

Reactors – Antiresonance Harmonic Filter

Power Quality Solutions



Reactors – Antiresonance Harmonic Filter

SABA KHAZEN

General

The increasing use of modern power electronic apparatus (drives, uninterruptible power supplies, etc) produces nonlinear current and thus influences and loads the network with harmonics (line pollution).

The power factor correction or capacitance of the power capacitor forms a resonant circuit in conjunction with the feeding transformer. Experience shows that the self-resonant frequency of this circuit is typically between 250 and 500 Hz, i.e. in the region of the 5th and 7th harmonics.

Such a resonance although can lead to the following undesirable effects:

- overloading of capacitors,
- overloading of transformers and transmission equipment,
- interference with metering and control systems, computers and electrical gear,
- resonance elevation, i.e. amplification of harmonics,
- voltage distortion.

These resonance phenomena can be avoided by connecting capacitors in series with filter reactors in the PFC system. These so called “detuned” PFC systems are scaled

in a way that the self-resonant frequency is below the lowest line harmonic. The detuned PFC system is purely inductive seen by harmonics above this frequency. For the base line frequency (50 or 60 Hz usually), the detuned system on the other hand acts purely capacitive, thus correcting the reactive power.



Applications

- Avoidance of resonance conditions
- Tuned and detuned harmonic filters
- Reduction of harmonic distortion (network clearing)
- Reduction of power losses

Features

- High harmonic loading capability
- Very low losses
- High linearity to avoid choke tilt
- Low noise
- Convenient mounting
- Long expected life time
- Temperature protection (NC contact)

Technical data and limit values

Filter reactors

Harmonics*	$V_3 = 0.5\% V_R$ (duty cycle = 100%) $V_5 = 6.0\% V_R$ (duty cycle = 100%) $V_7 = 5.0\% V_R$ (duty cycle = 100%) $V_{11} = 3.5\% V_R$ (duty cycle = 100%) $V_{13} = 3.0\% V_R$ (duty cycle = 100%)
Effective current	$I_{rms} = \sqrt{I_1^2 + I_3^2 + \dots + I_{13}^2}$
Fundamental current	$I_1 = 1.06 \cdot I_R$ (50 Hz or 60 Hz current of capacitor)
Temperature protection	microswitch (NC)
Dimensional drawings and terminals	see specific datasheets

Three-phase filter reactors to VDE 0532 / EN 60289

Frequency	50 Hz or 60 Hz
Voltage	400, 440
Output	10 ... 100 kvar
Detuning	5.67%, 7%, 14%
Cooling	natural
Ambient temperature	+40 °C
Class of protection	I
Enclosure	IP00

* According to DIN ENV VV61000-2-2

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Characteristics							
Power	Δ capacitance	Inductance	I_{rms} (I_{eff})	Losses ¹⁾	Weight	Terminal	Ordering code
kvar	3 · μ F	mH	A	W	kg		
Rated voltage V = 400 V, f = 50 Hz, p = 5.67% (f_r = 210 Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $2.08 \cdot I_1$							
10	62	3.06	18.5	95	6.4	10 mm ² Kl.	B44066D5010*400
12.5	78	2.45	23.0	120	8.4	10 mm ² Kl.	B44066D5012*400
20	125	1.53	36.9	100	13	16 mm ² Kl.	B44066D5020*400
25	156	1.23	46.1	135	17	16 mm ² Kl.	B44066D5025*400
40	250	0.77	73.7	150	23	M6 Al-flat	B44066D5040*400
50	312	0.61	92.1	240	31	M6 Al-flat	B44066D5050*400
75	496	0.41	138.2	260	35	M8 Al-flat	B44066D5075*400
100	625	0.31	183.8	360	47	M8 Al-flat	B44066D5100*400
Rated voltage V = 400 V, f = 50 Hz, p = 7% (f_r = 189 Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $1.73 \cdot I_1$							
10	61	3.84	16.4	70	5.9	10 mm ² Kl.	B44066D7010*400
12.5	77	3.01	20.5	75	8.6	10 mm ² Kl.	B44066D7012*400
20	123	1.92	32.7	120	18	Cu bars Ø 9 mm	B44066D7020*400
25	154	1.53	40.9	180	18	Cu bars Ø 9 mm	B44066D7025*400
40	246	0.96	65.4	230	26	Cu bars Ø 9 mm	B44066D7040*400
50	308	0.77	81.8	270	27	Cu bars Ø 9 mm	B44066D7050*400
75	462	0.51	122.7	330	39	Cu bars Ø 9 mm	B44066D7075*400
100	617	0.38	163.3	390	50	Cu bars Ø 11 mm	B44066D7100*400
Rated voltage V = 400 V, f = 50 Hz, p = 14% (f_r = 135 Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $1.37 \cdot I_1$							
10	57	8.29	15.4	80	9.4	10 mm ² Kl.	B44066D1410*400
12.5	71	6.64	19.2	95	12	10 mm ² Kl.	B44066D1412*400
20	114	4.15	30.8	150	22	Cu bars Ø 9 mm	B44066D1420*400
25	142	3.32	38.5	200	26	Cu bars Ø 9 mm	B44066D1425*400
40	228	2.07	61.6	270	38	Cu bars Ø 9 mm	B44066D1440*400
50	285	1.66	77	290	40	Cu bars Ø 9 mm	B44066D1450*400
75	427	1.11	115.5	380	58	Cu bars Ø 9 mm	B44066D1475*400
100	570	0.83	153.9	470	66	Cu bars Ø 11 mm	B44066D1499*400
Rated voltage V = 440 V, f = 50 Hz, p = 5.67% (f_r = 210 Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $2.08 \cdot I_1$							
10	51	3.71	16.8	100	7	10 mm ² Kl.	B44066D5010*440
12.5	64	2.97	21.0	120	9	10 mm ² Kl.	B44066D5012*440
25	129	1.48	42.0	110	16.5	16 mm ² Kl.	B44066D5025*440
50	258	0.74	83.8	200	25	M6 Al-flat	B44066D5050*440
75	387	0.49	125.6	370	36	M8 Al-flat	B44066D5075*440
100	517	0.37	168.0	320	50	M8 Al-flat	B44066D5100*440

¹⁾ Total max. losses, considering max. specified overvoltage and harmonic currents

* EPCOS offers reactors with slightly different specifications (e.g. dimensions) that can be used for the same application although sometimes with slightly different resulting performances. These types are distinguished by different letters at digit 12 of the product code. Thus this digit is not specified here.

Other voltages upon request

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Characteristics

Power	Δ capacitance	Inductance	I_{rms} (I_{eff})	Losses ¹⁾	Weight	Terminal	Ordering code
kvar	$3 \cdot \mu F$	mH	A	W	kg		
Rated voltage $V = 440$ V, $f = 50$ Hz, $p = 7\%$ ($f_r = 189$ Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $1.73 \cdot I_1$							
10	50	4.64	14.9	70	6.5	10 mm ² Kl.	B44066D7010*440
12.5	63	3.71	18.7	65	8.5	10 mm ² Kl.	B44066D7012*440
25	127	1.87	37.2	170	18	Cu bars Ø 9 mm	B44066D7025*440
50	254	0.93	74.3	250	33	Cu bars Ø 9 mm	B44066D7050*440
75	382	0.62	111.4	340	43	Cu bars Ø 9 mm	B44066D7075*440
100	509	0.46	148.7	410	49	Cu bars Ø 9 mm	B44066D7100*440
Rated voltage $V = 440$ V, $f = 50$ Hz, $p = 14\%$ ($f_r = 135$ Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $1.37 \cdot I_1$							
10	47	10.04	14.0	90	10	10 mm ² Kl.	B44066D1410*440
12.5	58	8.03	17.5	100	13	10 mm ² Kl.	B44066D1412*440
25	117	4.02	35.0	160	27	Cu bars Ø 9 mm	B44066D1425*440
50	235	2.01	70.0	300	40	Cu bars Ø 9 mm	B44066D1450*440
75	353	1.34	105.0	440	53	Cu bars Ø 9 mm	B44066D1475*440
100	471	1.00	140.0	490	65	Cu bars Ø 9 mm	B44066D1499*440
Rated voltage $V = 440$ V, $f = 60$ Hz, $p = 5.67\%$ ($f_r = 252$ Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $2.08 \cdot I_1$							
25	107	1.24	42.0	140	16	16 mm ² Kl.	B44066D5025*441
50	215	0.62	83.8	210	25	M6 Al-flat	B44066D5050*441
75	323	0.41	126.0	340	33	M8 Al-flat	B44066D5075*441
100	431	0.31	167.4	310	47	M8 Al-flat	B44066D5100*441
Rated voltage $V = 440$ V, $f = 60$ Hz, $p = 7\%$ ($f_r = 227$ Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $1.73 \cdot I_1$							
25	106	1.55	37.2	130	18	Cu bars Ø 9 mm	B44066D7025*441
50	212	0.77	74.4	250	27	Cu bars Ø 9 mm	B44066D7050*441
75	318	0.52	111.4	320	39	Cu bars Ø 9 mm	B44066D7075*441
100	424	0.39	148.6	380	44	Cu bars Ø 9 mm	B44066D7100*441
Rated voltage $V = 440$ V, $f = 60$ Hz, $p = 14\%$ ($f_r = 162$ Hz) / Linearity: $L \geq 0.95 \cdot L_R$ for current up to $1.37 \cdot I_1$							
25	98	3.35	34.8	180	22	Cu bars Ø 9 mm	B44066D1425*441
50	196	1.67	69.5	290	34	Cu bars Ø 9 mm	B44066D1450*441
75	294	1.12	104.3	380	45	Cu bars Ø 9 mm	B44066D1475*441
100	392	0.84	139.1	480	54	Cu bars Ø 9 mm	B44066D1499*441

¹⁾ Total max. losses, considering max. specified overvoltage and harmonic currents

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