1,42 | 235 W |

FEATURES

| | RE / RBE |
|-----------------------------|-------------------|
| Insulation voltage | 4 kV |
| Tolerance of L | 3 % |
| Linearity (5 % of L) to | 1,8 I_n |
| Maximum ambient temperature | 45 °C |
| Internal insulation | Class F (155 °C)* |

* On request, H class (180 °C)

| | RE / RBE |
|-----------------------|-------------------------------|
| Maximum overload | $\sqrt{\sum (n \cdot I_n)^2}$ |
| Permanent | 1,17 I_n |
| Transient (1 min) | 2 I_n |
| Protection thermostat | 90 °C |
| Standards | IEC-289, IEC-076 |

ACCESSORIES

Capacitors
see catalogue R1/2

REACTORS FOR POWER CONVERTERS



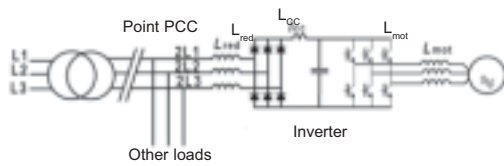
The variable speed drives, for D.C. or A.C. motors (frequency converters) the UPS, and in general all the converters based on thyristors or power transistors, produce a large harmonic distortion and commutation noise in the mains. Also sometimes an excess of ripple at the D.C. side (motor side in case of D.C. drives). All these perturbations may disturb the converter controller or disturb some electronic equipment supplied by the same supply network.

The basic problems caused by power converters are:

- Notches in the voltage wave and excessive di/dt at the mains side of the converters
- Current spikes at the mains side, due to connection of capacitors at the D.C. side of the frequency converters
- Excess of ripple in the armature current and commutation sparks at the collector of D.C. motors

All these problems may be palliated and corrected by the use of chokes or filters. See the next drawings:

Filtering of commutation notches at mains and motor side



PCC voltage without L_{red}



PCC voltage with L_{red}



Motor current without L_{mot}



Motor current with L_{mot}

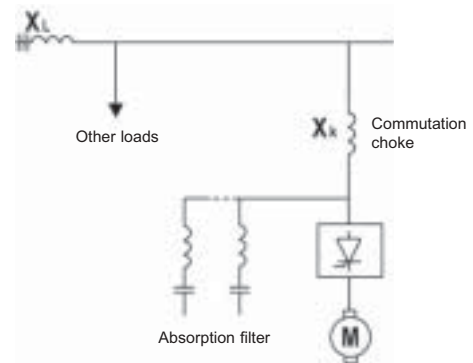


Mains current without L_{cc}

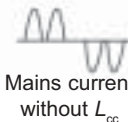
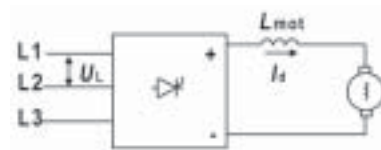


Mains current with L_{cc}

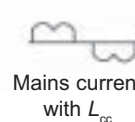
Notch suppression and harmonics filter



D.C. inductance for commutation improving



Mains current without L_{cc}



Mains current with L_{cc}



FILTERS FOR POWER CONVERTERS: MAINS SIDE, L_{MAINS} AND MOTOR SIDE L_{MOT}

May be used both at mains and at motor side. Allow the attenuation of notches and spikes due to initial connection and commutation and reduce the harmonics of current at the mains side. When placed at the motor side the harmonic frequencies due to commutation are damped.

Three-phase reactors (*)

MAINS / MOTOR at 380 V / 415 V

- Short circuit voltage U_k : 4 % for 400 V - 50 Hz
4,8 % for 400 V - 60 Hz

LR, MAINS SIDE REACTORS

400 V a.c., 50 Hz, 4 %



| Motor Power | | I_n A | L mH | Losses (W) | Type | Code |
|-------------|-----|------------|---------|---------------|------------|--------|
| kW | CV | | | | | |
| 0,75 | 1 | 2,5 | 14,8 | 6 | LR 04-003 | P70301 |
| 1,5 | 2 | 4 | 7,9 | 8 | LR 04-004 | P70302 |
| 2,2 | 3 | 5,5 | 5,9 | 10 | LR 04-006 | P70303 |
| 3 | 4 | 7,5 | 4,3 | 12 | LR 04-008 | P70304 |
| 4 | 5 | 10 | 3,2 | 15 | LR 04-010 | P70305 |
| 5,5 | 7 | 13 | 2,5 | 18 | LR 04-013 | P70306 |
| 7,5 | 10 | 17 | 1,85 | 25 | LR 04-017 | P70307 |
| 11 | 15 | 22 | 1,47 | 30 | LR 04-022 | P70308 |
| 15 | 20 | 32 | 0,98 | 45 | LR 04-033 | P70309 |
| 18,5 | 25 | 40 | 0,80 | 55 | LR 04-041 | P7030A |
| 22 | 30 | 47 | 0,67 | 64 | LR 04-050 | P7030B |
| 25 | 34 | 53 | 0,59 | 77 | LR 04-058 | P7030C |
| 30 | 41 | 64 | 0,49 | 88 | LR 04-066 | P7030D |
| 37 | 50 | 76 | 0,40 | 110 | LRB 04-080 | P7030E |
| 45 | 61 | 90 | 0,34 | 120 | LRB 04-095 | P7030F |
| 55 | 75 | 110 | 0,28 | 145 | LRB 04-115 | P7030G |
| 75 | 102 | 148 | 0,20 | 190 | LRB 04-150 | P7030H |
| 90 | 122 | 180 | 0,17 | 230 | LRB 04-185 | P7030J |
| 110 | 150 | 200 | 0,15 | 245 | LRB 04-200 | P7030K |
| 132 | 180 | 250 | 0,12 | 285 | LRB 04-250 | P7030L |
| 160 | 220 | 300 | 0,10 | 355 | LRB 04-300 | P7030M |
| 200 | 270 | 400 | 0,07 | 475 | LRB 04-400 | P7030N |
| 250 | 340 | 500 | 0,06 | 550 | LRB 04-500 | P7030P |
| 315 | 428 | 600 | 0,05 | 634 | LRB 04-600 | P7030Q |

The same 400 V – 50 Hz – 4% reactors may be used with other voltages.
The voltage drops obtained at the same current (I_n) are as follows:

| 50 Hz | |
|------------------|-----------------------|
| Voltage (V a.c.) | Short circuit voltage |
| 400 | 4 % |
| 440 | 3,60 % |
| 460 | 3,50 % |
| 480 | 3,34 % |

| 60 Hz | |
|------------------|-----------------------|
| Voltage (V a.c.) | Short circuit voltage |
| 400 | 4,80 % |
| 440 | 4,30 % |
| 460 | 4,17 % |
| 480 | 4 % |

* Single-phase types for mains side and other values of voltage drop, under request

LR, MAINS SIDE REACTORS

230 V a.c., 50 Hz, 4 %



| Motor power | | I_n A | I_{calc} A | L mH | Losses (W) | Type | Code |
|-------------|------|------------|-----------------|-----------|---------------|------------|--------|
| kW | CV | | | | | | |
| 0,75 | 1 | 4 | 3,4 | 4,90 | 8 | LR 02-004 | P70311 |
| 1,5 | 2 | 7 | 6,5 | 2,60 | 10 | LR 02-007 | P70312 |
| 2,2 | 3 | 10 | 8,6 | 1,96 | 14 | LR 02-010 | P70313 |
| 3 | 4 | 13 | 11,7 | 1,43 | 17 | LR 02-013 | P70314 |
| 4 | 5,5 | 16 | 15,7 | 1,07 | 20 | LR 02-016 | P70315 |
| 5,5 | 7,5 | 22 | 20,2 | 0,84 | 26 | LR 02-023 | P70316 |
| 7,5 | 10 | 30 | 27,5 | 0,61 | 35 | LR 02-030 | P70317 |
| 10 | 13,5 | 38 | 34,8 | 0,49 | 44 | LR 02-039 | P70318 |
| 15 | 20 | 58 | 52,2 | 0,32 | 66 | LRB 02-058 | P70319 |
| 18,5 | 25 | 70 | 64,3 | 0,26 | 80 | LRB 02-071 | P7031A |
| 22 | 30 | 82 | 76,5 | 0,22 | 94 | LRB 02-083 | P7031B |
| 25 | 34 | 92 | 86,9 | 0,19 | 105 | LRB 02-094 | P7031C |
| 30 | 40 | 112 | 104,3 | 0,16 | 115 | LRB 02-100 | P7031D |
| 37 | 50 | 138 | 125,5 | 0,13 | 148 | LRB 02-130 | P7031E |

FEATURES

| | |
|-----------------------------|-----------|
| Voltage drop (standard) * | 4 % |
| Insulation voltage | 2 kV |
| Linearity (5 % of L) to | $1,5 I_n$ |
| Maximum ambient temperature | 45 °C |

| | |
|-----------------------------------|------------------------------|
| Maximum overload | $\sqrt{\sum(n \cdot I_n)^2}$ |
| - permanent - transient (30 s) | $1,17 I_n$ $2 I_n$ |
| Protection thermostat | Under request |
| Standards | IEC 289, IEC 076 |

* Single-phase types for mains side and other values of voltage drop, under request

LM, THREE-PHASE REACTORS FOR RIPPLE REDUCTION (MOTOR SIDE)



Switching frequency > 10 kHz

The main role of this type of reactors is the filtering of ripple at commutation frequency and its main harmonics.

| Motor power | | I_n A | L μ H | Type | Code |
|-------------|---------|------------|----------------|------------|--------|
| from (kW) | to (kW) | | | | |
| 7,5 | 11 | 20 | 50 | LM 22-050 | P71111 |
| 11 | 22 | 40 | 50 | LM 40-050 | P71121 |
| 22 | 37 | 75 | 50 | LM 75-050 | P71131 |
| 37 | 55 | 110 | 50 | LM 110-050 | P71141 |
| 55 | 90 | 180 | 50 | LM 180-050 | P71151 |

FEATURES

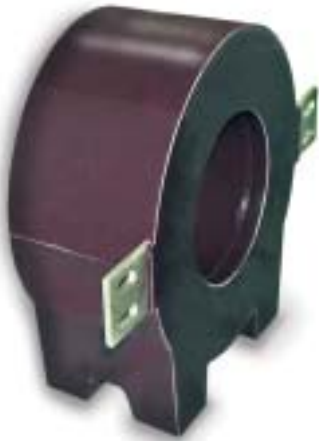
| | |
|-------------------------------|-------------|
| For switching frequencies | > 10 kHz |
| Losses according to frequency | máx. 25 kHz |
| Insulation voltage | 2 kV |
| Linearity (5 % of L) to | $1,5 I_n$ |
| Maximum ambient temperature | 45 °C |

| | |
|-----------------------------------|------------------------------|
| Maximum overload | $\sqrt{\sum(n \cdot I_n)^2}$ |
| - permanent - transient (30 s) | $1,17 I_n$ $2 I_n$ |
| Protection thermostat | On request |
| Standards | IEC 289, IEC 076 |

* Other values, on request



CHOKES REACTORS, RMV



Connecting capacitor banks bring about voltage and current transients and very high currents.

The IEC 60871-1 standard defines the maximum value that a capacitor bank is capable of supporting as a connection spike. Specifically this is 100 times its nominal current.

If this value is exceeded, shock RMV reactancies need to be installed to limit the current transient to acceptable values for the capacitors.

The value of this reactance varies with the installation's conditions and basically depends on the following parameters:

- Short circuit power in the installation.
- Existence of more capacitor banks.
- Closure power of the automatic switches. Once the reactance is assembled, the residual connection value must also be less than the closure powers of the equipment in general.

| RMV | | | | |
|-------|-----------------------|--------|--------|--------|
| I (A) | Type | L (μH) | Weight | Code |
| 50 | RMV - 260 - 50 - 350 | 350 | 13 | R80628 |
| 60 | RMV - 260 - 60 - 250 | 250 | 14 | R80637 |
| 100 | RMV - 260 - 100 - 100 | 100 | 16 | R80664 |
| 125 | RMV - 260 - 125 - 50 | 560 | 14 | R80672 |
| 175 | RMV - 260 - 175 - 30 | 30 | 14 | R80691 |

| RMV | | | | |
|-------|-----------------------|--------|--------|--------|
| I (A) | Type | L (μH) | Weight | Code |
| 60 | RMV - 330 - 60 - 450 | 450 | 20 | R80739 |
| 75 | RMV - 330 - 75 - 350 | 350 | 21 | R80748 |
| 90 | RMV - 330 - 90 - 250 | 250 | 26 | R80757 |
| 125 | RMV - 330 - 125 - 100 | 100 | 22 | R80774 |
| 200 | RMV - 330 - 200 - 50 | 50 | 22 | R807A2 |
| 250 | RMV - 330 - 250 - 30 | 30 | 23 | R807B1 |

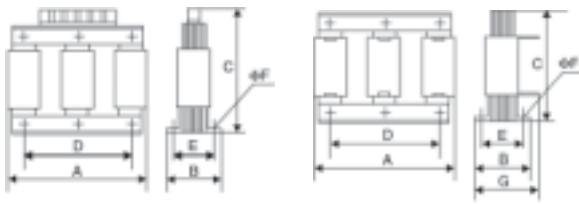
FEATURES

| Electrical features | |
|---------------------------------|------------------------|
| Assigned short duration current | $43 I_n / 1 \text{ s}$ |
| Dynamic current | $2,5 I_t$ |
| Insulation level | 12 kV (28/75) |
| Environmental conditions | |
| Operating temperature | Category B |
| Maximum temperature | 135° |

| Assembly features | |
|-------------------|---------------------------------|
| Type | Encapsulated in resin, air core |
| Mountings | M/12 / M/16 according to type |
| Dimensions (mm) | According to type |
| Weight | According to type (See table) |
| Color | RAL 8016 |
| Standards | IEC 60289 |

DIMENSIONS

R / RB / RX / RBX-7%



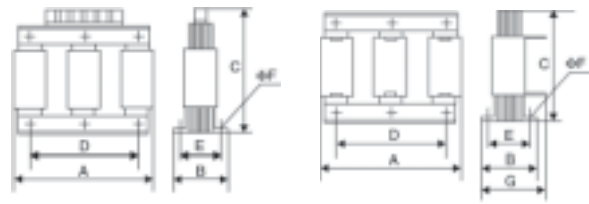
R / RX type

RB / RBX type

| Type | A mm | B mm | C mm | D* mm | E* mm | F mm | G mm | kg |
|-------------|------|------|------|-------|-------|------|------|-----|
| R-5-400 | 155 | 112 | 165 | 75 | 85 | 7 | --- | 6 |
| R-10-400 | 180 | 102 | 190 | 90 | 75 | 7 | --- | 8 |
| R-12,5-400 | 180 | 112 | 192 | 90 | 85 | 7 | -- | 9,2 |
| R-15-400 | 180 | 112 | 190 | 90 | 85 | 7 | --- | 9,5 |
| RB-20-400 | 260 | 124 | 174 | 150 | 90 | 7 | 150 | 14 |
| RB-25-400 | 260 | 124 | 174 | 150 | 90 | 7 | 150 | 14 |
| RB-30-400 | 290 | 124 | 231 | 160 | 90 | 9 | 150 | 19 |
| RB-40-400 | 293 | 124 | 231 | 160 | 90 | 9 | 150 | 20 |
| RB-50-400 | 310 | 144 | 233 | 160 | 110 | 9 | 175 | 27 |
| RB-60-400 | 305 | 146 | 260 | 160 | 110 | 11 | 180 | 31 |
| RB-80-400 | 335 | 155 | 280 | 180 | 120 | 11 | 185 | 38 |
| RB-100-400 | 338 | 170 | 300 | 180 | 135 | 11 | 215 | 50 |
| RB-120-400 | 355 | 170 | 350 | 200 | 135 | 13 | 220 | 58 |
| RX-6,25-400 | 180 | 102 | 190 | 90 | 75 | 7 | -- | 8 |
| RX-12,5-400 | 180 | 112 | 192 | 90 | 85 | 7 | -- | 9,2 |
| RBX-25-400 | 180 | 137 | 196 | 90 | 110 | 7 | -- | 15 |
| RBX-50-400 | 292 | 144 | 232 | 160 | 110 | 9 | 175 | 26 |

* Distance between fixing screws

RE / RBE



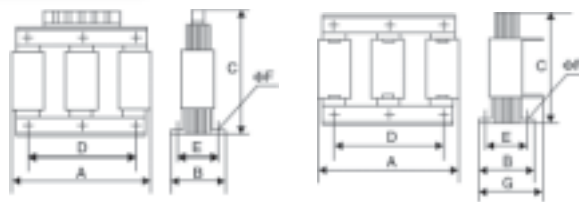
RE type

RBE type

| Type | A mm | B mm | C mm | D* mm | E* mm | F mm | G mm | kg |
|------------|------|------|------|-------|-------|------|------|------|
| RE-05-400 | 155 | 92 | 165 | 75 | 75 | 7 | -- | 6 |
| RE-10-400 | 180 | 102 | 190 | 90 | 75 | 7 | -- | 8 |
| RE-15-400 | 180 | 112 | 190 | 90 | 85 | 7 | -- | 9,5 |
| RE-20-400 | 180 | 122 | 190 | 90 | 95 | 7 | -- | 11,5 |
| RE-25-400 | 240 | 122 | 250 | 130 | 90 | 9 | -- | 17 |
| RE-30-400 | 240 | 132 | 250 | 130 | 100 | 9 | -- | 20,5 |
| RE-40-400 | 240 | 147 | 250 | 130 | 115 | 9 | -- | 25,5 |
| RBE-50-400 | 310 | 154 | 233 | 160 | 120 | 9 | 185 | 29 |
| RBE-60-400 | 310 | 154 | 234 | 160 | 120 | 9 | 185 | 30 |
| RBE-80-400 | 338 | 165 | 280 | 180 | 130 | 11 | 195 | 41 |

* Distance between fixing screws

R-14% / RBC-14%



Type R-14%

Type RB-14%

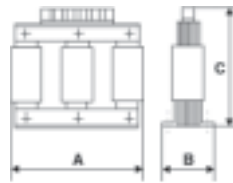
| Type | A mm | B mm | C mm | D* mm | E* mm | F mm | G mm | kg |
|----------------|------|------|------|-------|-------|------|------|------|
| R-5-400-14% | 180 | 102 | 197 | 90 | 75 | 7 | - | 9,5 |
| R-10-400-14% | 180 | 122 | 197 | 90 | 95 | 7 | - | 13 |
| R-12,5-400-14% | 180 | 137 | 197 | 90 | 110 | 7 | - | 16 |
| R-15-400-14% | 250 | 122 | 250 | 130 | 90 | 9 | - | 21,5 |
| R-20-400-14% | 250 | 132 | 250 | 130 | 100 | 9 | - | 25 |
| R-25-400-14% | 250 | 147 | 256 | 130 | 115 | 9 | - | 30,5 |
| RBC-30-400-14% | 285 | 154 | 233 | 160 | 120 | 9 | 181 | 35 |
| RBC-40-400-14% | 290 | 159 | 233 | 160 | 125 | 9 | 184 | 41 |
| RBC-50-400-14% | 307 | 164 | 233 | 160 | 130 | 9 | 194 | 48 |
| RBC-60-400-14% | 335 | 196 | 280 | 280 | 150 | 11 | 197 | 60 |

* Distance between fixing screws

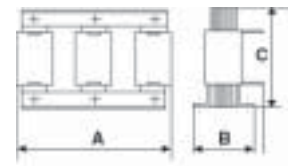


DIMENSIONS

LR / LRB



LR type



LRB type

| Type | A mm | B mm | C mm | kg |
|-----------|------|------|------|-----|
| LR 04-003 | 120 | 60 | 125 | 1,8 |
| LR 04-004 | 120 | 60 | 125 | 1,8 |
| LR 04-006 | 120 | 60 | 125 | 2 |
| LR 04-008 | 120 | 60 | 125 | 2 |
| LR 04-010 | 120 | 70 | 125 | 2,3 |
| LR 04-013 | 120 | 70 | 125 | 2,3 |
| LR 04-017 | 150 | 75 | 150 | 3,5 |
| LR 04-022 | 150 | 90 | 152 | 4,6 |
| LR 04-033 | 150 | 90 | 152 | 5 |
| LR 04-041 | 180 | 100 | 193 | 7,5 |
| LR 04-050 | 180 | 110 | 197 | 9 |
| LR 04-058 | 180 | 110 | 197 | 9,5 |
| LR 04-066 | 180 | 120 | 197 | 11 |

| Type | A mm | B mm | C mm | kg |
|------------|------|------|------|-----|
| LRB 04-080 | 180 | 135 | 160 | 13 |
| LRB 04-095 | 237 | 120 | 195 | 18 |
| LRB 04-115 | 237 | 131 | 195 | 21 |
| LRB 04-150 | 237 | 131 | 215 | 26 |
| LRB 04-185 | 242 | 154 | 256 | 32 |
| LRB 04-200 | 245 | 154 | 256 | 36 |
| LRB 04-250 | 285 | 154 | 300 | 44 |
| LRB 04-300 | 280 | 164 | 300 | 48 |
| LRB 04-400 | 320 | 208 | 350 | 72 |
| LRB 04-500 | 320 | 228 | 350 | 80 |
| LRB 04-600 | 385 | 320 | 505 | 105 |

LM

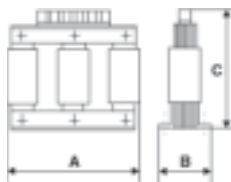


Figure A

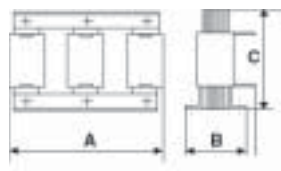
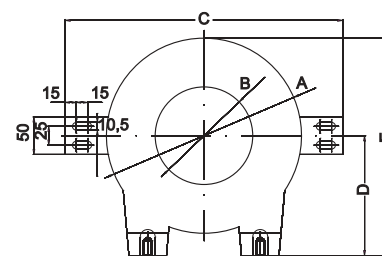
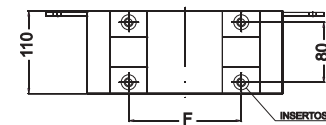


Figure B

| Type | A mm | B mm | C mm | G mm | kg | Figure |
|------------|------|------|------|------|-----|--------|
| LM 22-050 | 120 | 70 | 125 | -- | 2,2 | A |
| LM 40-050 | 150 | 90 | 152 | -- | 5 | A |
| LM 75-050 | 180 | 110 | 160 | 185 | 10 | B |
| LM 110-050 | 180 | 120 | 160 | 175 | 12 | B |
| LM 180-050 | 237 | 145 | 220 | 175 | 25 | B |

RMV



| Type | A Ø mm | B Ø mm | C mm | D mm | E mm | F mm | Inserts |
|---------|--------|--------|------|------|------|------|---------|
| RMV-260 | 260 | 130 | 370 | 160 | 370 | 290 | M12 |
| RMV-330 | 330 | 150 | 470 | 190 | 355 | 210 | M12/M16 |



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