



Product Brief 2016

Power Factor Correction

DeltaCap MKD Capacitors for Power Quality Solutions

Based on the well-proven MKP technology with stacked windings, DeltaCap™ capacitors are especially developed for LV-PFC applications in Industrial installations. The cost-effective design offers abroad output range from 0.5 kvar to 33.0 kvar. The voltage range covers 230 VAC to 525 VAC.

Applications

- Power Factor Correction
- Automatic capacitor banks
- Fixed PFC applications, e.g. motor compensation
- AC power electronics
- Tuned and detuned PFC systems

Features

- Compact design in cylindrical aluminum can with stud
- MKD technology with stacked windings

- Output range 0.5 ... 33 kvar
- Voltage range 230 ... 525 VAC

Safety

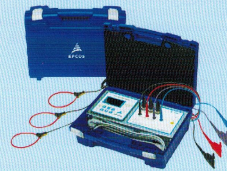
- Self-healing technology
- Overpressure disconnecter
- Isolated terminal (IP20) for B32304 series

Electrical

- Up to 33 kvar per capacitor for three-phase applications
- Long life expectancy up to 135 000 hours (at temperature class -40/C)
- High inrush current withstand ability (up to $200 \times I_n$)

Mechanical and maintenance

- Reduced mounting costs, easy installation and connection
- Low weight and compact volume
- Maintenance-free



DeltaCap MKD Capacitors

Technical data and limit values		
Standards IEC 60831-1+2, IS: 13340/41		
Overvoltage	V_{max}	$V_R + 10\%$ (up to 8 h daily) / $V_R + 15\%$ (up to 30 min daily) $V_R + 20\%$ (up to 5 min daily) / $V_R + 30\%$ (up to 1 min daily)
Overcurrent	I_{max}	up to $1.5 \cdot I_R$ (including combined effects of harmonics, overvoltages and capacitance)
Inrush current	I_s	up to $200 \cdot I_R$
Losses: - Dielectric - Total*		< 0.2 W/kvar < 0.45 W/kvar
Rated frequency	f	50/60 Hz
Capacitance tolerance		-5% / + 10%
Test voltage, terminal / terminal	V_{TT}	$2.15 \cdot V_R$, AC 2 s
Test voltage, terminal / case	V_{TC}	3000 V AC, 10 s
Mean life expectancy	t_{LDC}	up to 100 000 h at temperature class -40/D up to 135 000 h at temperature class -40/C
Ambient temperature		-40/D; max. temperature 55 °C; max. mean 24 h = 45 °C; max. mean 1 year = 35 °C; lowest temperature = -40 °C -40/C; max. temperature 50 °C; max. mean 24 h = 40 °C; max. mean 1 year = 30 °C lowest temperature = -40 °C; Tmax Hospost +85 °C
Cooling		natural or forced
Humidity	H_{rel}	max. 95%
Altitude		max. 4000 m above sea level
Mounting position		upright
Mounting and grounding		threaded M12 (10 Nm) for case size diameter > 50 mm
Safety		self-healing technology, overpressure disconnecter, max. allowed fault current 10,000 A in accordance with UL 810 standard
Discharge resistor		discharge module included in delivery, integrated in terminal for B32304 series
Case		extruded aluminum can
Enclosure		IP20 for B32304
Dielectric		polypropylene film
Impregnation		biodegradable soft resin (non PCB)
Terminals		screw terminal for B32304 series, max. 25 mm ² cable cross-section; fast-on terminals for B332300 and B32303 series, max current : 50A
Number of switching operations		I_{max} . 5000 switchings per year according to IEC 60831-1+2

*without discharge resistors

DeltaCap MKD Capacitors

Terminal designs / dimensional drawings



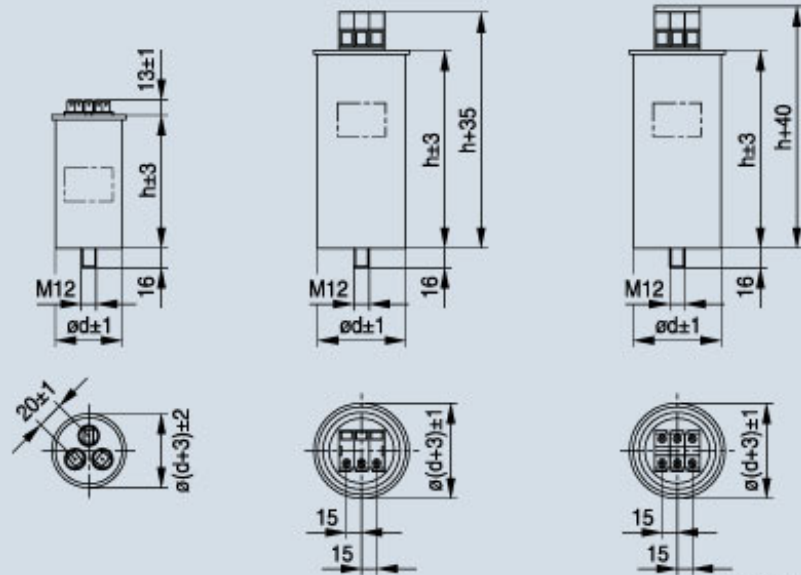
B32300 / B32303 series



B32304****A*** series



B32304****B*** series



DeltaCap MKD Capacitors

Three-phase capacitors									
Type	50 Hz		60 Hz		C _R μF	d x h mm	Weight kg	Ordering code	Packing unit pcs
	Output kvar	I _R A	Output kvar	I _R A					
Rated voltage 230 V AC, 50/60 Hz, delta connection									
MKD230-D-5.0	5.0	12.6	6.0	15.1	3 · 100	75 x 200	1.1	B32304A2052#030*	6
MKD230-D-10.0	10.0	25.1	12.0	30.1	3 · 201	85 x 275	1.7	B32304A2102#030*	4
MKD230-D-15.0	15.0	37.7	18.0	45.2	3 · 301	85 x 350	2.2	B32304A2152#030*	4
Rated voltage 400 V AC, 50/60 Hz, delta connection									
MKD400-D-5.0	5.0	7.2	6.0	8.6	3 · 33	63.5 x 148	0.6	B32303A4052A000	12
MKD400-D-10.0	10.0	14.4	12.0	17.3	3 · 66	75 x 200	1.1	B32304A4102#000*	6
MKD400-D-15.0	15.0	21.7	18.0	26.0	3 · 100	75 x 275	1.4	B32304A4152#000*	6
MKD400-D-20.0	20.0	28.9	24.0	34.7	3 · 133	96 x 275	1.8	B32304A4202#000*	4
MKD400-D-25.0	25.0	36.1	30.0	43.3	3 · 166	85 x 350	2.2	B32304A4252#000*	4
MKD400-D-30.0	30.0	43.4	--	--	3 · 200	96 x 275	2.7	B32304A4302#000*	4
Rated voltage 415 V AC, 50/60 Hz, delta connection									
MKD415-D-5.0	5.0	7.0	6.0	8.4	3 · 31	63.5 x 148	0.8	B32303A4052A010	12
MKD415-D-10.0	10.0	13.9	12.0	16.7	3 · 62	75 x 275	1.4	B32304A4102#010*	6
MKD415-D-12.5	12.5	17.4	15.0	20.9	3 · 77	75 x 275	1.4	B32304A4122#510*	6
MKD415-D-15.0	15.0	20.9	18.0	25.1	3 · 93	85 x 275	1.7	B32304A4152#010*	4
MKD415-D-20.0	20.0	27.8	24.0	33.4	3 · 123	85 x 350	2.2	B32304A4202#010*	4
MKD415-D-25.0	25.0	34.8	30.0	41.8	3 · 154	85 x 350	2.2	B32304A4252#010*	4
MKD415-D-30.0	30.0	42.0	--	--	3 · 185	96 x 350	2.7	B32304A4302#010*	4

*) Available either as B32304A****A*** series (3-terminal design, integrated resistor) or B32304A****B*** series (6-terminal design, pluggable ceramic resistor). Please replace # with the right character before ordering.

Three-phase capacitors									
Type	50 Hz		60 Hz		C _R μF	d x h mm	Weight kg	Ordering code	Packing unit pcs
	Output kvar	I _R A	Output kvar	I _R A					
Rated voltage 440 V AC, 50/60 Hz, delta connection									
MKD440-D-5.0	5.0	6.6	6.0	7.9	3 · 27	63.5 x 148	0.8	B32303A4052A040	12
MKD440-D-10.0	10.0	13.1	12.0	15.7	3 · 55	75 x 275	1.4	B32304A4102#040*	6
MKD440-D-12.5	12.5	16.4	15.0	19.7	3 · 69	75 x 275	1.4	B32304A4151#040*	6
MKD440-D-15.0	15.0	19.7	18.0	23.6	3 · 82	85 x 275	1.7	B32304A4152#040*	4
MKD440-D-20.8	20.8	27.3	25.0	32.8	3 · 114	85 x 275	2.3	B32304A4251V040*	4
MKD440-D-25.0	25.0	32.8	30.0	39.4	3 · 137	96 x 275	2.3	B32304A4252V040*	4
MKD440-D-28.0	28.0	36.7	33.6	44.0	3 · 154	85 x 350	2.2	B32304A4282#040*	4
MKD440-D-30.0	30.0	39.4	36.0	47.3	3 · 165	116 x 230	3.3	B32304A4302V040*	4
MKD440-D-33.7	33.7	44.3	--	--	3 · 185	96 x 350	2.7	B32304A4332#040*	4
Rated voltage 480 V AC, 50/60 Hz, delta connection									
MKD480-D-12.5	12.5	15.0	15.0	18.0	3 · 58	75 x 275	1.4	B32304A4151#080*	6
MKD480-D-15.0	15.0	18.0	18.0	21.6	3 · 69	85 x 275	1.7	B32304A4152#080*	6
MKD480-D-20.8	20.8	25.0	25.0	30.0	3 · 96	85 x 350	2.2	B32304A4202#080*	4
MKD480-D-25.0	25.0	30.1	30.0	36.1	3 · 115	85 x 350	2.2	B32304A4252#080*	4
MKD480-D-30.0	30.0	36.0	36.0	43.0	3 · 138	96 x 350	2.7	B32304A4302#080*	4
MKD480-D-33.0	33	39.7	--	--	3 · 152	96 x 350	2.7	B32304A4332#080*	4
Rated voltage 525 V AC, 50/60 Hz, delta connection									
MKD525-D-12.5	12.5	13.7	15.0	16.4	3 · 48	75 x 275	1.4	B32304A5151#020*	6
MKD525-D-20.8	20.8	22.9	25.0	27.5	3 · 80	96 x 275	2.3	B32304A5202V020*	4
MKD525-D-25.0	25.0	27.5	30.0	33.0	3 · 96	96 x 350	3.3	B32304A5252V020*	4
MKD525-D-30.0	30.0	33.0	36.0	39.0	3 · 115	96 x 350	2.7	B32304A5302#020*	4

*) Available either as B32304A****A*** series (3-terminal design, integrated resistor) or B32304A****B*** series (6-terminal design, pluggable ceramic resistor). Please replace # with the right character before ordering.

DeltaCap MKD Capacitors

Outdoor type

Single-phase capacitors										
Type	50 Hz		60 Hz		C _R μF	d x h mm	Weight kg	Ordering code	Packing unit pcs	
	Output kvar	I _R A	Output kvar	I _R A						
Rated voltage 230 V AC, 50/60 Hz										
MKD230-I-2.5-P	2.5	6.0	3.0	7.2	151	63.5 x 180	0.8	B32301P2022A530	4	
MKD230-I-5.0-P	5.0	21.7	6.0	26.1	301	75 x 235	1.25	B32301P2062A030	4	
MKD230-I-10.0-P	10.0	43.5	12.0	52.2	602	96 x 255	2.0	B32301P2102A030	2	
Three-phase capacitors										
Rated voltage 400 V AC, 50/60 Hz										
MKD400-D-5.0-P	5.0	7.2	6.0	8.8	3 · 33	63.5 x 148	0.6	B32303P4052A000	12	
MKD400-D-10.0-P	10.0	14.4	12.0	17.3	3 · 66	75 x 200	1.1	B32304P4102A000	6	
MKD400-D-15.0-P	15.0	21.7	18.0	26.0	3 · 100	75 x 275	1.4	B32304P4152A000	6	
MKD400-D-20.0-P	20.0	28.9	24.0	34.7	3 · 133	96 x 275	1.8	B32304P4202A000	4	
MKD400-D-25.0-P	25.0	36.1	30.0	43.3	3 · 166	85 x 350	2.2	B32304P4252A000	4	
MKD400-D-30.0-P	30.0	43.4	--	--	3 · 200	96 x 350	2.7	B32304P4302A000	4	
Rated voltage 415 V AC, 50/60 Hz										
MKD415-D-5.0-P	5.0	7.0	6.0	8.4	3 · 31	63.5 x 203	1.1	B32303P4052A010	4	
MKD415-D-10.0-P	10.0	13.9	12.0	16.7	3 · 62	75 x 330	1.8	B32304P4102A010	2	
MKD415-D-15.0-P	15.0	20.9	18.0	25.1	3 · 93	85 x 330	2.2	B32304P4152A010	2	
MKD415-D-20.0-P	20.0	27.8	24.0	33.4	3 · 123	85 x 330	2.3	B32304P4202A010	2	
MKD415-D-25.0-P	25.0	34.8	30.0	41.8	3 · 154	85 x 350	2.2	B32304P4252A010	4	
MKD415-D-30.0-P	30.0	42.0	--	--	3 · 185	96 x 350	2.7	B32304P4302A010	4	



DeltaCap MKD Capacitors

Outdoor type

Film Capacitors - Power Factor Correction	
DeltaCap capacitors	
Maximum ratings	
V_{rms}	$V_N + 10\%$ (up to 8 h daily) / $V_N + 15\%$ (up to 30 min daily) / $V_N + 20\%$ (up to 5 min daily) / $V_N + 30\%$ (up to 1 min daily)
I_{rms}	Up to $1.3 \cdot I_N$ (up to $1.5 \cdot I_N$ including combined effects of harmonics overvoltages and capacitance tolerance)
I_S	Up to $200 \cdot I_N$ (A)
*Power Losses	≤ 0.2 W/kvar (dielectric) and ≤ 0.45 W / kvar(total)
*Without discharge resistor	
Test data	
V_{TI}	$2.15 \times V_N$ during 2s
V_{IC}	3000 V AC / 50 Hz during 10 s
Lightning impulse voltage test (terminal and container)	15kvp
*tan δ (50 Hz)	$\leq 1.0 \times 10^{-5}$
*Without discharge resistor	
Climatic category -40/D	
T_{min}	-40°C
T_{max}	+55°C
Storage temperature	-40°C ... +85°C
$T_{max \text{ hotspot}}$	+85°C
Humidity	Avg. rel. < 95%
Maximum altitude	4000 m
Mean life expectancy	
t_D	Up to 135 000 hours at temperature class -40/C Up to 100 000 hours at temperature class -40/D
Max. 5000 switchings per year acc. to IEC 60831	
Design data	
Impregnation	Non PCB, resin filling; soft polyurethane resin
Fixing	Threaded bolt M12
Max. torque (Al can stud)	10 Nm
Mounting position	Preferably in vertical position, horizontal position possible See "Maintenance and Installation Manual" for further details.
Safety	
Mechanical safety	Overpressure disconnecter
Max. short circuit current	(AFC: 10 kA according UL 810 standard)
Discharge resistor time	60 s to 75 V or less
Protection degree	IP54
Reference standards	
IEC 60831-1/2	

Reactors - Antiresonance Harmonic Filter

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 an 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 har

monic. 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

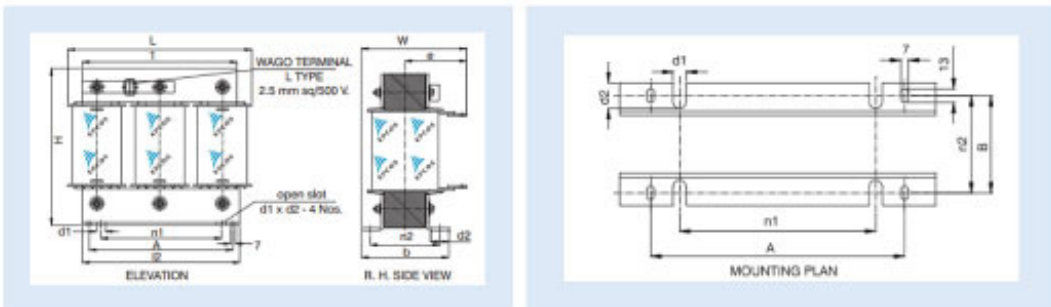
- High harmonic loading capability
- Very low losses
- High linearity to avoid choke tilt
- Low noise
- Convenient mounting
- Long expected life time
- Temperature protection (NC contact)

Technical data and limit values

Filter reactors	
Harmonics*	V3 = 0,5% V_N (duty cycle = 100%) V5 = 6,0% V_N (duty cycle=100%) V7 = 5,0% V_N (duty cycle=100%) V11 = 3,5% V_N (duty cycle=100%) V13 = 3,0% V_N (duty cycle=100%)
Effective current	$I_{\text{eff}} = \sqrt{I_1^2 + I_2^2 + \dots + I_n^2}$
Fundamental current	$I_1 = 1,06 \cdot I_N$ (50Hz 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

Harmonic Filter Reactors

Characteristics								
Power kvar	Δ Capacitance 3 · μ F	Inductance mH	I_{rms} (int) A	Losses* W	Weight kg	Terminal	Capacitor/ Volt	Ordering code
Rated voltage V= 400V, f=50 Hz, p=5.67% (f_r=210 Hz) / Linearity: L \geq 0.95 x L_n for current up to 2.80 x I1								
10	62	3.06	18.5	95	6.4	10 mm ² KI		B44066D7010M400
12.5	78	2.45	23.0	120	8.4	10 mm ² KI		B44066D7012M400
20	125	1.53	36.9	100	13	16 mm ² KI		B44066D7020M400
25	156	1.23	46.1	135	17	16 mm ² KI		B44066D7025M400
40	250	0.77	73.7	150	23	M6 AH-flat		B44066D7040M400
50	312	0.61	92.1	240	31	M6 AH-flat		B44066D7050M400
75	496	0.41	138.2	280	35	M6 AH-flat		B44066D7075M400
100	625	0.31	183.8	360	47	M6 AH-flat		B44066D7100M400
Rated voltage V= 400V, f=50 Hz, p=7% (f_r=189 Hz) / Linearity: L \geq 0.95 · L_n for current up to 1.73 x I1								
10	61	3.84	16.4	70	5.9	10 mm ² KI		B44066D7010M400
12.5	77	3.01	20.5	75	8.6	10 mm ² KI		B44066D7012M400
20	123	1.92	32.7	120	18	busbars 9 mm		B44066D7020M400
26.7	494	1.435	43.73	140	18	busbars 9 mm	30#40	B44066D7026M400N1
40	246	0.96	65.4	230	26	busbars 9 mm		B44066D7040M400
44.4	822	0.663	72.73	210	27	busbars 9 mm	50#40	B44066D7044E400N1
53	967	0.719	87.3	275	39	busbars 9 mm	60#40	B44066D7053E400N1
89	1646	0.431	145.78	320	50	busbars 11 mm	100#40	B44066D7089E400N1
Rated voltage V= 400V, f=50 Hz, p=14% (f_r=135 Hz) / Linearity: L \geq 0.95 x L_n for current up to 1.37 x I1								
10	57	8.29	15.4	60	9.4	10 mm ² KI		B44066D1410M400
12.5	71	6.64	19.2	95	12	10 mm ² KI		B44066D1412M400
20	114	4.15	30.8	150	22	busbars \varnothing 9 mm		B44066D1420M400
25	142	3.32	38.5	200	26	busbars \varnothing 9 mm		B44066D1425M400
40	228	2.07	61.6	270	38	busbars \varnothing 9 mm		B44066D1440M400
50	285	1.66	77	290	40	busbars \varnothing 9 mm		B44066D1450M400
75	427	1.11	115.5	380	58	busbars \varnothing 9 mm		B44066D1475M400
100	570	0.83	153.9	470	66	busbars \varnothing 11 mm		B44066D1499M400
Rated voltage V= 400V, f=50 Hz, p=5.67% (f_r=210 Hz) / Linearity: L \geq 0.95 x L_n for current up to 2.08 x I1								
10	51	3.71	16.8	100	7	10 mm ² KI		B44066D5010M440
12.5	64	2.97	21.0	120	9	10 mm ² KI		B44066D5012M440
25	129	1.48	42.0	110	16.5	16 mm ² KI		B44066D5025M440
50	258	0.74	83.8	200	25	M6 AH-flat		B44066D5050M440
75	387	0.49	125.6	370	36	M6 AH-flat		B44066D5075M440
100	517	0.37	168.0	320	50	M6 AH-flat		B44066D50100M440



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