

Detuned reactor

Overview



In past few years the use of power electronics equipment's like drives, SMPS, UPS etc has increased tremendously. These devices distort the pure sinusoidal waveform of power supply. These distortions can be called as harmonics. When a capacitor is used for power factor correction, it might create a resonating circuit with the feeding transformer. The resonance frequency is generally from 250Hz to 500Hz, that means 5th to 7th harmonics. This resonance is undesired condition and it might lead to

- Overloading of capacitors- reduce the life of capacitor
- Overloading of transformer, cables and other switchgear elements in the circuit- reduces life of all components
- Voltage distortion
- Increased power losses
- Nuisance tripping of protection equipment

This resonance can be avoided by putting a detuned reactor in series with the capacitor. The reactor shall be such that the tuning frequency with capacitor shall be less than the dominant harmonics. This combination of power factor correction capacitor and detuned reactors behaves inductively to frequencies above tuning frequency. Thus provide high impedance path to harmonics present in the system.

Detuning factor

Detuning factor can be defined by following formula:-

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

Where

X_L = Inductive reactance

X_C = Capacitive reactance

p = detuning factor in percentage

Tuning frequency of LC filter can be calculated by below formula:-

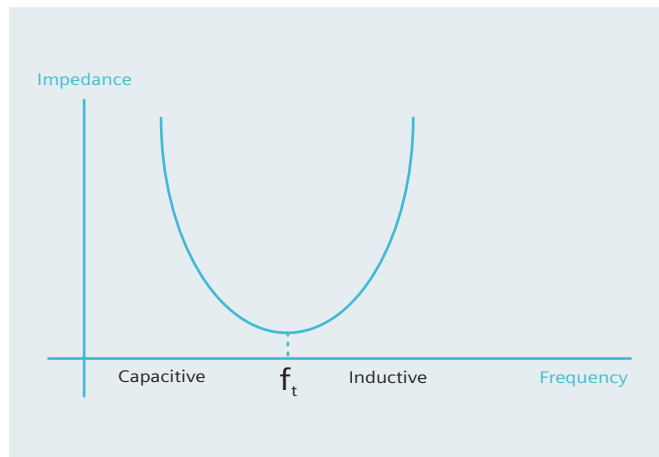
$$f_t = \frac{f_s}{\sqrt{\frac{p}{100}}}$$

Where

f_t = tuning frequency

f_s = supply frequency

p = detuning factor in percentage



This combination of detuned LC filter will act capacitive for frequency below f_t and inductive for frequency above f_t . Thus for base frequency of 50 or 60Hz this detune filter will act as capacitive and improves the power factor. This LC detuned filter is selected such that the tuning frequency is much less than the dominant harmonic frequency. Thus harmonics always see higher impedance and the condition of resonance with feeding transformer is avoided.

For example if the dominant harmonics is 5th harmonic and base frequency is 50Hz, a 7% detuned reactor shall be selected. The tuning frequency of this filter will be

$$f_t = \frac{f_s}{\sqrt{\frac{p}{100}}}$$

$$f_t = \frac{50}{\sqrt{\frac{7}{100}}} \Rightarrow 189 \text{ Hz}$$

189Hz, the tuning frequency in this case is lesser than 250Hz, the harmonic frequency. Hence there will not be a situation of resonance between the feeding transformer and capacitor.

Technical Specifications

7% Cu Reactor										
Technical Data										
De-tuning factor	%	7%	7%	7%	7%	7%	7%	7%	7%	7%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	76.5	172	191	229.5	306	382.5	765	1147	1530
Inductivity L	mH	3 X 9.28	3 X 4.64	3 X 3.71	3 X 3.1	3 X 2.32	3 X 1.86	3 X 0.93	3 X 0.62	3 X 0.46
Linear up to	A	11.4	22.7	28.4	34	45.4	57	113.5	170.3	227
Effective current Irms	A	7.45	14.9	18.61	22.34	29.78	37.2	74.45	111.7	148.9
Temperature protection (NC)		yes								
Total losses P D	W	45	75	80	90	100	120	210	275	350
Total weight	kg	7	9	10	15	16	17	26	42	50
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	175	175	225	225	225	260	300	310
Height	mm	158	160	160	230	205	205	240	270	270
Width	mm	100	125	125	145	155	155	215	180	205

14%, Cu reactors										
Technical Data										
De-tuning factor	%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	70.7	141.5	176.8	212.2	282.9	356.7	707.4	1061	1061
Inductivity L	mH	3 X 20.06	3 X 10.03	3 X 8.03	3 X 6.69	3 X 5.02	3 X 4.01	3 X 2.01	3 X 1.34	3 X 1
Linear up to	A	9.38	18.76	23.45	28.15	37.53	46.91	93.82	140.7	187.6
Effective current Irms	A	7.01	14.03	17.53	21.04	28.05	35.07	70.13	105.2	140.3
Temperature protection (NC)		yes								
Total losses P D	W	80	105	120	150	180	210	270	375	500
Total weight	kg	9	15	16	18	26	27	45	75	84
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	225	225	225	260	260	310	378	378
Height	mm	156	205	205	205	232	240	270	300	300
Width	mm	125	150	155	155	210	208	204	225	225

Technical Specifications

5.67%, Cu reactors										
Technical Data										
De-tuning factor	%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H 5.67%								
Capacitance C delta	µF	77.6	155.2	191	232.8	310.4	387.9	775.9	1164	1552
Inductivity L	mH	3 X 7.41	3 X 3.7	3 X 2.96	3 X 2.47	3 X 1.85	3 X 1.48	3 X 0.74	3 X 0.49	3 X 0.37
Linear up to	A	13.65	27.3	34.12	40.94	54.59	68.23	136.5	204.7	272.9
Effective current Irms	A	8.37	16.74	20.93	25.11	33.48	41.85	83.71	125.6	167.4
Temperature protection (NC)		yes								
Total losses P D	W	45	75	80	90	100	120	210	275	350
Total weight	kg	7	9	10	15	16	17	26	42	50
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	175	190	225	225	225	260	310	330
Height	mm	158	160	160	230	205	205	240	270	270
Width	mm	95	124	124	145	155	155	208	180	180

7%, Al reactors										
Technical Data										
De-tuning factor	%	7%	7%	7%	7%	7%	7%	7%	7%	7%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	76.5	172	191	229.5	306	382.5	765	1147	1530
Inductivity L	mH	3 X 9.28	3 X 4.64	3 X 3.71	3 X 3.1	3 X 2.32	3 X 1.86	3 X 0.93	3 X 0.62	3 X 0.46
Linear up to	A	11.4	22.7	28.4	34	45.4	57	113.5	170.3	227
Effective current Irms	A	7.45	14.9	18.61	22.34	29.78	37.2	74.45	111.7	148.9
Temperature protection (NC)		yes								
Total losses P D	W	50	83	85	100	110	130	240	285	380
Total weight	kg	7	9	10	15	16	17	26	42	50
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	175	175	225	225	225	275	310	335
Height	mm	158	160	160	230	205	205	238	270	270
Width	mm	100	125	125	155	175	175	230	180	185

Technical Specifications

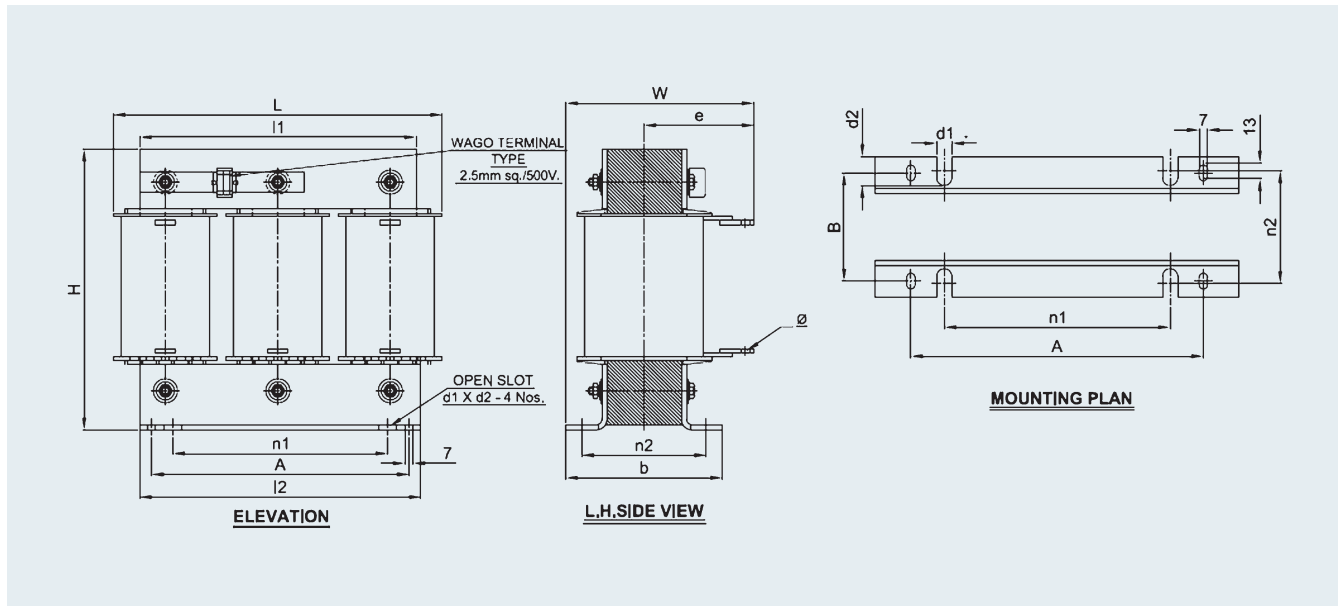
14%, Al reactors								
Technical Data								
De-tuning factor	%	14%	14%	14%	14%	14%	14%	14%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50
Rated voltage VR	V	440						
Rated frequency	Hz	50						
Ambient temperature / Insulation class:		40 °C/H						
Capacitance C delta	µF	70.7	176.8	176.8	212.2	282.9	353.7	707.4
Inductivity L	mH	3 X 20.06	3 X 10.03	3 X 8.03	3 X 6.69	3 X 5.02	3 X 4.01	3 X 2.01
Linear up to	A	9.38	18.76	23.45	28.15	37.53	46.91	93.82
Effective current Irms	A	7.01	14.03	17.53	21.04	28.05	35.07	70.13
Temperature protection (NC)		yes						
Total losses P D	W	80	105	120	150	200	210	380
Total weight	kg	9	15	16	18	25	28	42
Connection								
Line		1U1-1V1-1W1						
Capacitors		1U2-1V2-1W2						
Temperature control:		1-2						
Dimension								
Length	mm	175	225	225	225	285	285	335
Height	mm	156	205	205	205	210	230	270
Width	mm	125	150	155	155	188	188	190

5.67%, Al reactors										
Technical Data										
De-tuning factor	%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	77.6	155.2	194	232.8	310.4	387.9	775.9	1164	1552
Inductivity L	mH	3 X 7.41	3 X 3.7	3 X 2.96	3 X 2.47	3 X 1.85	3 X 1.48	3 X 0.74	3 X 0.49	3 X 0.37
Linear up to	A	13.65	27.3	34.12	40.94	54.59	68.23	136.5	204.7	272.9
Effective current Irms	A	8.37	16.74	20.93	25.11	33.48	41.85	83.71	125.6	167.4
Temperature protection (NC)		yes								
Total losses P D	W	55	85	88	105	115	135	250	290	390
Total weight	kg	8	10	11	16	18	20	27	43	51
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	190	175	225	225	240	275	310	310
Height	mm	158	160	158	230	205	205	238	270	270
Width	mm	100	125	125	155	175	175	230	180	210

Ordering Information

Bank Size	Type	Detuning Factor	Voltage	Material
5kVAr	4KA1220-1AA01-0AA0	7%	440V AC	Cu
10kVAr	4KA1220-3AA01-0AA0	7%	440V AC	Cu
12.5kVAr	4KA1220-4AA01-0AA0	7%	440V AC	Cu
15kVAr	4KA1220-5AA01-0AA0	7%	440V AC	Cu
20kVAr	4KA1220-6AA01-0AA0	7%	440V AC	Cu
25kVAr	4KA1220-7AA01-0AA0	7%	440V AC	Cu
50kVAr	4KA1220-2BA01-0AA0	7%	440V AC	Cu
75kVAr	4KA1220-3BA03-0AA0	7%	440V AC	Cu
100kVAr	4KA1220-4BA03-0AA0	7%	440V AC	Cu
5kVAr	4KA1220-1AB01-0AA0	14%	440V AC	Cu
10kVAr	4KA1220-3AB01-0AA0	14%	440V AC	Cu
12.5kVAr	4KA1220-4AB01-0AA0	14%	440V AC	Cu
15kVAr	4KA1220-5AB01-0AA0	14%	440V AC	Cu
20kVAr	4KA1220-6AB01-0AA0	14%	440V AC	Cu
25kVAr	4KA1220-7AB01-0AA0	14%	440V AC	Cu
50kVAr	4KA1220-2BB01-0AA0	14%	440V AC	Cu
75kVAr	4KA1220-3BB03-0AA0	14%	440V AC	Cu
100kVAr	4KA1220-4BB03-0AA0	14%	440V AC	Cu
5kVAr	4KA1220-1AC01-0AA0	5.67%	440V AC	Cu
10kVAr	4KA1220-3AC01-0AA0	5.67%	440V AC	Cu
12.5kVAr	4KA1220-4AC01-0AA0	5.67%	440V AC	Cu
15kVAr	4KA1220-5AC01-0AA0	5.67%	440V AC	Cu
20kVAr	4KA1220-6AC01-0AA0	5.67%	440V AC	Cu
25kVAr	4KA1220-7AC01-0AA0	5.67%	440V AC	Cu
50kVAr	4KA1220-2BC01-0AA0	5.67%	440V AC	Cu
75kVAr	4KA1220-3BC03-0AA0	5.67%	440V AC	Cu
100kVAr	4KA1220-4BC03-0AA0	5.67%	440V AC	Cu
5kVAr	4KA1420-1AA01-0AA0	7%	440V AC	Al
10kVAr	4KA1420-3AA01-0AA0	7%	440V AC	Al
12.5kVAr	4KA1420-4AA01-0AA0	7%	440V AC	Al
15kVAr	4KA1420-5AA01-0AA0	7%	440V AC	Al
20kVAr	4KA1420-6AA01-0AA0	7%	440V AC	Al
25kVAr	4KA1420-7AA01-0AA0	7%	440V AC	Al
50kVAr	4KA1420-2BA01-0AA0	7%	440V AC	Al
75kVAr	4KA1420-3BA03-0AA0	7%	440V AC	Al
100kVAr	4KA1420-4BA03-0AA0	7%	440V AC	Al
5kVAr	4KA1420-1AB01-0AA0	14%	440V AC	Al
10kVAr	4KA1420-3AB01-0AA0	14%	440V AC	Al
12.5kVAr	4KA1420-4AB01-0AA0	14%	440V AC	Al
15kVAr	4KA1420-5AB01-0AA0	14%	440V AC	Al
20kVAr	4KA1420-6AB01-0AA0	14%	440V AC	Al
25kVAr	4KA1420-7AB01-0AA0	14%	440V AC	Al
50kVAr	4KA1420-2BB01-0AA0	14%	440V AC	Al
5kVAr	4KA1420-1AC01-0AA0	5.67%	440V AC	Al
10kVAr	4KA1420-3AC01-0AA0	5.67%	440V AC	Al
12.5kVAr	4KA1420-4AC01-0AA0	5.67%	440V AC	Al
15kVAr	4KA1420-5AC01-0AA0	5.67%	440V AC	Al
20kVAr	4KA1420-6AC01-0AA0	5.67%	440V AC	Al
25kVAr	4KA1420-7AC01-0AA0	5.67%	440V AC	Al
50kVAr	4KA1420-2BC01-0AA0	5.67%	440V AC	Al
75kVAr	4KA1420-3BC03-0AA0	5.67%	440V AC	Al
100kVAr	4KA1420-4BC03-0AA0	5.67%	440V AC	Al

Dimension drawing

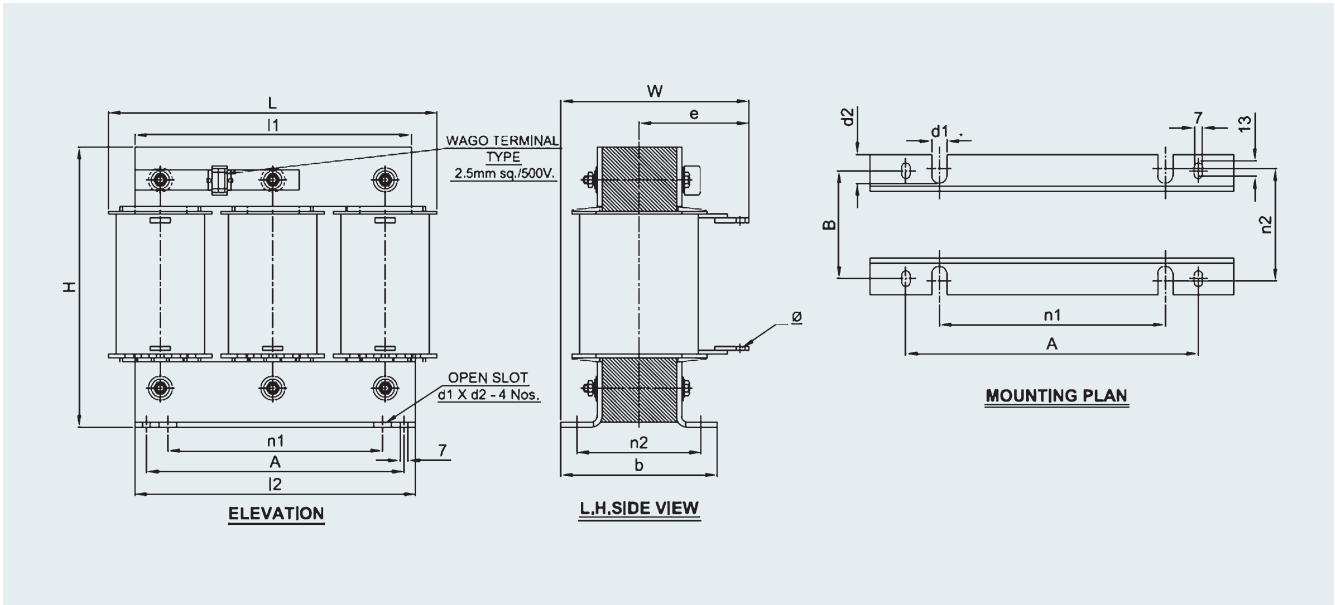


7% Cu detuned reactor (all dimensions in mm)

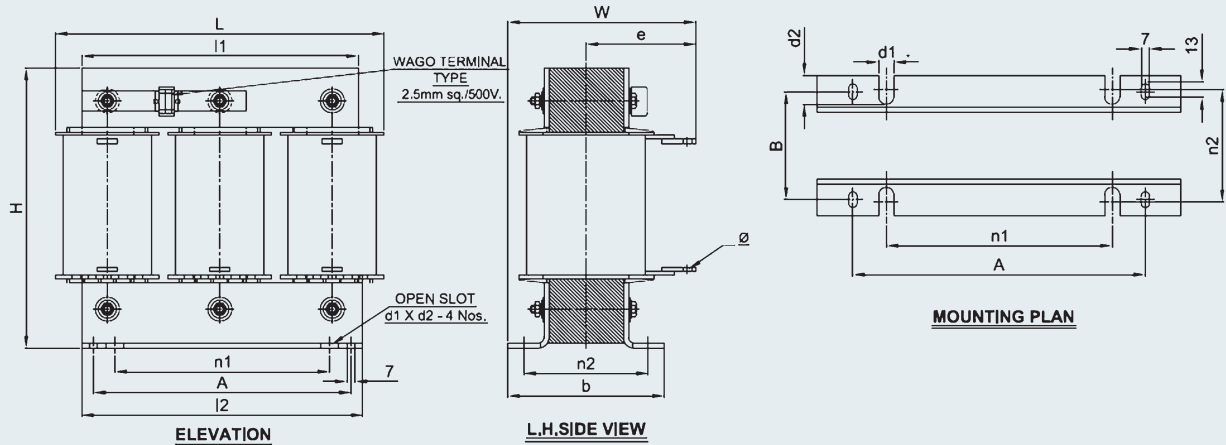
kVAr	Type	L	H	W	I1	I2	n1	n2	b	e	d1	d2	A	B	Ø
5	4KA1220-1AA01-0AA0	175	158	100	150	150	100	62	78	62	10.8	15.5	125	58	6.5
10	4KA1220-3AA01-0AA0	175	160	125	150	150	100	83	98	76	10.8	15.5	125	58	6.5
12.5	4KA1220-4AA01-0AA0	175	160	125	150	150	100	83	98	76	10.8	15.5	125	58	6.5
15	4KA1220-5AA01-0AA0	225	230	145	190	190	150	73	90	97	10.8	15.5	175	71.5	8.5
20	4KA1220-6AA01-0AA0	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
25	4KA1220-7AA01-0AA0	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
50	4KA1220-2BA01-0AA0	260	240	215	220	220	150	168	185	118	10.8	15.5	175	165	8.5
75	4KA1220-3BA03-0AA0	300	270	180	250	250	150	136.5	150	97	10.8	15.5	175	132	10.5
100	4KA1220-4BA03-0AA0	310	270	205	265	265	150	162.5	178	110	10.8	15.5	175	159	10.5

7% Al detuned reactor (all dimensions in mm)

kVAr	Type	L	H	W	I1	I2	n1	n2	b	e	d1	d2	A	B	Ø
5	4KA1420-1AA01-0AA0	175	158	100	150	150	100	61.5	78	62	10.8	15.5	125	58	6.5
10	4KA1420-3AA01-0AA0	175	160	125	150	150	100	82.5	98	76	10.8	15.5	125	58	6.5
12.5	4KA1420-4AA01-0AA0	175	160	125	150	150	100	82.5	98	76	10.8	15.5	125	78	6.5
15	4KA1420-5AA01-0AA0	225	230	155	190	190	150	73	90	105	10.8	15.5	175	71.5	8.5
20	4KA1420-6AA01-0AA0	225	205	175	190	190	150	97.8	112	115	10.8	15.5	175	95	8.5
25	4KA1420-7AA01-0AA0	225	205	175	190	190	150	97.8	112	115	10.8	15.5	175	95	8.5
50	4KA1420-2BA01-0AA0	275	238	230	235	235	150	168	185	135	10.8	15.5	175	165	8.5
75	4KA1420-3BA03-0AA0	310	270	180	265	265	150	135	150	99	10.8	15.5	175	132	10.5
100	4KA1420-4BA03-0AA0	335	270	185	285	285	150	136.5	150	97	10.8	15.5	175	132	10.5



14% Cu detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	4KA1220-1AB01-0AA0	175	156	125	150	150	100	84	100	76	10.8	15.5	125	81	6.5
10	4KA1220-3AB01-0AA0	225	205	150	190	190	150	97.5	112	96	10.8	15.5	175	95	6.5
12.5	4KA1220-4AB01-0AA0	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
15	4KA1220-5AB01-0AA0	225	205	155	190	190	150	97.5	112	100	10.8	15.5	175	95	8.5
20	4KA1220-6AB01-0AA0	260	232	210	220	220	150	168	185	120	10.8	15.5	175	165	8.5
25	4KA1220-7AB01-0AA0	260	240	208	220	220	150	168	185	116	10.8	15.5	175	165	8.5
50	4KA1220-2BB01-0AA0	310	270	204	265	265	150	135	150	120	10.8	15.5	175	132	8.5
75	4KA1220-3BB03-0AA0	378	300	225	330	330	150	170	190	122	10.5	15.5	175	170	10.5
100	4KA1220-4BB03-0AA0	378	300	225	330	330	150	170	190	122	10.5	15.5	175	170	10.5
14% Al detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	4KA1420-1AB01-0AA0	175	156	125	150	150	100	84	100	76	10.8	15.5	125	81	6.5
10	4KA1420-3AB01-0AA0	225	205	150	190	190	150	97.5	112	96	10.8	15.5	175	95	6.5
12.5	4KA1420-4AB01-0AA0	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
15	4KA1420-5AB01-0AA0	225	205	155	190	190	150	97.5	112	100	10.8	15.5	175	95	8.5
20	4KA1420-6AB01-0AA0	285	210	188	235	235	150	168	185	92	10.8	15.5	175	165	8.5
25	4KA1420-7AB01-0AA0	285	230	188	235	235	150	165	185	95	10.8	15.5	175	168	8.5
50	4KA1420-2BB01-0AA0	335	270	190	285	285	150	136	150	99	10.8	15.5	175	132	10.5



5.67% Cu detuned reactor (all dimensions in mm)

kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	4KA1220-1AC01-0AA0	175	158	95	150	150	100	56	73	60	10.8	15.5	125	56	6.5
10	4KA1220-3AC01-0AA0	175	160	124	150	150	100	78	95	75	10.8	15.5	125	78	6.5
12.5	4KA1220-4AC01-0AA0	190	160	124	165	165	60	80	98	75	10.8	15.5	85	80	6.5
15	4KA1220-5AC01-0AA0	225	230	145	190	190	150	73	90	97	10.8	15.5	175	71.5	8.5
20	4KA1220-6AC01-0AA0	225	205	155	190	190	150	95	112	100	10.8	15.5	175	95	8.5
25	4KA1220-7AC01-0AA0	225	205	155	190	190	150	95	112	100	10.8	15.5	175	95	8.5
50	4KA1220-2BC01-0AA0	260	240	208	220	220	150	165	185	116	10.8	15.5	175	165	8.5
75	4KA1220-3BC03-0AA0	310	270	180	265	265	150	132	150	97	10.8	15.5	175	132	10.5
100	4KA1220-4BC03-0AA0	330	270	180	285	285	150	132	155	97	10.8	15.5	175	132	10.5

5.67% Al detuned reactor (all dimensions in mm)

kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	4KA1420-1AC01-0AA0	175	158	100	150	150	100	61.5	78	62	10.8	15.5	125	58	6.5
10	4KA1420-3AC01-0AA0	190	160	125	165	165	60	78	98	76	10.8	15.5	85	76	6.5
12.5	4KA1420-4AC01-0AA0	175	160	125	150	150	100	82.5	98	76	10.8	15.5	125	78	6.5
15	4KA1420-5AC01-0AA0	225	230	155	190	190	150	73	90	105	10.8	15.5	175	71.5	8.5
20	4KA1420-6AC01-0AA0	225	205	175	190	190	150	97.8	112	115	10.8	15.5	175	95	8.5
25	4KA1420-7AC01-0AA0	240	205	175	205	205	150	98	112	115	10.8	15.5	175	95	8.5
50	4KA1420-2BC01-0AA0	275	238	230	235	235	150	168	185	135	10.8	15.5	175	165	8.5
75	4KA1420-3BC03-0AA0	310	270	180	265	265	150	135	150	99	10.8	15.5	175	132	10.5
100	4KA1420-4BC03-0AA0	310	270	210	265	265	150	160	175	110	10.8	15.5	175	160	10.5