LV Detuning Reactors

General technical parameters

Standards	IEC EN 60076-6, IEC EN 61558-2-20
Rated Voltage	400 - 800 V / 50 Hz
Rated Power	1 - 100 kvar
Inductance Tolerance	-5 / +5 %
Detuning Factor	5,67 %, 7 %, 14 %
Resonance Frequency	210 Hz, 189 Hz, 134 Hz
Temperature Class	F (155 °C)
Ambient Temperature	40 °C
Statistical Life Expectancy	> 200 000 hours
Protection Degree	IP 00
Insulation (winding - core)	3 kV
Max. Relative Humidity	95 %
Max. Altitude	4 000 m
Cooling	Natural Air or Forced
Design	Three phase, iron core with multi air gap
Winding Material	Copper, Aluminium
Impregnant	Polyester (epoxy) resin
Safety Device	Thermal switch (Al-130°C,Cu-90°C)
Terminals	Terminal block, Cable lug, Al bar

Application

Frequent use of power electronic devices with nonlinear loads leads to harmonic distortion in electrical system. This nonsinusoidal load causes increase of effective current of power capacitor and other components of the system as well as the posibility of capacitor resonance with other inductive loads. Finally it may lead to problems or even failures in the installation. The solution is to use detuning (filtering) reactors, which creates a series resonant circuit with power capacitors. This detuned system prevents the installation from resonance effect and also acts as a filter for higher harmonic content. Usually there is recommended to use detuning reactors for the total voltage distortion THD-U higher than 3 %.

Construction

Detuning reactors are produced from high grade, low loss transformer sheets, with winding either from copper wire or aluminium band. Iron core is designed with multi air gap to meet high current linearity and low thermal losses. They are impregnated with high quality epoxy resin to ensure good insulation, low noise and long lifetime. Reactors are equipped with thermal protection to prevent overheating. Reactors with lower rated power are designed with copper wire and outlets via terminal block or cable lug. Higher power rated reactors are produced from aluminium band with outlets as aluminium bars (copper outlets are possible on request).

Reactor power designation

Reactor type designation is according to the total power of the detuned system Q_{LC}.

Q_C - Rated power of the capacitor

Q_{LC} - Rated power of the detuned system (capacitor + reactor)

p = 7 % U_N = 400 V

Q_{LC} (kvar)	Q_C (kvar)	C_N	Type	L_N (mH)	I_N (A)	m (kg)	WxDxH (mm)
44,4	60,0	3 x 274	TK-44,4-189-400	0,86	64,1	23	255 x 185 x 215
50	66,6	3 x 308	TK-50-189-400	0,77	72,0	23	255 x 185 x 215

See Components matching guide on pages 24-25 with our recommendation.

Basic terms and definitions

EFFECTIVE CURRENT

An effective current load of a reactor operating continuously is calculated with a fundamental wave and superposed harmonics:

$$I_{rms} = \sqrt{I_1^2 + I_3^2 + ... + I_{13}^2}$$

The fundamental wave is presumed with a 10 % increase of a nominal current, resulting from voltage tolerances in a distribution network:

$$I_1 = 1{,}1 \cdot I_N$$

Permitted harmonics in the distribution network for continuous operation:

$$U_3 = 0{,}5\,\%\ U_N$$
$$U_5 = 6\,\%\ U_N$$
$$U_7 = 5\,\%\ U_N$$
$$U_{11} = 3{,}5\,\%\ U_N$$
$$U_{13} = 3\,\%\ U_N$$

DETUNING FACTOR

The ratio between reactances of reactor X_L and capacitor X_C is called the detuning coefficient:

$$p = \frac{X_L}{X_C}$$

SERIES RESONANCE FREQUENCY

Series resonance frequency is an important parameter for filtering and blocking effect of the reactor and capacitor. It is determined with a fundamental frequency of the distribution network and the detuning factor:

$$f_r = f_N \cdot \sqrt{\frac{100}{p}}$$

CURRENT LINEARITY

Current linearity I_{lin} is a parameter of the reactor which specifies the maximum current, up to which inductance does not decrease by more than 5 %.

STANDARD REACTORS PROPERTIES

f_N (Hz)	p (%)	f_r (Hz)	I_{lin} (x I_N)
50	5,67	210	2
50	7	189	1,6
50	14	134	1,38

CAPACITOR VOLTAGE

A series connection of reactor and capacitor causes an increase of voltage at the capacitor terminals. In this case, it is necessary to use capacitors dimensioned at a voltage level above result determined by formula:

$$U_C = \frac{U_N}{\left(1 - \frac{p}{100}\right)}$$

The tolerance for a distribution network with a voltage level of 400 V may be ±10 %. The voltage of 415 - 430 V is commonly measured. Our recommendation is therefore to use capacitors with higher nominal voltage.

RECOMMENDED CAPACITORS

U_N (V)	p (%)	U_C (V)
400	5,67	480
400	7	480
400	14	525

p = 7 % U_N = 400 V

Q_{LC} (kvar)	C_N (Δ) (µF)	Type	L_N (mH)	I_N (A)	m (kg)	Losses (W)	WxDxH (mm)	Design
2,8	3 x 17,3	TK-2,8-189-400	13,7	4,0	4,5	36	150 x 90 x 155	1
4,4	3 x 27,4	TK-4,4-189-400	8,63	6,4	4,5	40	150 x 90 x 155	1
5	3 x 30,8	TK-5-189-400	7,67	7,2	4,5	47	150 x 90 x 155	1
5,6	3 x 34,4	TK-5,6-189-400	6,90	8,0	4,5	46	150 x 90 x 155	1
6,25	3 x 38,6	TK-6,25-189-400	6,13	9,0	5,0	39	150 x 90 x 155	1
7,5	3 x 46,3	TK-7,5-189-400	5,11	10,8	7,5	39	180 x 90 x 180	1
8,9	3 x 54,8	TK-8,9-189-400	4,31	12,8	7,5	48	180 x 90 x 180	1
10	3 x 61,7	TK-10-189-400	3,83	14,4	7,5	55	180 x 100 x 180	1
11,1	3 x 69,0	TK-11,1-189-400	3,45	16,0	8,5	52	180 x 100 x 180	1
12,5	3 x 76,8	TK-12,5-189-400	3,07	18,0	11	55	180 x 110 x 180	1
15	3 x 92,5	TK-15-189-400	2,56	21,7	11	67	180 x 110 x 180	1
17,8	3 x 110	TK-17,8-189-400	2,16	25,7	11	87	180 x 110 x 180	1
20	3 x 124	TK-20-189-400	1,92	28,8	13	97	240 x 160 x 160	2
22,2	3 x 137	TK-22,2-189-400	1,73	32,1	13	107	240 x 160 x 160	2
2x22,2	2 x 3 x 137	TK-2x22,2-189-400	1,73	32,1	25	207	240 x 160 x 290	3
25	3 x 154	TK-25-189-400	1,54	36,0	13	136	240 x 160 x 160	2
2x25	2 x 3 x 154	TK-2x25-189-400	1,54	36,0	25	253	240 x 160 x 290	3
26,7	3 x 165	TK-26,7-189-400	1,44	38,4	17	112	255 x 165 x 195	2
30	3 x 183	TK-30-189-400	1,28	43,3	17	124	255 x 165 x 195	2
35,5	3 x 219	TK-35,5-189-400	1,08	51,3	18	142	255 x 165 x 195	2
40	3 x 248	TK-40-189-400	0,96	57,8	23	147	255 x 185 x 215	2
44,4	3 x 274	TK-44,4-189-400	0,86	64,1	23	150	255 x 185 x 215	2
2x44,4	2 x 3 x 274	TK-2x44,4-189-400	0,86	64,1	40	288	255 x 185 x 380	3
50	3 x 308	TK-50-189-400	0,77	72,1	23	172	255 x 185 x 215	2
2x50	2 x 3 x 308	TK-2x50-189-400	0,77	72,1	40	335	255 x 185 x 380	3
55	3 x 330	TK-55-189-400	0,70	79,4	26	191	285 x 185 x 235	2
60	3 x 366	TK-60-189-400	0,64	86,6	26	219	285 x 185 x 235	2
66,7	3 x 412	TK-66,7-189-400	0,58	96,2	31	218	310 x 190 x 255	2
70	3 x 438	TK-70-189-400	0,55	101	31	240	310 x 190 x 255	2
75	3 x 463	TK-75-189-400	0,51	108	34	203	310 x 190 x 255	2
80	3 x 492	TK-80-189-400	0,48	115	34	237	310 x 190 x 255	2
88,9	3 x 548	TK-88,9-189-400	0,43	128	34	240	310 x 190 x 255	2
90	3 x 555	TK-90-189-400	0,43	130	34	250	310 x 190 x 255	2
100	3 x 616	TK-100-189-400	0,38	144	34	274	310 x 190 x 255	2

p = 14 % U_N = 400 V

Q_{LC} (kvar)	C_N (Δ) (µF)	Type	L_N (mH)	I_N (A)	m (kg)	Losses (W)	WxDxH (mm)	Design
5	3 x 28,7	TK-5-134-400	16,6	7,2	12	49	180 x 125 x 180	1
6,25	3 x 34,5	TK-6,25-134-400	13,3	9,0	13	49	180 x 125 x 180	1
10	3 x 57,6	TK-10-134-400	8,29	14,4	13	86	180 x 125 x 180	1
12,5	3 x 69,1	TK-12,5-134-400	6,63	18,0	17	92	225 x 125 x 180	1
15	3 x 84,7	TK-15-134-400	5,53	21,7	17	114	225 x 125 x 180	1
20	3 x 115	TK-20-134-400	4,15	28,9	24	115	285 x 185 x 215	2
25	3 x 144	TK-25-134-400	3,32	36,1	24	159	285 x 185 x 215	2
30	3 x 173	TK-30-134-400	2,76	43,3	24	202	285 x 185 x 215	2
40	3 x 230	TK-40-134-400	2,07	57,7	36	130	330 x 190 x 255	2
50	3 x 286	TK-50-134-400	1,66	72,2	36	257	330 x 190 x 255	2
60	3 x 345	TK-60-134-400	1,38	86,6	40	269	350 x 190 x 255	2
75	3 x 438	TK-75-134-400	1,11	108,3	40	372	350 x 190 x 255	2

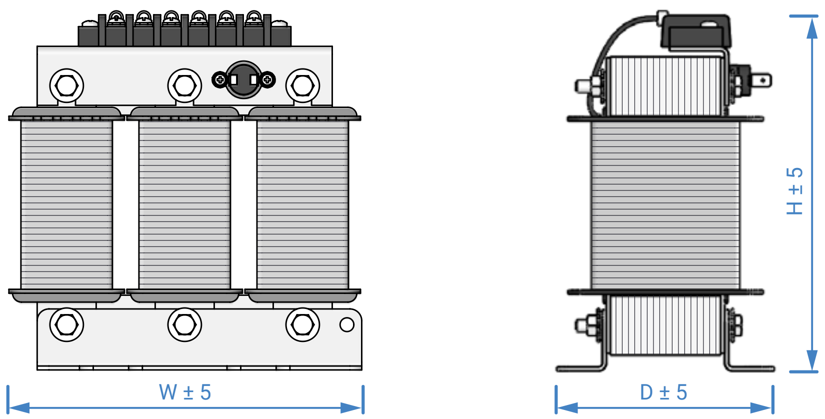
p = 5,67 % U_N = 400 V

Q_{LC} (kvar)	C_N (Δ) (µF)	Type	L_N (mH)	I_N (A)	m (kg)	Losses (W)	WxDxH (mm)	Design
6,25	3 x 39,0	TK-6,25-210-400	4,90	9,0	7	38	180 x 90 x 180	1
12,5	3 x 76,8	TK-12,5-210-400	2,45	18,0	10	71	180 x 110 x 180	1
15	3 x 93,8	TK-15-210-400	2,04	21,7	10	92	180 x 110 x 180	1
20	3 x 125	TK-20-210-400	1,53	28,9	12	87	240 x 160 x 160	2
25	3 x 154	TK-25-210-400	1,23	36,1	12	120	240 x 160 x 160	2
30	3 x 183	TK-30-210-400	1,02	43,3	17	119	255 x 165 x 195	2
40	3 x 246	TK-40-210-400	0,77	57,7	21	143	255 x 185 x 215	2
50	3 x 308	TK-50-210-400	0,61	72,2	22	177	255 x 185 x 215	2
60	3 x 366	TK-60-210-400	0,51	86,6	31	193	310 x 190 x 225	2
75	3 x 462	TK-75-210-400	0,41	108,3	32	207	310 x 190 x 225	2

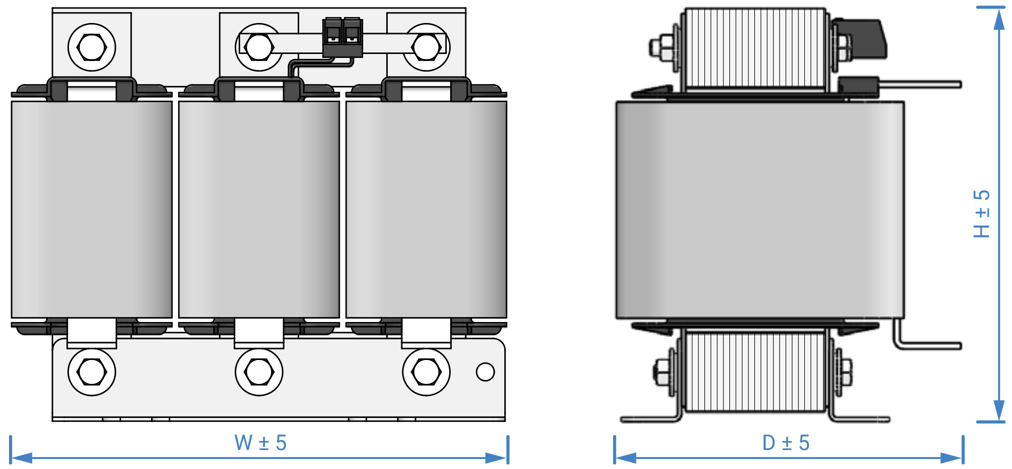
p = 7 % U_N = 690 V

Q_{LC} (kvar)	C_N (Δ) (μF)	Type	L_N (mH)	I_N (A)	m (kg)	Losses (W)	WxDxH (mm)	Design
6,25	3 x 13,0	TK-6,25-189-690	18,3	5,2	8	29	180 x 90 x 180	1
12,5	3 x 25,9	TK-12,5-189-690	9,13	10,5	13	54	180 x 125 x 180	1
15	3 x 31,1	TK-15-189-690	7,61	12,6	13	69	180 x 125 x 180	1
25	3 x 51,8	TK-25-189-690	4,56	20,9	16	101	225 x 125 x 180	1
30	3 x 62,2	TK-30-189-690	3,80	25,1	24	94	285 x 185 x 215	2
40	3 x 82,9	TK-40-189-690	2,85	33,5	24	128	285 x 185 x 215	2
50	3 x 104	TK-50-189-690	2,28	41,8	24	180	285 x 185 x 215	2
60	3 x 124	TK-60-189-690	1,90	50,2	25	191	285 x 185 x 215	2
75	3 x 155	TK-75-189-690	1,52	62,8	35	197	330 x 190 x 255	2

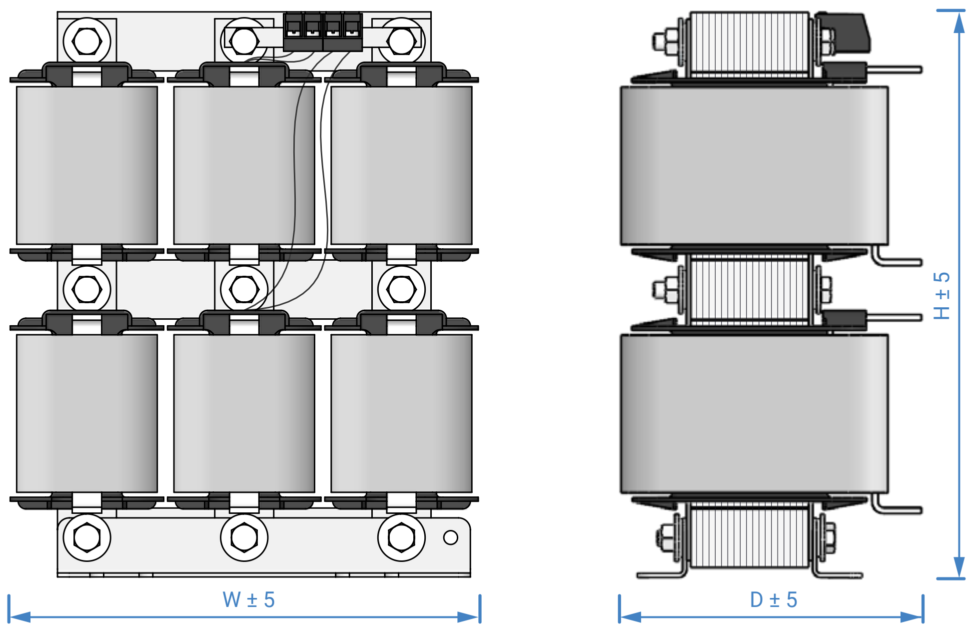
Design	1	2	3
Terminal Type	Terminal Block	Al bar	Al bar



Design 1



Design 2



Design 3