

# Harmonic blocking reactors



The growing use of power electronic devices is causing an increasing level of harmonic distortion in the electrical systems, which frequently leads to problems with capacitor installations. This is the reason why energy suppliers and actual conditions require the usage of harmonic blocking reactors.

A detuned capacitor system works out the function of power factor correction whilst preventing any amplification of harmonic currents and voltages caused by resonance between capacitor and inductance impedances of the electrical system.

By adding an appropriately rated series reactor to the power capacitor, both elements form a low-pass resonant circuit (usually below the 5th) which prevents higher order harmonics to flow into capacitors.

ICAR harmonic blocking reactors are made of high-class transformer sheets and aluminium or copper coils.

They are fully manufactured at our premises, dried and impregnated in a vacuum with environmentally-friendly, low-styrole resin which ensures high voltage withstand, low noise levels, and enjoys a long operating life.

## PARAMETERS AND SELECTION

### Coupling of Capacitors and Reactors

Combination of capacitors and reactors is a delicate procedure which has to be properly done. The scheme ICAR is proposing in following pages comes from its experience in the Automatic Power Factor Correction systems design and manufacturing and it considers all of the aspects involved, such as:

Voltage increase across capacitor terminals

- Allowable harmonic overload of reactors and capacitors
- Actual reactive power output

It is then warmly recommended to respect the proposed coupling of capacitance and reactance, as well as capacitor rated voltage.

### Detuning frequency [ $f_N$ ]

Harmonic blocking reactor choice is based on the actual harmonic current spectrum; the most relevant and lowest harmonic current determines the harmonic blocking frequency, hence the reactor selection.

In detail

- 140Hz will be used if THD in current is substantial higher than 60%,
- 189Hz or 215Hz will be used if THD in current is up to 60%.

### Rated inductance [I]

Inductance rating of reactor, measured at rated current  $I_n$ , expressed in mH (Milli-Henry) is the main component feature.

### Capacitance [C]

It comes from the delta connection of three single phase capacitive elements. Stated value is the multiple by three of each element and it expressed in  $\mu\text{F}$  (micro Farad).

### Capacitor Rated voltage [v]

The series connection of capacitor and reactor causes a voltage rise at the capacitor terminals as described by the following formula which must be considered when selecting a capacitor for the case.

$$U_c = \frac{U_N}{\left[1 - \frac{p}{100\%}\right]}$$

where

$$p = 100\% \cdot \frac{X_L}{X_C}$$

examples:

Detung factor p	Resonance frequency Fr	
	$F_N = 50 \text{ Hz}$	$F_N = 60 \text{ Hz}$
5,67 %	210 Hz	227 Hz
7 %	189 Hz	252 Hz
14 %	134 Hz	160 Hz

### Rated capacitor power [Q]

The rated capacitor output is defined as the power the capacitor can generate if supplied at rated voltage; it is important to follow the manufacturer recommendation in terms of voltage selection.

This parameter also makes easier the selection of proper CRTE capacitor in series to reactor.

### Real output [Qc]

Actual capacitor output is increased respect to the rated value by the higher voltage at capacitor terminals.

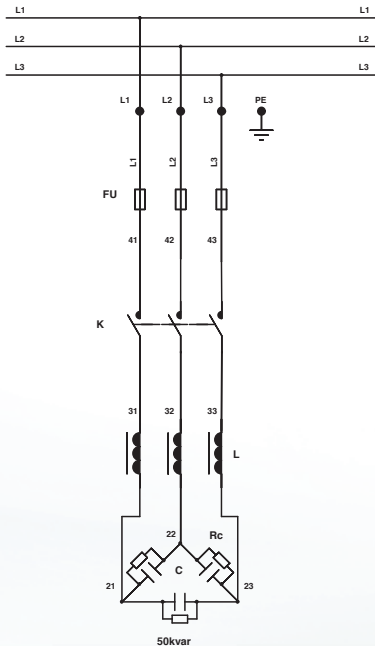
However this effect is already incorporated in the table Qc Reactive Power.

### RMS Current $I_{\text{eff}}$ [ $I_{\text{rms}}$ ]

Actual load flowing on the reactor in permanent operation, it is composed by the fundamental wave plus harmonic currents. Component selections described in this catalogue are made in respect to the maximum reactor and capacitor allowed manufacturer limits.

## RECOMMENDED CONNECTING SCHEME

Reactors shown in this catalogue are designed for the following scheme of wiring.



## INSTALLATION AND MAINTENANCE

### Handling and Storage

Reactors shall have to be handled and stored with care in order to avoid any mechanical damage during transportation. Protection against environmental influences shall also be taken.

### Installation

Reactors are suitable for indoor installation and for vertical position. Reactors must be installed in such a way that the specified limit temperature is not overcome. Not being in compliance with the above instructions will result as a reduction of the expected service life.

### Assembly

Total losses are sum of all iron, winding, and stray field losses at max. specified over voltage and harmonic content. Depending on the detuning factor, actual dissipation power of our reactors is between 4 and 6W/kvar. While using capacitors and reactors within a capacitor bank, suitable means for heat dissipation and cooling of components shall be taken. A minimum 20mm distance between the units has to be maintained.

### Maintenance

Periodical checks and inspections are required to ensure reliable operation of reactors. Monitoring and recording of the electrical service parameters are also recommended to become acquainted with progressive reactors stress conditions.

### Protections

**Temperature Switch** All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil. These leads shall be wired in series to contactor coils to switch off in case of over load.

## SAFETY INSTRUCTIONS

**DO NOT MISAPPLY REACTORS FOR POWER FACTOR CORRECTION APPLICATIONS**

To prevent damage to people and goods due to improper usage and/or application of reactors, the "RECOMMENDATION FOR THE SAFE USE OF STATIC CAPACITORS, BANKS AND EQUIPMENT FOR POWERFACTOR CORRECTION". Published by ANIE shall have to be strictly respected. ICAR is not responsible for any kind of possible damages occurred to people or things, derived from the improper installation and application of Power Factor Correction capacitors and reactors.

### Most common misapplication forms

Current, voltage, harmonics and frequency above specification;

- Working or storage temperature beyond the specified limits;
- Unusual service conditions as mechanical shock and vibrations, corrosive or abrasive conductive parts in cooling air, oil or water vapour or corrosive substances, explosive gas or dust, radioactivity, excessive and fast variations of ambient conditions, service areas higher than 2000 m above sea level...

In case of doubt in choice or in performances of the capacitors and reactors ICAR technical service MUST be contacted.

### Personal Safety

Electrical or mechanical misapplications of Harmonic Blocking Reactors capacitors may become hazardous. Special attention must be taken to make sure the reactors are correctly used for each application and that warnings and instructions are strictly followed. Reactors are made not only but also with iron, aluminium, paper and resin that are partially flammable materials. The risk of fire cannot be totally eliminated; therefore suitable precautions shall be taken. Reliability data quoted by ICAR should be considered as statistical i.e. based on a number of components, and does not guarantee properties or performance in the legal sense. ICAR liability is limited to the replacement of defective components. This applies in particular to consequential damage caused by component failure.



# 5,4% 400V - 50Hz Reactors

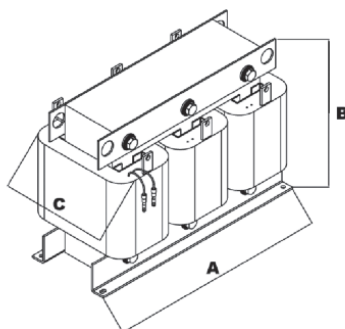
$U_N$	f	$f_N$	P
400V	50Hz	215 Hz	5,4%



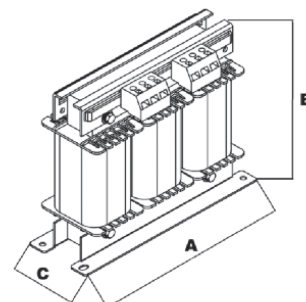
### TECHNICAL CHARACTERISTICS

Applicable standards	CEI-EN 60289 IEC 60289
Rated voltages	230...700V
Rated frequencies	50 Hz
Tolerance of inductance	±5% ( mean value across three phases)
Linearity	$I_{lin} = 1.6...2.0 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	$Q_c$ at 400V (kvar)	L (mH)	$I_{rms}$ (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	$Q_c$ at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance ( $\mu F$ )
46015810	5	5,8	8	copper	205x167x68	7	7,5	450	112,5
46012910	10	2,9	16	copper	205x164x68	8,6	12,5	450	196
46012401	12,5	2,4	19	copper	205x184x68	6	15	450	236
46011451	20	1,45	32	copper	205x184x88	9,5	25	450	393
46011452	25	1,22	39	copper	180x180x170	11,6	30	450	471
PRG0030DAB57579	40	0,73	64,3	aluminium	320x220x120	18	50	450	786
PRG0037DAB57692	50	0,6	78	aluminium	320x220x130	20	60	450	942



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$U_N$	f	$f_N$	P
400V	50Hz	180 Hz	7%

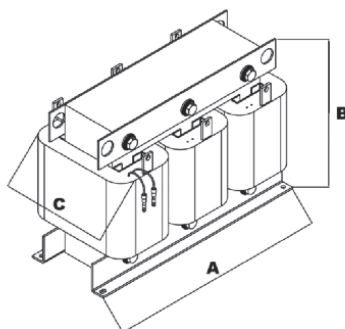
# 7% 400V - 50Hz Reactors



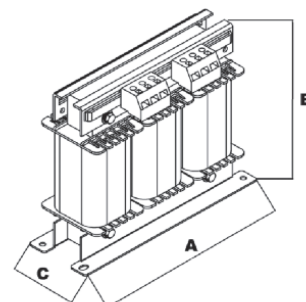
### TECHNICAL CHARACTERISTICS

Applicable standards	CEI-EN 60289 IEC 60289
Rated voltages	230...700V
Rated frequencies	50 Hz
Tolerance of inductance	$\pm 5\%$ ( mean value across three phases)
Linearity	$I_{lin} = 1.6...2.0 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	$\pm 5K$

PART NUMBER	Qc at 400V (kvar)	L (mH)	I <sub>rms</sub> (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
4618300	5	8,3	8	copper	205x170x65	6,0	7,5	450	112,5
46014200	10	4,2	17	copper	205x181x79	7,7	12,5	450	196
46014201	12,5	3,03	21	copper	180x180x150	11	15	450	236
PRG0028DAB57538	20	1,73	40	aluminium	320x220x120	17	25	450	393
PRG0025DAB57568	25	1,572	39,5	aluminium	320x220x120	17	30	450	471
PRG0056DAB57524	40	0,865	80	aluminium	320x220x145	26	50	450	786
PRG0050DAB57567	50	0,786	79	aluminium	320x220x140	26	60	450	942



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# 14% 400V - 50Hz Reactors

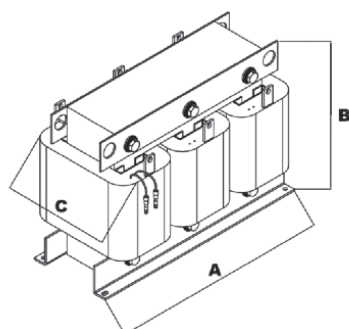
$U_N$	f	$f_N$	P
400V	50Hz	140 Hz	14%



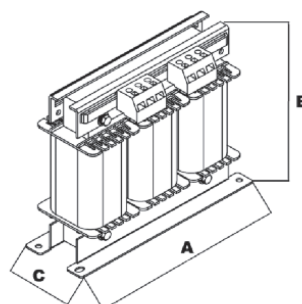
### TECHNICAL CHARACTERISTICS

Applicable standards	CEI-EN 60289 IEC 60289
Rated voltages	230...700V
Rated frequencies	50 Hz
Tolerance of inductance	±5% ( mean value across three phases)
Linearity	$I_{lin} = 1.6...2.0 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I <sub>rms</sub> (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46021480	5	14,8	9	copper	205x170x78	7,4	7,5	525	87
46017400	10	7,4	18	copper	205x180x113	12,8	15	525	173
46016300	12,5	6,3	19	copper	205x170x113	13,5	20	525	231
PRG0042DAB57551	20	3,7	35	aluminium	320x220x130	21	30	525	345
PRG0047DAB57427	25	3,13	38	aluminium	320x220x135	22	35	525	404
PRG0078DAB57592	40	2,056	63	aluminium	320x220x165	34	60	525	692
PRG0093DAB57418	50	1,57	77	aluminium	380x215x165	37	75	525	865



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$U_N$	f	$f_N$	P
380V	60Hz	227 Hz	7%

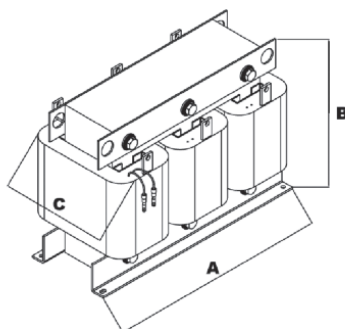
# 7% 380V - 60Hz Reactors



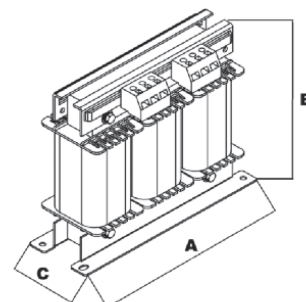
### TECHNICAL CHARACTERISTICS

Applicable standards	CEI-EN 60289 IEC 60289
Rated voltages	230...700V
Rated frequencies	50 Hz
Tolerance of inductance	±5% ( mean value across three phases)
Linearity	$I_{lin} = 1.6...2.0 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I <sub>rms</sub> (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46188300	5	8,3	8	copper	205x170x65	13,5	6	450	78
46012910	10	2,9	16	copper	205x184x68	8,6	12	450	157
46012600	12,5	2,6	27	copper	205x184x98	11	15	450	196
46011451	20	1,45	32	copper	205x184x88	9,5	24	450	314
46011452	25	1,22	39	copper	180x180x170	13,6	30	450	393
PRG0030DAB57579	40	0,73	64,3	aluminium	320x220x120	18	54	450	707
PRG0037DAB57692	50	0,6	78	aluminium	320x220x130	20	66	450	864



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# 6% 400V - 60Hz Reactors

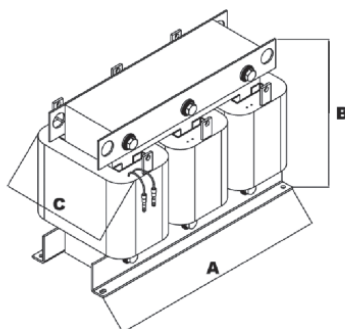
$U_N$	f	$f_N$	P
400V	60Hz	215 Hz	5,4%



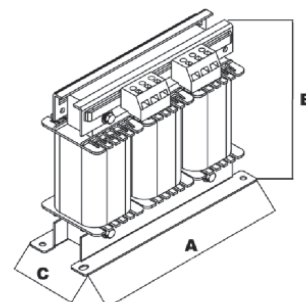
### TECHNICAL CHARACTERISTICS

Applicable standards	CEI-EN 60289 IEC 60289
Rated voltages	230...700V
Rated frequencies	60 Hz
Tolerance of inductance	±5% ( mean value across three phases)
Linearity	$I_{lin} = 1.6...2.0 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I <sub>rms</sub> (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46015810	5	5,8	8	copper	205x167x68	7	6	450	78
46012600	10	2,6	27	copper	205xx184x98	11	12	450	157
46012601	12,5	1,8	26	copper	180x180x130	8	18	450	236
46012602	20	1,31	30	copper	180x180x140	9,7	24	450	314
46012603	25	1,05	44	copper	180x180x150	11,4	30	450	393
PRG0037DAB57692	40	0,6	78	aluminium	320x220x130	20	54	450	707
PRG0035DAB57693	50	0,45	88	aluminium	320x220x130	19,5	66	450	864



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$U_N$	f	$f_N$	P
230V	60Hz	227 Hz	7%

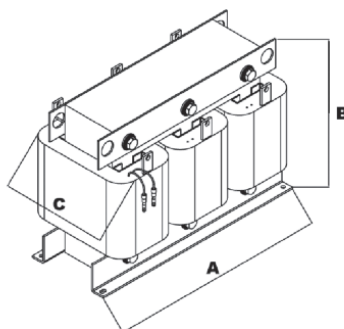
# 7% 230V - 60Hz Reactors



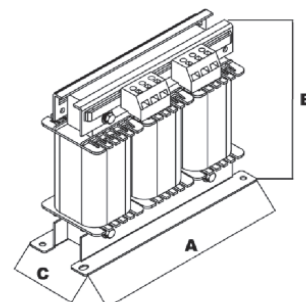
### TECHNICAL CHARACTERISTICS

Applicable standards	CEI-EN 60289 IEC 60289
Rated voltages	230...700V
Rated frequencies	60 Hz
Tolerance of inductance	±5% ( mean value across three phases)
Linearity	$I_{lin} = 1.6...2.0 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I <sub>rms</sub> (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
46012100	5	2,1	33	copper	205x180x113	13,3	15	400	249
46012101	10	1,04	35	copper	180x180x130	7,9	30	400	497
46012102	12,5	0,82	37	copper	180x180x130	8	12	230	602
PRG0037DAB57692	20	0,6	78	aluminium	320x220x130	20	54	400	896
PRG0035DAB57693	25	0,45	88	aluminium	320x220x130	18,5	24	230	1204
PRG0033DAB57694	40	0,273	109	aluminium	320x220x120	18,5	36	230	1806
PRG0043DAB57695	50	0,2	146	aluminium	320x220x135	21,5	48	230	2408



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# 5,67% 230V - 60Hz Reactors

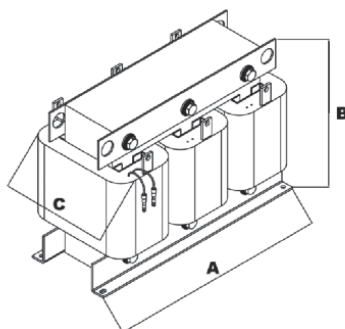
$U_N$	f	$f_N$	P
230V	60Hz	252 Hz	5,67%



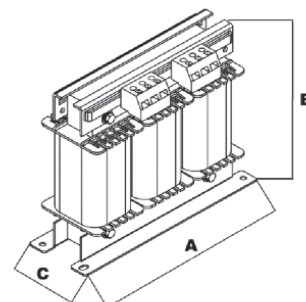
### TECHNICAL CHARACTERISTICS

Applicable standards	CEI-EN 60289 IEC 60289
Rated voltages	230...700V
Rated frequencies	60 Hz
Tolerance of inductance	±5% ( mean value across three phases)
Linearity	$I_{lin} = 1.6...2.0 I_n$
Insulation (winding-core)	3 kV
Temperature class	F (155°C)
Maximum Ambient Temperature	40°C
Protection class	IP00 indoor mounting
Humidity	95%
Cooling	natural
Design	Three phase, iron core double air gap
Winding material	Aluminium foil/copper wires
Impregnation	Polyester resin, class H
Terminals	Terminal blocks, or cable lugs.
Temperature Switch	All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside every coil
Switching temperature	140°C
Voltage	250Vac (<5A)
Tolerance	±5K

PART NUMBER	Qc at 400V (kvar)	L (mH)	I <sub>rms</sub> (A)	Material	Dimensions (AxBxC) (mm)	Weight (Kg)	Qc at rated voltage (kvar)	Capacitor rated voltage (V)	Capacitance (µF)
460120103	5	1,6	15	copper	180x180x120	5,7	15	400	249
460120104	10	0,82	37	copper	180x180x130	8,2	30	400	497
460120105	12,5	0,66	36	copper	180x180x120	6,8	12	230	602
PRG0035DAB57693	20	0,45	88	aluminium	320x220x130	19,5	54	400	896
PRG0024DAB57696	25	0,282	86	aluminium	320x220x115	16	24	230	1204
PRG0026DAB57697	40	0,22	108	aluminium	320x220x120	16,5	36	230	1806
PRG0035DAB57698	50	0,167	144	aluminium	320x220x130	19,5	48	230	2408

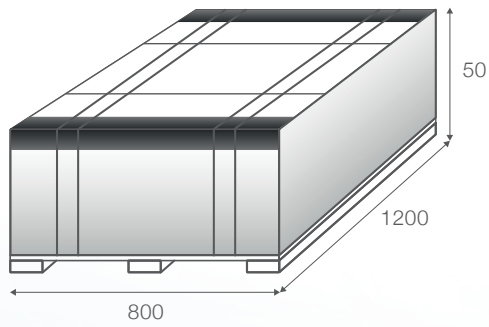


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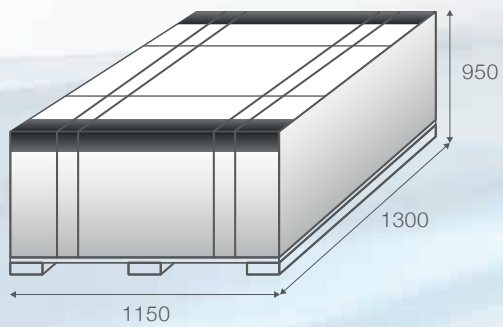
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# Packing details: Reactors



## PALLET

Reactor type	Reactors per package
Copper winding	20
Aluminium winding	16



## WOODEN BOX

Reactor type	Reactors per package
Copper winding	90
Aluminium winding	72