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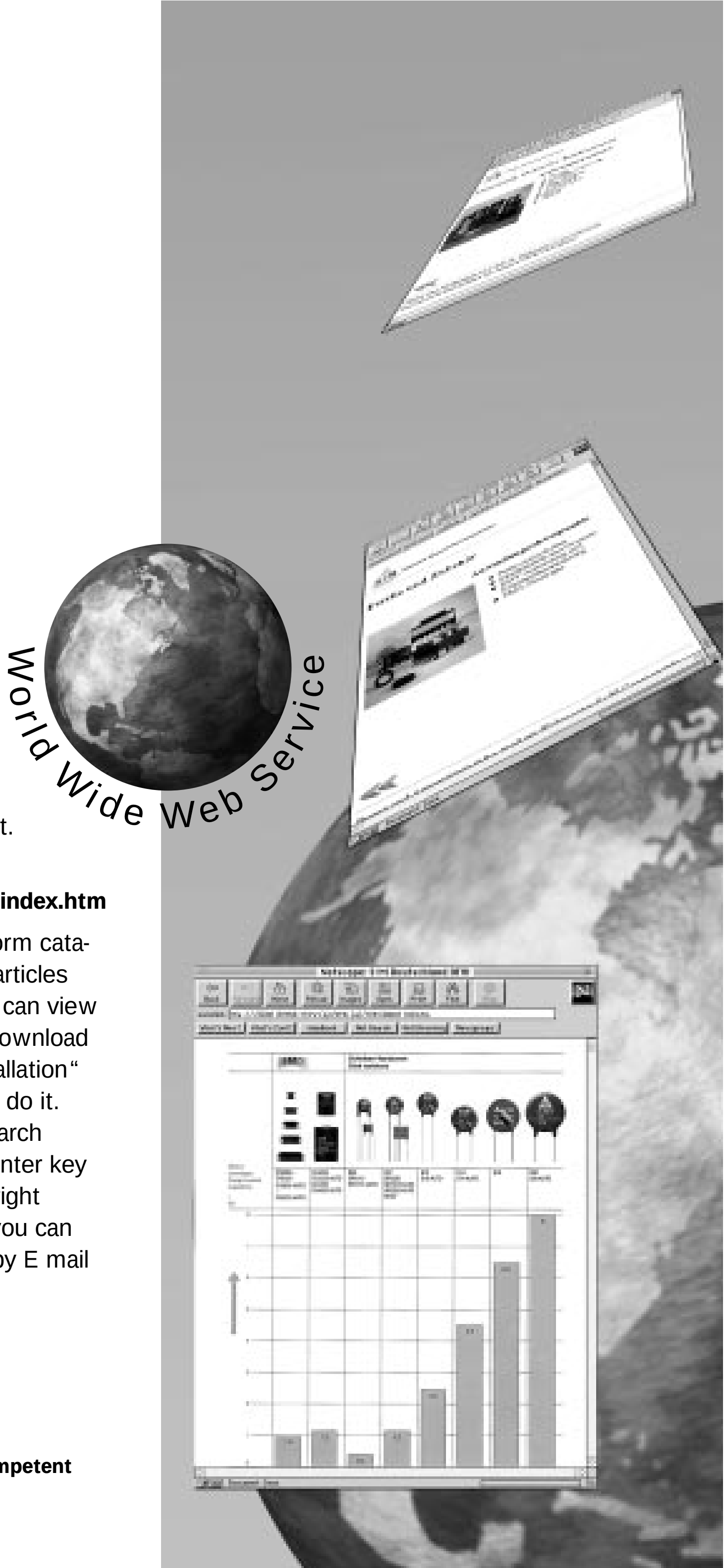
SCS on the Internet

Creating new links



As of now you can tie up with Passive Components and Electron Tubes Group plus Siemens Matsushita Components on the Internet. On our home page under

http://www.siemens.de/pr/index.htm

you'll find the latest short form catalogs, data books, technical articles and more subjects too. You can view the documents on-line, or download them to your PC. The "Installation" menu item tells you how to do it. Thanks to the integrated search function, you only have to enter key terms to go straight to the right document. And of course, you can get in touch with us direct by E mail at any time.

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Film Capacitors

Siemens Matsushita Components

Applications with a future

We set your ideas in motion

When it comes to implementing ideas, you couldn’t choose a better partner. Our flexibility turns standard products into new ones with all the right features. Whether capacitors and converter filters for wind-driven power plants, ferrite antennas for radio wrist-watches or SAW filters for the new wide-screen TV generation. If you’ve got the application, we’ve got the component.

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Contents

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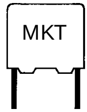
Dielectric	Style	Application	Construction/ features	Type number		Page
Polyethylene terephthalate (Polyester) (PET)	MKT	General use in consumer electronics and in industrial electronics DC blockage Signal coupling Impulse circuitry, logic circuitry and timers	**Plastic case**			
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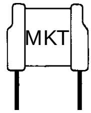
			Long-life grade	B 32 530... B 32 539		14
			Partially coated (Silver Blue Cap)			
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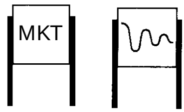
			Uncoated (Silver Cap)			
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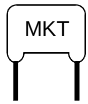
			Coated (Powder Dipped)			
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			Flat windings	B 32 227		98
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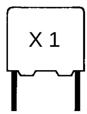
		Electro-magnetic compatibility (Electro-magnetic interference suppression)	**Y 2**			
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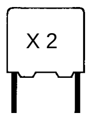
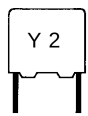
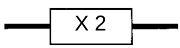
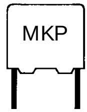
			X 2			
			275 V_{ac} (50/60 Hz)	B 81 133		177
			300 V_{ac} (50/60 Hz)	B 81 131		180
			300 V_{ac} (50/60 Hz)	B 81 121		183
			axial 250 V_{ac} (50/60 Hz)	B 81 191		189
Polypropylene (PP)	MKP		250 V_{ac} (50...400 Hz)	B 81 121		174
			400 V_{ac} (50...1000Hz)	B 81 121		186
			X 1			
			440 V_{ac} (50...400 Hz)	B 81 141		171
			Y 2			
			250 V_{ac} (50...1000Hz)	B 81 121		195

Dielectric	Style	Application	Construction/ features	Type number		Page
Polypropylene (PP)	MKP	Video electronics Measuring and control engineering Impulse circuitry Switched-mode power supplies RF circuits	Plastic case			
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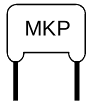
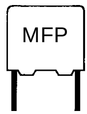
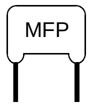
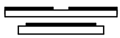
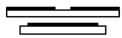
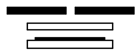
			Coated (Powder Dipped)			
			Wound capacitor technology	B 32 612 ... B 32 614		131
			Axial			
			AC applications	B 32 669		137
	MFP		Plastic case			
			High pulse handling capability	B 32 682 ... B 32 686		140
			Highest possible pulse handling capability	B 32 642 ... B 32 644		151
			Coated (Powder Dipped)			
			High pulse handling capability	B 32 692 ... B 32 694		159

Technical data in brief, different capacitor types (comparison table)

The following table is a summary of the most important technical data (generalized typical values) and provides an initial orientation aid for the classification of the respective capacitor types and their suitability for an intended application.

Style	MKT	MKP	MFP	
Dielectric	Polyester/ Polyethylene terephthalate (PET)	Polypropylene (PP)	Polypropylene (PP)	
Dielectric constant (permittivity)	3,2	2,2	2,2	
Electrodes	Al metallization	Al metallization	Al metal foils and Al metallization	
Construction principle Simple connection			——	——
Internal series connection				
Contact method	Sprayed metal layer	Sprayed metal layer	Sprayed metal layer	Sprayed metal layer
Pulse handling capability	medium	high	very high	
Dissipation factor	0,0050	0,0005	0,0004	
Self-heating, intrinsic heating	medium	low	very low	
Insulation resistance	50 GΩ	200 GΩ	400 GΩ	
Capacitance drift	3 %	2 %	2 %	
Temperature coefficient of capacitance	+ 600 10^{-6}/K	– 250 10^{-6}/K	– 250 10^{-6}/K	
Humidity coefficient of capacitance	800 10^{-6}/% r. h.	40 10^{-6}/% r. F.	40 10^{-6}/% r. h.	
Upper category temperature	100 °C (125 °C)	85 °C; 100 °C	85 °C	
Special notes	self-healing, small dimensions	self-healing, low dissipa-tion factor	self-healing, low dissipation factor, high pulse-handling capability	

 Metal foil

 Metallized plastic film

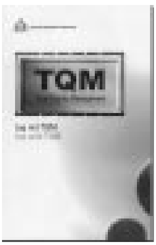
 Unmetallized plastic film

Siemens Matsushita Components

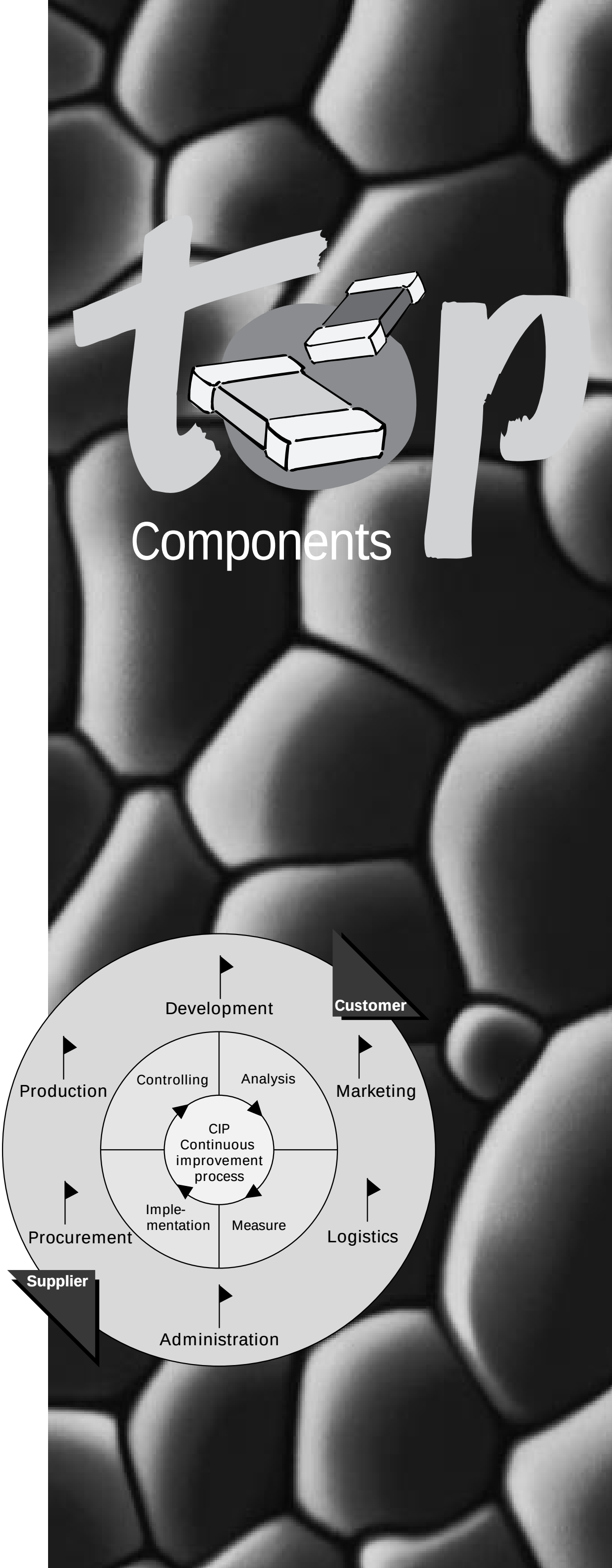
Quality without compromises

top with TQM

We’re not satisfied until you are. So our quality demands are quite tough. And they don’t start in production, they span the whole field from development to despatch. To watch over it all we implemented Total Quality Management, a system aimed at continuous improvement – in everything. That includes true-to-schedule delivery and service readiness, ISO 9000 for all plants, modern QA, commitment to the environment in manufacturing, materials and packing plus constant training of employees. All embedded in *top*, the worldwide quality campaign of the Siemens organization.



More about “top with TQM“ in this brochure!



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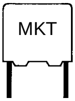
Index of Type Numbers

EMI suppression capacitors

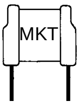
Overview, MKT capacitors

Leads	Version	Type	Application	Rated voltage	Page
Radial leads	Plastic case	B 32 520 ... B 32 529	Standard applications	50 … 630 V_{dc}	14
		B 32 530 ... B 32 539	Long-life grade	50 … 400 V_{dc}	14
	Partially coated Silver Blue Cap	B 32 510 ... B 32 513	Small dimensions	63 … 400 V_{dc}	39
	Uncoated Silver Cap	B 32 560 ... B 32 564	Smallest possible dimensions	63 … 400 V_{dc}	52
		B 32 572 ... B 32 573	For ignition circuits	250 V_{dc}	67
	Coated Powder Dipped	B 32 590 ... B 32 594	Standard applications	100 … 630 V_{dc}	72
Axial leads	$V_R \leq 630\ V_{dc}$	B 32 231 (Flat winding) B 32 232 (Cylindrical winding)	Standard applications	100 … 630 V_{dc}	86 92
	$V_R \geq 1000\ V_{dc}$	B 32 227 (Flat winding) B 32 237 (Cylindrical winding)	High-voltage capacitors	1,0 … 6,3 kV_{dc}; 1,0 … 12,5 kV_{dc}	98 103

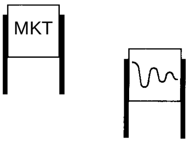
Plastic case:



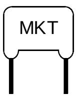
Partially coated, Silver Blue Cap:



Uncoated, Silver Cap:



Coated, Powder Dipped:



Axial leads, $V_R \leq 630\ V_{dc}$:

Axial leads, $V_R \geq 1000\ V_{dc}$:

Standard applications

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Stacked-film technology for lead spacing 5 … 15 mm (50 … 400 V_{dc})
  Wound capacitor technology for lead spacing 10 and 15 mm (400 and 630 V_{dc}) as well as for lead spacing 22,5 and 27,5 mm
- Plastic case (UL 94 V-0)
- Epoxy resin sealing

Features

- High pulse strength
- High contact reliability

Terminals

- Parallel wire leads, tinned
- Also available with (3,2 ± 0,3) mm lead length
- Special lead lengths available upon request

Marking

Manufacturer's logo,
lot number for lead spacing ≥ 15 mm,
style (MKT) for lead spacing ≥ 7,5 mm,
type (coded) for lead spacing 5 mm
(B32529 ≙ 1, B32539 ≙ 2),
rated capacitance (coded),
capacitance tolerance (code letter),
rated dc voltage,
date of manufacture (coded)

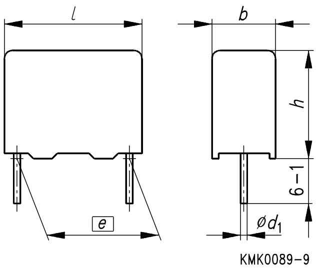
Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping, refer to page 252.

Detail specifications

General-purpose grade (B 32 520 … B 32 529):
CECC 30 401-043
CECC 30 401-052/DIN 44 112

Long-life grade (B 32 530 … B 32 539):
CECC 30 401-026
CECC 30 401-054/DIN 44 122
Long-life grade models available upon request.



Dimensions in mm

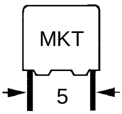
Lead spacing e ± 0,4	Diameter d_1	Type
5,0	0,5	B 32 529
7,5	0,5	B 32 520
10,0	0,5[1)] /0,6	B 32 521
15,0	0,8	B 32 522
22,5	0,8	B 32 523
27,5	0,8	B 32 524

1) 0,5 mm for capacitor width *b* = 4 mm

Overview of available types

Lead spacing	5 mm	7,5 mm	10 mm	15 mm	22,5 mm	27,5 mm
Type	B 32 529	B 32 520	B 32 521	B 32 522	B 32 523	B 32 524
Page	16	19	21	23	25	26
Capacitance range	50 V_{dc}: 0,33 µF … 3,3 µF 63 V_{dc}: 1,0 nF … 2,2 µF 100 V_{dc}: 1,0 nF … 0,47 µF 250 V_{dc}: 1,0 nF … 0,22 µF 400 V_{dc}: 1,0 nF … 0,10 µF	63 V_{dc}: 68 nF … 2,2 µF 100 V_{dc}: 47 nF … 0,68 µF 250 V_{dc}: 15 nF … 0,15 µF 400 V_{dc}: 1,0 nF … 68 nF	63 V_{dc}: 0,47 µF … 3,3 µF 100 V_{dc}: 0,10 µF … 1,0 µF 250 V_{dc}: 33 nF … 0,47 µF 400 V_{dc}: 10 nF … 0,10 µF 630 V_{dc}: 6,8 nF … 33 nF	63 V_{dc}: 0,68 µF … 4,7 µF 100 V_{dc}: 0,33 µF … 3,3 µF 250 V_{dc}: 0,10 µF … 1,0 µF 400 V_{dc}: 47 nF … 0,68 µF 630 V_{dc}: 33 nF … 0,10 µF	63 V_{dc}: 6,8 µF … 10 µF 100 V_{dc}: 1,5 µF … 6,8 µF 250 V_{dc}: 0,47 µF … 3,3 µF 400 V_{dc}: 0,22 µF … 0,68 µF 630 V_{dc}: 0,10 µF … 0,22 µF	100 V_{dc}: 6,8 µF … 33 µF 250 V_{dc}: 2,2 µF … 10 µF 400 V_{dc}: 1,0 µF … 4,7 µF 630 V_{dc}: 0,33 µF … 1,5 µF
Note	Stacked-film technology	Stacked-film technology	Stacked-film technology (63 … 400 V_{dc}); Stacked-film/Wound capacitor technology (630 V_{dc})	Wound capacitor technology	Wound capacitor technology	Wound capacitor technology

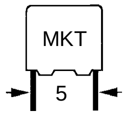
Capacitance steps: 1,0 nF, 1,5 nF, 2,2 nF, 3,3 nF, 4,7 nF, 6,8 nF, 10 nF, 15 nF, 22 nF, 33 nF, 47 nF, 68 nF, 0,10 µF, 0,15 µF, 0,22 µF, 0,33 µF, 0,47 µF, 0,68 µF, 1,0 µF, 1,5 µF, 2,2 µF, 3,3 µF, 4,7 µF, 6,8 µF, 10 µF, 15 µF, 22 µF, 33 µF



Ordering codes and packing units, lead spacing 5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
50 V_{dc} (32 V_{ac})	0,33 µF	3,0 × 6,5 × 7,2	B32529-C5334-+***	2700	2400	2000
	0,47 µF	3,5 × 8,0 × 7,2	B32529-C5474-+***	2300	2000	2000
	0,68 µF	4,5 × 9,5 × 7,2	B32529-C5684-+***	1800	1500	1500
	1,0 µF	4,5 × 9,5 × 7,2	B32529-C5105-+***	1800	1500	1500
	1,5 µF	6,0 × 10,5 × 7,2	B32529-C5155-+***	1300	1100	1000
	2,2 µF	7,2 × 13,0 × 7,8	B32529-C5225-+***	1000	1000	1000
	3,3 µF	7,2 × 13,0 × 7,8	B32529-C5335-+***	1000	1000	1000
63 V_{dc} (40 V_{ac})	1,0 nF	2,5 × 6,5 × 7,2	B32529-C102-+***	3200	2800	2000
	1,5 nF	2,5 × 6,5 × 7,2	B32529-C152-+***	3200	2800	2000
	2,2 nF	2,5 × 6,5 × 7,2	B32529-C222-+***	3200	2800	2000
	3,3 nF	2,5 × 6,5 × 7,2	B32529-C332-+***	3200	2800	2000
	4,7 nF	2,5 × 6,5 × 7,2	B32529-C472-+***	3200	2800	2000
	6,8 nF	2,5 × 6,5 × 7,2	B32529-C682-+***	3200	2800	2000
	10 nF	2,5 × 6,5 × 7,2	B32529-C103-+***	3200	2800	2000
	15 nF	2,5 × 6,5 × 7,2	B32529-C153-+***	3200	2800	2000
	22 nF	2,5 × 6,5 × 7,2	B32529-C223-+***	3200	2800	2000
	33 nF	2,5 × 6,5 × 7,2	B32529-C333-+***	3200	2800	2000
	47 nF	2,5 × 6,5 × 7,2	B32529-C473-+***	3200	2800	2000
	68 nF	2,5 × 6,5 × 7,2	B32529-C683-+***	3200	2800	2000
	0,10 µF	2,5 × 6,5 × 7,2	B32529-C104-+***	3200	2800	2000
	0,15 µF	2,5 × 6,5 × 7,2	B32529-C154-+***	3200	2800	2000
	0,22 µF	3,0 × 6,5 × 7,2	B32529-C224-+***	2700	2400	2000
	0,33 µF	3,5 × 8,0 × 7,2	B32529-C334-+***	2300	2000	2000
	0,47 µF	3,5 × 8,0 × 7,2	B32529-C474-+***	2300	2000	2000
	0,68 µF	4,5 × 9,5 × 7,2	B32529-C684-+***	1800	1500	1500
	1,0 µF	5,0 × 10,0 × 7,2	B32529-C105-+***	1600	1400	1500
	1,5 µF	6,0 × 10,5 × 7,2	B32529-C155-+***	1300	1100	1000
	2,2 µF	7,2 × 13,0 × 7,8	B32529-C225-+***	1000	1000	1000

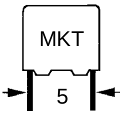
1) For instructions on how to determine the ordering code, refer to page 18.



Ordering codes and packing units, lead spacing 5 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
100 V_{dc} (63 V_{ac})	1,0 nF	2,5 × 6,5 × 7,2	B32529-C1102-+***	3200	2800	2000
	1,5 nF	2,5 × 6,5 × 7,2	B32529-C1152-+***	3200	2800	2000
	2,2 nF	2,5 × 6,5 × 7,2	B32529-C1222-+***	3200	2800	2000
	3,3 nF	2,5 × 6,5 × 7,2	B32529-C1332-+***	3200	2800	2000
	4,7 nF	2,5 × 6,5 × 7,2	B32529-C1472-+***	3200	2800	2000
	6,8 nF	2,5 × 6,5 × 7,2	B32529-C1682-+***	3200	2800	2000
	10 nF	2,5 × 6,5 × 7,2	B32529-C1103-+***	3200	2800	2000
	15 nF	2,5 × 6,5 × 7,2	B32529-C1153-+***	3200	2800	2000
	22 nF	2,5 × 6,5 × 7,2	B32529-C1223-+***	3200	2800	2000
	33 nF	2,5 × 6,5 × 7,2	B32529-C1333-+***	3200	2800	2000
	47 nF	2,5 × 6,5 × 7,2	B32529-C1473-+***	3200	2800	2000
	68 nF	2,5 × 6,5 × 7,2	B32529-C1683-+***	3200	2800	2000
	0,10 µF	3,0 × 6,5 × 7,2	B32529-C1104-+***	2700	2400	2000
	0,15 µF	3,5 × 8,0 × 7,2	B32529-C1154-+***	2300	2000	2000
	0,22 µF	4,5 × 9,5 × 7,2	B32529-C1224-+***	1800	1500	1500
	0,33 µF	4,5 × 9,5 × 7,2	B32529-C1334-+***	1800	1500	1500
	0,47 µF	6,0 × 10,5 × 7,2	B32529-C1474-+***	1300	1100	1000
250 V_{dc} (160 V_{ac})	1,0 nF	2,5 × 6,5 × 7,2	B32529-C3102-+***	3200	2800	2000
	1,5 nF	2,5 × 6,5 × 7,2	B32529-C3152-+***	3200	2800	2000
	2,2 nF	2,5 × 6,5 × 7,2	B32529-C3222-+***	3200	2800	2000
	3,3 nF	2,5 × 6,5 × 7,2	B32529-C3332-+***	3200	2800	2000
	4,7 nF	2,5 × 6,5 × 7,2	B32529-C3472-+***	3200	2800	2000
	6,8 nF	2,5 × 6,5 × 7,2	B32529-C3682-+***	3200	2800	2000
	10 nF	2,5 × 6,5 × 7,2	B32529-C3103-+***	3200	2800	2000
	15 nF	2,5 × 6,5 × 7,2	B32529-C3153-+***	3200	2800	2000
	22 nF	2,5 × 6,5 × 7,2	B32529-C3223-+***	3200	2800	2000
	33 nF	3,0 × 6,5 × 7,2	B32529-C3333-+***	2700	2400	2000
	47 nF	3,5 × 8,0 × 7,2	B32529-C3473-+***	2300	2000	2000
	68 nF	4,5 × 9,5 × 7,2	B32529-C3683-+***	1800	1500	1500
	0,10 µF	4,5 × 9,5 × 7,2	B32529-C3104-+***	1800	1500	1500
	0,15 µF	5,0 × 10,0 × 7,2	B32529-C3154-+***	1600	1400	1500
	0,22 µF	7,2 × 13,0 × 7,8	B32529-C3224-+***	1000	1000	1000

1) For instructions on how to determine the ordering code, refer to page 18.



B 32 529

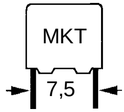
Ordering codes and packing units, lead spacing 5 mm

V_R (V_{rms} , $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
400 V_{dc} (200 V_{ac})	1,0 nF	2,5 × 6,5 × 7,2	B32529-C6102-+***	3200	2800	2000
	1,5 nF	2,5 × 6,5 × 7,2	B32529-C6152-+***	3200	2800	2000
	2,2 nF	2,5 × 6,5 × 7,2	B32529-C6222-+***	3200	2800	2000
	3,3 nF	2,5 × 6,5 × 7,2	B32529-C6332-+***	3200	2800	2000
	4,7 nF	2,5 × 6,5 × 7,2	B32529-C6472-+***	3200	2800	2000
	6,8 nF	2,5 × 6,5 × 7,2	B32529-C6682-+***	3200	2800	2000
	10 nF	3,0 × 6,5 × 7,2	B32529-C6103-+***	2700	2400	2000
	15 nF	3,5 × 8,0 × 7,2	B32529-C6153-+***	2300	2000	2000
	22 nF	4,5 × 9,5 × 7,2	B32529-B6223-+***	1800	1500	1500
	33 nF	5,0 × 10,0 × 7,2	B32529-B6333-+***	1600	1400	1500
	47 nF	6,0 × 10,5 × 7,2	B32529-B6473-+***	1300	1100	1000
	68 nF	7,2 × 13,0 × 7,8	B32529-B6683-+***	1000	1000	1000
	0,10 µF	7,2 × 13,0 × 7,8	B32529-C6104-+***	1000	1000	1000

Capacitance tolerance: ± 20 % ≙ M, ± 10 % ≙ K, ± 5 % ≙ J

Capacitors with lead spacings of 5 mm are also available as long-life grade models in accordance with CECC 30 401-026. In this case, the first block of the ordering code is B32539.

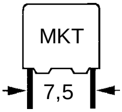
1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32529-C6104-K3



Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
63 V_{dc} (40 V_{ac})	68 nF	2,5 × 7,0 × 10,0	B32520-C683-+***	3200	2800	2500
	0,10 µF	2,5 × 7,0 × 10,0	B32520-C104-+***	3200	2800	2500
	0,15 µF	2,5 × 7,0 × 10,0	B32520-C154-+***	3200	2800	2500
	0,22 µF	2,5 × 7,0 × 10,0	B32520-C224-+***	3200	2800	2500
	0,33 µF	2,5 × 7,0 × 10,0	B32520-C334-+***	3200	2800	2500
	0,47 µF	3,0 × 8,0 × 10,0	B32520-C474-+***	2600	2400	2000
	0,68 µF	4,0 × 8,5 × 10,0	B32520-C684-+***	2000	1800	1500
	1,0 µF	5,0 × 10,5 × 10,0	B32520-C105-+***	1600	1400	1000
	1,5 µF	5,0 × 10,5 × 10,0	B32520-C155-+***	1600	1400	1000
	2,2 µF	6,0 × 12,0 × 10,0	B32520-C225-+***	1300	1100	750
100 V_{dc} (63 V_{ac})	47 nF	2,5 × 7,0 × 10,0	B32520-C1473-+***	3200	2800	2500
	68 nF	2,5 × 7,0 × 10,0	B32520-C1683-+***	3200	2800	2500
	0,10 µF	2,5 × 7,0 × 10,0	B32520-C1104-+***	3200	2800	2500
	0,15 µF	3,0 × 8,0 × 10,0	B32520-C1154-+***	2600	2400	2000
	0,22 µF	3,0 × 8,0 × 10,0	B32520-C1224-+***	2600	2400	2000
	0,33 µF	4,0 × 8,5 × 10,0	B32520-C1334-+***	2000	1800	1500
	0,47 µF	5,0 × 10,5 × 10,0	B32520-C1474-+***	1600	1400	1000
	0,68 µF	6,0 × 12,0 × 10,0	B32520-C1684-+***	1300	1100	750
250 V_{dc} (160 V_{ac})	15 nF	2,5 × 7,0 × 10,0	B32520-C3153-+***	3200	2800	2500
	22 nF	2,5 × 7,0 × 10,0	B32520-C3223-+***	3200	2800	2500
	33 nF	2,5 × 7,0 × 10,0	B32520-C3333-+***	3200	2800	2500
	47 nF	2,5 × 7,0 × 10,0	B32520-C3473-+***	3200	2800	2500
	68 nF	3,0 × 8,0 × 10,0	B32520-C3683-+***	2600	2400	2000
	0,10 µF	4,0 × 8,5 × 10,0	B32520-C3104-+***	2000	1800	1500
	0,15 µF	5,0 × 10,5 × 10,0	B32520-C3154-+***	1600	1400	1000

1) For instructions on how to determine the ordering code, refer to page 20.



B 32 520

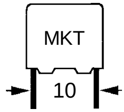
Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms}, $f \le 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
400 V_{dc} (200 V_{ac})	1,0 nF	2,5 × 7,0 × 10,0	B32520-C6102-+***	3200	2800	2500
	1,5 nF	2,5 × 7,0 × 10,0	B32520-C6152-+***	3200	2800	2500
	2,2 nF	2,5 × 7,0 × 10,0	B32520-C6222-+***	3200	2800	2500
	3,3 nF	2,5 × 7,0 × 10,0	B32520-C6332-+***	3200	2800	2500
	4,7 nF	2,5 × 7,0 × 10,0	B32520-C6472-+***	3200	2800	2500
	6,8 nF	2,5 × 7,0 × 10,0	B32520-C6682-+***	3200	2800	2500
	10 nF	2,5 × 7,0 × 10,0	B32520-C6103-+***	3200	2800	2500
	15 nF	3,0 × 8,0 × 10,0	B32520-C6153-+***	2600	2400	2000
	22 nF	4,0 × 8,5 × 10,0	B32520-C6223-+***	2000	1800	1500
	33 nF	5,0 × 10,5 × 10,0	B32520-C6333-+***	1600	1400	1000
	47 nF	5,0 × 10,5 × 10,0	B32520-C6473-+***	1600	1400	1000
	68 nF	6,0 × 12,0 × 10,0	B32520-C6683-+***	1300	1100	750

Capacitance tolerance: ± 20 % ≙ M, ± 10 % ≙ K, ± 5 % ≙ J

Capacitors with lead spacings of 7,5 mm are also available as long-life grade models in accordance with CECC 30 401-026. In this case, the first block of the ordering code is B32530.

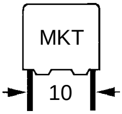
1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packaging: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number "3" to the tolerance code, e.g.: B32520-C6102-K3



Ordering codes and packing units, lead spacing 10 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
63 V_{dc} (40 V_{ac})	0,47 µF	4,0 × 7,0 × 13,0	B32521-C474-+***	1000	1700	1500
	0,68 µF	4,0 × 7,0 × 13,0	B32521-C684-+***	1000	1700	1500
	1,0 µF	4,0 × 9,0 × 13,0	B32521-C105-+***	1000	1700	1000
	1,5 µF	5,0 × 11,0 × 13,0	B32521-C155-+***	800	1300	1000
	2,2 µF	5,0 × 11,0 × 13,0	B32521-C225-+***	800	1300	1000
	3,3 µF	6,0 × 12,0 × 13,0	B32521-C335-+***	600	1100	1000
100 V_{dc} (63 V_{ac})	0,10 µF	4,0 × 7,0 × 13,0	B32521-C1104-+***	1000	1700	1500
	0,15 µF	4,0 × 7,0 × 13,0	B32521-C1154-+***	1000	1700	1500
	0,22 µF	4,0 × 7,0 × 13,0	B32521-C1224-+***	1000	1700	1500
	0,33 µF	4,0 × 7,0 × 13,0	B32521-C1334-+***	1000	1700	1500
	0,47 µF	4,0 × 9,0 × 13,0	B32521-C1474-+***	1000	1700	1000
	0,68 µF	5,0 × 11,0 × 13,0	B32521-C1684-+***	800	1300	1000
	1,0 µF	6,0 × 12,0 × 13,0	B32521-C1105-+***	600	1100	1000
250 V_{dc} (160 V_{ac})	33 nF	4,0 × 7,0 × 13,0	B32521-C3333-+***	1000	1700	1500
	47 nF	4,0 × 7,0 × 13,0	B32521-C3473-+***	1000	1700	1500
	68 nF	4,0 × 7,0 × 13,0	B32521-C3683-+***	1000	1700	1500
	0,10 µF	4,0 × 7,0 × 13,0	B32521-C3104-+***	1000	1700	1500
	0,15 µF	4,0 × 9,0 × 13,0	B32521-C3154-+***	1000	1700	1000
	0,22 µF	5,0 × 11,0 × 13,0	B32521-C3224-+***	800	1300	1000
	0,33 µF	5,0 × 11,0 × 13,0	B32521-C3334-+***	800	1300	1000
	0,47 µF	6,0 × 12,0 × 13,0	B32521-C3474-+***	600	1100	1000
400 V_{dc} (200 V_{ac})	10 nF	4,0 × 7,0 × 13,0	B32521-C6103-+***	1000	1700	1500
	15 nF	4,0 × 7,0 × 13,0	B32521-C6153-+***	1000	1700	1500
	22 nF	4,0 × 7,0 × 13,0	B32521-C6223-+***	1000	1700	1500
	33 nF	4,0 × 9,0 × 13,0	B32521-C6333-+***	1000	1700	1000
	47 nF	5,0 × 11,0 × 13,0	B32521-C6473-+***	800	1300	1000
	68 nF	5,0 × 11,0 × 13,0	B32521-C6683-+***	800	1300	1000
	0,10 µF	6,0 × 12,0 × 13,0	B32521-C6104-+***	600	1100	1000

1) For instructions on how to determine the ordering code, refer to page 22.



B 32 521

Ordering codes and packing units, lead spacing 10 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
630 V_{dc} (220 V_{ac})	6,8 nF[2]	4,0 × 9,0 × 13,0	B32521-N8682-+***	1000	1700	1000
	10 nF[2]	4,0 × 9,0 × 13,0	B32521-N8103-+***	1000	1700	1000
	15 nF[2]	5,0 × 11,0 × 13,0	B32521-N8153-+***	800	1300	1000
	22 nF[2]	5,0 × 11,0 × 13,0	B32521-N8223-+***	800	1300	1000
	33 nF[2]	6,0 × 12,0 × 13,0	B32521-N8333-+***	600	1100	1000

Capacitance tolerance: ± 20 % ≙ M, ± 10 % ≙ K, ± 5 % ≙ J

Capacitors with lead spacings of 10 mm (63 … 400 V_{dc}) are also available as long-life grade models in accordance with CECC 30 401-026. In this case, the first block of the ordering code is B32531.

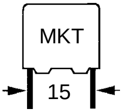
1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32521-N8682-K3

2) Wound capacitor technology

Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
63 V_{dc} (40 V_{ac})	0,68 µF	5,0 × 10,5 × 18,0	B32522-C684-+***	1180	1300	1000
	1,0 µF	5,0 × 10,5 × 18,0	B32522-C105-+***	1180	1300	1000
	1,5 µF	5,0 × 10,5 × 18,0	B32522-C155-+***	1180	1300	1000
	2,2 µF	7,0 × 12,5 × 18,0	B32522-C225-+***	840	900	1000
	3,3 µF	8,5 × 14,5 × 18,0	B32522-C335-+***	690	700	500
	4,7 µF	8,5 × 14,5 × 18,0	B32522-C475-+***	690	700	500
100 V_{dc} (63 V_{ac})	0,33 µF	5,0 × 10,5 × 18,0	B32522-C1334-+***	1180	1300	1000
	0,47 µF	5,0 × 10,5 × 18,0	B32522-C1474-+***	1180	1300	1000
	0,68 µF	5,0 × 10,5 × 18,0	B32522-C1684-+***	1180	1300	1000
	1,0 µF	6,0 × 11,0 × 18,0	B32522-C1105-+***	1000	1100	1000
	1,5 µF	7,0 × 12,5 × 18,0	B32522-C1155-+***	840	900	1000
	2,2 µF	8,5 × 14,5 × 18,0	B32522-C1225-+***	690	700	500
	3,3 µF	8,5 × 14,5 × 18,0	B32522-C1335-+***	690	700	500
250 V_{dc} (160 V_{ac})	0,10 µF	5,0 × 10,5 × 18,0	B32522-C3104-+***	1180	1300	1000
	0,15 µF	5,0 × 10,5 × 18,0	B32522-C3154-+***	1180	1300	1000
	0,22 µF	5,0 × 10,5 × 18,0	B32522-C3224-+***	1180	1300	1000
	0,33 µF	6,0 × 11,0 × 18,0	B32522-C3334-+***	1000	1100	1000
	0,47 µF	7,0 × 12,5 × 18,0	B32522-C3474-+***	840	900	1000
	0,68 µF	8,5 × 14,5 × 18,0	B32522-C3684-+***	690	700	500
	1,0 µF	9,0 × 17,5 × 18,0	B32522-C3105-+***	660	700	500
	1,0 µF[2]	8,5 × 14,5 × 18,0	B32522-N3105-+***	690	700	500
400 V_{dc} (200 V_{ac})	47 nF	5,0 × 10,5 × 18,0	B32522-C6473-+***	1180	1300	1000
	68 nF	5,0 × 10,5 × 18,0	B32522-C6683-+***	1180	1300	1000
	0,10 µF	5,0 × 10,5 × 18,0	B32522-C6104-+***	1180	1300	1000
	0,10 µF[2]	5,0 × 10,5 × 18,0	B32522-N6104-+***	1180	1300	1000
	0,15 µF	6,0 × 11,0 × 18,0	B32522-C6154-+***	1000	1100	1000
	0,15 µF[2]	5,0 × 10,5 × 18,0	B32522-N6154-+***	1180	1300	1000
	0,22 µF	7,0 × 12,5 × 18,0	B32522-C6224-+***	840	900	1000
	0,22 µF[2]	6,0 × 11,0 × 18,0	B32522-N6224-+***	1000	1100	1000
	0,33 µF	8,5 × 14,5 × 18,0	B32522-C6334-+***	690	700	500
	0,33 µF[2]	8,5 × 14,5 × 18,0	B32522-N6334-+***	690	700	500
	0,47 µF[2]	8,5 × 14,5 × 18,0	B32522-N6474-+***	690	700	500
	0,68 µF[2]	9,0 × 17,5 × 18,0	B32522-N6684-+***	660	700	500

1) For instructions on how to determine the ordering code, refer to page 24.
2) Wound capacitor technology



B 32 522

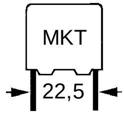
Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
630 V_{dc} (220 V_{ac})	33 nF[2]	5,0 × 10,5 × 18,0	B32522-Q8333-+***	1180	1300	1000
	47 nF[2]	5,0 × 10,5 × 18,0	B32522-Q8473-+***	1180	1300	1000
	68 nF[2]	6,0 × 11,0 × 18,0	B32522-Q8683-+***	1000	1100	1000
	0,10 µF[2]	7,0 × 12,5 × 18,0	B32522-Q8104-+***	840	900	1000

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Capacitors with lead spacings of 15 mm (63 … 400 V_{dc}) are also available as long-life grade models in accordance with CECC 30 401-026. In this case, the first block of the ordering code is B32532.

1) Replace the + by the code letter for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32522-Q8104-K3
2) Wound capacitor technology



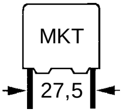
Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
63 V_{dc} (40 V_{ac})	6,8 µF	8,5 × 16,5 × 26,5	B32523-Q685-+***	500	500	510
	10 µF	11,0 × 20,5 × 26,5	B32523-Q106-+***	380	350	510
100 V_{dc} (63 V_{ac})	1,5 µF	6,0 × 15,0 × 26,5	B32523-Q1155-+***	690	700	720
	2,2 µF	6,0 × 15,0 × 26,5	B32523-Q1225-+***	690	700	720
	3,3 µF	6,0 × 15,0 × 26,5	B32523-Q1335-+***	690	700	720
	4,7 µF	8,5 × 16,5 × 26,5	B32523-Q1475-+***	500	500	510
	6,8 µF	10,5 × 16,5 × 26,5	B32523-Q1685-+***	400	400	540
250 V_{dc} (160 V_{ac})	0,47 µF	6,0 × 15,0 × 26,5	B32523-Q3474-+***	690	700	720
	0,68 µF	6,0 × 15,0 × 26,5	B32523-Q3684-+***	690	700	720
	1,0 µF	6,0 × 15,0 × 26,5	B32523-Q3105-+***	690	700	720
	1,5 µF	7,0 × 16,0 × 26,5	B32523-Q3155-+***	590	600	630
	2,2 µF	10,5 × 16,5 × 26,5	B32523-Q3225-+***	400	400	540
	3,3 µF	11,0 × 20,5 × 26,5	B32523-Q3335-+***	380	350	510
400 V_{dc} (200 V_{ac})	0,22 µF	6,0 × 15,0 × 26,5	B32523-Q6224-+***	690	700	720
	0,33 µF	6,0 × 15,0 × 26,5	B32523-Q6334-+***	690	700	720
	0,47 µF	7,0 × 16,0 × 26,5	B32523-Q6474-+***	590	600	630
	0,68 µF	8,5 × 16,5 × 26,5	B32523-Q6684-+***	500	500	510
630 V_{dc} (220 V_{ac})	0,10 µF	6,0 × 15,0 × 26,5	B32523-Q8104-+***	690	700	720
	0,15 µF	6,0 × 15,0 × 26,5	B32523-Q8154-+***	690	700	720
	0,22 µF	7,0 × 16,0 × 26,5	B32523-Q8224-+***	590	600	630

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Capacitors with lead spacings of 22,5 mm (63 … 400 V_{dc}) are also available as long-life grade models in accordance with CECC 30 401-026. In this case, the first block of the ordering code is B32533.

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32523-Q685-K3



B 32 524

Ordering codes and packing units, lead spacing 27,5 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
100 V_{dc} (63 V_{ac})	6,8 µF	11,0 × 21,0 × 31,5	B32524-Q1685-+***	–	350	320
	10 µF	11,0 × 21,0 × 31,5	B32524-Q1106-+***	–	350	320
	15 µF	12,5 × 21,5 × 31,5	B32524-Q1156-+***	–	300	280
	22 µF	15,0 × 24,5 × 31,5	B32524-Q1226-+***	–	–	240
	33 µF	19,0 × 30,0 × 31,5	B32524-Q1336-+***	–	–	180
250 V_{dc} (160 V_{ac})	2,2 µF	11,0 × 21,0 × 31,5	B32524-Q3225-+***	–	350	320
	3,3 µF	11,0 × 21,0 × 31,5	B32524-Q3335-+***	–	350	320
	4,7 µF	11,0 × 21,0 × 31,5	B32524-Q3475-+***	–	350	320
	6,8 µF	14,0 × 24,5 × 31,5	B32524-Q3685-+***	–	–	260
	10 µF	18,0 × 27,5 × 31,5	B32524-Q3106-+***	–	–	200
400 V_{dc} (200 V_{ac})	1,0 µF	11,0 × 21,0 × 31,5	B32524-Q6105-+***	–	350	320
	1,5 µF	11,0 × 21,0 × 31,5	B32524-Q6155-+***	–	350	320
	2,2 µF	12,5 × 21,5 × 31,5	B32524-Q6225-+***	–	300	280
	3,3 µF	15,0 × 24,5 × 31,5	B32524-Q6335-+***	–	–	240
	4,7 µF	18,0 × 27,5 × 31,5	B32524-Q6475-+***	–	–	200
630 V_{dc} (220 V_{ac})	0,33 µF	11,0 × 21,0 × 31,5	B32524-Q8334-+***	–	350	320
	0,47 µF	11,0 × 21,0 × 31,5	B32524-Q8474-+***	–	350	320
	0,68 µF	11,0 × 21,0 × 31,5	B32524-Q8684-+***	–	350	320
	1,0 µF	14,0 × 24,5 × 31,5	B32524-Q8105-+***	–	–	260
	1,5 µF	18,0 × 27,5 × 31,5	B32524-Q8155-+***	–	–	200

Capacitance tolerance: ± 20 % ≙ M, ± 10 % ≙ K, ± 5 % ≙ J

Capacitors with lead spacings of 27,5 mm (63 … 400 V_{dc}) are also available as long-life grade models in accordance with CECC 30 401-026. In this case, the first block of the ordering code is B32534.

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packaging: reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32524-Q1685-K3

Technical data

Climatic category in accordance with IEC 68-1	55/100/56
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 100 °C (+ 125 °C for 1000 h and $V_C = 0,5 \cdot V_R$)
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ ≤ 5 % Dissipation factor change $\Delta \tan \delta$ ≤ $5 \cdot 10^{-3}$ (at 1 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ ≥ 50 % of minimum as-delivered values
Reliability: Reference conditions Failure rate	 $0,5 \cdot V_R$; 40 °C $1 \cdot 10^{-9}$/h = 1 fit For a conversion table for other operating conditions and temperatures refer to page 247.
Service life	200 000 h
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ > 10 % Dissipation factor $\tan \delta$ > 2 · upper limit value Insulation resistance R_{is} < 150 MΩ ($C_R \leq 0,33$ µF) or time constant $\tau = C_R \cdot R_{is}$ < 50 s ($C_R > 0,33$ µF)
DC test voltage	$1,4 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	$T \leq$ 85 °C: $V_C = 1,0 \cdot V_R$ or $1,0 \cdot V_{rms}$ T = 100 °C: $V_C = 0,8 \cdot V_R$ or $0,8 \cdot V_{rms}$
Category voltage for short operating periods	$T \leq$ 100 °C: $1,25 \cdot V_C$ for max. 2000 h T = 125 °C: $V_C = 0,5 \cdot V_R$ or $0,5 \cdot V_{rms}$ for max. 1000 h

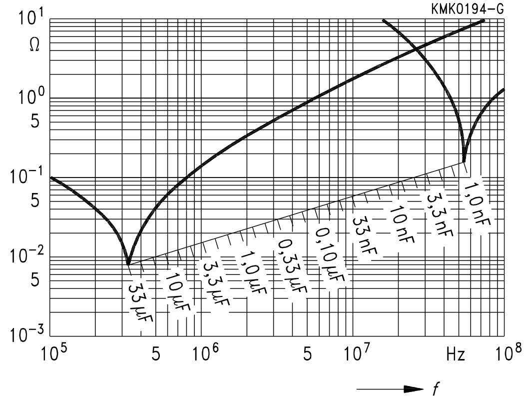
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)

	$C_R \leq 0,1$ µF	$0,1$ µF $< C_R \leq 1$ µF	$C_R > 1$ µF
at 1 kHz	8	10	10
10 kHz	15	20	–
100 kHz	30	–	–

Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)

V_R	$C_R \leq 0,33$ µF	$C_R > 0,33$ µF
≤ 100 V_{dc}	3750 MΩ	1250 s
≥ 250 V_{dc}	7500 MΩ	2500 s

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

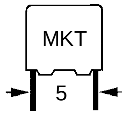
Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)					
	Lead spacing					
	5 mm	7,5 mm	10 mm[1)]	15 mm[1)]	22,5 mm[1)]	27,5 mm[1)]
50 V_{dc}	150					
63 V_{dc}	160	80	50	30	(2)	
100 V_{dc}	200	100	75	50	(2,5)	(2)
250 V_{dc}	250	200	150	100 (10)	(4)	(3)
400 V_{dc}	400	250	175	125 (12,5)	(7)	(5)
630 V_{dc}			(20)	(15)	(10)	(8)

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}.
Also refer to the calculation example on page 220.

V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)					
	Lead spacing					
	5 mm	7,5 mm	10 mm[1)]	15 mm[1)]	22,5 mm[1)]	27,5 mm[1)]
50 V_{dc}	15 000					
63 V_{dc}	20 000	10 000	6 300	3 800	(250)	
100 V_{dc}	40 000	20 000	15 000	10 000	(500)	(400)
250 V_{dc}	125 000	100 000	75 000	50 000 (5 000)	(2 000)	(1 500)
400 V_{dc}	320 000	200 000	140 000	100 000 (10 000)	(5 600)	(4 000)
630 V_{dc}			(25 000)	(19 000)	(12 600)	(10 000)

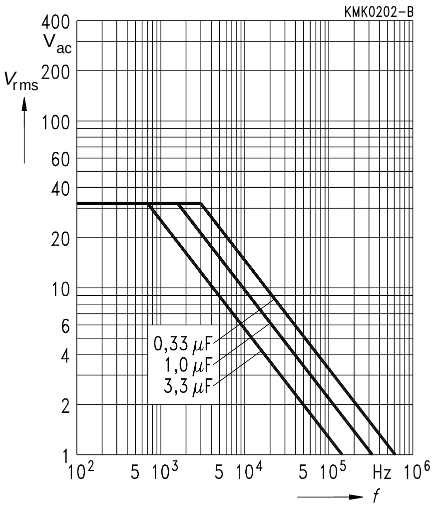
1) Values in brackets apply to wound capacitors



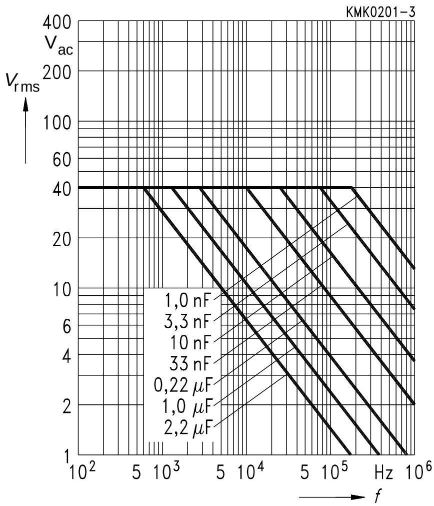
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 5 mm

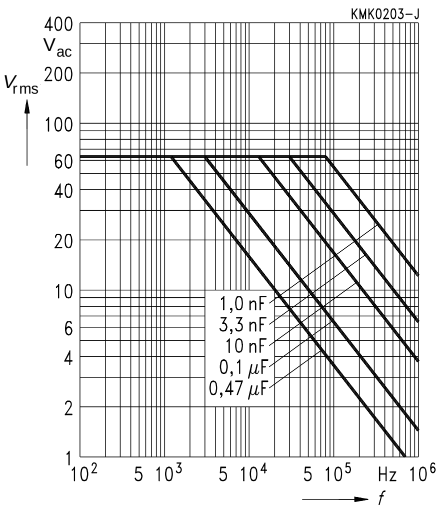
50 V_{dc} / 32 V_{ac}



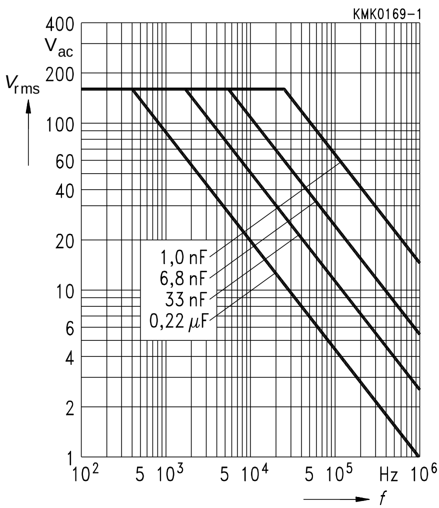
63 V_{dc} / 40 V_{ac}

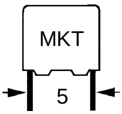


100 V_{dc} / 63 V_{ac}



250 V_{dc} / 160 V_{ac}

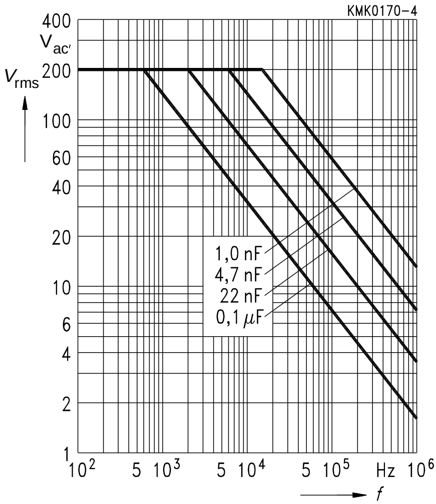




Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 5 mm

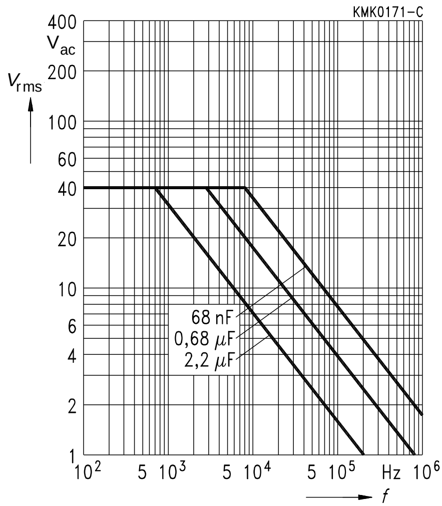
400 V_{dc} / 200 V_{ac}



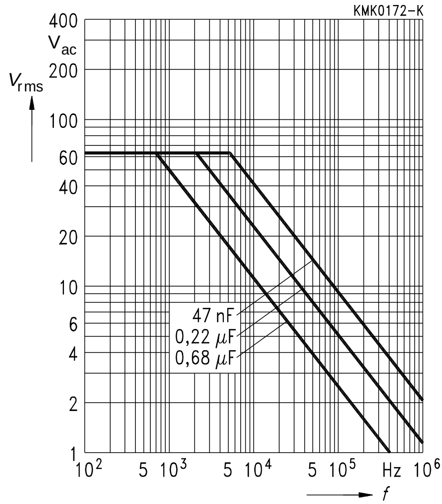
Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 7,5 mm

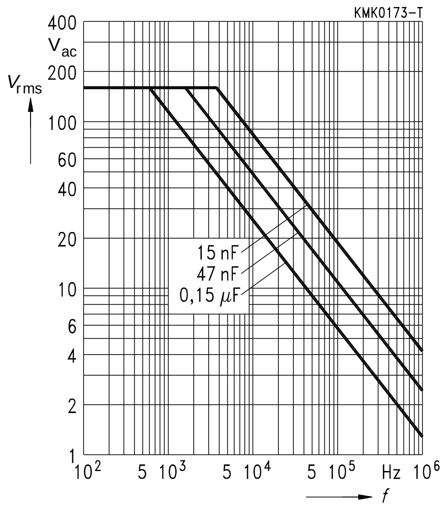
63 V_{dc} / 40 V_{ac}



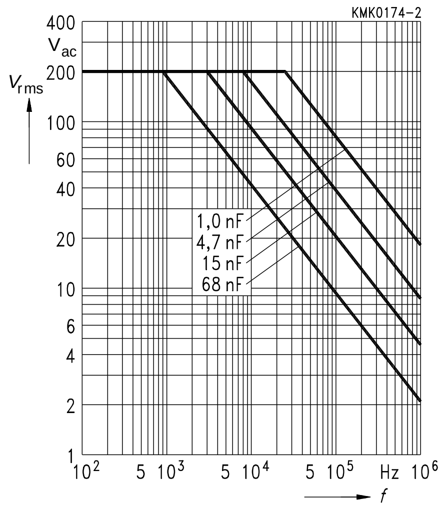
100 V_{dc} / 63 V_{ac}

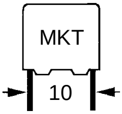


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



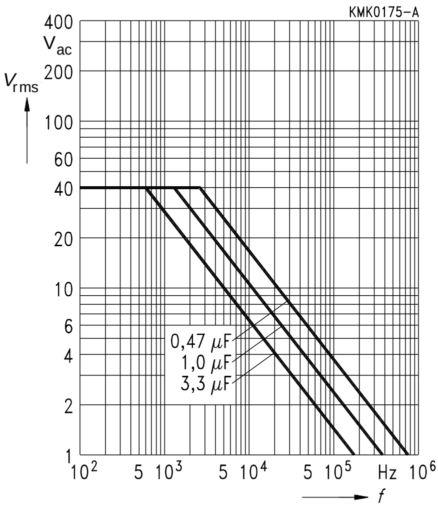


B 32 521

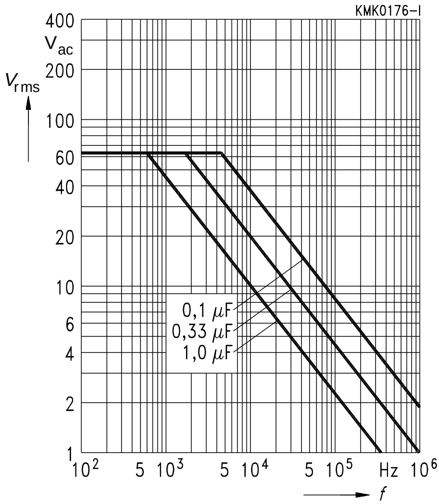
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 10 mm

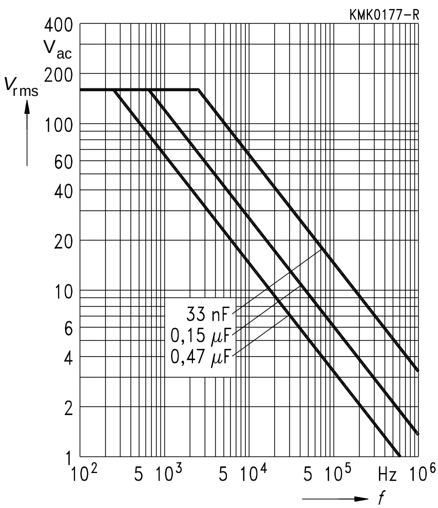
63 V_{dc} / 40 V_{ac}



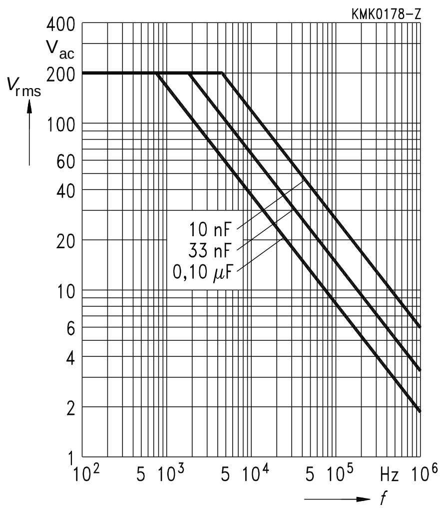
100 V_{dc} / 63 V_{ac}

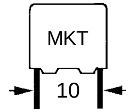


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}

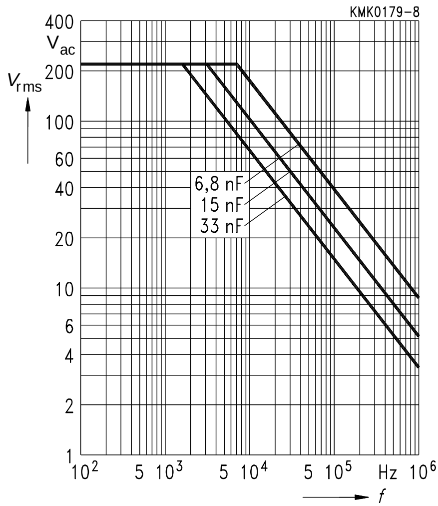


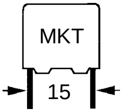


Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 10 mm

630 V_{dc} / 220 V_{ac}

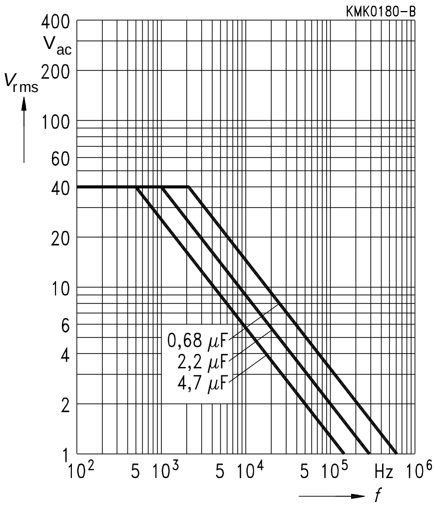




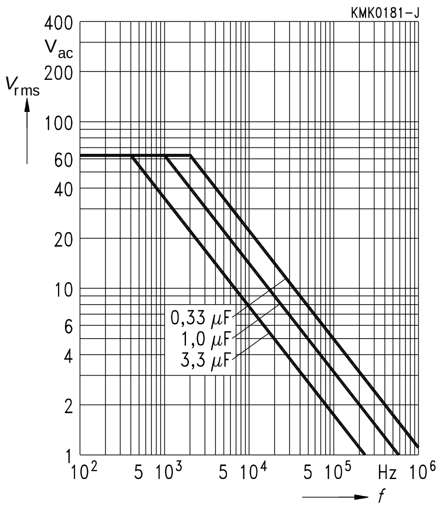
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 mm

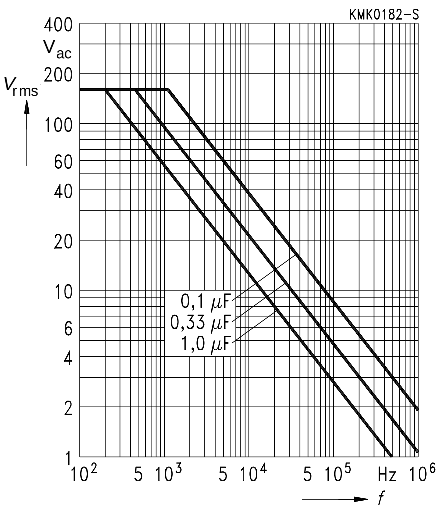
63 V_{dc} / 40 V_{ac}



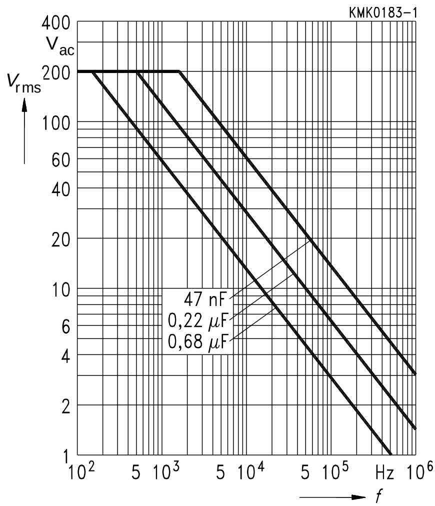
100 V_{dc} / 63 V_{ac}

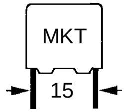


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}

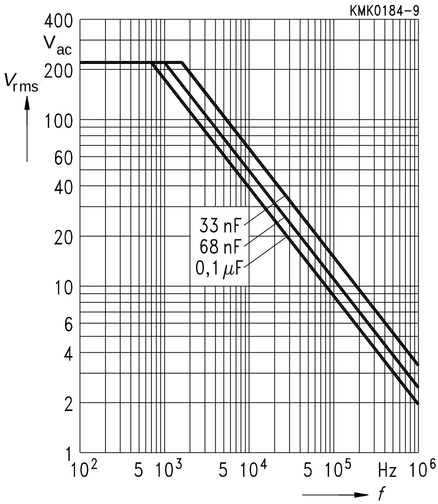


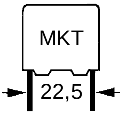


Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 15 mm

630 V_{dc} / 220 V_{ac}



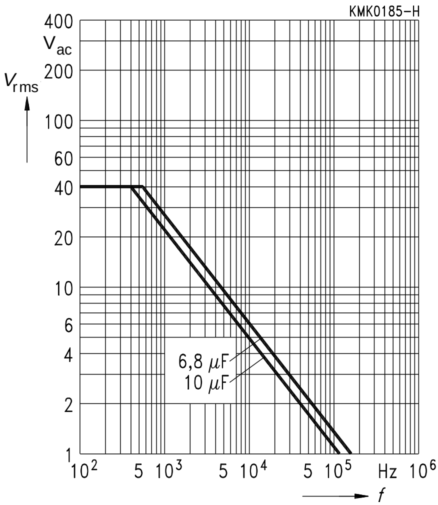


B 32 523

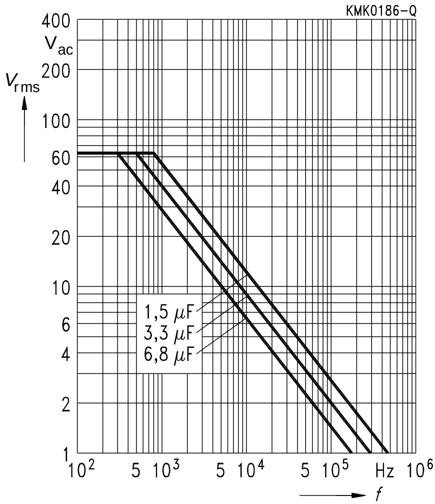
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 22,5 mm

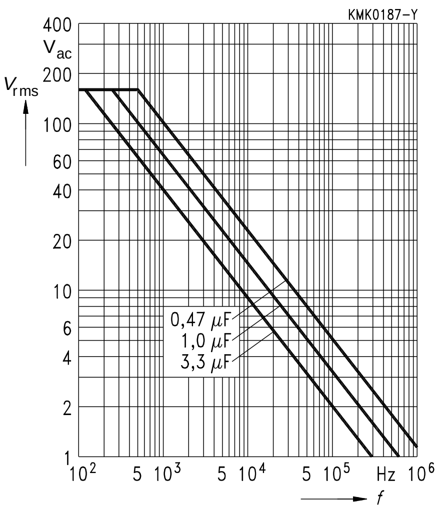
63 V_{dc} / 40 V_{ac}



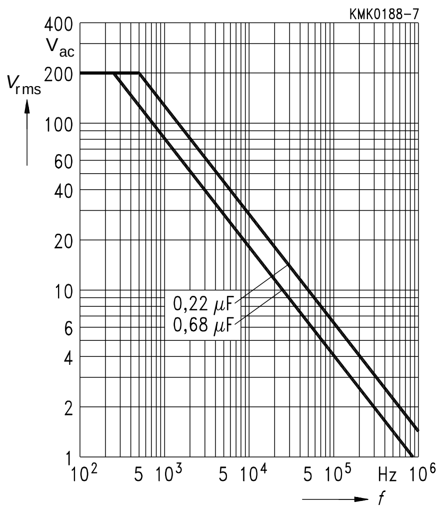
100 V_{dc} / 63 V_{ac}

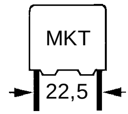


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}

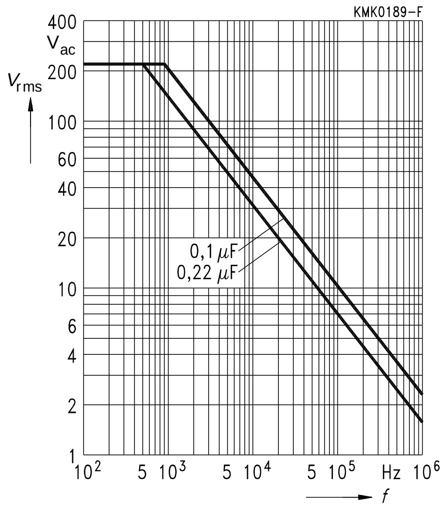


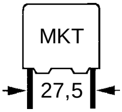


Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 22,5 mm

630 V_{dc} / 220 V_{ac}

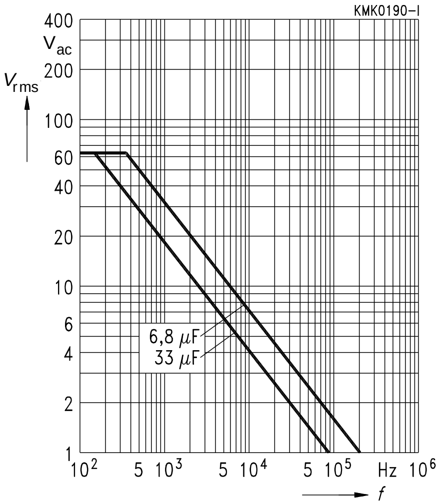




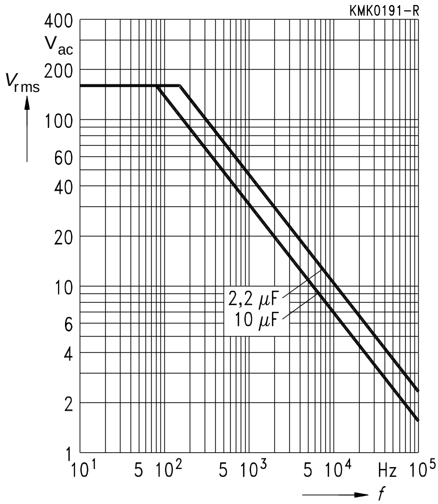
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 27,5 mm

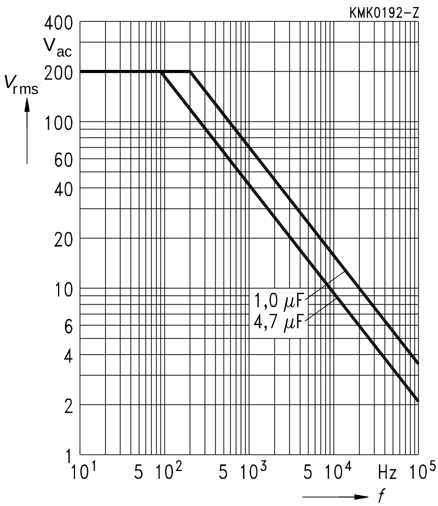
100 V_{dc} / 63 V_{ac}



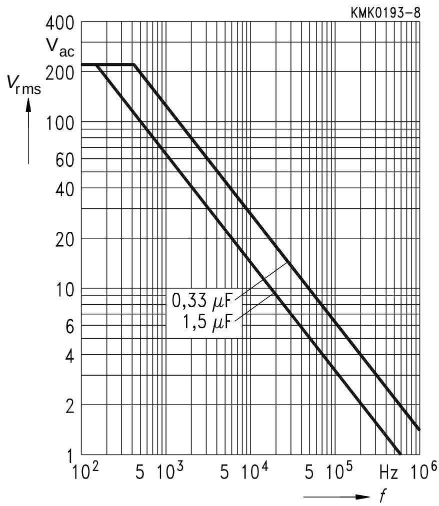
250 V_{dc} / 160 V_{ac}



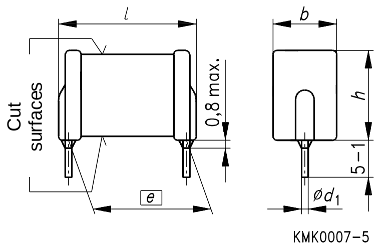
400 V_{dc} / 200 V_{ac}



630 V_{dc} / 220 V_{ac}



Small dimensions
Insulated face ends
Versions with special dimensions can be supplied at short notice



Dimensions in mm

Lead spacing e ± 0,4	Diameter d_1	Type
7,5	0,5	B 32 510
10,0	0,5	B 32 511
15,0	0,6	B 32 512
22,5	0,8	B 32 513

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Stacked-film technology
- Insulated face ends

Features

- Form and size can be tailored to customer's specifications
- High pulse strength
- Coating material covers the leads for a length of ≤ 0,8 mm from the capacitor body

Typical applications

- Standard applications
- Lamp ballast circuits
- Energy-saving lamps

Terminals

- Parallel wire leads, tinned
- Also available with (3,2 ± 0,5) mm lead length upon request
- Taped versions also available with crimped leads

Marking

Rated capacitance (coded),
rated dc voltage

Delivery mode

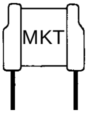
Bulk (untaped)
Taped, with straight leads or crimped leads (Ammo pack or reel)
Capacitors with 7,5 mm lead spacings (taped versions) can be supplied with leads bent to fit 5 mm grids.
For notes on taping, refer to page 252.

Detail specification

CECC 30 401-007

Notes on mounting

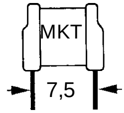
When mounting these capacitors, take into account creepage distances and clearances to adjacent live parts. The insulating strength of the cut surfaces to other live parts of the circuit is 1,5 times the capacitor's rated dc voltage, but is always at least 300 V_{dc}.



B 32 510 … B 32 513

Overview of available types

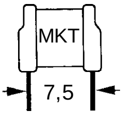
Lead spacing	7,5 mm				10 mm			15 mm			22,5 mm		
Type	B 32 510				B 32 511			B 32 512			B 32 513		
Page	41				43			44			45		
1,0 nF				400 V_{dc}									
1,5 nF				400 V_{dc}									
2,2 nF				400 V_{dc}									
3,3 nF				400 V_{dc}									
4,7 nF				400 V_{dc}									
6,8 nF				400 V_{dc}									
10 nF				400 V_{dc}			400 V_{dc}						
15 nF				400 V_{dc}			400 V_{dc}						
22 nF				400 V_{dc}			400 V_{dc}			400 V_{dc}			
33 nF			250 V_{dc}	400 V_{dc}			400 V_{dc}			400 V_{dc}			
47 nF			250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}			
68 nF			250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}			
0,10 µF		100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}			
0,15 µF		100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}			
0,22 µF	63 V_{dc}	100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}
0,33 µF	63 V_{dc}	100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}			400 V_{dc}
0,47 µF	63 V_{dc}	100 V_{dc}			100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}			400 V_{dc}
0,68 µF	63 V_{dc}	100 V_{dc}			100 V_{dc}				250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}
1,0 µF	63 V_{dc}	100 V_{dc}			100 V_{dc}			100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}
1,5 µF	63 V_{dc}	100 V_{dc}			100 V_{dc}			100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	400 V_{dc}
2,2 µF	63 V_{dc}				100 V_{dc}			100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	400 V_{dc}
3,3 µF								100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	
4,7 µF								100 V_{dc}			100 V_{dc}	250 V_{dc}	
6,8 µF								100 V_{dc}			100 V_{dc}	250 V_{dc}	
10 µF								100 V_{dc}			100 V_{dc}		
15 µF											100 V_{dc}		
22 µF											100 V_{dc}		



Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
63 V_{dc} (40 V_{ac})	0,22 µF	2,6 × 6,4 × 10,0	B32510-J224-+***	3400	2600	3000
	0,33 µF	3,0 × 6,8 × 10,0	B32510-J334-+***	2900	2300	3000
	0,47 µF	3,4 × 7,0 × 10,0	B32510-J474-+***	2500	2000	2500
	0,68 µF	4,0 × 7,4 × 10,0	B32510-J684-+***	2100	1700	2000
	1,0 µF	4,8 × 8,0 × 10,0	B32510-J105-+***	1700	1400	1500
	1,5 µF	5,9 × 8,8 × 10,0	B32510-J155-+***	1400	1200	1000
	2,2 µF	7,3 × 9,4 × 10,0	B32510-J225-+***	1100	900	1000
100 V_{dc} (63 V_{ac})	0,10 µF	2,8 × 5,9 × 10,0	B32510-J1104-+***	3100	2400	3000
	0,15 µF	2,8 × 5,9 × 10,0	B32510-J1154-+***	3100	2400	3000
	0,22 µF	3,1 × 6,3 × 10,0	B32510-J1224-+***	2800	2200	3000
	0,33 µF	3,5 × 6,9 × 10,0	B32510-J1334-+***	2400	1900	2500
	0,47 µF	4,2 × 7,3 × 10,0	B32510-J1474-+***	2000	1600	2000
	0,68 µF	5,0 × 7,7 × 10,0	B32510-J1684-+***	1700	1300	1500
	1,0 µF	6,3 × 8,2 × 10,0	B32510-J1105-+***	1300	1100	1000
	1,5 µF	7,5 × 9,4 × 10,0	B32510-J1155-+***	1100	900	1000
250 V_{dc} (160 V_{ac})	33 nF	2,7 × 6,0 × 10,0	B32510-J3333-+***	3200	2500	3000
	47 nF	3,0 × 6,4 × 10,0	B32510-J3473-+***	2900	2300	3000
	68 nF	3,4 × 6,9 × 10,0	B32510-J3683-+***	2500	2000	2500
	0,10 µF	4,0 × 7,3 × 10,0	B32510-J3104-+***	2100	1700	2000
	0,15 µF	4,7 × 8,2 × 10,0	B32510-J3154-+***	1800	1400	1500
	0,22 µF	5,7 × 8,7 × 10,0	B32510-J3224-+***	1400	1200	1000
	0,33 µF	7,2 × 9,4 × 10,0	B32510-J3334-+***	1100	900	1000

1) For instructions on how to determine the ordering code, refer to page 42.



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Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
400 V_{dc}	1,0 nF	3,0 × 6,7 × 10,0	B32510-J6102-+***	2900	2300	3000
(200 V_{ac})	1,5 nF	3,0 × 6,7 × 10,0	B32510-J6152-+***	2900	2300	3000
	2,2 nF	3,0 × 6,7 × 10,0	B32510-J6222-+***	2900	2300	3000
	3,3 nF	3,0 × 6,7 × 10,0	B32510-J6332-+***	2900	2300	3000
	4,7 nF	3,0 × 6,7 × 10,0	B32510-J6472-+***	2900	2300	3000
	6,8 nF	3,0 × 6,7 × 10,0	B32510-J6682-+***	2900	2300	3000
	10 nF	3,0 × 6,7 × 10,0	B32510-J6103-+***	2900	2300	3000
	15 nF	3,0 × 6,7 × 10,0	B32510-J6153-+***	2900	2300	3000
	22 nF	3,0 × 6,7 × 10,0	B32510-J6223-+***	2900	2300	3000
	33 nF	3,4 × 7,2 × 10,0	B32510-J6333-+***	2500	2000	2500
	47 nF	4,0 × 7,7 × 10,0	B32510-J6473-+***	2100	1700	2000
	68 nF	4,6 × 8,5 × 10,0	B32510-J6683-+***	1800	1500	1500
	0,10 µF	5,7 × 8,9 × 10,0	B32510-J6104-+***	1400	1200	1000
	0,15 µF	7,3 × 9,4 × 10,0	B32510-J6154-+***	1100	900	1000

Capacitance tolerance: ± 20 % ≙ M, ± 10 % ≙ K, ± 5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206

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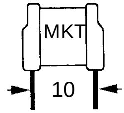
1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: (taping cf. p. 252).
- For straight leads: Ammo pack = 289, reel = 189
- For crimped leads: Ammo pack = 249, reel = 149
- Lead spacing changed from 7,5 to 5 mm by bending leads: Ammo pack = 259, reel = 159
The ordering code for untaped components ends after the tolerance code letter.



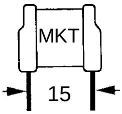
Ordering codes and packing units, lead spacing 10 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
100 V_{dc} (63 V_{ac})	0,33 µF	3,3 × 6,4 × 12,5	B32511-J1334-+***	1200	1900	2000
	0,47 µF	3,7 × 7,0 × 12,5	B32511-J1474-+***	1100	1700	2000
	0,68 µF	4,4 × 7,5 × 12,5	B32511-J1684-+***	900	1400	1500
	1,0 µF	5,3 × 8,1 × 12,5	B32511-J1105-+***	750	1200	1000
	1,5 µF	6,4 × 9,0 × 12,5	B32511-J1155-+***	600	1000	1000
	2,2 µF	7,7 × 10,2 × 12,5	B32511-J1225-+***	500	800	500
250 V_{dc} (160 V_{ac})	47 nF	2,9 × 5,6 × 12,5	B32511-J3473-+***	1300	2100	2500
	68 nF	3,1 × 6,0 × 12,5	B32511-J3683-+***	1300	2100	2500
	0,10 µF	3,6 × 6,5 × 12,5	B32511-J3104-+***	1100	1800	2000
	0,15 µF	4,1 × 7,2 × 12,5	B32511-J3154-+***	950	1600	1500
	0,22 µF	5,0 × 7,8 × 12,5	B32511-J3224-+***	800	1300	1000
	0,33 µF	6,0 × 8,7 × 12,5	B32511-J3334-+***	650	1100	1000
	0,47 µF	7,1 × 9,7 × 12,5	B32511-J3474-+***	550	900	500
400 V_{dc} (200 V_{ac})	10 nF	3,1 × 6,3 × 12,5	B32511-J6103-+***	1300	2100	2500
	15 nF	3,1 × 6,3 × 12,5	B32511-J6153-+***	1300	2100	2500
	22 nF	3,1 × 6,3 × 12,5	B32511-J6223-+***	1300	2100	2500
	33 nF	3,1 × 6,3 × 12,5	B32511-J6333-+***	1300	2100	2500
	47 nF	3,4 × 7,2 × 12,5	B32511-J6473-+***	1200	1900	2000
	68 nF	4,0 × 7,8 × 12,5	B32511-J6683-+***	1000	1600	1500
	0,10 µF	4,8 × 8,1 × 12,5	B32511-J6104-+***	800	1400	1000
	0,15 µF	6,0 × 8,9 × 12,5	B32511-J6154-+***	650	1100	1000
	0,22 µF	7,4 × 9,7 × 12,5	B32511-J6224-+***	500	800	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing form: (taping cf. p. 252).
- For straight leads: Ammo pack = 289, reel = 189
- For crimped leads: Ammo pack = 249, reel = 149
The ordering code for untaped components ends after the tolerance code letter.



B 32 512

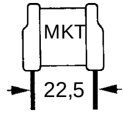
Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
100 V_{dc} (63 V_{ac})	1,0 µF	4,2 × 7,5 × 17,5	B32512-J1105-+***	1450	1500	1000
	1,5 µF	5,0 × 8,5 × 17,5	B32512-J1155-+***	1200	1300	500
	2,2 µF	5,9 × 9,2 × 17,5	B32512-J1225-+***	1000	1100	500
	3,3 µF	7,0 × 10,5 × 17,5	B32512-J1335-+***	850	900	500
	4,7 µF	8,3 × 11,8 × 17,5	B32512-J1475-+***	700	700	400
	6,8 µF	10,0 × 13,0 × 17,5	B32512-J1685-+***	550	600	250
	10 µF	12,8 × 14,2 × 17,5	B32512-J1106-+***	450	500	200
250 V_{dc} (160 V_{ac})	0,22 µF	4,2 × 6,8 × 17,5	B32512-J3224-+***	1450	1500	1000
	0,33 µF	5,0 × 7,4 × 17,5	B32512-J3334-+***	1200	1300	1000
	0,47 µF	6,0 × 7,9 × 17,5	B32512-J3474-+***	1000	1000	500
	0,68 µF	7,0 × 9,0 × 17,5	B32512-J3684-+***	850	900	500
	1,0 µF	8,0 × 10,5 × 17,5	B32512-J3105-+***	700	800	400
	1,5 µF	9,7 × 12,2 × 17,5	B32512-J3155-+***	600	600	300
	2,2 µF	11,7 × 14,0 × 17,5	B32512-J3225-+***	500	500	200
	3,3 µF	14,9 × 15,7 × 17,5	B32512-J3335-+***	350	400	150
400 V_{dc} (200 V_{ac})	22 nF	4,3 × 6,8 × 17,5	B32512-J6223-+***	1400	1400	1000
	33 nF	4,3 × 6,8 × 17,5	B32512-J6333-+***	1400	1400	1000
	47 nF	4,3 × 6,8 × 17,5	B32512-J6473-+***	1400	1400	1000
	68 nF	4,3 × 6,8 × 17,5	B32512-J6683-+***	1400	1400	1000
	0,10 µF	4,3 × 6,8 × 17,5	B32512-J6104-+***	1400	1400	1000
	0,15 µF	4,9 × 7,7 × 17,5	B32512-J6154-+***	1250	1300	1000
	0,22 µF	5,7 × 8,7 × 17,5	B32512-J6224-+***	1050	1100	500
	0,33 µF	7,0 × 9,5 × 17,5	B32512-J6334-+***	850	900	500
	0,47 µF	8,3 × 10,5 × 17,5	B32512-J6474-+***	700	700	400
	0,68 µF	9,9 × 12,0 × 17,5	B32512-J6684-+***	550	600	250
	1,0 µF	11,9 × 13,7 × 17,5	B32512-J6105-+***	450	500	250

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing (taping cf. p. 252).
- For straight leads: Ammo pack = 289, reel = 189
- For crimped leads: Ammo pack = 249, reel = 149
The ordering code for untaped components ends after the tolerance code letter.



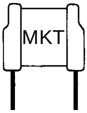
Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
100 V_{dc} (63 V_{ac})	1,5 µF	6,0 × 9,3 × 25,0	B32513-J1155-+***	–	650	1100
	2,2 µF	6,0 × 9,5 × 25,0	B32513-J1225-+***	–	650	1100
	3,3 µF	6,0 × 9,5 × 25,0	B32513-J1335-+***	–	650	1100
	4,7 µF	6,9 × 10,3 × 25,0	B32513-J1475-+***	–	550	900
	6,8 µF	8,0 × 11,8 × 25,0	B32513-J1685-+***	–	500	700
	10 µF	9,6 × 13,5 × 25,0	B32513-J1106-+***	–	450	500
	15 µF	11,9 × 15,3 × 25,0	B32513-J1156-+***	–	350	350
	22 µF	13,8 × 18,5 × 25,0	B32513-J1226-+***	–	300	250
250 V_{dc} (160 V_{ac})	0,68 µF	5,8 × 8,5 × 25,0	B32513-J3684-+***	–	700	1300
	1,0 µF	6,6 × 9,5 × 25,0	B32513-J3105-+***	–	600	1000
	1,5 µF	7,9 × 10,8 × 25,0	B32513-J3155-+***	–	500	700
	2,2 µF	9,3 × 12,5 × 25,0	B32513-J3225-+***	–	400	500
	3,3 µF	11,1 × 14,8 × 25,0	B32513-J3335-+***	–	350	400
	4,7 µF	13,2 × 16,8 × 25,0	B32513-J3475-+***	–	300	250
400 V_{dc} (200 V_{ac})	0,22 µF	6,1 × 9,3 × 25,0	B32513-J6224-+***	–	650	1100
	0,33 µF	6,1 × 9,3 × 25,0	B32513-J6334-+***	–	650	1100
	0,47 µF	6,7 × 9,6 × 25,0	B32513-J6474-+***	–	600	1000
	0,68 µF	7,9 × 10,9 × 25,0	B32513-J6684-+***	–	500	700
	1,0 µF	9,3 × 12,5 × 25,0	B32513-J6105-+***	–	400	500
	1,5 µF	11,3 × 14,5 × 25,0	B32513-J6155-+***	–	350	400
	2,2 µF	13,6 × 16,8 × 25,0	B32513-J6225-+***	–	300	250

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing (taping cf. p. 252).
- For straight leads: Reel = 189
- For crimped leads: Reel = 149
The ordering code for untaped components ends after the tolerance code letter.



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Technical data

Climatic category in accordance with IEC 68-1	55/100/56[1]
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 100 °C
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test[1]	Capacitance change $\lvert\Delta C/C\rvert$ ≤ 5 % Dissipation factor change $\Delta \tan \delta$ ≤ $3 \cdot 10^{-3}$ (at 1 kHz) ≤ $5 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ ≥ 50 % of minimum as-delivered values
Reliability:	
Reference conditions Failure rate	$0{,}5 \cdot V_R$; 40 °C $2 \cdot 10^{-9}$/h = 2 fit For a conversion table for other operating conditions and temperatures refer to page 247.
Service life	200 000 h
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change $\lvert\Delta C/C\rvert$ > 10 % Dissipation factor tan δ > 2 · upper limit value Insulation resistance R_{is} < 150 MΩ (C_R ≤ 0,33 µF) or time constant $\tau = C_R \cdot R_{is}$ < 50 s (C_R > 0,33 µF)
DC test voltage	$1{,}6 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	$T \leq$ 85 °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$ T = 100 °C: $V_C = 0{,}8 \cdot V_R$ or $0{,}8 \cdot V_{rms}$
Category voltage for short operating periods	$T \leq$ 100 °C: $1{,}25 \cdot V_C$ for max. 2000 h
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)	see table below
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	see table below

Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)

	C_R ≤ 0,1 µF	0,1 µF < C_R ≤ 1 µF	C_R > 1 µF
at 1 kHz	8	8	10
10 kHz	15	15	–
100 kHz	30	–	–

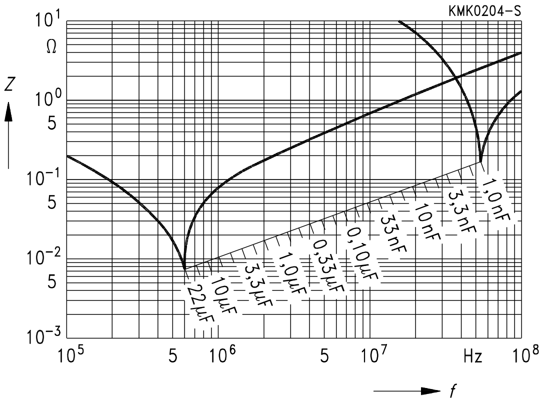
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)

V_R	C_R ≤ 0,33 µF	C_R > 0,33 µF
≤ 100 V_{dc}	3750 MΩ	1250 s
≥ 250 V_{dc}	7500 MΩ	2500 s

1) According to CECC 30401-007, test criteria must be met after exposure to damp heat for 21 days.

MKT

Impedance Z versus frequency f (typical values)



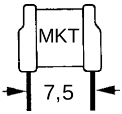
Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)			
	Lead spacing			
	7,5 mm	10 mm	15 mm	22,5 mm
63 V_{dc}	80			
100 V_{dc}	100	75	50	50
250 V_{dc}	200	150	100	100
400 V_{dc}	250	175	125	125

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 246.

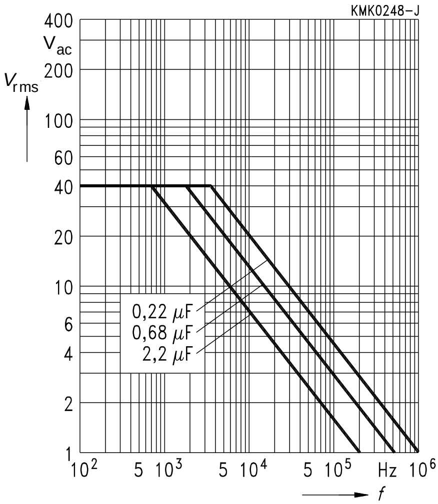
V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)			
	Lead spacing			
	7,5 mm	10 mm	15 mm	22,5 mm
63 V_{dc}	10 000			
100 V_{dc}	20 000	15 000	10 000	10 000
250 V_{dc}	100 000	75 000	50 000	50 000
400 V_{dc}	200 000	150 000	100 000	100 000



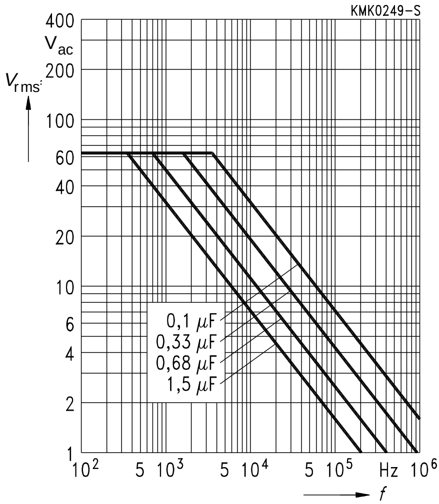
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 7,5 mm

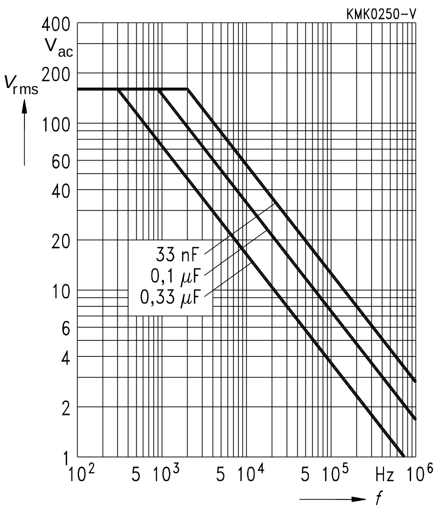
63 V_{dc} / 40 V_{ac}



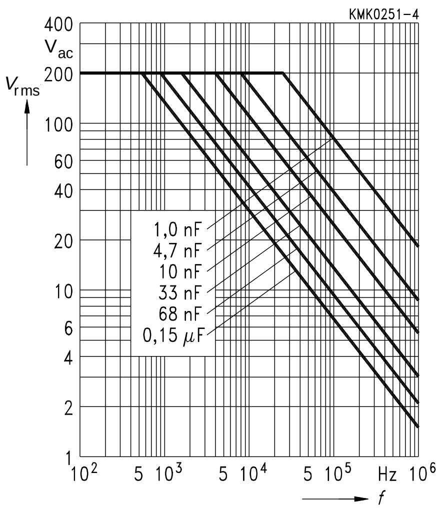
100 V_{dc} / 63 V_{ac}

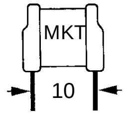


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}

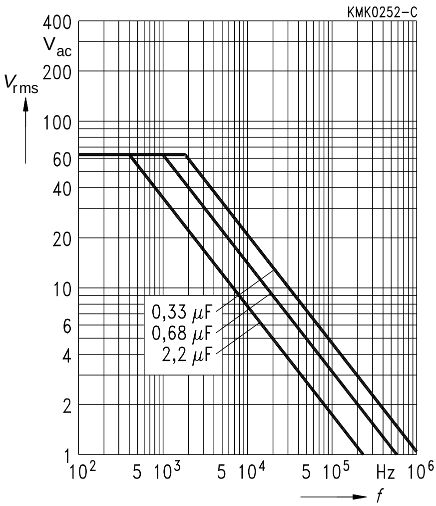




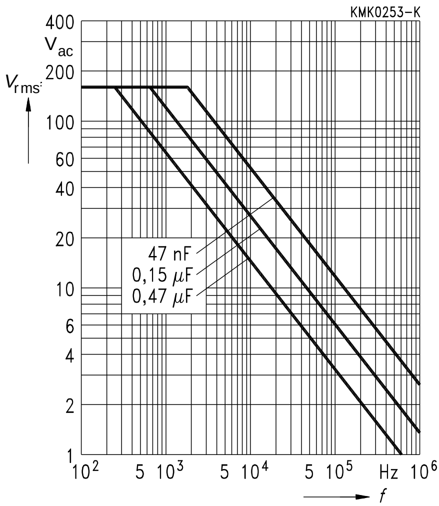
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 10 mm

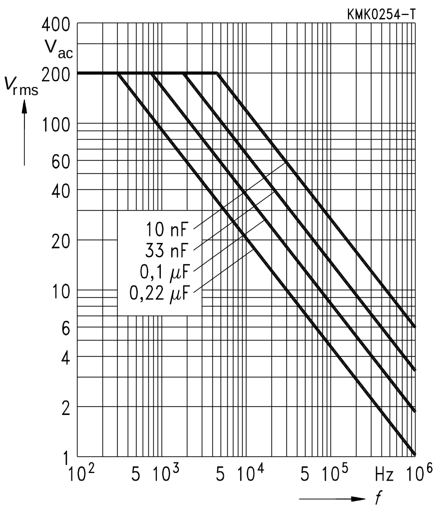
100 V_{dc} / 63 V_{ac}

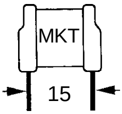


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



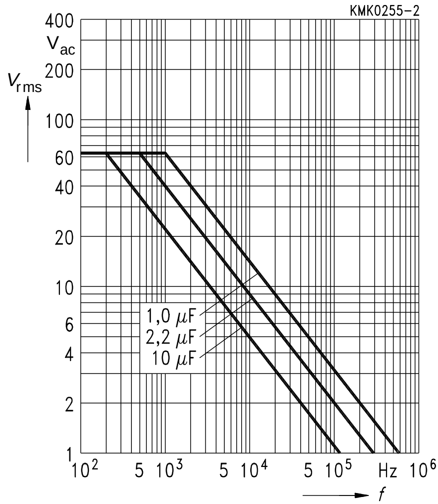


B 32 512

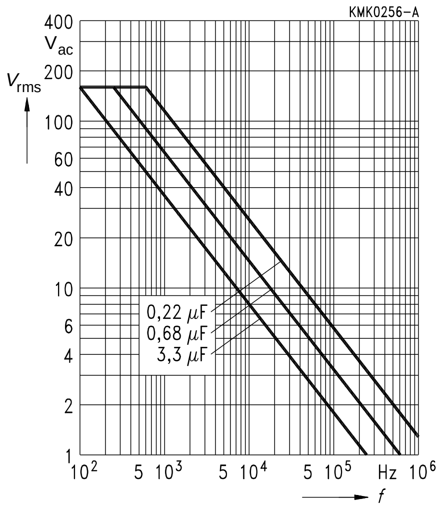
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 mm

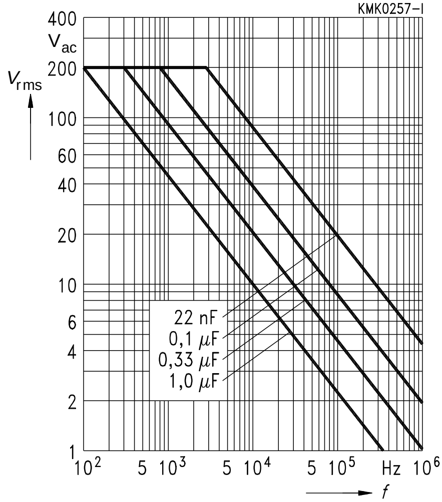
100 V_{dc} / 63 V_{ac}

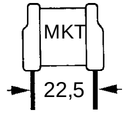


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}

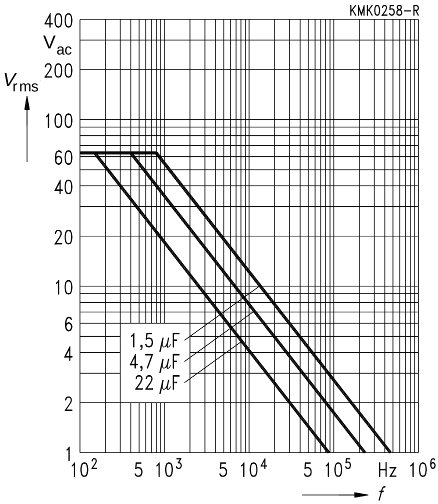




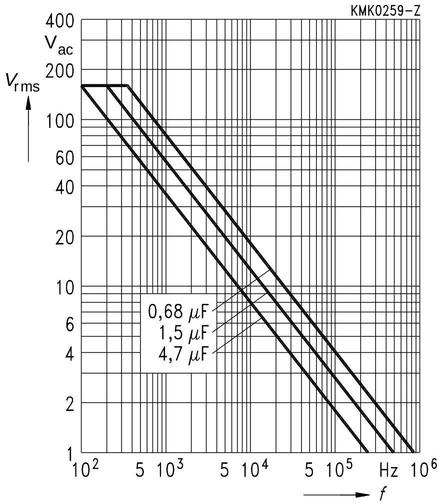
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 22,5 mm

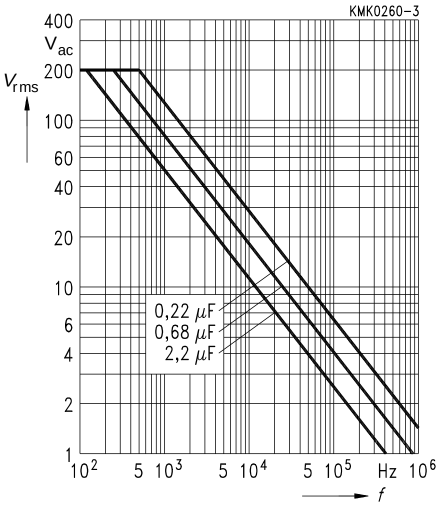
100 V_{dc} / 63 V_{ac}



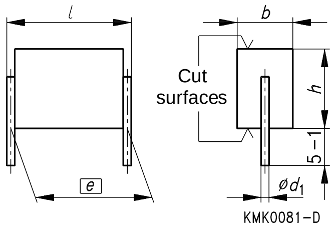
250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



Extremely small dimensions
Versions with special dimensions can be supplied at short notice



Dimensions in mm

Lead spacing e ± 0,4	Diameter d_1	Type
7,5	0,5	B 32 560
10,0	0,5	B 32 561
15,0	0,6	B 32 562
22,5	0,8	B 32 563
27,5	0,8	B 32 564

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Stacked-film technology
- Uncoated

Features

- Form and size can be tailored to customer's specifications
- High pulse strength
- Minimum tensile strength of leads >10 N

Typical applications

- Standard applications
- Lamp ballast circuits
- Energy-saving lamps

Terminals

- Parallel wire leads, tinned
- Also available with (3,2 ± 0,5) mm lead length upon request

Marking

Rated capacitance (coded),
rated dc voltage

Delivery mode

Bulk (untaped)

Detail specification

CECC 30 401-007

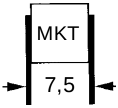
Notes on mounting

When mounting these capacitors, take into account creepage distances and clearances to adjacent live parts. The insulating strength of the cut surfaces to other live parts of the circuit is 1,5 times the capacitors rated dc voltage, but is always at least 300 V_{dc}.

Capacitors with 7,5 mm lead spacing are only suitable for use with single-clad printed circuit boards.

Overview of available types

Lead spacing	7,5 mm					10 mm			15 mm			22,5 mm			27,5 mm		
Type	B 32 560					B 32 561			B 32 562			B 32 563			B 32 564		
Page	54					56			57			58			59		
1,0 nF					400 V_{dc}												
1,5 nF					400 V_{dc}												
2,2 nF					400 V_{dc}												
3,3 nF					400 V_{dc}												
4,7 nF					400 V_{dc}												
6,8 nF					400 V_{dc}												
10 nF					400 V_{dc}			400 V_{dc}									
15 nF					400 V_{dc}			400 V_{dc}									
22 nF				300 V_{dc}	400 V_{dc}			400 V_{dc}			400 V_{dc}						
33 nF			250 V_{dc}	300 V_{dc}	400 V_{dc}			400 V_{dc}			400 V_{dc}						
47 nF			250 V_{dc}	300 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}						
68 nF			250 V_{dc}	300 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}						
0,10 µF		100 V_{dc}	250 V_{dc}	300 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}						
0,15 µF		100 V_{dc}	250 V_{dc}	300 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}						
0,22 µF	63 V_{dc}	100 V_{dc}	250 V_{dc}	300 V_{dc}			250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			400 V_{dc}			
0,33 µF	63 V_{dc}	100 V_{dc}	250 V_{dc}			100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}			400 V_{dc}			
0,47 µF	63 V_{dc}	100 V_{dc}				100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}			400 V_{dc}			
0,68 µF	63 V_{dc}	100 V_{dc}				100 V_{dc}				250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}			
1,0 µF	63 V_{dc}	100 V_{dc}				100 V_{dc}			100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}
1,5 µF	63 V_{dc}	100 V_{dc}				100 V_{dc}			100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}
2,2 µF	63 V_{dc}	100 V_{dc}				100 V_{dc}			100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}
3,3 µF	63 V_{dc}								100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}
4,7 µF	63 V_{dc}								100 V_{dc}			100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	400 V_{dc}
6,8 µF	63 V_{dc}								100 V_{dc}			100 V_{dc}			100 V_{dc}	250 V_{dc}	
10 µF									100 V_{dc}			100 V_{dc}			100 V_{dc}	250 V_{dc}	
15 µF												100 V_{dc}			100 V_{dc}	250 V_{dc}	
22 µF												100 V_{dc}			100 V_{dc}		
33 µF															100 V_{dc}		
47 µF															100 V_{dc}		



B 32 560

Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
63 V_{dc} (40 V_{ac})	0,22 µF	1,8 × 5,2 × 9,0	B32560-J224-+	3000
	0,33 µF	2,2 × 5,6 × 9,0	B32560-J334-+	2500
	0,47 µF	2,6 × 5,8 × 9,0	B32560-J474-+	2000
	0,68 µF	3,2 × 6,2 × 9,0	B32560-J684-+	1500
	1,0 µF	4,0 × 6,8 × 9,0	B32560-J105-+	1000
	1,5 µF	5,1 × 7,6 × 9,0	B32560-J155-+	500
	2,2 µF	6,5 × 8,2 × 9,0	B32560-J225-+	500
	3,3 µF	8,5 × 9,1 × 9,0	B32560-J335-+	400
	4,7 µF	9,8 × 11,0 × 9,0	B32560-J475-+	300
	6,8 µF	11,5 × 13,3 × 9,0	B32560-J685-+	200
100 V_{dc} (63 V_{ac})	0,10 µF	2,0 × 4,7 × 9,0	B32560-J1104-+	3000
	0,15 µF	2,0 × 4,7 × 9,0	B32560-J1154-+	3000
	0,22 µF	2,3 × 5,1 × 9,0	B32560-J1224-+	2500
	0,33 µF	2,7 × 5,7 × 9,0	B32560-J1334-+	2000
	0,47 µF	3,4 × 6,1 × 9,0	B32560-J1474-+	1500
	0,68 µF	4,2 × 6,5 × 9,0	B32560-J1684-+	1000
	1,0 µF	5,5 × 7,0 × 9,0	B32560-J1105-+	500
	1,5 µF	6,7 × 8,2 × 9,0	B32560-J1155-+	500
	2,2 µF	8,5 × 9,2 × 9,0	B32560-J1225-+	400
250 V_{dc} (160 V_{ac})	33 nF	1,9 × 4,8 × 9,0	B32560-J3333-+	3000
	47 nF	2,2 × 5,2 × 9,0	B32560-J3473-+	2500
	68 nF	2,6 × 5,7 × 9,0	B32560-J3683-+	2000
	0,10 µF	3,2 × 6,1 × 9,0	B32560-J3104-+	1500
	0,15 µF	3,9 × 7,0 × 9,0	B32560-J3154-+	1000
	0,22 µF	4,9 × 7,5 × 9,0	B32560-J3224-+	1000
	0,33 µF	6,4 × 8,2 × 9,0	B32560-J3334-+	500

1) For instructions on how to determine the ordering code, refer to page 55.

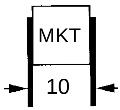
Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
400 V_{dc} (200 V_{ac})	1,0 nF	2,2 × 5,5 × 9,0	B32560-J6102-+	2500
	1,5 nF	2,2 × 5,5 × 9,0	B32560-J6152-+	2500
	2,2 nF	2,2 × 5,5 × 9,0	B32560-J6222-+	2500
	3,3 nF	2,2 × 5,5 × 9,0	B32560-J6332-+	2500
	4,7 nF	2,2 × 5,5 × 9,0	B32560-J6472-+	2500
	6,8 nF	2,2 × 5,5 × 9,0	B32560-J6682-+	2500
	10 nF	2,2 × 5,5 × 9,0	B32560-J6103-+	2500
	15 nF	2,2 × 5,5 × 9,0	B32560-J6153-+	2500
	22 nF	2,2 × 5,5 × 9,0	B32560-J6223-+	2500
	33 nF	2,6 × 6,0 × 9,0	B32560-J6333-+	2000
	47 nF	3,2 × 6,5 × 9,0	B32560-J6473-+	1500
	68 nF	3,8 × 7,3 × 9,0	B32560-J6683-+	1000
	0,10 µF	4,9 × 7,7 × 9,0	B32560-J6104-+	500
	0,15 µF	6,5 × 8,2 × 9,0	B32560-J6154-+	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.



B 32 561

Ordering codes and packing units, lead spacing 10 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
100 V_{dc} (63 V_{ac})	0,33 µF	2,5 × 5,2 × 11,5	B32561-J1334-+	1500
	0,47 µF	2,9 × 5,8 × 11,5	B32561-J1474-+	1500
	0,68 µF	3,6 × 6,3 × 11,5	B32561-J1684-+	1000
	1,0 µF	4,5 × 6,9 × 11,5	B32561-J1105-+	500
	1,5 µF	5,6 × 7,8 × 11,5	B32561-J1155-+	500
	2,2 µF	6,9 × 9,0 × 11,5	B32561-J1225-+	400
250 V_{dc} (160 V_{ac})	47 nF	2,1 × 4,4 × 11,5	B32561-J3473-+	2000
	68 nF	2,3 × 4,8 × 11,5	B32561-J3683-+	2000
	0,10 µF	2,8 × 5,3 × 11,5	B32561-J3104-+	1500
	0,15 µF	3,3 × 6,0 × 11,5	B32561-J3154-+	1000
	0,22 µF	4,2 × 6,6 × 11,5	B32561-J3224-+	1000
	0,33 µF	5,2 × 7,5 × 11,5	B32561-J3334-+	500
	0,47 µF	6,3 × 8,5 × 11,5	B32561-J3474-+	500
400 V_{dc} (200 V_{ac})	10 nF	2,3 × 5,1 × 11,5	B32561-J6103-+	2000
	15 nF	2,3 × 5,1 × 11,5	B32561-J6153-+	2000
	22 nF	2,3 × 5,1 × 11,5	B32561-J6223-+	2000
	33 nF	2,3 × 5,1 × 11,5	B32561-J6333-+	2000
	47 nF	2,6 × 6,0 × 11,5	B32561-J6473-+	1500
	68 nF	3,2 × 6,6 × 11,5	B32561-J6683-+	1000
	0,10 µF	4,0 × 6,9 × 11,5	B32561-J6104-+	1000
	0,15 µF	5,2 × 7,7 × 11,5	B32561-J6154-+	500
	0,22 µF	6,6 × 8,5 × 11,5	B32561-J6224-+	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.

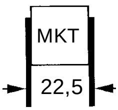
Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
100 V_{dc} (63 V_{ac})	1,0 µF	3,2 × 6,3 × 16,5	B32562-J1105-+	2000
	1,5 µF	4,0 × 7,3 × 16,5	B32562-J1155-+	1500
	2,2 µF	4,9 × 8,0 × 16,5	B32562-J1225-+	1000
	3,3 µF	6,0 × 9,3 × 16,5	B32562-J1335-+	500
	4,7 µF	7,3 × 10,6 × 16,5	B32562-J1475-+	500
	6,8 µF	9,0 × 11,8 × 16,5	B32562-J1685-+	400
	10 µF	11,8 × 13,0 × 16,5	B32562-J1106-+	250
250 V_{dc} (160 V_{ac})	0,22 µF	3,2 × 5,6 × 16,5	B32562-J3224-+	2000
	0,33 µF	4,0 × 6,2 × 16,5	B32562-J3334-+	1500
	0,47 µF	5,0 × 6,7 × 16,5	B32562-J3474-+	1000
	0,68 µF	6,0 × 7,8 × 16,5	B32562-J3684-+	500
	1,0 µF	7,0 × 9,3 × 16,5	B32562-J3105-+	500
	1,5 µF	8,7 × 11,0 × 16,5	B32562-J3155-+	400
	2,2 µF	10,7 × 12,8 × 16,5	B32562-J3225-+	250
	3,3 µF	13,9 × 14,5 × 16,5	B32562-J3335-+	200
400 V_{dc} (200 V_{ac})	22 nF	3,3 × 5,6 × 16,5	B32562-J6223-+	2000
	33 nF	3,3 × 5,6 × 16,5	B32562-J6333-+	2000
	47 nF	3,3 × 5,6 × 16,5	B32562-J6473-+	2000
	68 nF	3,3 × 5,6 × 16,5	B32562-J6683-+	2000
	0,10 µF	3,3 × 5,6 × 16,5	B32562-J6104-+	2000
	0,15 µF	3,9 × 6,5 × 16,5	B32562-J6154-+	1500
	0,22 µF	4,7 × 7,5 × 16,5	B32562-J6224-+	1000
	0,33 µF	6,0 × 8,3 × 16,5	B32562-J6334-+	500
	0,47 µF	7,3 × 9,3 × 16,5	B32562-J6474-+	500
	0,68 µF	8,9 × 10,8 × 16,5	B32562-J6684-+	400
	1,0 µF	10,9 × 12,5 × 16,5	B32562-J6105-+	250

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.



B 32 563

Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
100 V_{dc} (63V_{ac})	1,5 µF	5,0 × 8,0 × 24,0	B32563-J1155-+	1200
	2,2 µF	5,0 × 8,2 × 24,0	B32563-J1225-+	1200
	3,3 µF	5,0 × 8,2 × 24,0	B32563-J1335-+	1200
	4,7 µF	5,9 × 9,0 × 24,0	B32563-J1475-+	1000
	6,8 µF	7,0 × 10,5 × 24,0	B32563-J1685-+	600
	10 µF	8,6 × 12,2 × 24,0	B32563-J1106-+	400
	15 µF	10,9 × 14,0 × 24,0	B32563-J1156-+	300
	22 µF	12,8 × 17,2 × 24,0	B32563-J1226-+	200
250 V_{dc} (160 V_{ac})	0,68 µF	4,8 × 7,2 × 24,0	B32563-J3684-+	1400
	1,0 µF	5,6 × 8,2 × 24,0	B32563-J3105-+	1100
	1,5 µF	6,9 × 9,5 × 24,0	B32563-J3155-+	700
	2,2 µF	8,3 × 11,2 × 24,0	B32563-J3225-+	500
	3,3 µF	10,1 × 13,5 × 24,0	B32563-J3335-+	350
	4,7 µF	12,2 × 15,5 × 24,0	B32563-J3475-+	250
400 V_{dc} (200V_{ac})	0,22 µF	5,1 × 8,0 × 24,0	B32563-J6224-+	1200
	0,33 µF	5,1 × 8,0 × 24,0	B32563-J6334-+	1200
	0,47 µF	5,7 × 8,3 × 24,0	B32563-J6474-+	1000
	0,68 µF	6,9 × 9,6 × 24,0	B32563-J6684-+	700
	1,0 µF	8,3 × 11,2 × 24,0	B32563-J6105-+	500
	1,5 µF	10,3 × 13,2 × 24,0	B32563-J6155-+	350
	2,2 µF	12,6 × 15,5 × 24,0	B32563-J6225-+	250

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.

Ordering codes and packing units, lead spacing 27,5 mm

V_R (V_{rms} , $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
100 V_{dc} (63V_{ac})	4,7 µF	5,6 × 8,3 × 29,0	B32564-J1475-+	1000
	6,8 µF	6,3 × 9,5 × 29,0	B32564-J1685-+	850
	10 µF	7,6 × 11,0 × 29,0	B32564-J1106-+	720
	15 µF	9,1 × 13,5 × 29,0	B32564-J1156-+	430
	22 µF	11,0 × 16,0 × 29,0	B32564-J1226-+	350
	33 µF	13,0 × 19,8 × 29,0	B32564-J1336-+	360
	47 µF	14,5 × 25,0 × 29,0	B32564-J1476-+	260
250 V_{dc} (160 V_{ac})	1,0 µF	5,1 × 7,6 × 29,0	B32564-J3105-+	830
	1,5 µF	5,3 × 10,2 × 29,0	B32564-J3155-+	770
	2,2 µF	6,4 × 11,8 × 29,0	B32564-J3225-+	650
	3,3 µF	7,9 × 14,0 × 29,0	B32564-J3335-+	510
	4,7 µF	9,6 × 15,8 × 29,0	B32564-J3475-+	400
	6,8 µF	11,9 × 18,0 × 29,0	B32564-J3685-+	300
	10 µF	13,8 × 22,5 × 29,0	B32564-J3106-+	280
	15 µF	17,9 × 25,5 × 29,0	B32564-J3156-+	220
400 V_{dc} (200 V_{ac})	1,0 µF	6,8 × 11,2 × 29,0	B32564-J6105-+	790
	1,5 µF	7,8 × 14,2 × 29,0	B32564-J6155-+	510
	2,2 µF	9,6 × 16,4 × 29,0	B32564-J6225-+	400
	3,3 µF	12,2 × 18,8 × 29,0	B32564-J6335-+	330
	4,7 µF	14,2 × 22,8 × 29,0	B32564-J6475-+	280

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.

Technical data

Climatic category in accordance with IEC 68-1	55/100/56[1]
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 100 °C (+ 125 °C for 1000 h and $V_C = 0,5 \cdot V_R$)
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test[1]	Capacitance change $\|\Delta C/C\|$ ≤ 5 % Dissipation factor change $\Delta \tan \delta$ $\leq 3 \cdot 10^{-3}$ (at 1 kHz) $\leq 5 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ ≥ 50 % of minimum as-delivered values
Reliability:	
Reference conditions Failure rate	$0,5 \cdot V_R$; 40 °C $2 \cdot 10^{-9}$/h = 2 fit For a conversion table for other operating conditions and temperatures refer to page 247.
Service life	200 000 h
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ > 10 % Dissipation factor $\tan \delta$ > 2 · upper limit value Insulation resistance R_{is} < 150 MΩ ($C_R \leq 0,33$ µF) or time constant $\tau = C_R \cdot R_{is}$ < 50 s ($C_R > 0,33$ µF)
DC test voltage	$1,6 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	$T \leq$ 85 °C: $V_C = 1,0 \cdot V_R$ or $1,0 \cdot V_{rms}$ T = 100 °C: $V_C = 0,8 \cdot V_R$ or $0,8 \cdot V_{rms}$
Category voltage for short operating periods	$T \leq$ 100 °C: $1,25 \cdot V_C$ for max. 2000 h

Dissipation factor $\tan \delta$ (in 10^{-3}) at 20 °C (upper limit values)

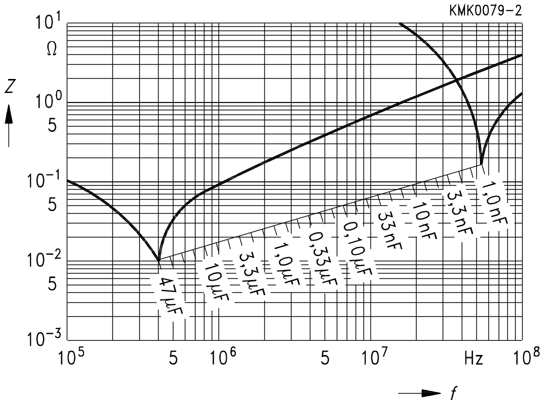
	$C_R \leq 0,1$ µF	0,1 µF < $C_R \leq 1$ µF	$C_R > 1$ µF
at 1 kHz	8	8	10
10 kHz	15	15	–
100 kHz	30	–	–

Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)

V_R	$C_R \leq 0,33$ µF	$C_R > 0,33$ µF
≤ 100 V_{dc}	3750 MΩ	1250 s
≥ 250 V_{dc}	7500 MΩ	2500 s

1) According to CECC 30401-007, test criteria must be met after exposure to damp heat for 21 days.

Impedance Z
versus
frequency f
(typical values)



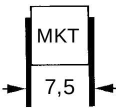
Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)				
	Lead spacing				
	7,5 mm	10 mm	15 mm	22,5 mm	27,5 mm
63 V_{dc}	80				
100 V_{dc}	100	75	50	50	25
250 V_{dc}	200	150	100	100	50
400 V_{dc}	250	175	125	125	60

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 220.

V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)				
	Lead spacing				
	7,5 mm	10 mm	15 mm	22,5 mm	27,5 mm
63 V_{dc}	10 000				
100 V_{dc}	20 000	15 000	10 000	10 000	5 000
250 V_{dc}	100 000	75 000	50 000	50 000	25 000
400 V_{dc}	200 000	150 000	100 000	100 000	50 000

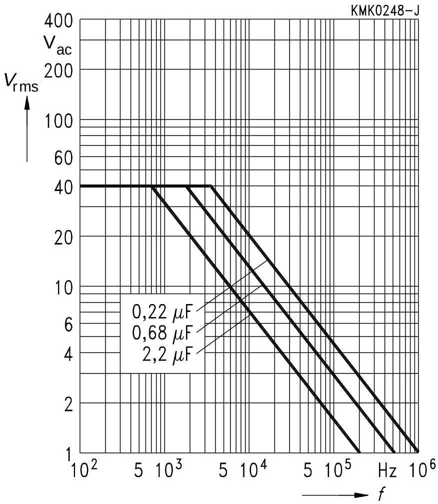


B 32 560

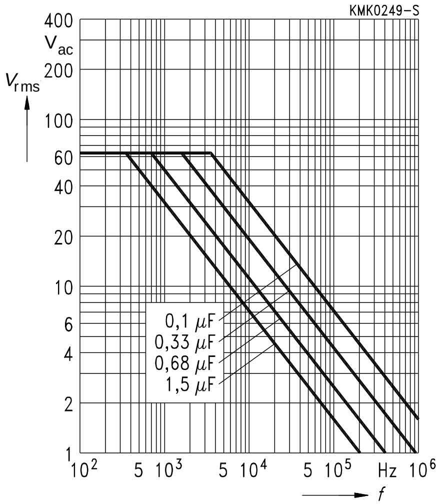
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 7,5 mm

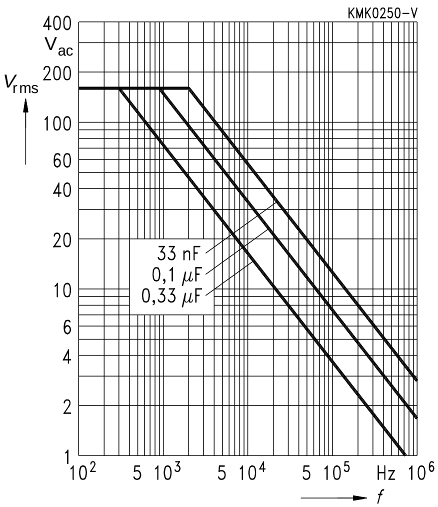
63 V_{dc} / 40 V_{ac}



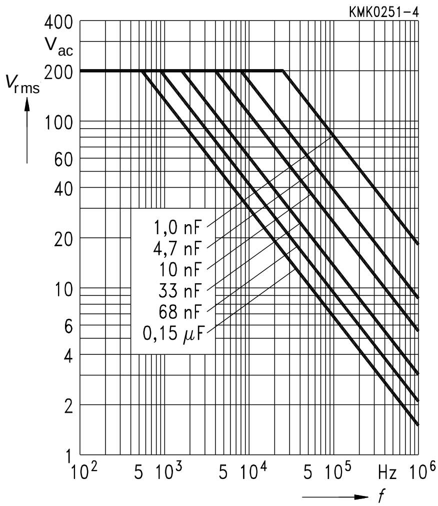
100 V_{dc} / 63 V_{ac}



250V_{dc} / 160V_{ac} (300 V_{dc} / 180 V_{ac})[1)]



400 V_{dc} / 200 V_{ac}

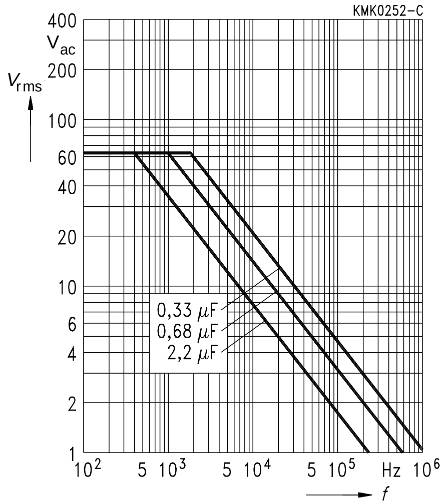


1) Values for 300 V_{dc} / 180 V_{ac} can be calculated by extrapolation of the 250 V_{dc} / 160 V_{ac} values.

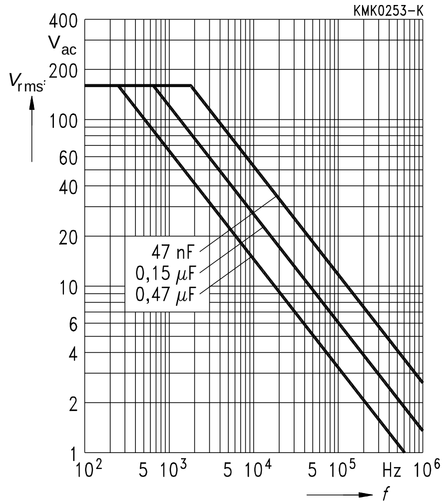
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 10 mm

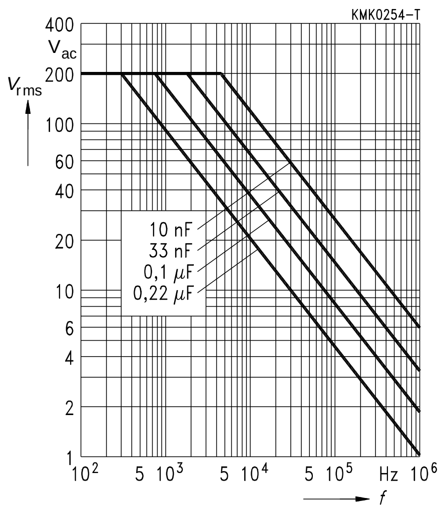
100 V_{dc} / 63 V_{ac}

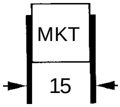


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



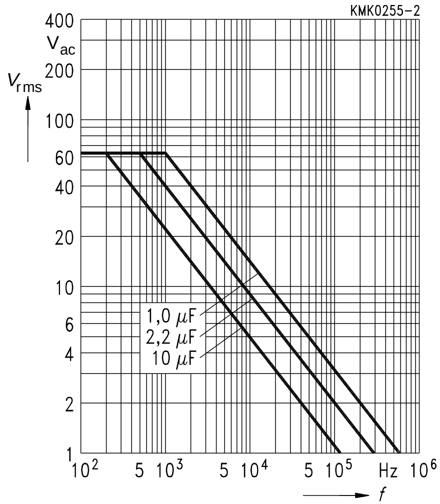


B 32 562

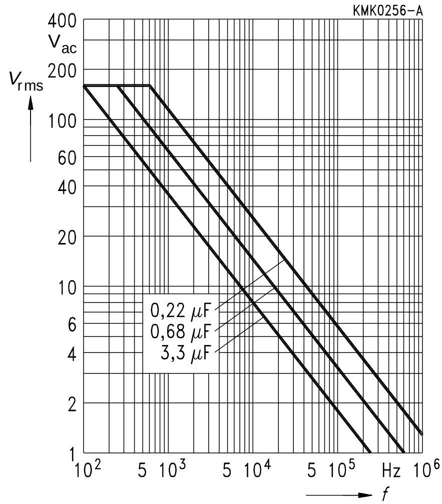
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 mm

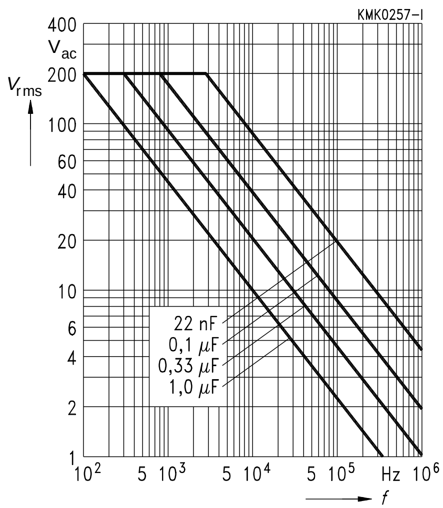
100 V_{dc} / 63 V_{ac}



250 V_{dc} / 160 V_{ac}



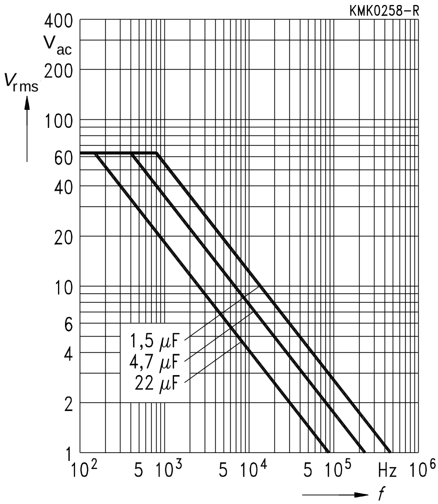
400 V_{dc} / 200 V_{ac}



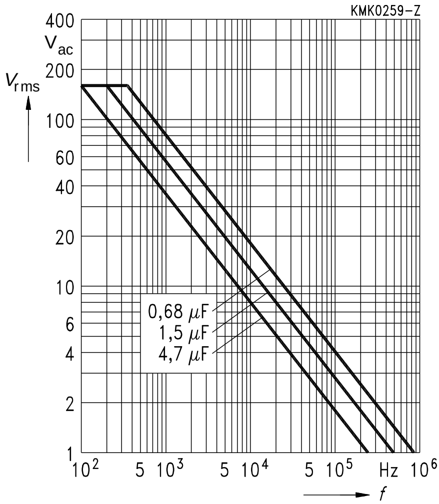
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 22,5 mm

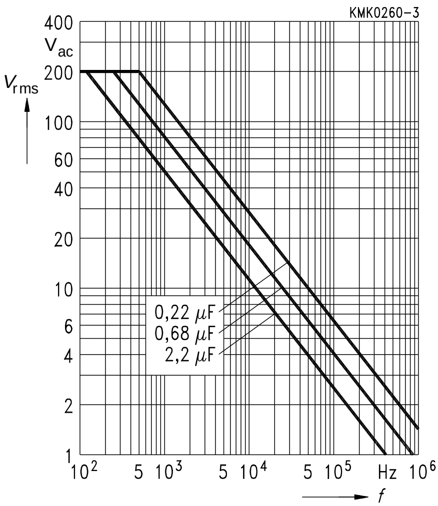
100 V_{dc} / 63 V_{ac}

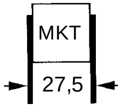


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



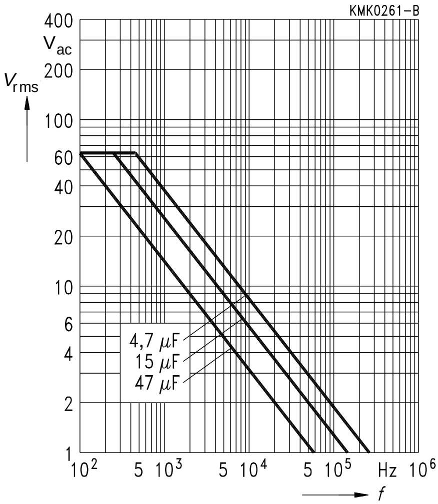


B 32 564

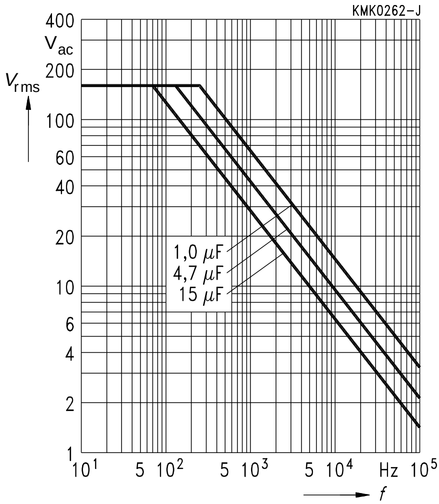
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 27,5 mm

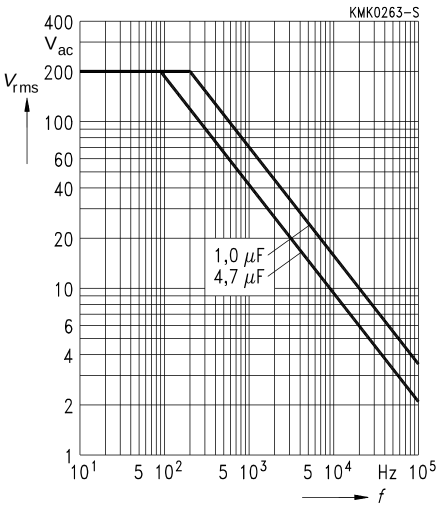
100 V_{dc} / 63 V_{ac}



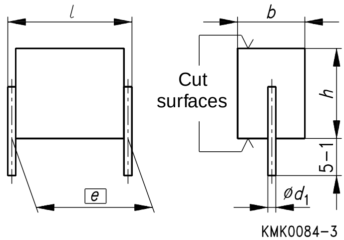
250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



For ignition devices
Versions with special dimensions can be supplied at short notice



Dimensions in mm

Lead spacing e ± 0,4	Diameter d_1	Type
15,0	0,8	B 32 572
22,5	0,8	B 32 573

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Stacked-film technology
- Uncoated

Features

- Form and size can be tailored to customer's specifications
- High pulse strength
- Minimum tensile strength of leads >10 N
- Can be embedded in resins (refer to page 258)

Typical applications

- Ignition devices for gas heating appliances
- Internal combustion engine ignitions, e.g. in motor saws, lawn mowers, small motorcycles, emergency generators

Terminals

- Parallel wire leads, tinned

Marking

Orange (to distinguish from B 32 56*):
rated capacitance (coded),
rated dc voltage

Delivery mode

Bulk (untaped)

Notes on mounting

When mounting these capacitors, take into account creepage distances and clearances to adjacent live parts. The insulating strength of the cut surfaces to other live parts of the circuit is 1,5 times the capacitors rated dc voltage, but is always at least 300 V_{dc}.

Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
250 V_{dc} (160 V_{ac})	0,68 µF	7,0 × 11,0 × 16,5	B32572-A3684-+	500
	1,0 µF	9,1 × 11,7 × 16,5	B32572-A3105-+	350
	1,5 µF	11,5 × 13,5 × 16,5	B32572-A3155-+	250
	2,2 µF	11,5 × 19,8 × 16,5	B32572-A3225-+	150

Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms}, $f \leq$ 60 Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
250 V_{dc} (160 V_{ac})	0,68 µF	5,6 × 9,2 × 24,0	B32573-A3684-+	500
	1,0 µF	6,4 × 11,8 × 24,0	B32573-A3105-+	500
	1,5 µF	7,6 × 14,3 × 24,0	B32573-A3155-+	350
	2,2 µF	8,9 × 17,4 × 24,0	B32573-A3225-+	350

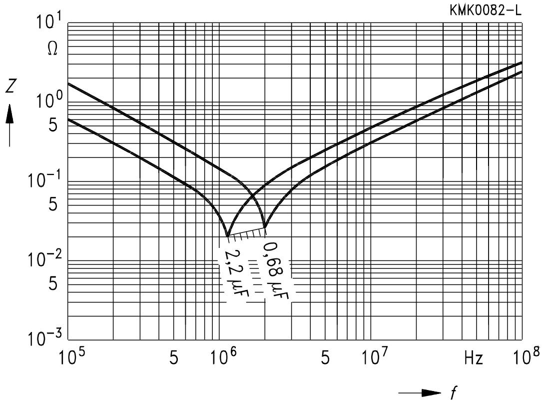
Capacitance tolerance: ±20 % $\hat{=}$ M, ±10 % $\hat{=}$ K, ±5 % $\hat{=}$ J

Special dimensions available upon request. For corresponding design rules, refer to page 206.

1) Replace the + by the code letter for the required capacitance tolerance.

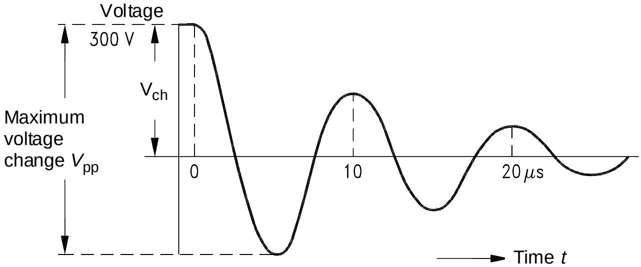
Technical data

<table>
<tr><td>Climatic category
in accordance with IEC 68-1</td><td>55/100/56</td></tr>
<tr><td>Lower category temperature T_{min}
Upper category temperature T_{max}</td><td>– 55 °C
+ 100 °C</td></tr>
<tr><td>Damp heat test</td><td>56 days/40 °C/93 % relative humidity</td></tr>
<tr><td>Limit values after damp heat test</td><td>Capacitance change $|\Delta C/C|$ ≤ 5 %
Dissipation factor change $\Delta \tan \delta$ ≤ $3 \cdot 10^{-3}$ (at 1 kHz)
≤ $5 \cdot 10^{-3}$ (at 10 kHz)
Time constant $\tau = C_R \cdot R_{is}$ ≥ 50 % of minimum as-delivered values</td></tr>
<tr><td>Reliability:
Reference conditions
Failure rate</td><td>
$0{,}5 \cdot V_R$; 40 °C
$2 \cdot 10^{-9}$/h = 2 fit
For a conversion table for other operating conditions and temperatures refer to page 247</td></tr>
<tr><td>Service life</td><td>200 000 h</td></tr>
<tr><td>Failure criteria:
Total failure
Failure due to variation of parameters</td><td>
Short circuit or open circuit
Capacitance change $|\Delta C/C|$ > 10 %
Dissipation factor $\tan \delta$ > 2 · upper limit value
Time constant $\tau = C_R \cdot R_{is}$ < 50 s</td></tr>
<tr><td>DC test voltage</td><td>$1{,}6 \cdot V_R$, 2 s</td></tr>
<tr><td>Category voltage V_C
Operation with dc voltage or ac voltage V_{rms} up to 60 Hz</td><td>$T \leq$ 85 °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$
T = 100 °C: $V_C = 0{,}8 \cdot V_R$ or $0{,}8 \cdot V_{rms}$</td></tr>
<tr><td>Category voltage for short operating periods</td><td>$T \leq$ 100 °C: $1{,}25 \cdot V_C$ for max. 2000 h</td></tr>
<tr><td>Dissipation factor $\tan \delta$ (in 10^{-3})
at 20 °C
(upper limit values)</td><td><table><tr><td></td><td>$C_R \leq 1$ µF</td><td>$C_R > 1$ µF</td></tr><tr><td>at 1 kHz</td><td>8</td><td>10</td></tr><tr><td>10 kHz</td><td>15</td><td>–</td></tr></table></td></tr>
<tr><td>Time constant $\tau = C_R \cdot R_{is}$
at 20 °C, rel. humidity ≤ 65 %
(minimum as-delivered values)</td><td>2500 s</td></tr>
</table>

Impedance Z versus frequency f (typical values)	

Pulse handling capability

The capacitors are especially manufactured and tested to suit their intended applications. Typical permissible loads:



KMK0083-U

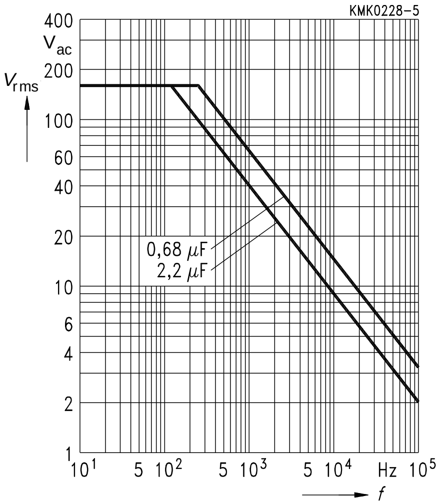
Lead spacing	15 and 22,5 mm
Max. rate of voltage rise V_{pp}/τ	200 V/µs (at V_{pp} = 500 V)
Pulse characteristic k_0	200 000 V^2/µs (at $V_{pp} \leq$ 500 V)
Max. charging voltage V_{ch}	300 V_{dc}
Max. voltage change V_{pp} (at f = 100 kHz)	500 V

Unlimited number of pulses permitted.

Permissible ac voltage V_{rms} versus frequency *f*

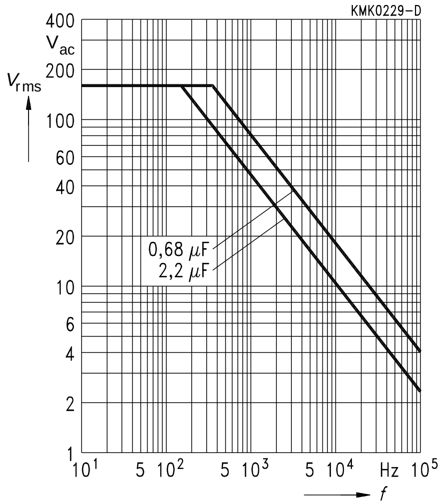
Lead spacing 15 mm

250 V_{dc} / 160 V_{ac}



Lead spacing 22,5 mm

250 V_{dc} / 160 V_{ac}



Standard applications

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Stacked-film technology for lead spacing 7,5 … 15 mm (100 … 400 V_{dc});
  Wound capacitor technology for lead spacing 15 mm (630 V_{dc}) as well as for lead spacing 22,5 and 27,5 mm
- Epoxy resin coating (UL 94 V-0)

Features

- High pulse strength
- High contact reliability

Terminals

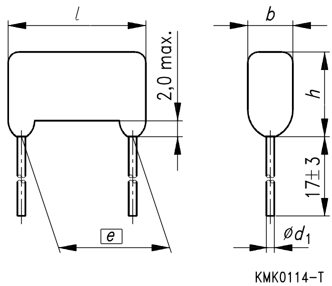
- Parallel wire leads, tinned
- Taped version with crimped leads

Marking

Manufacturer's logo,
rated capacitance (coded),
capacitance tolerance (code letter),
rated dc voltage

Delivery mode

Bulk (untaped)
Capacitors with lead spacing 7,5 also available on tape (Ammo pack). In this case, the wire leads are bent to obtain a spacing of 5 mm.
For notes on taping, refer to page 252.



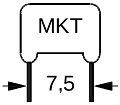
Dimensions in mm

Lead spacing e ± 0,8	Diameter d_1	Type
7,5	0,5	B 32 590
10,0	0,5/0,6[1)]	B 32 591
15,0	0,6	B 32 592
22,5	0,8	B 32 593
27,5	0,8	B 32 594

1) 0,6 mm for capacitor width *b* >5 mm

Overview of available types

Lead spacing	7,5 mm			10 mm			15 mm				22,5 mm				27,5 mm			
Type	B 32 590			B 32 591			B 32 592				B 32 593				B 32 594			
Page	74			75			76				77				78			
6,8 nF			400 V_{dc}															
10 nF	100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}												
15 nF	100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}												
22 nF	100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}												
33 nF	100 V_{dc}	250 V_{dc}	400 V_{dc}		250 V_{dc}	400 V_{dc}				630 V_{dc}								
47 nF	100 V_{dc}	250 V_{dc}	400 V_{dc}	100 V_{dc}	250 V_{dc}	400 V_{dc}			400 V_{dc}	630 V_{dc}								
68 nF	100 V_{dc}	250 V_{dc}	400 V_{dc}	100 V_{dc}	250 V_{dc}	400 V_{dc}			400 V_{dc}	630 V_{dc}								
0,10 µF	100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	400 V_{dc}			400 V_{dc}					630 V_{dc}				
0,15 µF	100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}				400 V_{dc}					630 V_{dc}				
0,22 µF	100 V_{dc}			100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}				400 V_{dc}	630 V_{dc}				
0,33 µF	100 V_{dc}			100 V_{dc}	250 V_{dc}			250 V_{dc}	400 V_{dc}				400 V_{dc}					630 V_{dc}
0,47 µF	100 V_{dc}			100 V_{dc}	250 V_{dc}		100 V_{dc}	250 V_{dc}	400 V_{dc}				400 V_{dc}					630 V_{dc}
0,68 µF	100 V_{dc}			100 V_{dc}			100 V_{dc}	250 V_{dc}				250 V_{dc}					400 V_{dc}	630 V_{dc}
1,0 µF	100 V_{dc}			100 V_{dc}			100 V_{dc}	250 V_{dc}				250 V_{dc}					400 V_{dc}	
1,5 µF							100 V_{dc}				100 V_{dc}					250 V_{dc}	400 V_{dc}	
2,2 µF							100 V_{dc}				100 V_{dc}					250 V_{dc}	400 V_{dc}	
3,3 µF											100 V_{dc}					250 V_{dc}		
4,7 µF															100 V_{dc}	250 V_{dc}		
6,8 µF															100 V_{dc}			
10 µF															100 V_{dc}			
Note	Stacked-film technology									Wound capacitor technology								



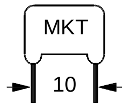
B 32 590

Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Ammo pack	Untaped
100 V_{dc} (63 V_{ac})	10 nF	4,0 × 8,5 × 11,0	B32590-C1103-+***	2600	1500
	15 nF	4,0 × 8,5 × 11,0	B32590-C1153-+***	2500	1500
	22 nF	4,5 × 9,0 × 11,0	B32590-C1223-+***	2400	1500
	33 nF	4,5 × 9,0 × 11,0	B32590-C1333-+***	2400	1500
	47 nF	4,0 × 9,0 × 11,0	B32590-C1473-+***	2500	1500
	68 nF	4,5 × 9,0 × 11,0	B32590-C1683-+***	2400	1500
	0,10 µF	4,0 × 9,0 × 11,0	B32590-C1104-+***	2500	1500
	0,15 µF	4,5 × 9,0 × 11,0	B32590-C1154-+***	2300	1500
	0,22 µF	4,5 × 9,0 × 11,0	B32590-C1224-+***	2400	1500
	0,33 µF	5,0 × 9,0 × 11,0	B32590-C1334-+***	2000	1000
	0,47 µF	5,0 × 10,5 × 11,0	B32590-C1474-+***	1800	1000
	0,68 µF	5,5 × 12,5 × 11,0	B32590-C1684-+***	1700	1000
	1,0 µF	6,5 × 12,5 × 11,0	B32590-C1105-+***	1400	500
250 V_{dc} (160 V_{ac})	10 nF	4,0 × 8,5 × 11,0	B32590-C3103-+***	2600	1500
	15 nF	4,5 × 9,0 × 11,0	B32590-C3153-+***	2400	1500
	22 nF	4,5 × 9,0 × 11,0	B32590-C3223-+***	2400	1500
	33 nF	4,5 × 9,0 × 11,0	B32590-C3333-+***	2400	1500
	47 nF	4,0 × 9,0 × 11,0	B32590-C3473-+***	2500	1500
	68 nF	5,0 × 9,0 × 11,0	B32590-C3683-+***	2000	1000
	0,10 µF	5,0 × 10,5 × 11,0	B32590-C3104-+***	2000	1000
	0,15 µF	6,0 × 11,0 × 11,0	B32590-C3154-+***	1600	1000
400 V_{dc} (200 V_{ac})	6,8 nF	4,0 × 8,5 × 11,0	B32590-C6682-+***	2500	1500
	10 nF	4,0 × 9,0 × 11,0	B32590-C6103-+***	2500	1500
	15 nF	4,0 × 8,5 × 11,0	B32590-C6153-+***	2500	1500
	22 nF	4,0 × 8,5 × 11,0	B32590-C6223-+***	2500	1500
	33 nF	4,5 × 10,0 × 11,0	B32590-C6333-+***	2200	1000
	47 nF	5,5 × 9,5 × 11,0	B32590-C6473-+***	1700	1000
	68 nF	7,0 × 12,0 × 11,0	B32590-C6683-+***	1300	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing:
– Ammo pack = 259 (leads bent from 7,5 mm lead spacing to 5 mm lead spacing). Taping cf. p. 278.
– Untaped (17 mm lead length) = 8, e.g.: B32590-C1103-K8

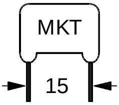


Ordering codes and packing units, lead spacing 10 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing unit (pcs) Untaped
100 V_{dc} (63 V_{ac})	47 nF	4,5 × 9,0 × 13,0	B32591-C1473-+8	1500
	68 nF	4,5 × 9,0 × 13,0	B32591-C1683-+8	1500
	0,10 µF	4,5 × 9,0 × 13,0	B32591-C1104-+8	1500
	0,15 µF	4,5 × 9,0 × 13,0	B32591-C1154-+8	1500
	0,22 µF	4,5 × 9,0 × 13,0	B32591-C1224-+8	1500
	0,33 µF	4,5 × 9,0 × 13,0	B32591-C1334-+8	1500
	0,47 µF	5,0 × 9,5 × 13,0	B32591-C1474-+8	1000
	0,68 µF	5,5 × 10,0 × 13,0	B32591-C1684-+8	1000
	1,0 µF	6,5 × 10,5 × 13,0	B32591-C1105-+8	1000
250 V_{dc} (160 V_{ac})	10 nF	4,0 × 8,5 × 13,0	B32591-C3103-+8	1500
	15 nF	4,5 × 8,5 × 13,0	B32591-C3153-+8	1500
	22 nF	4,5 × 8,5 × 13,0	B32591-C3223-+8	1500
	33 nF	4,5 × 9,0 × 13,0	B32591-C3333-+8	1500
	47 nF	4,5 × 9,0 × 13,0	B32591-C3473-+8	1500
	68 nF	4,0 × 9,0 × 13,0	B32591-C3683-+8	1500
	0,10 µF	5,0 × 9,0 × 13,0	B32591-C3104-+8	1000
	0,15 µF	5,5 × 10,0 × 13,0	B32591-C3154-+8	1000
	0,22 µF	6,0 × 10,5 × 13,0	B32591-C3224-+8	1000
	0,33 µF	6,5 × 12,5 × 13,0	B32591-C3334-+8	500
	0,47 µF	8,0 × 13,5 × 13,0	B32591-C3474-+8	500
400 V_{dc} (200 V_{ac})	10 nF	4,0 × 8,5 × 13,0	B32591-C6103-+8	1500
	15 nF	4,5 × 9,0 × 13,0	B32591-C6153-+8	1500
	22 nF	4,0 × 9,0 × 13,0	B32591-C6223-+8	1500
	33 nF	4,5 × 9,0 × 13,0	B32591-C6333-+8	1500
	47 nF	4,5 × 10,5 × 13,0	B32591-C6473-+8	1000
	68 nF	5,5 × 10,0 × 13,0	B32591-C6683-+8	1000
	0,10 µF	6,0 × 11,5 × 13,0	B32591-C6104-+8	500

Capacitance tolerance: ±20 % $\hat{=}$ M, ±10 % $\hat{=}$ K, ±5 % $\hat{=}$ J

1) Replace the + by the code letter for the required capacitance tolerance.

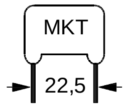


Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing unit (pcs) Untaped
100 V_{dc} (63 V_{ac})	0,47 µF	5,0 × 9,5 × 18,0	B32592-C1474-+8	1000
	0,68 µF	5,0 × 10,5 × 18,0	B32592-C1684-+8	1000
	1,0 µF	6,0 × 10,5 × 18,0	B32592-C1105-+8	500
	1,5 µF	6,5 × 10,0 × 18,0	B32592-C1155-+8	500
	2,2 µF	7,5 × 11,0 × 18,0	B32592-C1225-+8	500
250 V_{dc} (160 V_{ac})	0,22 µF	5,5 × 9,0 × 18,0	B32592-C3224-+8	1000
	0,33 µF	6,0 × 10,0 × 18,0	B32592-C3334-+8	500
	0,47 µF	7,0 × 11,0 × 18,0	B32592-C3474-+8	500
	0,68 µF	8,0 × 11,5 × 18,0	B32592-C3684-+8	500
	1,0 µF	9,5 × 13,0 × 18,0	B32592-C3105-+8	250
400 V_{dc} (200 V_{ac})	47 nF	5,0 × 9,0 × 18,0	B32592-C6473-+8	1000
	68 nF	4,5 × 9,0 × 18,0	B32592-C6683-+8	1000
	0,10 µF	5,0 × 10,0 × 18,0	B32592-C6104-+8	1000
	0,15 µF	6,0 × 10,5 × 18,0	B32592-C6154-+8	500
	0,22 µF	7,0 × 11,0 × 18,0	B32592-C6224-+8	500
	0,33 µF	8,0 × 12,0 × 18,0	B32592-C6334-+8	500
	0,47 µF	9,5 × 13,0 × 18,0	B32592-C6474-+8	250
630 V_{dc} (220 V_{ac})	33 nF[2]	7,0 × 13,5 × 18,0	B32592-C8333-+8	500
	47 nF[2]	7,5 × 13,5 × 18,0	B32592-C8473-+8	500
	68 nF[2]	8,0 × 15,5 × 18,0	B32592-C8683-+8	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.
2) Wound capacitor technology

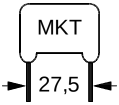


Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing unit (pcs) Untaped
100 V_{dc}	1,5 µF	8,0 × 13,5 × 26,0	B32593-C1155-+8	500
(63 V_{ac})	2,2 µF	9,0 × 14,5 × 26,0	B32593-C1225-+8	500
	3,3 µF	10,5 × 18,5 × 26,0	B32593-C1335-+8	200
250 V_{dc}	0,68 µF	8,5 × 18,5 × 26,0	B32593-C3684-+8	500
(160 V_{ac})	1,0 µF	9,0 × 20,5 × 26,0	B32593-C3105-+8	500
400 V_{dc}	0,22 µF	9,0 × 14,5 × 26,0	B32593-C6224-+8	500
(200 V_{ac})	0,33 µF	9,5 × 16,5 × 26,0	B32593-C6334-+8	500
	0,47 µF	10,5 × 20,5 × 26,0	B32593-C6474-+8	500
630 V_{dc}	0,10 µF	8,5 × 15,5 × 26,0	B32593-C8104-+8	500
(220 V_{ac})	0,15 µF	9,5 × 16,5 × 26,0	B32593-C8154-+8	250
	0,22 µF	10,0 × 21,5 × 26,0	B32593-C8224-+8	250

Capacitance tolerance: ± 20 % ≙ M, ± 10 % ≙ K, ± 5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.



Ordering codes and packing units, lead spacing 27,5 mm

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing unit (pcs) Untaped
100 V_{dc} (63 V_{ac})	4,7 µF	11,0 × 19,5 × 31,5	B32594-C1475-+8	200
	6,8 µF	13,0 × 21,5 × 31,5	B32594-C1685-+8	200
	10 µF	17,5 × 24,5 × 31,5	B32594-C1106-+8	200
250 V_{dc} (160 V_{ac})	1,5 µF	10,5 × 20,5 × 31,5	B32594-C3155-+8	500
	2,2 µF	10,5 × 20,5 × 31,5	B32594-C3225-+8	500
	3,3 µF	14,0 × 24,5 × 31,5	B32594-C3335-+8	200
	4,7 µF	15,0 × 25,0 × 31,5	B32594-C3475-+8	200
400 V_{dc} (200 V_{ac})	0,68 µF	11,0 × 21,5 × 31,5	B32594-C6684-+8	250
	1,0 µF	13,0 × 22,5 × 31,5	B32594-C6105-+8	250
	1,5 µF	13,0 × 22,5 × 31,5	B32594-C6155-+8	250
	2,2 µF	15,5 × 22,5 × 31,5	B32594-C6225-+8	200
630 V_{dc} (220 V_{ac})	0,33 µF	10,0 × 21,5 × 31,5	B32594-C8334-+8	250
	0,47 µF	12,0 × 23,5 × 31,5	B32594-C8474-+8	200
	0,68 µF	13,0 × 24,0 × 31,5	B32594-C8684-+8	200

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.

Technical data

Climatic category in accordance with IEC 68-1	55/100/56
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 100 °C (+ 125 °C for 1000 h and V_C = 0,5 · V_R)
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change |ΔC/C| ≤ 5 % Dissipation factor change Δ tan δ ≤ 5 · 10^{-3} (at 10 kHz) Insulation resistance R_{is} or time constant τ = C_R · R_{is} ≥ 50 % of minimum as-delivered values
Reliability: Reference conditions Failure rate	 0,5 · V_R; 40 °C 2 · 10^{-9}/h = 2 fit For a conversion table for other operating conditions and temperatures refer to page 247.
Service life	200 000 h
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change|ΔC/C| > 10 % Dissipation factor tan δ > 2 · upper limit value Insulation resistance R_{is} < 150 MΩ (C_R ≤ 0,33 µF) or time constant τ = C_R · R_{is} < 50 s (C_R > 0,33 µF)
DC test voltage	1,4 · V_R, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	T ≤ 85 °C: V_C = 1,0 · V_R or 1,0 · V_{rms} T = 100 °C: V_C = 0,8 · V_R or 0,8 · V_{rms}
Category voltage for short operating periods	T ≤ 100 °C: 1,25 · V_C for max. 2000 h T = 125 °C: V_C = 0,5 · V_R or 0,5 · V_{rms} for max. 1000 h

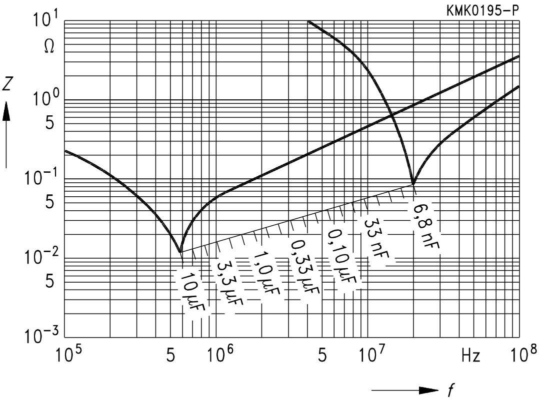
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)

	C_R ≤ 0,1 µF	0,1 µF < C_R ≤ 1 µF	C_R > 1 µF
at 1 kHz	8	10	10
10 kHz	15	20	–
100 kHz	30	–	–

Insulation resistance R_{is} or time constant τ = C_R · R_{is} at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)

V_R	C_R ≤ 0,33 µF	C_R > 0,33 µF
100 V_{dc}	3750 MΩ	1250 s
≥ 250 V_{dc}	7500 MΩ	2500 s

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)				
	Lead spacing				
	7,5 mm	10 mm	15 mm	22,5 mm	27,5 mm
100 V_{dc}	100	75	50	2,5[1)]	2[1)]
250 V_{dc}	200	150	100	4 [1)]	3[1)]
400 V_{dc}	250	175	125	7 [1)]	5[1)]
630 V_{dc}			15[1)]	10 [1)]	8[1)]

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}.
Also refer to the calculation example on page 220.

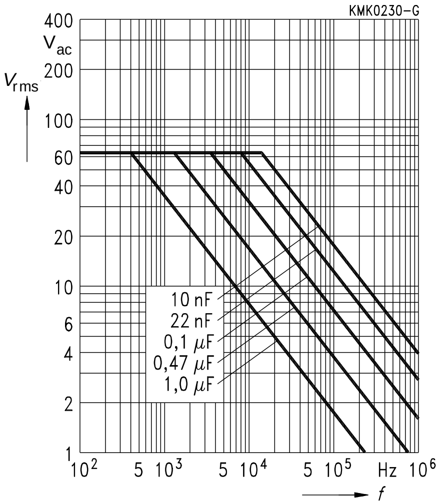
V_R	Pulse characteristic k_0 in $V^2/\mu s$ (for $V_{pp} \leq V_R$)				
	Lead spacing				
	7,5 mm	10 mm	15 mm	22,5 mm	27,5 mm
100 V_{dc}	20 000	15 000	10 000	500[1)]	400[1)]
250 V_{dc}	100 000	75 000	50 000	2 000[1)]	1 500[1)]
400 V_{dc}	200 000	140 000	100 000	5 600[1)]	4 000[1)]
630 V_{dc}			19 000[1)]	12 600[1)]	10 000[1)]

1) Wound capacitor technology

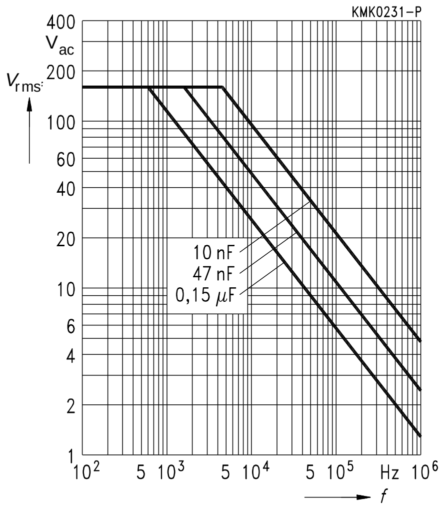
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 7,5 mm

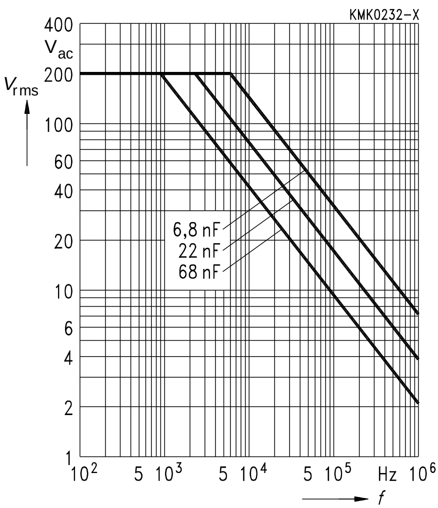
100 V_{dc} / 63 V_{ac}



250 V_{dc} / 160 V_{ac}



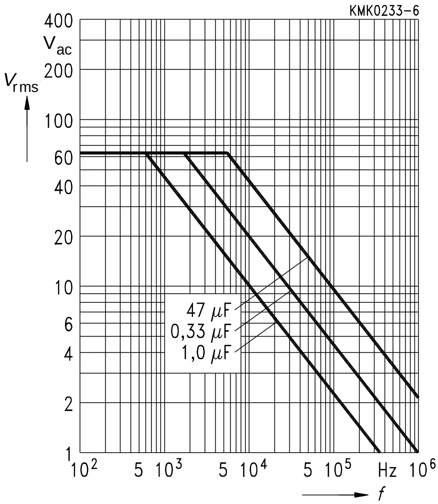
400 V_{dc} / 200 V_{ac}



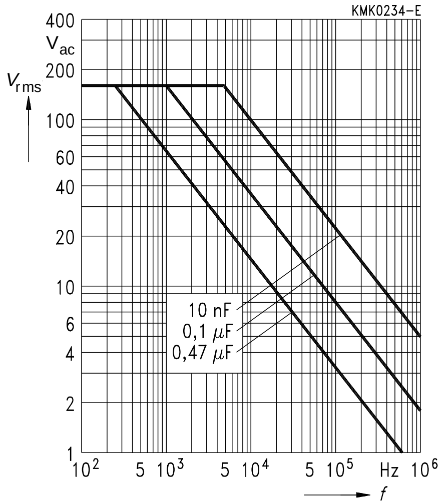
Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 10 mm

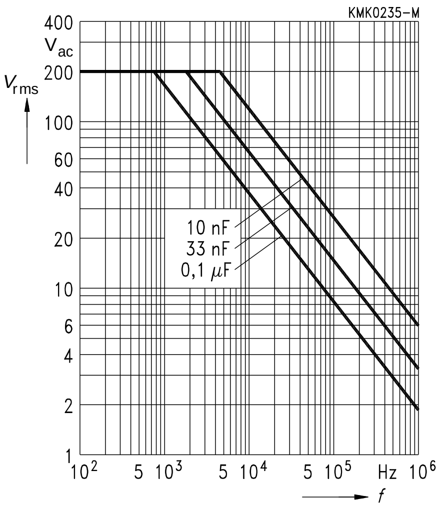
100 V_{dc} / 63 V_{ac}

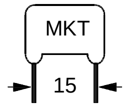


250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}

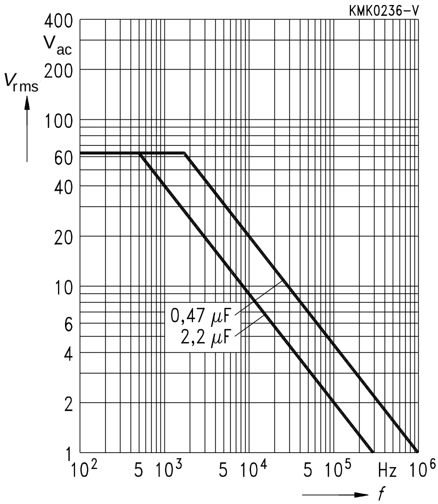




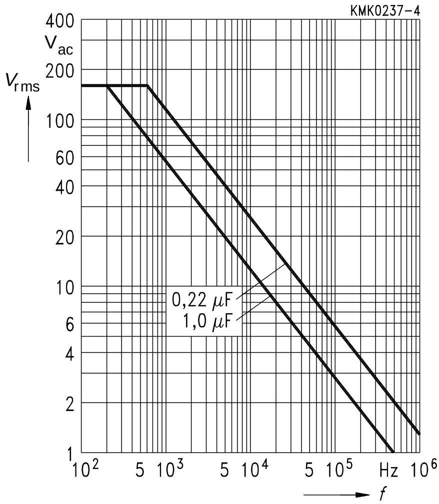
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 mm

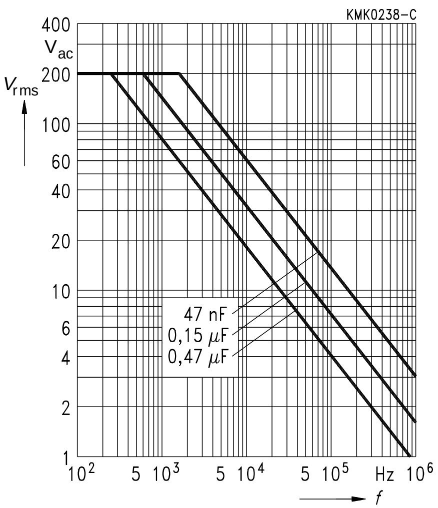
100 V_{dc} / 63 V_{ac}



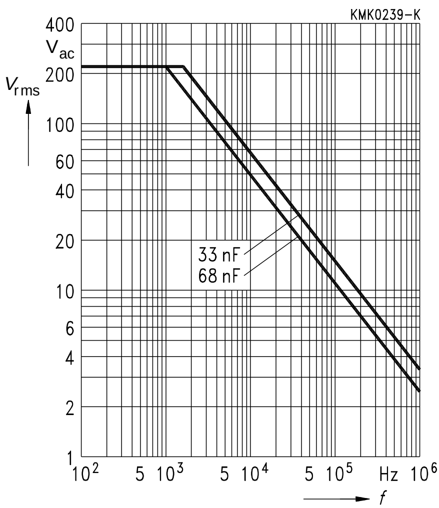
250 V_{dc} / 160 V_{ac}

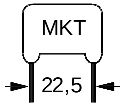


400 V_{dc} / 200 V_{ac}



630 V_{dc} / 220 V_{ac}





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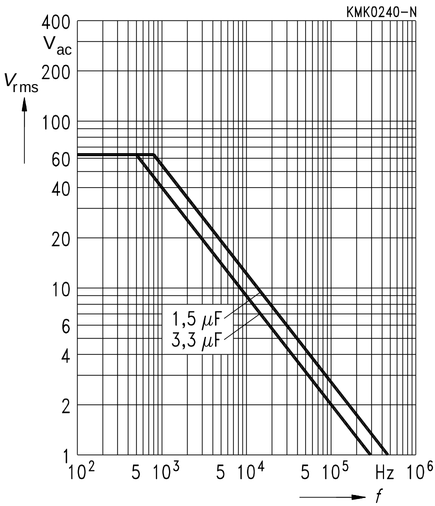
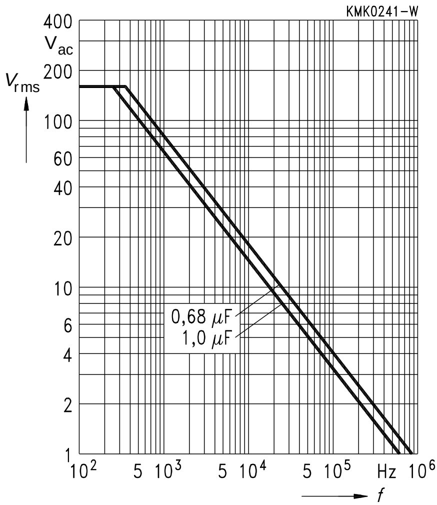
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 22,5 mm

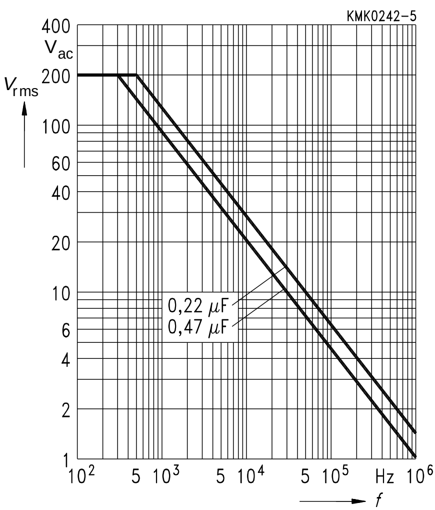
100 V_{dc} / 63 V_{ac}



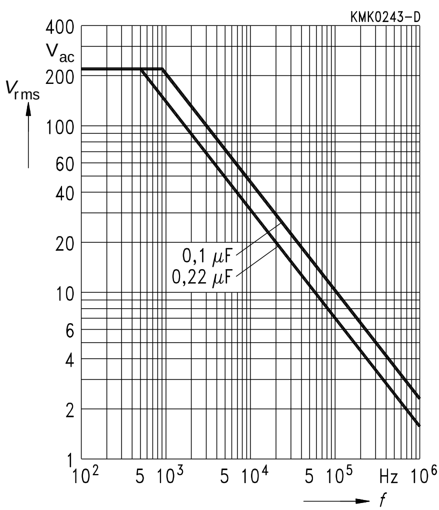
250 V_{dc} / 160 V_{ac}

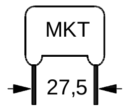


400 V_{dc} / 200 V_{ac}



630 V_{dc} / 220 V_{ac}

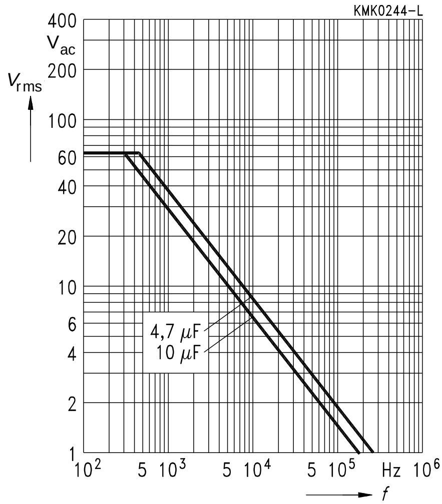




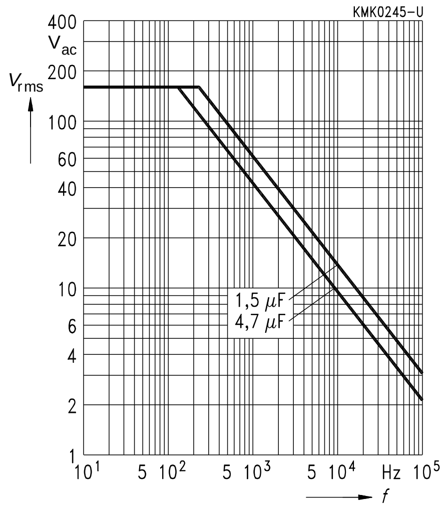
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 27,5 mm

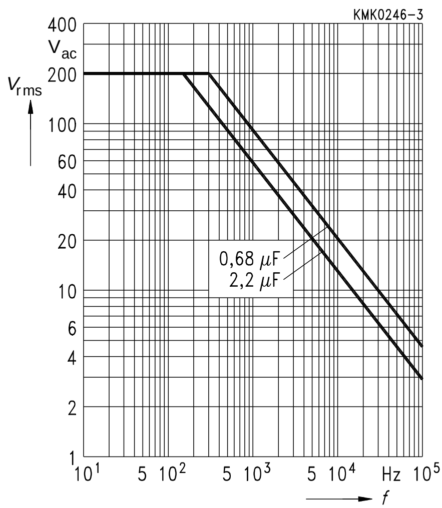
100 V_{dc} / 63 V_{ac}



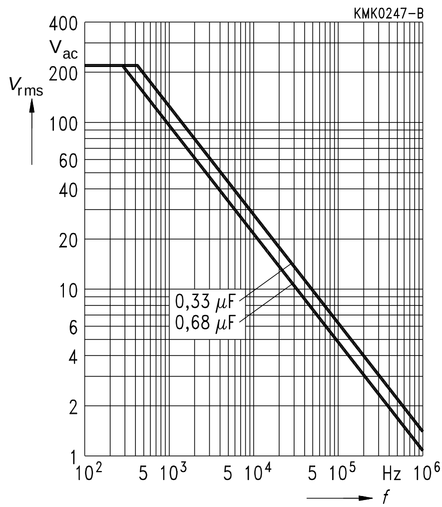
250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



630 V_{dc} / 220 V_{ac}



Flat-winding type for standard applications

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Flat winding
- Insulating sleeve
- Face ends sealed with epoxy resin

Terminals

- Central axial wire leads, tinned

Marking

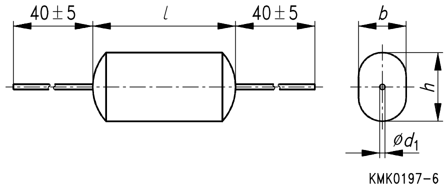
Manufacturer's logo,
style (MKT), rated capacitance,
capacitance tolerance (code letter),
rated dc voltage

Delivery mode

Bulk (untaped)

Detail specification

DIN 44 113



Dimensions in mm

Width b_{max}	≤ 6,0	6,5...13,5
Diameter d_1	0,6	0,8

When bending leads take care to leave a clearance of 1 mm to the capacitor body.

Overview of available types

Type	B 32 231			
10 nF				630 V_{dc}
15 nF				630 V_{dc}
22 nF			400 V_{dc}	630 V_{dc}
33 nF			400 V_{dc}	630 V_{dc}
47 nF		250 V_{dc}	400 V_{dc}	630 V_{dc}
68 nF		250 V_{dc}	400 V_{dc}	630 V_{dc}
0,10 µF		250 V_{dc}	400 V_{dc}	630 V_{dc}
0,15 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	630 V_{dc}
0,22 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	630 V_{dc}
0,33 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	630 V_{dc}
0,47 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	630 V_{dc}
0,68 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	
1,0 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	
1,5 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	
2,2 µF	100 V_{dc}	250 V_{dc}	400 V_{dc}	
3,3 µF	100 V_{dc}	250 V_{dc}		
4,7 µF	100 V_{dc}	250 V_{dc}		
6,8 µF	100 V_{dc}			
10 µF	100 V_{dc}			

Ordering codes and packing units

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
100 V_{dc} (63 V_{ac})	0,15 µF	4,5 × 8,0 × 14,0	B32231-A1154-+	1500
	0,22 µF	5,0 × 9,0 × 14,0	B32231-A1224-+	1500
	0,33 µF	4,5 × 8,5 × 19,0	B32231-A1334-+	1500
	0,47 µF	5,0 × 9,0 × 19,0	B32231-A1474-+	1500
	0,68 µF	6,0 × 10,0 × 19,0	B32231-A1684-+	1500
	1,0 µF	7,5 × 11,0 × 19,0	B32231-A1105-+	1000
	1,5 µF	6,0 × 13,0 × 26,5	B32231-A1155-+	1000
	2,2 µF	7,0 × 15,5 × 26,5	B32231-A1225-+	1000
	3,3 µF	9,5 × 16,5 × 26,5	B32231-A1335-+	500
	4,7 µF	9,0 × 18,0 × 32,0	B32231-A1475-+	500
	6,8 µF	12,5 × 20,0 × 32,0	B32231-A1685-+	500
	10 µF	13,5 × 25,0 × 32,0	B32231-A1106-+	250
250 V_{dc} (160 V_{ac})	47 nF	4,5 × 8,5 × 14,0	B32231-A3473-+	1500
	68 nF	5,5 × 9,0 × 14,0	B32231-A3683-+	1500
	0,10 µF	4,5 × 8,5 × 14,0	B32231-A3104-+	1500
	0,15 µF	4,0 × 8,0 × 19,0	B32231-A3154-+	1500
	0,22 µF	4,5 × 10,0 × 19,0	B32231-A3224-+	1500
	0,33 µF	6,0 × 10,5 × 19,0	B32231-A3334-+	1000
	0,47 µF	4,5 × 11,5 × 26,5	B32231-A3474-+	1000
	0,68 µF	6,0 × 13,0 × 26,5	B32231-A3684-+	1000
	1,0 µF	6,5 × 16,0 × 26,5	B32231-A3105-+	1000
	1,5 µF	8,0 × 16,0 × 32,0	B32231-J3155-+	500
	2,2 µF	9,5 × 18,0 × 32,0	B32231-J3225-+	500
	3,3 µF	10,5 × 22,0 × 32,0	B32231-J3335-+	500
	4,7 µF	10,0 × 25,0 × 44,0	B32231-A3475-+	250

1) For instructions on how to determine the ordering code, refer to page 89.

Ordering codes and packing units

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
400 V_{dc} (200 V_{ac})	22 nF	4,5 × 7,5 × 14,0	B32231-C6223-+	1500
	33 nF	4,5 × 7,5 × 14,0	B32231-C6333-+	1500
	47 nF	4,5 × 8,0 × 19,0	B32231-C6473-+	1500
	68 nF	4,5 × 8,0 × 19,0	B32231-C6683-+	1500
	0,10 µF	5,5 × 8,5 × 19,0	B32231-C6104-+	1500
	0,15 µF	6,5 × 10,0 × 19,0	B32231-C6154-+	1500
	0,22 µF	5,0 × 12,0 × 26,5	B32231-C6224-+	1000
	0,33 µF	6,0 × 13,5 × 26,5	B32231-C6334-+	1000
	0,47 µF	7,0 × 16,0 × 26,5	B32231-C6474-+	1000
	0,68 µF	8,0 × 15,5 × 32,0	B32231-J6684-+	500
	1,0 µF	10,5 × 17,5 × 32,0	B32231-J6105-+	500
	1,5 µF	8,5 × 24,0 × 44,0	B32231-C6155-+	250
	2,2 µF	10,0 × 25,5 × 44,0	B32231-C6225-+	250
630 V_{dc} (220 V_{ac})	10 nF	4,5 × 8,0 × 14,0	B32231-C8103-+	1500
	15 nF	4,5 × 8,0 × 14,0	B32231-C8153-+	1500
	22 nF	5,0 × 8,5 × 14,0	B32231-C8223-+	1500
	33 nF	4,5 × 8,0 × 19,0	B32231-C8333-+	1500
	47 nF	5,0 × 10,5 × 19,0	B32231-C8473-+	1500
	68 nF	6,0 × 12,0 × 19,0	B32231-C8683-+	1000
	0,10 µF	5,0 × 12,5 × 26,5	B32231-C8104-+	1000
	0,15 µF	6,5 × 14,0 × 26,5	B32231-C8154-+	1000
	0,22 µF	7,5 × 16,5 × 26,5	B32231-C8224-+	500
	0,33 µF	9,0 × 16,5 × 32,0	B32231-J8334-+	500
	0,47 µF	11,0 × 18,5 × 32,0	B32231-J8474-+	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, (±5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.

Technical data

Climatic category in accordance with IEC 68-1	40/100/21	
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 100 °C	
Damp heat test	21 days/40 °C/93 % relative humidity	
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ Dissipation factor change Δ tan δ Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$	$\leq$ 5 % $\leq 5 \cdot 10^{-3}$ (at 1 kHz) $\leq 7 \cdot 10^{-3}$ (at 10 kHz) $\geq$ 20 % of minimum as-delivered values
DC test voltage	$1{,}6 \cdot V_R$, 2 s	
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	$T \leq$ 85 °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$ T = 100 °C: $V_C = 0{,}8 \cdot V_R$ or $0{,}8 \cdot V_{rms}$	
Category voltage for short operating periods	$T \leq$ 100 °C: $1{,}25 \cdot V_C$ for max. 2000 h	

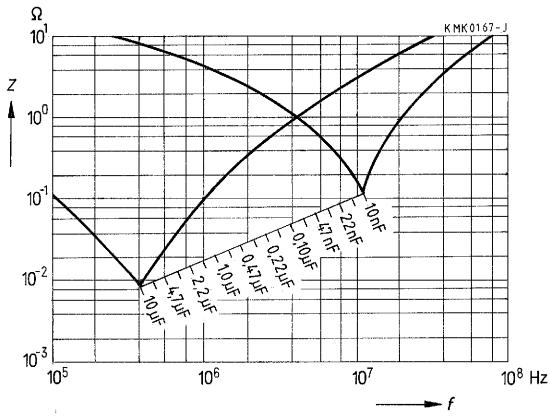
Dissipation factor tan δ (in 10^{-3})
at 20 °C
(upper limit values)

	$C_R \leq$ 47 nF	47 nF < $C_R \leq$ 1 µF	C_R > 1 µF
at 1 kHz	10	10	10
10 kHz	20	25	–

Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$
at 20 °C, rel. humidity $\leq$ 65 %
(minimum as-delivered values)

V_R	$C_R \leq$ 0,33 µF	C_R > 0,33 µF
100 V_{dc}	3750 MΩ	1250 s
$\geq$ 250 V_{dc}	7500 MΩ	2500 s

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

Rated voltage V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$) Length of capacitor				
	14 mm	19 mm	26,5mm	32 mm	44 mm
100 V_{dc}	6	3	2	1,5	–
250 V_{dc}	10	5	3	2,5	2
400 V_{dc}	14	7	4	3	2,5
630 V_{dc}	20	10	7	5	–

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 220.

Rated voltage V_R	Pulse characteristic k_0 in $V^2/\mu s$ (for $V_{pp} \leq V_R$) Length of capacitor				
	14 mm	19 mm	26,5mm	32 mm	44 mm
100 V_{dc}	1 200	600	400	300	–
250 V_{dc}	5 000	2 500	1 500	1 250	1 000
400 V_{dc}	11 000	5 600	3 200	2 400	2 000
630 V_{dc}	25 000	12 500	8 800	6 300	–

Permissible ac voltage V_{rms} versus frequency f

Values can be obtained upon request. In specific cases please provide a scaled voltage/ time graph and state operating conditions.

Cylindrical-winding type for standard applications

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Cylindrical winding
- Insulating sleeve
- Face ends sealed with epoxy resin

Terminals

- Central axial wire leads, tinned

Marking

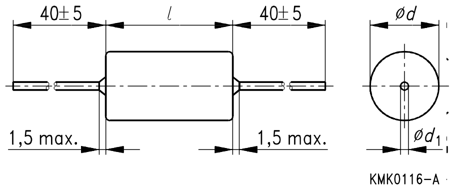
Manufacturer's logo,
style (MKT), rated capacitance,
capacitance tolerance (code letter),
rated dc voltage

Delivery mode

Bulk (untaped)

Detail specifications

DIN 45 910-112
CECC 30 401-051



Dimensions in mm

Diameter d	Diameter d_1
≤ 7,0	0,6
> 7,0	0,8

When bending leads take care to leave a clearance of 1 mm to the capacitor body.

Overview of available types

Type	B 32 232			
10 nF				
15 nF				
22 nF				
33 nF				
47 nF				
68 nF				
0,10 µF			400 V_{dc}	630 V_{dc}
0,15 µF				
0,22 µF				
0,33 µF				
0,47 µF		250 V_{dc}		
0,68 µF	100 V_{dc}			
1,0 µF				
1,5 µF				
2,2 µF				
3,3 µF				
4,7 µF				
6,8 µF				

Ordering codes and packing units

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions ∅ $d \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
100 V_{dc} (63 V_{ac})	0,10 µF	6,0 × 14,0	B32232-A1104-+	500
	0,15 µF	6,0 × 14,0	B32232-A1154-+	500
	0,22 µF	6,0 × 14,0	B32232-A1224-+	500
	0,33 µF	6,0 × 19,0	B32232-A1334-+	500
	0,47 µF	6,5 × 19,0	B32232-A1474-+	500
	0,68 µF	7,0 × 19,0	B32232-A1684-+	500
	1,0 µF	8,5 × 19,0	B32232-A1105-+	500
	1,5 µF	8,0 × 26,5	B32232-A1155-+	500
	2,2 µF	9,5 × 26,5	B32232-A1225-+	500
	3,3 µF	11,5 × 26,5	B32232-A1335-+	500
	4,7 µF	12,0 × 31,5	B32232-A1475-+	500
	6,8 µF	14,0 × 31,5	B32232-A1685-+	250
250 V_{dc} (160 V_{ac})	47 nF	6,0 × 14,0	B32232-A3473-+	500
	68 nF	6,0 × 14,0	B32232-A3683-+	500
	0,10 µF	6,0 × 14,0	B32232-A3104-+	500
	0,15 µF	7,0 × 14,0	B32232-A3154-+	500
	0,22 µF	7,0 × 19,0	B32232-A3224-+	500
	0,33 µF	8,0 × 19,0	B32232-A3334-+	500
	0,47 µF	9,0 × 19,0	B32232-A3474-+	500
	0,68 µF	8,5 × 26,5	B32232-A3684-+	500
	1,0 µF	10,0 × 26,5	B32232-A3105-+	500
	1,5 µF	11,0 × 31,5	B32232-A3155-+	500
	2,2 µF	13,0 × 31,5	B32232-A3225-+	500
	3,3 µF	14,0 × 31,5	B32232-A3335-+	250
	4,7 µF	16,5 × 31,5	B32232-A3475-+	250
400 V_{dc} (200 V_{ac})	15 nF	6,0 × 14,0	B32232-A6153-+	500
	22 nF	6,0 × 14,0	B32232-A6223-+	500
	33 nF	6,0 × 14,0	B32232-A6333-+	500
	47 nF	7,0 × 14,0	B32232-A6473-+	500
	68 nF	8,0 × 14,0	B32232-A6683-+	500
	0,10 µF	7,0 × 19,0	B32232-A6104-+	500
	0,15 µF	8,5 × 19,0	B32232-A6154-+	500
	0,22 µF	8,0 × 26,5	B32232-A6224-+	500
	0,33 µF	9,5 × 26,5	B32232-A6334-+	500
	0,47 µF	11,0 × 26,5	B32232-A6474-+	500
	0,68 µF	11,5 × 31,5	B32232-A6684-+	500
	1,0 µF	13,5 × 31,5	B32232-A6105-+	500

1) For instructions on how to determine the ordering code, refer to page 95.

Ordering codes and packing units

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions ∅ $d \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
630V_{dc} (220 V_{ac})	10 nF	6,0 × 14,0	B32232-A8103-+	500
	15 nF	6,5 × 14,0	B32232-A8153-+	500
	22 nF	7,5 × 14,0	B32232-A8223-+	500
	33 nF	6,5 × 19,0	B32232-A8333-+	500
	47 nF	7,5 × 19,0	B32232-A8473-+	500
	68 nF	8,5 × 19,0	B32232-A8683-+	500
	0,10 µF	10,5 × 19,0	B32232-A8104-+	500
	0,15 µF	10,0 × 26,5	B32232-A8154-+	500
	0,22 µF	11,5 × 26,5	B32232-A8224-+	500
	0,33 µF	13,5 × 26,5	B32232-A8334-+	500
	0,47 µF	14,5 × 31,5	B32232-A8474-+	500
	0,68 µF	15,0 × 31,5	B32232-A8684-+	500
	1,0 µF	16,0 × 31,5	B32232-A8105-+	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, (±5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.

Technical data

Climatic category in accordance with IEC 68-1	40/100/56
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 100 °C
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ ≤ 5 % Dissipation factor change $\Delta \tan \delta$ ≤ $5 \cdot 10^{-3}$ (at 1 kHz) ≤ $7 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ ≥ 20 % of minimum as-delivered values
DC test voltage	$1{,}6 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	$T \leq$ 85 °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$ T = 100 °C: $V_C = 0{,}8 \cdot V_R$ or $0{,}8 \cdot V_{rms}$
Category voltage for short operating periods	$T \leq$ 100 °C: $1{,}25 \cdot V_C$ for max. 2000 h

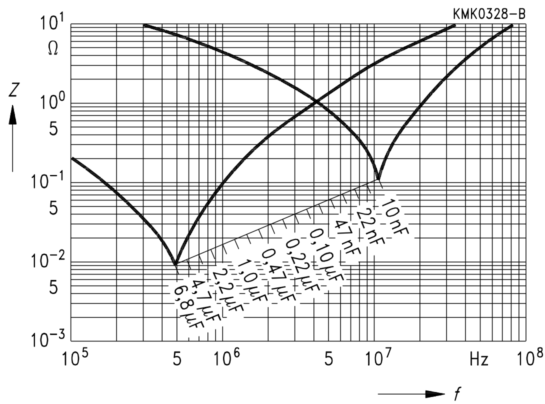
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)

	$C_R \leq$ 47 nF	47 nF < $C_R \leq$ 1 µF	C_R > 1 µF
at 1 kHz	10	10	10
10 kHz	20	25	–

Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)

V_R	$C_R \leq$ 0,33 µF	C_R > 0,33 µF
100 V_{dc}	3750 MΩ	1250 s
≥ 250 V_{dc}	7500 MΩ	2500 s

Impedance Z versus frequency f (typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

Rated voltage V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)			
	Length of capacitor			
	14 mm	19 mm	26,5 mm	31,5 mm
100 V_{dc}	15	8	5	4
250 V_{dc}	25	13	8	6
400 V_{dc}	40	20	12	9
630 V_{dc}	60	30	20	15

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 220.

Rated voltage V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)			
	Length of capacitor			
	14 mm	19 mm	26,5 mm	31,5 mm
100 V_{dc}	3 000	1 600	1 000	800
250 V_{dc}	12 500	6 500	4 000	3 000
400 V_{dc}	32 000	16 000	9 500	7 200
630 V_{dc}	75 000	38 000	25 000	19 000

Permissible ac voltage V_{rms} versus frequency f

Values can be obtained upon request. In specific cases please provide a scaled voltage/ time graph and state operating conditions.

High-voltage capacitors
Flat winding

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Flat winding
- Insulating sleeve
- Face ends sealed with epoxy resin

Typical applications

- High-voltage circuits
- Professional electronics testing equipment
- Aerospace applications

Terminals

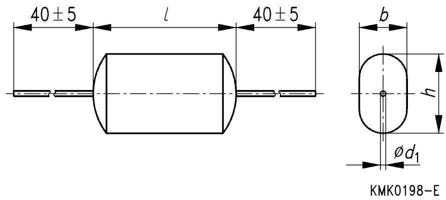
- Central axial wire leads, tinned
- Tab connectors available upon request

Markings

Manufacturer's logo,
style (MKT), rated capacitance,
capacitance tolerance (code letter),
rated dc voltage

Delivery mode

Bulk (untaped)



Dimensions in mm

Width b_{max}	≤ 6,0	8 ... 10	≥ 10,5
Diameter d_1	0,6	0,8	1,0

When bending leads take care to leave a clearance of 1 mm to the capacitor body.

Overview of available types

<table>
<tr><td>Type</td><td colspan="5">B 32 227</td><td></td></tr>
<tr><td>10 nF</td><td></td><td></td><td></td><td rowspan="4">4,0 kV$_{dc}$</td><td rowspan="3">6,3 kV$_{dc}$</td><td rowspan="5"></td></tr>
<tr><td>25 nF</td><td></td><td rowspan="4">1,6 kV$_{dc}$</td><td rowspan="4">2,5 kV$_{dc}$</td></tr>
<tr><td>50 nF</td><td rowspan="3">1,0 kV$_{dc}$</td></tr>
<tr><td>0,10 µF</td><td></td></tr>
<tr><td>0,25 µF</td><td></td><td></td></tr>
</table>

Ordering codes and packing units

V_R (V_{rms} $f \leq 60$ Hz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
1,0 kV_{dc} (220 V_{ac})	50 nF	5,5 × 12,0 × 33,0	B32227-J503-M	100
	0,10 µF	6,0 × 18,5 × 33,0	B32227-J104-M	50
	0,25 µF	9,5 × 25,0 × 33,0	B32227-J254-M	50
1,6 kV_{dc} (220 V_{ac})	25 nF	5,0 × 11,5 × 33,0	B32227-J1253-M	100
	50 nF	6,0 × 16,5 × 33,0	B32227-J1503-M	100
	0,10 µF	8,0 × 20,0 × 33,0	B32227-J1104-M	50
	0,25 µF	15,5 × 31,0 × 33,0	B32227-J1254-M	40
2,5 kV_{dc} (220 V_{ac})	25 nF	8,5 × 18,0 × 33,0	B32227-J2253-M	50
	50 nF	12,5 × 25,5 × 33,0	B32227-J2503-M	50
	0,10 µF	10,5 × 26,5 × 45,0	B32227-J2104-M	70
	0,25 µF	15,5 × 40,5 × 45,0	B32227-J2254-M	40
4,0 kV_{dc} (220 V_{ac})	10 nF	9,5 × 22,0 × 33,0	B32227-J4103-M	50
	25 nF	10,0 × 22,5 × 45,0	B32227-J4253-M	50
	50 nF	12,5 × 31,0 × 45,0	B32227-J4503-M	50
	0,10 µF	16,5 × 42,0 × 45,0	B32227-J4104-M	30
6,3 kV_{dc} (220 V_{ac})	10 nF	9,0 × 21,5 × 45,0	B32227-J6103-M	50
	25 nF	13,5 × 32,5 × 45,0	B32227-J6253-M	50
	50 nF	17,0 × 42,0 × 45,0	B32227-J6503-M	30

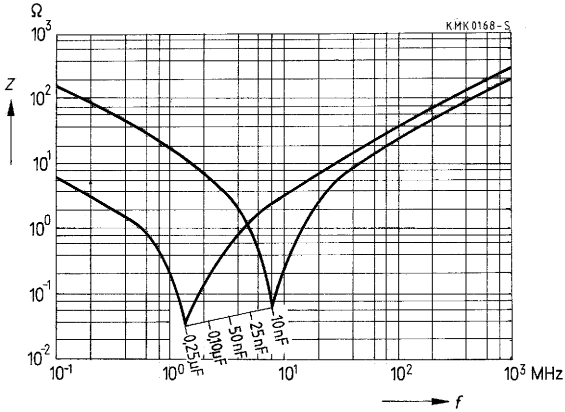
Capacitance tolerance: ±20 % $\hat{=}$ M

Technical data

Climatic category in accordance with IEC 68-1	40/100/21		
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 100 °C		
Damp heat test	21 days/40 °C/93 % relative humidity		
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$	≤ 3 % ≤ 5 %	(for $C_R > 0{,}1$ µF) (for $C_R \le 0{,}1$ µF)
	Dissipation factor change Δ tan δ	$\le 3 \cdot 10^{-3}$ (at 1 kHz) $\le 5 \cdot 10^{-3}$ (at 10 kHz)	
	Insulation resistance R_{is}	≥ 20 % of minimum as-delivered values	
Reliability:			
Reference conditions Failure rate	$0{,}5 \cdot V_R$; 40 °C; $10 \cdot 10^{-9}$/h = 10 fit		
	For a conversion table for other operating conditions an temperatures refer to page 247.		
Service life	200 000 h		
Failure criteria: Total failure	Short circuit or open circuit		
Failure due to variation of parameters	Capacitance change $\|\Delta C/C\|$	> 10 %	
	Dissipation factor tan δ	> 2 · upper limit values	
	Insulation resistance R_{is}	< 150 MΩ	
DC test voltage	$1{,}2 \cdot V_R$, 2 s		
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	$T \le$ 60 °C: $V_C = 1{,}0 \cdot V_R$ $T \le$ 70 °C: $V_C = 1{,}0 \cdot V_{rms}$ T = 100 °C: $V_C = 0{,}55 \cdot V_R$ or $0{,}7 \cdot V_{rms}$		
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)	at 1 kHz: $8 \cdot 10^{-3}$ at 10 kHz: $15 \cdot 10^{-3}$		
Insulation resistance R_{is} at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	30 000 MΩ		

B 32 227

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

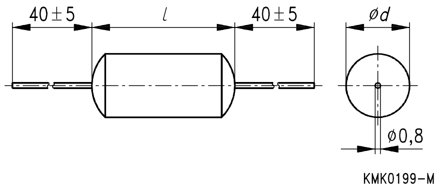
Rated voltage V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)	
	Length of capacitor 33 mm	Length of capacitor 45 mm
1,0 kV_{dc}	10	—
1,6 kV_{dc}	15	—
2,5 kV_{dc}	25	12,5
4,0 kV_{dc}	40	20
6,3 kV_{dc}	—	40

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 220.

Rated voltage V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)	
	Length of capacitor 33mm	Length of capacitor 45 mm
1,0 kV_{dc}	20 000	—
1,6 kV_{dc}	48 000	—
2,5 kV_{dc}	125 000	62 500
4,0 kV_{dc}	320 000	160 000
6,3 kV_{dc}	—	500 000

Permissible ac voltage V_{rms} versus frequency f

Values can be obtained upon request. In specific cases please provide a scaled voltage/ time graph and state operating conditions.



Dimensions in mm

When bending leads take care to leave a clearance of 1 mm to the capacitor body.

High-voltage capacitors
Cylindrical winding

Construction

- Dielectric: polyethylene terephthalate (polyester)
- Cylindrical winding
- In tubular plastic case
- Face ends sealed with epoxy resin

Typical applications

- High-voltage circuits
- Professional electronic testing equipment

Terminals

- Central axial wire leads, tinned

Markings

Manufacturer's logo,
style (MKT), rated capacitance,
capacitance tolerance (code letter),
rated dc voltage

Delivery mode

Bulk (untaped)

Overview of available types

<table>
<tr><th>Type</th><th colspan="8">B 32 237</th></tr>
<tr><td>0,68 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="3">12,5 kV_{dc}</td></tr>
<tr><td>1,0 nF</td><td></td><td></td><td></td><td rowspan="4">4,0 kV_{dc}</td><td rowspan="4">6,3 kV_{dc}</td><td rowspan="4">8,0 kV_{dc}</td><td rowspan="3">10 kV_{dc}</td></tr>
<tr><td>2,5 nF</td><td></td><td></td><td rowspan="4">2,5 kV_{dc}</td></tr>
<tr><td>5,0 nF</td><td></td><td rowspan="2">1,6 kV_{dc}</td><td></td></tr>
<tr><td>10 nF</td><td></td><td></td><td></td></tr>
<tr><td>25 nF</td><td>1,0 kV_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Ordering codes and packing units

V_R (V_{rms}, $f \leq 60$ Hz)	C_R	Maximum dimensions $d_{max} \times l_{max}$ (mm)	Ordering code[1)]	Packing unit (pcs) Untaped
1,0 kV_{dc} (200 V_{ac})	25 nF	11,5 × 24,0	B32237-A253-+	100
1,6 kV_{dc} (200 V_{ac})	5,0 nF	7,5 × 24,0	B32237-A1502-+	150
	10 nF	10,5 × 24,0	B32237-A1103-+	100
2,5 kV_{dc} (200 V_{ac})	2,5 nF	9,5 × 33,0	B32237-J2252-+	100
	5,0 nF	9,5 × 33,0	B32237-J2502-+	100
	10 nF	10,5 × 33,0	B32237-B2103-+	50
	25 nF	16,5 × 33,0	B32237-J2253-+	50
4,0 kV_{dc} (450 V_{ac})	1,0 nF	7,5 × 33,0	B32237-A4102-+	100
	2,5 nF	9,5 × 33,0	B32237-J4252-+	100
	5,0 nF	10,5 × 33,0	B32237-J4502-+	50
	10 nF	12,5 × 33,0	B32237-B4103-+	50
6,3 kV_{dc} (450 V_{ac})	1,0 nF	9,5 × 33,0	B32237-B6102-+	100
	2,5 nF	10,5 × 33,0	B32237-B6252-+	50
	5,0 nF	10,5 × 45,0	B32237-B6502-+	50
	10 nF	16,5 × 45,0	B32237-B6103-+	300
8,0 kV_{dc} (450 V_{ac})	1,0 nF	9,5 × 45,0	B32237-A8102-+	50
	2,5 nF	10,5 × 45,0	B32237-B8252-+	50
	5,0 nF	12,5 × 45,0	B32237-A8502-+	50
	10 nF	16,5 × 45,0	B32237-J8103-+	300
10 kV_{dc} (450 V_{ac})	1,0 nF	9,5 × 56,0	B32237-A9102-+	500
	2,5 nF	11,5 × 56,0	B32237-A9252-+	500
	5,0 nF	16,5 × 56,0	B32237-A9502-+	300
12,5 kV_{dc} (450 V_{ac})	0,68 nF	9,5 × 56,0	B32237-A3681-+	500
	1,0 nF	10,5 × 56,0	B32237-A3102-+	500
	2,5 nF	12,5 × 56,0	B32237-A3252-+	400

Capacitance tolerance: +50/–20 % ≙ S, ±20 % ≙ M

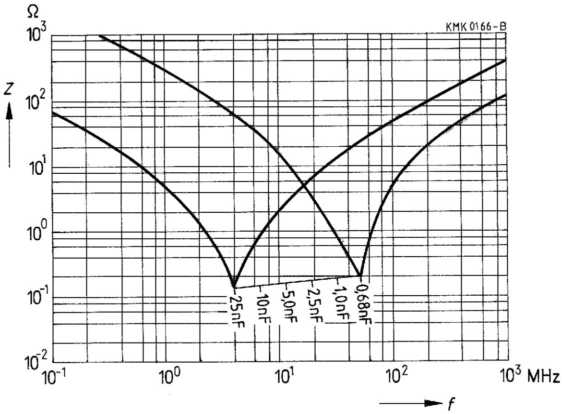
1) Replace the + by the code letter for the required capacitance tolerance.

B 32 237

Technical data

Climatic category in accordance with IEC 68-1	40/100/21
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 100 °C
Damp heat test	21 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ ≤ 5 % Dissipation factor change Δ tan δ ≤ $3 \cdot 10^{-3}$ (at 1 kHz) ≤ $5 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} ≥ 20 % of minimum as-delivered values
Reliability:	
Reference conditions Failure rate	$0{,}5 \cdot V_R$; 40 °C $10 \cdot 10^{-9}$/h = 10 fit For a conversion table for other operating conditions and temperatures, refer to page 247.
Service life	200 000 h
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ > 10 % Dissipation factor tan δ > 2 · upper limit value Insulation resistance R_{is} < 150 MΩ
DC test voltage	$1{,}2 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 60 Hz	$T \leq$ 60 °C: $V_C = 1{,}0 \cdot V_R$ $T \leq$ 70 °C: $V_C = 1{,}0 \cdot V_{rms}$ T = 100 °C: $V_C = 0{,}55 \cdot V_R$ or $0{,}7 \cdot V_{rms}$
Dissipation factor tan δ at 20 °C (upper limit values)	at 1 kHz: $8 \cdot 10^{-3}$ at 10 kHz: $15 \cdot 10^{-3}$
Insulation resistance R_{is} at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	30 000 MΩ

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (impulses, sawtooth)

Rated voltage V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)
1,0 kV_{dc}	15	30 000
1,6 kV_{dc}	25	80 000
2,5 kV_{dc}	25	125 000
4,0 kV_{dc}	40	320 000
6,3 kV_{dc}	50	630 000
8,0 kV_{dc}	50	800 000
10,0 kV_{dc}	370	7 500 000
12,5 kV_{dc}	1000	25 000 000

For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}.
Also refer to the calculation example on page 220.

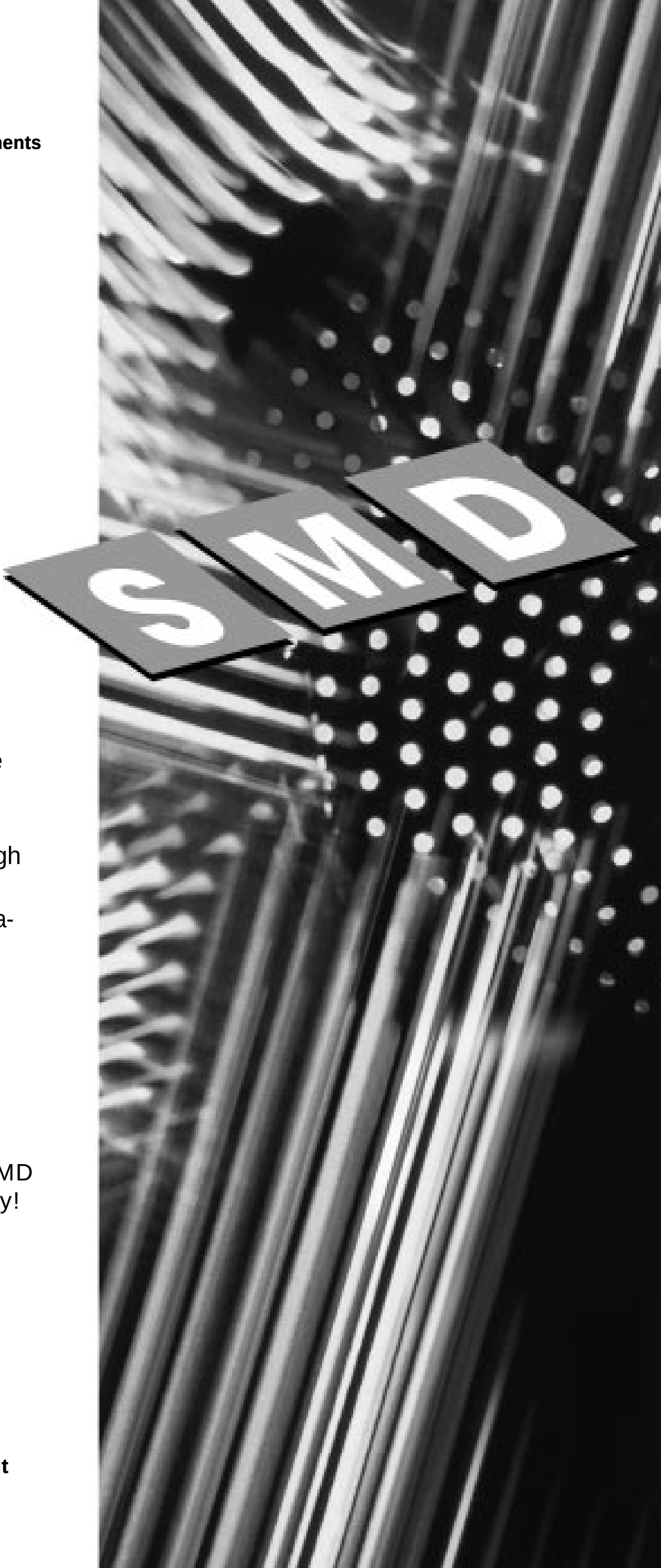
Permissible ac voltage V_{rms} versus frequency f

Values can be obtained upon request. In specific cases please provide a scaled voltage/ time graph and state operating conditions.

S+M COMPONENTS **Siemens Matsushita Components**

SMDs from stock

Focus on surface mounting



SCS also offers you an extensive range of components for surface mounting. For example you can have HF chokes SIMID 01 through SIMID 04, thermistor chips for temperature compensation, tantalum chips in sizes A, B, C and D plus surface-mount transformers and laboratory assortments of ceramic chip capacitors.

Ask for our SMD product survey!

SCS – dependable, fast and competent

Overview, MKP capacitors

Technology	Design	Type	Characteristics	Voltage	Page
Stacked-film technology	Plastic case (MKP)	B 32 620 ... B 32 622	Smallest possible dimensions Very high pulse strength	160 … 1000 V_{dc}	110
Wound capacitor technology	Plastic case (MKP)	B 32 652 ... B 32 656	Very small dimensions	250 … 2000 V_{dc}	119
	Coated Powder Dipped (MKP)	B 32 612 ... B 32 614	AC applications	250 V_{dc}, 400 V_{dc}	131
	Axial leads (MKP)	B 32 669	Electronic ballast circuit applications	250 V_{ac}, 400 V_{ac}	137

Overview, MFP capacitors

Technology	Design	Type	Characteristics	Voltage	Page
Wound capacitor technology	Plastic case (MFP)	B 32 682 ... B 32 686	Highest possible contact reliability	630 … 2000 V_{dc}	140
		B 32 642 ... B 32 644	Highest possible current loads	1600 V_{dc}, 2000 V_{dc}	151
	Coated Powder Dipped (MFP)	B 32 692 ... B 32 694	Very high contact reliability	630 V_{dc}, 1600 V_{dc}	159

Metallized Polypropylene Film Capacitors (MKP and MFP)

MKP stacked-film capacitors
Smallest possible dimensions

Construction

- Dielectric: polypropylene
- Stacked-film technology
- Plastic case (UL 94 V-0)
- Epoxy resin sealing

Features

- Very high pulse strength
- Very good self-healing properties
- Smallest possible dimensions
- High contact reliability

Typical applications

- Energy-saving lamps
- TV S-correction
- High pulse load applications
- AC applications

Terminals

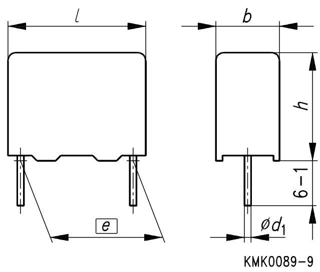
- Parallel wire leads, tinned
- Also available with (3,2 ± 0,3) mm lead length

Marking

Manufacturer's logo,
lot number for lead spacing 15 mm,
style (MKP),
rated capacitance (coded),
capacitance tolerance (code letter),
rated dc voltage,
date of manufacture (coded)

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping refer to page 252.



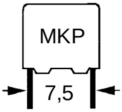
Dimensions in mm

Lead spacing e ± 0,4	Diameter d_1	Type
7,5	0,5	B 32 620
10	0,5[1)]/0,6	B 32 621
15	0,8	B 32 622

1) 0,5 mm for capacitor width b = 4 mm

Overview of available types

<table>
<tr><td>Lead spacing</td><td colspan="5">7,5 mm</td><td colspan="5">10 mm</td><td colspan="5">15 mm</td></tr>
<tr><td>Type</td><td colspan="5">B 32 620</td><td colspan="5">B 32 621</td><td colspan="5">B 32 622</td></tr>
<tr><td>Page</td><td colspan="5">112</td><td colspan="5">113</td><td colspan="5">114</td></tr>
<tr><td>1,5 nF</td><td></td><td></td><td></td><td rowspan="7">630 V_{dc}</td><td rowspan="5">1000 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2,2 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5">1000 V_{dc}</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3,3 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4,7 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5">630 V_{dc}</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6,8 nF</td><td></td><td></td><td rowspan="5">400 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>10 nF</td><td></td><td></td><td></td><td></td><td></td><td rowspan="5">400 V_{dc}</td><td></td><td></td><td></td><td></td><td rowspan="5">1000 V_{dc}</td></tr>
<tr><td>15 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>22 nF</td><td rowspan="6">160 V_{dc}</td><td rowspan="5">250 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>33 nF</td><td></td><td></td><td></td><td rowspan="4">250 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5">630 V_{dc}</td></tr>
<tr><td>47 nF</td><td></td><td></td><td></td><td rowspan="5">160 V_{dc}</td><td></td><td></td><td></td><td></td><td rowspan="5">400 V_{dc}</td></tr>
<tr><td>68 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,10 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="7">160 V_{dc}</td><td rowspan="6">250 V_{dc}</td><td></td></tr>
<tr><td>0,15 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,22 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,33 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,47 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,68 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,0 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

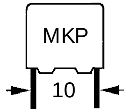


Ordering codes and packing units, lead spacing 7,5 mm

V_R (V_{rms} $f \le 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
160 V_{dc} (90 V_{ac})	22 nF	3,0 × 8,0 × 10,0	B32620-A5223-+***	2600	2400	2000
	33 nF	4,0 × 8,5 × 10,0	B32620-A5333-+***	2000	1800	1500
	47 nF	4,0 × 8,5 × 10,0	B32620-A5473-+***	2000	1800	1500
	68 nF	5,0 × 10,5 × 10,0	B32620-A5683-+***	1600	1400	1000
	0,10 µF	5,0 × 10,5 × 10,0	B32620-A5104-+***	1600	1400	1000
	0,15 µF	6,0 × 12,0 × 10,0	B32620-A5154-+***	1300	1100	750
250 V_{dc} (140 V_{ac})	22 nF	4,0 × 8,5 × 10,0	B32620-A3223-+***	2000	1800	1500
	33 nF	4,0 × 8,5 × 10,0	B32620-A3333-+***	2000	1800	1500
	47 nF	5,0 × 10,5 × 10,0	B32620-A3473-+***	1600	1400	1000
	68 nF	5,0 × 10,5 × 10,0	B32620-A3683-+***	1600	1400	1000
	0,10 µF	6,0 × 12,0 × 10,0	B32620-A3104-+***	1300	1100	750
400 V_{dc} (200 V_{ac})	6,8 nF	4,0 × 8,5 × 10,0	B32620-A4682-+***	2000	1800	1500
	10 nF	4,0 × 8,5 × 10,0	B32620-A4103-+***	2000	1800	1500
	15 nF	5,0 × 10,5 × 10,0	B32620-A4153-+***	1600	1400	1000
	22 nF	5,0 × 10,5 × 10,0	B32620-A4223-+***	1600	1400	1000
	33 nF	6,0 × 12,0 × 10,0	B32620-A4333-+***	1300	1100	750
630 V_{dc} (400 V_{ac})	1,5 nF	4,0 × 8,5 × 10,0	B32620-A6152-+***	2000	1800	1500
	2,2 nF	4,0 × 8,5 × 10,0	B32620-A6222-+***	2000	1800	1500
	3,3 nF	4,0 × 8,5 × 10,0	B32620-A6332-+***	2000	1800	1500
	4,7 nF	4,0 × 8,5 × 10,0	B32620-A6472-+***	2000	1800	1500
	6,8 nF	5,0 × 10,5 × 10,0	B32620-A6682-+***	1600	1400	1000
	10 nF	5,0 × 10,5 × 10,0	B32620-A6103-+***	1600	1400	1000
	15 nF	6,0 × 12,0 × 10,0	B32620-A6153-+***	1300	1100	750
1000 V_{dc} (500 V_{ac})	1,5 nF	4,0 × 8,5 × 10,0	B32620-A152-+***	2000	1800	1500
	2,2 nF	4,0 × 8,5 × 10,0	B32620-A222-+***	2000	1800	1500
	3,3 nF	5,0 × 10,5 × 10,0	B32620-A332-+***	1600	1400	1000
	4,7 nF	5,0 × 10,5 × 10,0	B32620-A472-+***	1600	1400	1000
	6,8 nF	6,0 × 12,0 × 10,0	B32620-A682-+***	1300	1100	750

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 249)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32620-A5104-K3

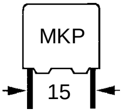


Ordering codes and packing units, lead spacing 10 mm

V_R (V_{rms} $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
160 V_{dc} (90 V_{ac})	47 nF	4,0 × 9,0 × 13,0	B32621-A5473-+***	1000	1700	1000
	68 nF	4,0 × 9,0 × 13,0	B32621-A5683-+***	1000	1700	1000
	0,10 µF	5,0 × 11,0 × 13,0	B32621-A5104-+***	800	1300	1000
	0,15 µF	5,0 × 11,0 × 13,0	B32621-A5154-+***	800	1300	1000
	0,22 µF	6,0 × 12,0 × 13,0	B32621-A5224-+***	600	1100	1000
250 V_{dc} (140 V_{ac})	33 nF	4,0 × 9,0 × 13,0	B32621-A3333-+***	1000	1700	1000
	47 nF	4,0 × 9,0 × 13,0	B32621-A3473-+***	1000	1700	1000
	68 nF	5,0 × 11,0 × 13,0	B32621-A3683-+***	800	1300	1000
	0,10 µF	6,0 × 12,0 × 13,0	B32621-A3104-+***	600	1100	1000
400 V_{dc} (200 V_{ac})	10 nF	4,0 × 9,0 × 13,0	B32621-A4103-+***	1000	1700	1000
	15 nF	4,0 × 9,0 × 13,0	B32621-A4153-+***	1000	1700	1000
	22 nF	5,0 × 11,0 × 13,0	B32621-A4223-+***	800	1300	1000
	33 nF	5,0 × 11,0 × 13,0	B32621-A4333-+***	800	1300	1000
	47 nF	6,0 × 12,0 × 13,0	B32621-A4473-+***	600	1100	1000
630 V_{dc} (400 V_{ac})	4,7 nF	4,0 × 9,0 × 13,0	B32621-A6472-+***	1000	1700	1000
	6,8 nF	4,0 × 9,0 × 13,0	B32621-A6682-+***	1000	1700	1000
	10 nF	4,0 × 9,0 × 13,0	B32621-A6103-+***	1000	1700	1000
	15 nF	5,0 × 11,0 × 13,0	B32621-A6153-+***	800	1300	1000
	22 nF	6,0 × 12,0 × 13,0	B32621-A6223-+***	600	1100	1000
1000 V_{dc} (500 V_{ac})	2,2 nF	4,0 × 9,0 × 13,0	B32621-A222-+***	1000	1700	1000
	3,3 nF	4,0 × 9,0 × 13,0	B32621-A332-+***	1000	1700	1000
	4,7 nF	4,0 × 9,0 × 13,0	B32621-A472-+***	1000	1700	1000
	6,8 nF	5,0 × 11,0 × 13,0	B32621-A682-+***	800	1300	1000
	10 nF	6,0 × 12,0 × 13,0	B32621-A103-+***	600	1100	1000

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 249)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32621-A5104-K3



B 32 622

Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms} $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
160 V_{dc} (90 V_{ac})	0,10 µF	5,0 × 10,5 × 18,0	B32622-A5104-+***	1180	1300	1000
	0,15 µF	5,0 × 10,5 × 18,0	B32622-A5154-+***	1180	1300	1000
	0,22 µF	5,0 × 10,5 × 18,0	B32622-A5224-+***	1180	1300	1000
	0,33 µF	6,0 × 11,0 × 18,0	B32622-A5334-+***	1000	1100	1000
	0,47 µF	7,0 × 12,5 × 18,0	B32622-A5474-+***	840	900	1000
	0,68 µF	8,5 × 14,5 × 18,0	B32622-A5684-+***	690	700	500
	1,0 µF	9,0 × 17,5 × 18,0	B32622-A5105-+***	660	700	500
250 V_{dc} (140 V_{ac})	0,10 µF	5,0 × 10,5 × 18,0	B32622-A3104-+***	1180	1300	1000
	0,15 µF	5,0 × 10,5 × 18,0	B32622-A3154-+***	1180	1300	1000
	0,22 µF	6,0 × 11,0 × 18,0	B32622-A3224-+***	1000	1100	1000
	0,33 µF	7,0 × 12,5 × 18,0	B32622-A3334-+***	840	900	1000
	0,47 µF	8,5 × 14,5 × 18,0	B32622-A3474-+***	690	700	500
	0,68 µF	9,0 × 17,5 × 18,0	B32622-A3684-+***	660	700	500
400 V_{dc} (200 V_{ac})	47 nF	5,0 × 10,5 × 18,0	B32622-A4473-+***	1180	1300	1000
	68 nF	6,0 × 11,0 × 18,0	B32622-A4683-+***	1000	1100	1000
	0,10 µF	7,0 × 12,5 × 18,0	B32622-A4104-+***	840	900	1000
	0,15 µF	8,5 × 14,5 × 18,0	B32622-A4154-+***	690	700	500
	0,22 µF	9,0 × 17,5 × 18,0	B32622-A4224-+***	660	700	500
630 V_{dc} (400 V_{ac})	33 nF	5,0 × 10,5 × 18,0	B32622-A6333-+***	1180	1300	1000
	47 nF	6,0 × 11,0 × 18,0	B32622-A6473-+***	1000	1100	1000
	68 nF	7,0 × 12,5 × 18,0	B32622-A6683-+***	840	900	1000
	0,10 µF	8,5 × 14,5 × 18,0	B32622-A6104-+***	690	700	500
	0,15 µF	9,0 × 17,5 × 18,0	B32622-A6154-+***	660	700	500
1000 V_{dc} (500 V_{ac})	10 nF	5,0 × 10,5 × 18,0	B32622-A103-+***	1180	1300	1000
	15 nF	6,0 × 11,0 × 18,0	B32622-A153-+***	1000	1100	1000
	22 nF	7,0 × 12,5 × 18,0	B32622-A223-+***	840	900	1000
	33 nF	8,5 × 14,5 × 18,0	B32622-A333-+***	690	700	500
	47 nF	8,5 × 14,5 × 18,0	B32622-A473-+***	690	700	500

Capacitance tolerance: ±20 % ≙ M, ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 249)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32622-A5104-K3

Technical data

Climatic category in accordance with IEC 68-1	55/100/56	
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 100 °C	
Damp heat test	56 days/40 °C/93 % relative humidity	
Limit values after damp heat test	Capacitance change $\lvert \Delta C/C \rvert$ Dissipation factor change $\Delta \tan \delta$ Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$	≤ 3 % $\leq 0{,}5 \cdot 10^{-3}$ (at 1 kHz) $\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz) ≥ 50 % of minimum as-delivered values
Reliability:		
Reference conditions Failure rate	$0{,}5 \cdot V_R$; 40 °C $1 \cdot 10^{-9}$/h = 1 fit	
	For a conversion table for other operating conditions and temperatures refer to page 247.	
Service life	200 000 h	
Failure criteria:		
Total failure	Short circuit or open circuit	
Failure due to variation of parameters	Capacitance change $\lvert \Delta C/C \rvert$ Dissipation factor $\tan \delta$ Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$	$> \pm 10$ % $4 \cdot$ upper limit values < 1500 MΩ ($C_R \leq 0{,}33$ µF) < 500 s ($C_R > 0{,}33$ µF)
DC test voltage	$1{,}6 \cdot V_R$, 2 s	
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 1 kHz	$T \leq 85$ °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$ $T = 100$ °C: $V_C = 0{,}7 \cdot V_R$ or $0{,}7 \cdot V_{rms}$	

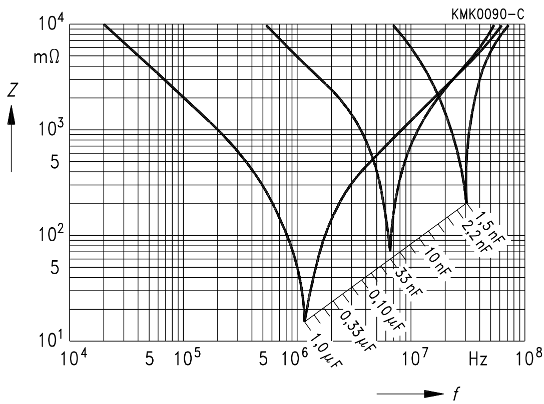
Dissipation factor $\tan \delta$ (in 10^{-3})
at 20 °C
(upper limit values)

	$C_R \leq 0{,}1$ µF	$0{,}1$ µF $< C_R \leq 1$ µF
at 1 kHz	–	0,5
10 kHz	–	1,5
100 kHz	4,0	–

Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$
at 20 °C, rel. humidity ≤ 65 %
(minimum as-delivered values)

$C_R \leq 0{,}33$ µF	$C_R > 0{,}33$ µF
100 GΩ	30 000 s

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)		
	Lead spacing		
	7,5 mm	10 mm	15 mm
160 V_{dc}	750	600	450
250 V_{dc}	1200	900	600
400 V_{dc}	1500	1050	750
630 V_{dc}	2700	1800	1200
1000 V_{dc}	3200	2400	1650

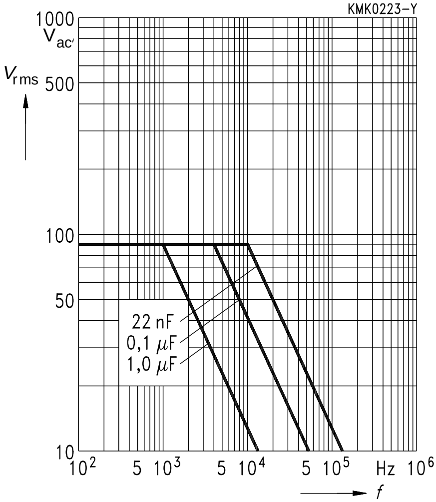
For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}.
Also refer to the calculation example on Seite 220.

V_R	Pulse characteristic k_0 in $V^2/\mu s$ (for $V_{pp} \leq V_R$)		
	Lead spacing		
	7,5 mm	10 mm	15 mm
160 V_{dc}	240 000	190 000	145 000
250 V_{dc}	600 000	450 000	300 000
400 V_{dc}	1 200 000	840 000	600 000
630 V_{dc}	3 400 000	2 250 000	1 500 000
1000 V_{dc}	6 400 000	4 800 000	3 300 000

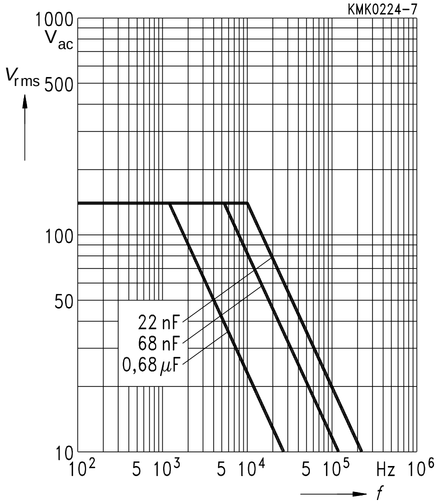
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 7,5 … 15 mm

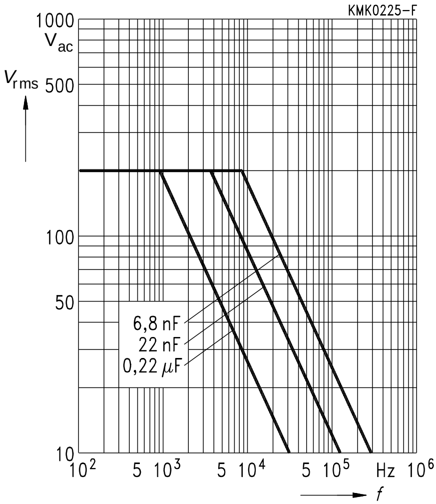
160 V_{dc} / 90 V_{ac}



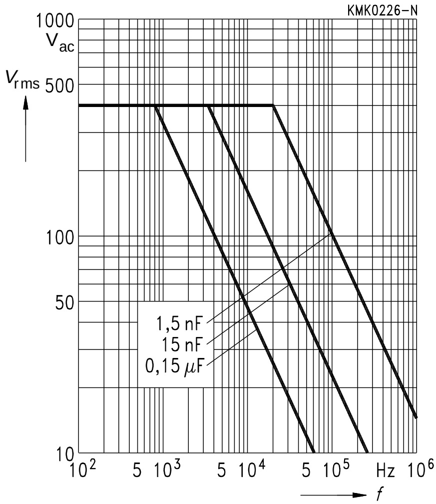
250 V_{dc} / 140 V_{ac}



400 V_{dc} / 200 V_{ac}



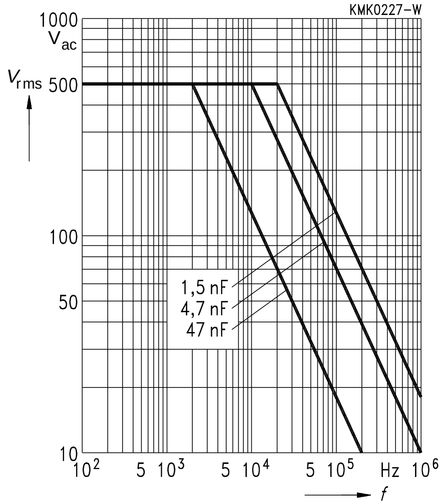
630 V_{dc} / 400 V_{ac}



Permissible ac voltage V_{rms} versus frequency f

Lead spacing 7,5 … 15 mm

1000 V_{dc} / 500 V_{ac}



MKP wound capacitors
Very small dimensions

Construction

- Dielectric: polypropylene
- Wound capacitor technology with internal series connection for V_R ≥1250 V_{dc}
- Plastic case (UL 94 V-0)
- Epoxy resin sealing

Features

- High pulse strength
- High contact reliability
- Very small dimensions

Typical applications

- TV S-correction
- TV flyback
- Electronic ballast circuits

Terminals

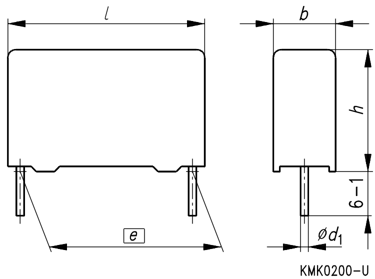
- Parallel wire leads, tinned
- Also available with (3,2 ± 0,3) mm lead length

Marking

Manufacturer's logo,
lot number for lead spacing ≤ 27,5 mm
style (MKP),
rated capacitance (coded),
capacitance tolerance (code letter),
rated dc voltage,
date of manufacture (coded)

Delivery mode

Bulk
Taped (Ammo pack or reel)
For notes on taping refer to page 252.



Dimensions in mm

Lead spacing e ± 0,4	Diameter d_1	Type
15,0	0,8	B 32 652
22,5	0,8	B 32 653
27,5	0,8	B 32 654
37,5	1,0	B 32 656

MKP

B 32 652 … B 32 656

Overview of available types

<table>
<tr><td>Lead spacing</td><td colspan="6">15 mm</td><td colspan="7">22,5 mm</td><td colspan="7">27,5 mm</td><td colspan="3">37,5 mm</td></tr>
<tr><td>Type</td><td colspan="6">B 32 652</td><td colspan="7">B 32 653</td><td colspan="7">B 32 654</td><td colspan="3">B 32 656</td></tr>
<tr><td>Page</td><td colspan="6">121</td><td colspan="7">122</td><td colspan="7">124</td><td colspan="3">124</td></tr>
<tr><td>1,0 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="8">2000 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,5 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2,2 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3,3 nF</td><td></td><td></td><td></td><td></td><td></td><td rowspan="5">1600 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4,7 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6,8 nF</td><td></td><td></td><td></td><td></td><td rowspan="5">1250 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td rowspan="6">1600 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>10 nF</td><td></td><td></td><td></td><td rowspan="7">1000 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>15 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>22 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5">1250 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="4">2000 V_{dc}</td><td></td><td></td><td></td></tr>
<tr><td>33 nF</td><td></td><td></td><td rowspan="6">630 V_{dc}</td><td></td><td></td><td></td><td></td><td rowspan="6">1000 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>47 nF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="4">1600 V_{dc}</td><td></td><td></td><td></td></tr>
<tr><td>68 nF</td><td></td><td rowspan="6">400 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,10 µF</td><td></td><td></td><td></td><td></td><td></td><td rowspan="5">630 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="4">1250 V_{dc}</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,15 µF</td><td rowspan="5">250 V_{dc}</td><td></td><td></td><td></td><td></td><td rowspan="6">400 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,22 µF</td><td></td><td></td><td></td><td rowspan="5">250 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="4">1000 V_{dc}</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,33 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="3">1250 V_{dc}</td><td></td></tr>
<tr><td>0,47 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="3">1000 V_{dc}</td><td></td></tr>
<tr><td>0,68 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="3">630 V_{dc}</td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,0 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="4">400 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,5 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="4">250 V_{dc}</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2,2 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3,3 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4,7 µF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

MKP

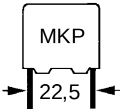
15

Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms} $f \leq$ 1 kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
250 V_{dc} (160 V_{ac})	0,15 µF	5,0 × 10,5 × 18,0	B32652-A3154-+***	1180	1300	1000
	0,22 µF	6,0 × 11,0 × 18,0	B32652-A3224-+***	1000	1100	1000
	0,33 µF	7,0 × 12,5 × 18,0	B32652-A3334-+***	840	900	1000
	0,47 µF	8,5 × 14,5 × 18,0	B32652-A3474-+***	690	700	500
	0,68 µF	9,0 × 17,5 × 18,0	B32652-A3684-+***	660	700	500
400 V_{dc} (200 V_{ac})	68 nF	5,0 × 10,5 × 18,0	B32652-A4683-+***	1180	1300	1000
	0,10 µF	5,0 × 10,5 × 18,0	B32652-A4104-+***	1180	1300	1000
	0,15 µF	6,0 × 11,0 × 18,0	B32652-A4154-+***	1000	1100	1000
	0,22 µF	7,0 × 12,5 × 18,0	B32652-A4224-+***	840	900	1000
	0,33 µF	8,5 × 14,5 × 18,0	B32652-A4334-+***	690	700	500
	0,47 µF	9,0 × 17,5 × 18,0	B32652-A4474-+***	660	700	500
630 V_{dc} (250 V_{ac})	33 nF	5,0 × 10,5 × 18,0	B32652-A6333-+***	1180	1300	1000
	47 nF	5,0 × 10,5 × 18,0	B32652-A6473-+***	1180	1300	1000
	68 nF	6,0 × 11,0 × 18,0	B32652-A6683-+***	1000	1100	1000
	0,10 µF	7,0 × 12,5 × 18,0	B32652-A6104-+***	840	900	1000
	0,15 µF	8,5 × 14,5 × 18,0	B32652-A6154-+***	690	700	500
	0,22 µF	9,0 × 17,5 × 18,0	B32652-A6224-+***	660	700	500
1000 V_{dc} (250 V_{ac})	10 nF	5,0 × 10,5 × 18,0	B32652-A103-+***	1180	1300	1000
	15 nF	5,0 × 10,5 × 18,0	B32652-A153-+***	1180	1300	1000
	22 nF	5,0 × 10,5 × 18,0	B32652-A223-+***	1180	1300	1000
	33 nF	6,0 × 11,0 × 18,0	B32652-A333-+***	1000	1100	1000
	47 nF	7,0 × 12,5 × 18,0	B32652-A473-+***	840	900	1000
	68 nF	8,5 × 14,5 × 18,0	B32652-A683-+***	690	700	500
	0,10 µF	9,0 × 17,5 × 18,0	B32652-A104-+***	660	700	500
1250 V_{dc} (500 V_{ac})	6,8 nF	5,0 × 10,5 × 18,0	B32652-A7682-+***	1180	1300	1000
	10 nF	6,0 × 11,0 × 18,0	B32652-A7103-+***	1000	1100	1000
	15 nF	7,0 × 12,5 × 18,0	B32652-A7153-+***	840	900	1000
	22 nF	8,5 × 14,5 × 18,0	B32652-A7223-+***	690	700	500
	33 nF	9,0 × 17,5 × 18,0	B32652-A7333-+***	660	700	500
1600 V_{dc} (500 V_{ac})	3,3 nF	5,0 × 10,5 × 18,0	B32652-A1332-+***	1180	1300	1000
	4,7 nF	6,0 × 11,0 × 18,0	B32652-A1472-+***	1000	1100	1000
	6,8 nF	7,0 × 12,5 × 18,0	B32652-A1682-+***	840	900	1000
	10 nF	8,5 × 14,5 × 18,0	B32652-A1103-+***	690	700	500
	15 nF	9,0 × 17,5 × 18,0	B32652-A1153-+***	660	700	500

Capacitance tolerance: ± 10 % ≙ K, ± 5 % ≙ J, (± 3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g: B32652-A4104-K3

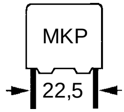


B 32 653

Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms} $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
250 V_{dc} (160 V_{ac})	0,22 µF	6,0 × 15,0 × 26,5	B32653-A3224-+***	690	700	720
	0,33 µF	6,0 × 15,0 × 26,5	B32653-A3334-+***	690	700	720
	0,47 µF	7,0 × 16,0 × 26,5	B32653-A3474-+***	590	600	630
	0,68 µF	8,5 × 16,5 × 26,5	B32653-A3684-+***	500	500	510
	1,0 µF	10,5 × 16,5 × 26,5	B32653-A3105-+***	400	400	540
400 V_{dc} (200 V_{ac})	0,15 µF	6,0 × 15,0 × 26,5	B32653-A4154-+***	690	700	720
	0,22 µF	6,0 × 15,0 × 26,5	B32653-A4224-+***	690	700	720
	0,33 µF	7,0 × 16,0 × 26,5	B32653-A4334-+***	590	600	630
	0,47 µF	8,5 × 16,5 × 26,5	B32653-A4474-+***	500	500	510
	0,68 µF	10,5 × 16,5 × 26,5	B32653-A4684-+***	400	400	540
	1,0 µF	11,0 × 20,5 × 26,5	B32653-A4105-+***	380	350	510
630 V_{dc} (250 V_{ac})	0,10 µF	6,0 × 15,0 × 26,5	B32653-A6104-+***	690	700	720
	0,15 µF	6,0 × 15,0 × 26,5	B32653-A6154-+***	690	700	720
	0,22 µF	8,5 × 16,5 × 26,5	B32653-A6224-+***	500	500	510
	0,33 µF	10,5 × 16,5 × 26,5	B32653-A6334-+***	400	400	540
	0,47 µF	11,0 × 20,5 × 26,5	B32653-A6474-+***	380	350	510
1000 V_{dc} (250 V_{ac})	33 nF	6,0 × 15,0 × 26,5	B32653-A333-+***	690	700	720
	47 nF	6,0 × 15,0 × 26,5	B32653-A473-+***	690	700	720
	68 nF	6,0 × 15,0 × 26,5	B32653-A683-+***	690	700	720
	0,10 µF	8,5 × 16,5 × 26,5	B32653-A104-+***	500	500	510
	0,15 µF	10,5 × 16,5 × 26,5	B32653-A154-+***	400	400	540
	0,22 µF	11,0 × 20,5 × 26,5	B32653-A224-+***	380	350	510
1250 V_{dc} (500 V_{ac})	22 nF	6,0 × 15,0 × 26,5	B32653-A7223-+***	690	700	720
	33 nF	6,0 × 15,0 × 26,5	B32653-A7333-+***	690	700	720
	47 nF	8,5 × 16,5 × 26,5	B32653-A7473-+***	500	500	510
	68 nF	10,5 × 16,5 × 26,5	B32653-A7683-+***	400	400	540
	0,10 µF	11,0 × 20,5 × 26,5	B32653-A7104-+***	380	350	510

1) For instructions on how to determine the ordering code refer to page 123.

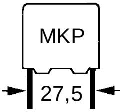


Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms} $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
1600 V_{dc} (500 V_{ac})	6,8 nF	6,0 × 15,0 × 26,5	B32653-A1682-+***	690	700	720
	10 nF	6,0 × 15,0 × 26,5	B32653-A1103-+***	690	700	720
	15 nF	7,0 × 16,0 × 26,5	B32653-A1153-+***	590	600	630
	22 nF	8,5 × 16,5 × 26,5	B32653-A1223-+***	500	500	510
	33 nF	10,5 × 16,5 × 26,5	B32653-A1333-+***	400	400	540
	47 nF	11,0 × 20,5 × 26,5	B32653-A1473-+***	380	350	510
2000 V_{dc} (700 V_{ac})	1,0 nF	6,0 × 15,0 × 26,5	B32653-A2102-+***	690	700	720
	1,5 nF	6,0 × 15,0 × 26,5	B32653-A2152-+***	690	700	720
	2,2 nF	6,0 × 15,0 × 26,5	B32653-A2222-+***	690	700	720
	3,3 nF	6,0 × 15,0 × 26,5	B32653-A2332-+***	690	700	720
	4,7 nF	6,0 × 15,0 × 26,5	B32653-A2472-+***	690	700	720
	6,8 nF	8,5 × 16,5 × 26,5	B32653-A2682-+***	500	500	510
	10 nF	10,5 × 16,5 × 26,5	B32653-A2103-+***	400	400	540
	15 nF	11,0 × 20,5 × 26,5	B32653-A2153-+***	380	350	510

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32653-A1682-K3



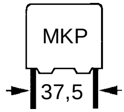
B 32 654

Ordering codes and packing units, lead spacing 27,5 mm

V_R (V_{rms} $f \le 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
250 V_{dc}	1,5 µF	11,0 × 21,0 × 31,5	B32654-A3155-+***	–	350	320
(160 V_{ac})	2,2 µF	12,5 × 21,5 × 31,5	B32654-A3225-+***	–	300	280
	3,3 µF	15,0 × 24,5 × 31,5	B32654-A3335-+***	–	–	240
	4,7 µF	18,0 × 27,5 × 31,5	B32654-A3475-+***	–	–	200
400 V_{dc}	1,0 µF	11,0 × 21,0 × 31,5	B32654-A4105-+***	–	350	320
(200 V_{ac})	1,5 µF	12,5 × 21,5 × 31,5	B32654-A4155-+***	–	300	280
	2,2 µF	14,0 × 24,5 × 31,5	B32654-A4225-+***	–	–	260
	3,3 µF	19,0 × 30,0 × 31,5	B32654-A4335-+***	–	–	180
630 V_{dc}	0,68 µF	11,0 × 21,0 × 31,5	B32654-A6684-+***	–	350	320
(250 V_{ac})	1,0 µF	13,5 × 23,0 × 31,5	B32654-A6105-+***	–	250	260
	1,5 µF	18,0 × 27,5 × 31,5	B32654-A6155-+***	–	–	200
1000 V_{dc}	0,22 µF	11,0 × 21,0 × 31,5	B32654-A224-+***	–	350	320
(250 V_{ac})	0,33 µF	11,0 × 21,0 × 31,5	B32654-A334-+***	–	350	320
	0,47 µF	14,0 × 24,5 × 31,5	B32654-A474-+***	–	–	260
	0,68 µF	18,0 × 27,5 × 31,5	B32654-A684-+***	–	–	200
1250 V_{dc}	0,10 µF	11,0 × 21,0 × 31,5	B32654-A7104-+***	–	350	320
(500 V_{ac})	0,15 µF	11,0 × 21,0 × 31,5	B32654-A7154-+***	–	350	320
	0,22 µF	14,0 × 24,5 × 31,5	B32654-A7224-+***	–	–	260
	0,33 µF	18,0 × 27,5 × 31,5	B32654-A7334-+***	–	–	200
1600 V_{dc}	47 nF	11,0 × 21,0 × 31,5	B32654-A1473-+***	–	350	320
(500 V_{ac})	68 nF	11,0 × 21,0 × 31,5	B32654-A1683-+***	–	350	320
	0,10 µF	14,0 × 24,5 × 31,5	B32654-A1104-+***	–	–	260
	0,15 µF	18,0 × 27,5 × 31,5	B32654-A1154-+***	–	–	200
2000 V_{dc}	22 nF	11,0 × 21,0 × 31,5	B32654-A2223-+***	–	350	320
(700 V_{ac})	33 nF	13,5 × 23,0 × 31,5	B32654-A2333-+***	–	250	260
	47 nF	18,0 × 27,5 × 31,5	B32654-A2473-+***	–	–	200
	68 nF	19,0 × 30,0 × 31,5	B32654-A2683-+***	–	–	180

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32654-A4105-K3

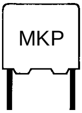


Ordering codes and packing units, lead spacing 37,5 mm

V_R (V_{rms} $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
1000 V_{dc} (500 V_{ac})	0,47 µF	16,0 × 25,0 × 41,5	B32656-A474-+	–	–	40
	0,68 µF	16,0 × 28,5 × 41,5	B32656-A684-+	–	–	35
	1,0 µF	20,0 × 39,5 × 41,5	B32656-A105-+	–	–	30
1250 V_{dc} (500 V_{ac})	0,33 µF	16,0 × 28,5 × 41,5	B32656-A7334-+	–	–	35
	0,47 µF	18,0 × 32,5 × 41,5	B32656-A7474-+	–	–	30
	0,68 µF	20,0 × 39,5 × 41,5	B32656-A7684-+	–	–	30

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
For capacitors with 3,2 mm wire leads, append code number “3” to the tolerance code, e.g.: B32656-A474-K3



Technical data

Climatic category in accordance with IEC 68-1	55/100/56
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 100 °C
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ — $\leq$ 3 % Dissipation factor change $\Delta \tan \delta$ — $\leq 0{,}5 \cdot 10^{-3}$ (at 1 kHz); $\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ — $\geq$ 50 % of minimum as-delivered values
Reliability:	
Reference conditions Failure rate	$0{,}5 \cdot V_R$; 40 °C $1 \cdot 10^{-9}$/h = 1 fit For a conversion table for other operating conditions and temperatures refer to page 247.
Service life	200 000 h
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ — > 10 % Dissipation factor $\tan \delta$ — > 4 · upper limit values Insulation resistance R_{is} — < 1500 MΩ ($C_R \leq 0{,}33$ µF) or time constant $\tau = C_R \cdot R_{is}$ — < 500 s ($C_R > 0{,}33$ µF)
DC test voltage	$1{,}6 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 1 kHz	$T \leq$ 85 °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$ T = 100 °C: $V_C = 0{,}7 \cdot V_R$ or $0{,}7 \cdot V_{rms}$

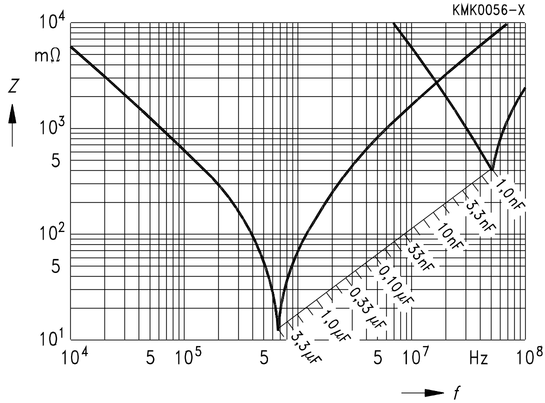
Dissipation factor $\tan \delta$ (in 10^{-3})
at 20 °C
(upper limit values)

	$C_R \leq 0{,}1$ µF	$0{,}1$ µF $< C_R \leq 1$ µF	$C_R > 1$ µF
at 1 kHz	–	0,5	0,5
10 kHz	–	0,8	1,5
100 kHz	5,0	–	–

Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$
at 20 °C, rel. humidity $\leq$ 65 %
(minimum as-delivered values)

$C_R \leq 0{,}33$ µF	$C_R > 0{,}33$ µF
100 GΩ	30 000 s

Impedance *Z*
versus
frequency *f*
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)			
	Lead spacing			
	15 mm	22,5 mm	27,5 mm	37,5 mm
250 V_{dc}	140	80	50	–
400 V_{dc}	200	100	70	–
630 V_{dc}	270	140	100	–
1000 V_{dc}	400	230	150	90
1250 V_{dc}	800	500	400	140
1600 V_{dc}	1500	1000	700	–
2000 V_{dc}	–	1400	900	–

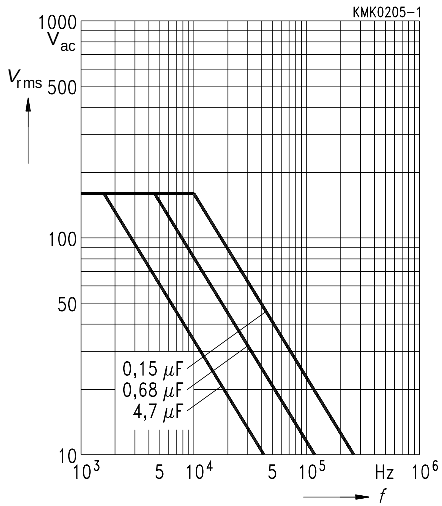
For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 220.

V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)			
	Lead spacing			
	15 mm	22,5 mm	27,5 mm	37,5 mm
250 V_{dc}	70 000	40 000	25 000	–
400 V_{dc}	160 000	80 000	55 000	–
630 V_{dc}	340 000	170 000	120 000	–
1000 V_{dc}	800 000	450 000	300 000	180 000
1250 V_{dc}	2 000 000	1 250 000	1 000 000	350 000
1600 V_{dc}	4 800 000	3 200 000	2 200 000	–
2000 V_{dc}	–	5 600 000	3 600 000	–

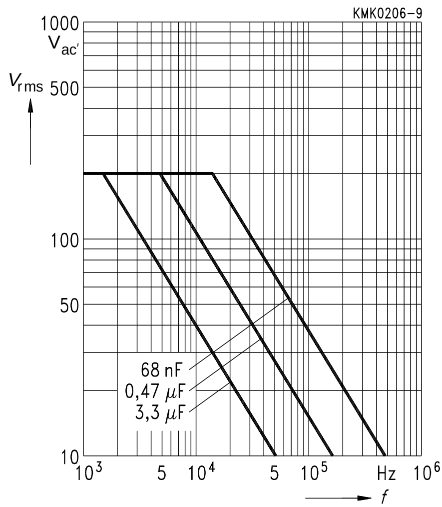
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 … 37,5 mm

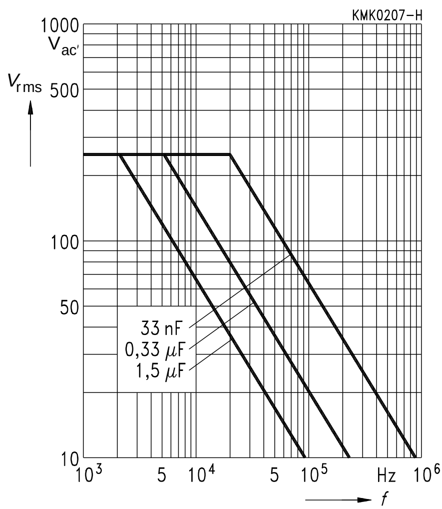
250 V_{dc} / 160 V_{ac}



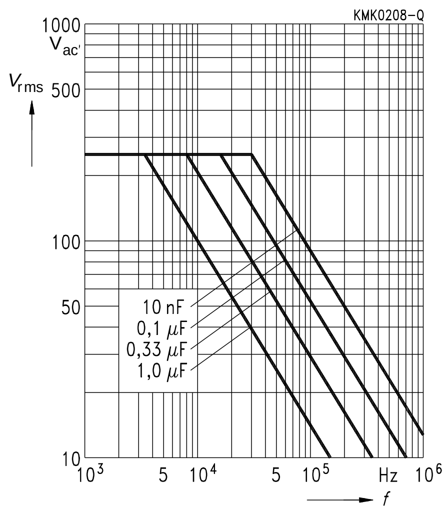
400 V_{dc} / 200 V_{ac}



630 V_{dc} / 250 V_{ac}



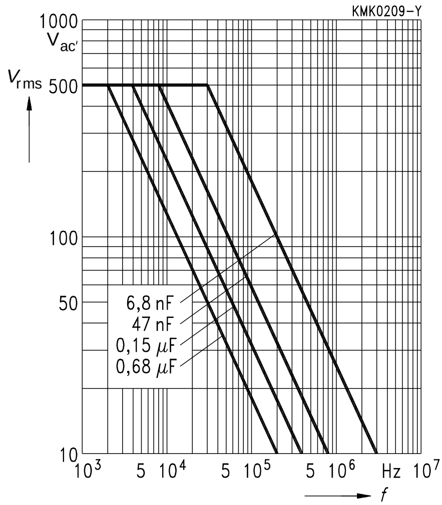
1000 V_{dc} / 250 V_{ac}



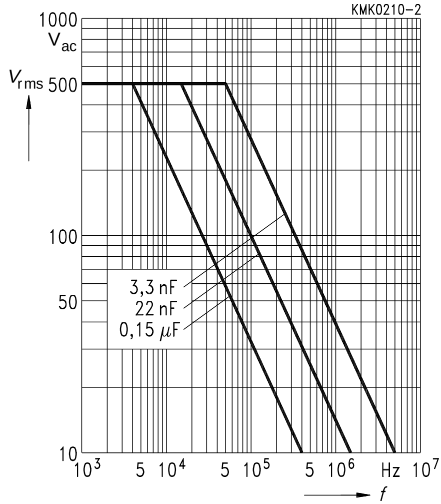
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 … 37,5 mm

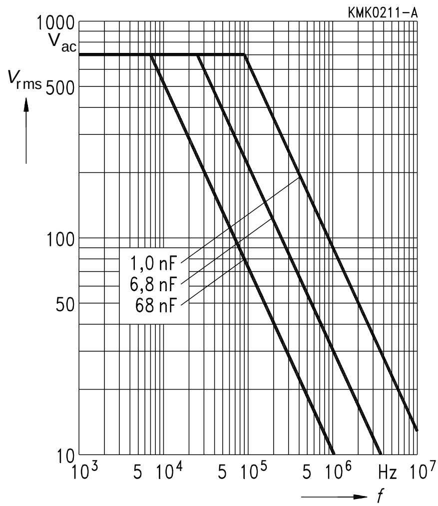
1250 V_{dc} / 500 V_{ac}



1600 V_{dc} / 500 V_{ac}



2000 V_{dc} / 700 V_{ac}



Wound MKP capacitors

Construction

- Dielectric: polypropylene
- Wound capacitor technology
- Epoxy resin coating (UL 94 V-0)

Features

- High pulse strength

Typical applications

- TV S-correction
- Electronic ballast circuits
- High pulse load applications
- AC applications

Terminals

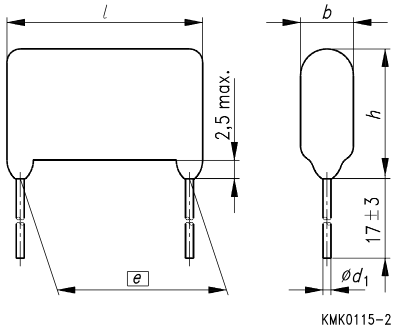
- Parallel wire leads, tinned

Marking

Manufacturer's logo,
style (MKP),
rated capacitance,
capacitance tolerance (code letter),
rated dc voltage

Delivery mode

Bulk (untaped)



Dimensions in mm

Lead spacing e ± 0,8	Diameter d_1	Type
15,0	0,8	B 32 612
22,5	0,8	B 32 613
27,5	0,8	B 32 614

Overview of available types

<table>
<tr><td>Lead spac-
ing</td><td colspan="2">15 mm</td><td colspan="2">22,5 mm</td><td colspan="2">27,5 mm</td></tr>
<tr><td>Type</td><td colspan="2">B 32 612</td><td colspan="2">B 32 613</td><td colspan="2">B 32 614</td></tr>
<tr><td>Page</td><td colspan="2">133</td><td colspan="2">133</td><td colspan="2">133</td></tr>
<tr><td>68 nF</td><td></td><td rowspan="4">400V_{dc}</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,10 µF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,15 µF</td><td rowspan="3">250 V_{dc}</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,22 µF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,33 µF</td><td></td><td></td><td rowspan="3">400 V_{dc}</td><td></td><td></td></tr>
<tr><td>0,47 µF</td><td></td><td></td><td rowspan="3">250 V_{dc}</td><td></td><td></td></tr>
<tr><td>0,68 µF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,0 µF</td><td></td><td></td><td></td><td></td><td rowspan="3">400 V_{dc}</td></tr>
<tr><td>1,5 µF</td><td></td><td></td><td></td><td></td><td rowspan="2">250 V_{dc}</td></tr>
<tr><td>2,2 µF</td><td></td><td></td><td></td><td></td></tr>
</table>

Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms} $f \leq$ 1 kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
250 V_{dc} (160 V_{ac})	0,15 µF	6,0 × 11,5 × 18,0	B32612-A3154-+	1000
	0,22 µF	8,0 × 13,5 × 18,0	B32612-A3224-+	1000
	0,33 µF	9,5 × 15,5 × 18,0	B32612-A3334-+	500
400 V_{dc} (200 V_{ac})	68 nF	6,0 × 11,5 × 18,0	B32612-A4683-+	1000
	0,10 µF	7,0 × 12,0 × 18,0	B32612-A4104-+	1000
	0,15 µF	8,0 × 13,5 × 18,0	B32612-A4154-+	1000
	0,22 µF	9,5 × 15,5 × 18,0	B32612-A4224-+	500

Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms} $f \leq$ 1 kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
250 V_{dc} (160 V_{ac})	0,47 µF	8,0 × 17,0 × 26,5	B32613-A3474-+	500
	0,68 µF	9,5 × 17,5 × 26,5	B32613-A3684-+	250
	1,0 µF	11,5 × 17,5 × 26,5	B32613-A3105-+	250
400 V_{dc} (200 V_{ac})	0,33 µF	8,0 × 17,0 × 26,5	B32613-A4334-+	500
	0,47 µF	9,5 × 17,5 × 26,5	B32613-A4474-+	250
	0,68 µF	11,5 × 17,5 × 26,5	B32613-A4684-+	250

Ordering codes and packaging units, lead spacing 27,5 mm

V_R (V_{rms} $f \leq$ 1 kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Untaped
250 V_{dc} (160 V_{ac})	1,5 µF	12,0 × 22,0 × 31,5	B32614-A3155-+	200
	2,2 µF	13,5 × 22,5 × 31,5	B32614-A3225-+	200
400 V_{dc} (200 V_{ac})	1,0 µF	12,0 × 22,0 × 31,5	B32614-A4105-+	200
	1,5 µF	13,5 × 22,5 × 31,5	B32614-A4155-+	200
	2,2 µF	15,0 × 25,5 × 31,5	B32614-A4225-+	150

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J

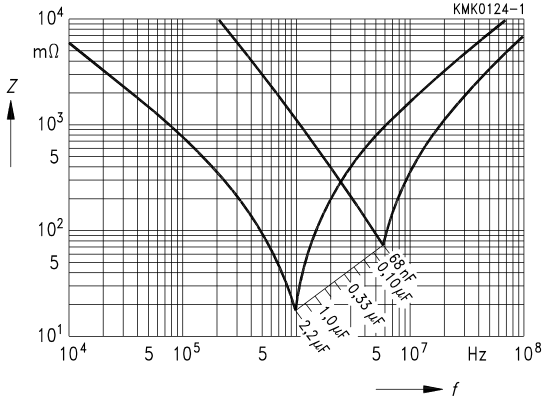
Customized capacitance ratings and lead spacings upon request.

1) Replace the + by the code letter for the required capacitance tolerance.

Technical data

Climatic category in accordance with IEC 68-1	55/085/56
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 85 °C
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ $\leq$ 3 % Dissipation factor change Δ tan δ $\leq 0,5 \cdot 10^{-3}$ (at 1 kHz) $\leq 1,0 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} $\geq$ 50 % of minimum or time constant $\tau = C_R \cdot R_{is}$ as-delivered values
Reliability: Reference conditions Failure rate	 $0,5 \cdot V_R$; 40 °C $2 \cdot 10^{-9}$/h = 2 fit For a conversion table for other operating conditions and temperatures refer to page 247.
Service life	200 000 h
Failure criteria: Total failure Failure due to variation of parameters	Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ > 10 % Dissipation factor tan δ > 4 · upper limit values Insulation resistance R_{is} < 1500 MΩ ($C_R \leq$0,33 µF) or time constant $\tau = C_R \cdot R_{is}$ < 500 s (C_R >0,33 µF)
DC test voltage	$1,6 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 1 kHz	$T \leq$ 85 °C: $V_C = 1,0 \cdot V_R$ or $1,0 \cdot V_{rms}$ T = 100 °C: $V_C = 0,7 \cdot V_R$ or $0,7 \cdot V_{rms}$ for max. 2000 h
Dissipation factor tan δ at 20 °C (upper limit values)	$1,0 \cdot 10^{-3}$ at 10 kHz
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity $\leq$ 65 % (minimum as-delivered values)	$C_R \leq$ 0,33 µF: 25 GΩ C_R > 0,33 µF: 7500 s

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)		
	Lead spacing		
	15 mm	22,5 mm	27,5 mm
250 V_{dc}	50	25	20
400 V_{dc}	50	30	20

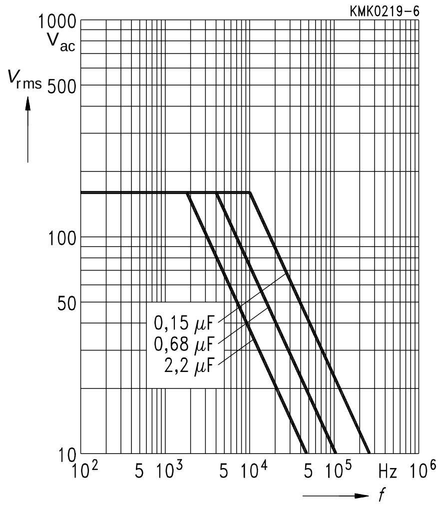
For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}.
Also refer to the calculation example on page 220.

V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)		
	Lead spacing		
	15 mm	22,5 mm	27,5 mm
250 V_{dc}	25 000	12 500	10 000
400 V_{dc}	40 000	24 000	16 000

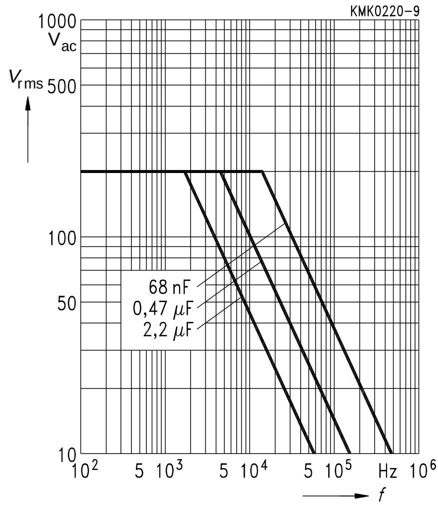
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 … 27,5 mm

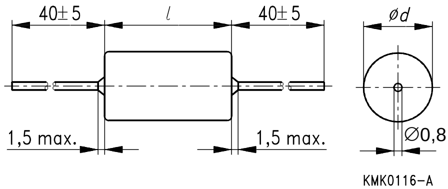
250 V_{dc} / 160 V_{ac}



400 V_{dc} / 200 V_{ac}



Rated AC voltages 250 and 400 V (50/60 Hz)
Not suitable for connection in parallel to line!



Dimensions in mm

When bending leads, take care to leave a clearance of 1 mm to the capacitor body.

Construction

- Dielectric: polypropylene
- Cylindrical winding
- Insulating sleeve
- Face ends sealed with epoxy resin

Features

- Good self-healing properties

Typical applications

- Electronic ballast circuits

Terminals

- Central axial wire leads, tinned

Marking

Manufacturer’s logo,
style (MKP),
rated capacitance,
capacitance tolerance (code letter),
rated ac voltage

Delivery mode

Bulk (untaped)

Ordering codes and packing units

V_R	C_R	Maximum dimensions $d_{max} \times l_{max}$ (mm)	Ordering code[1)]	Packing units (pcs) Untaped
250 V_{ac}	1,0 µF	13,0 × 36,0	B32669-A3105-+	200
	1,5 µF	15,5 × 36,0	B32669-A3155-+	200
	2,0 µF	17,5 × 36,0	B32669-A3205-+	200
	2,5 µF	19,5 × 36,0	B32669-A3255-+	200
	3,0 µF	18,5 × 44,0	B32669-A3305-+	150
	4,0 µF	21,0 × 44,0	B32669-A3405-+	150
400 V_{ac}	1,0 µF	15,0 × 36,0	B32669-A6105-+	200
	1,5 µF	18,0 × 36,0	B32669-A6155-+	200
	2,0 µF	20,5 × 36,0	B32669-A6205-+	200
	2,5 µF	23,0 × 36,0	B32669-A6255-+	150
	3,0 µF	22,0 × 44,0	B32669-A6305-+	150

Capacitance tolerance: ±10 % $\hat{=}$ K, ±5 % $\hat{=}$ J

1) Replace the + by the code letter for the required capacitance tolerance.

Technical data

Climatic category in accordance with IEC 68-1	55/085/56	
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 85 °C	
Damp heat test	56 days/40 °C/93 % relative humidity	
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ Dissipation factor change Δ tan δ Time constant $\tau = C_R \cdot R_{is}$	≤ 3 % $\leq 0{,}5 \cdot 10^{-3}$ (at 1 kHz) $\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz) ≥ 50 % of minimum as-delivered values
DC test voltage	V_R = 250 V_{ac}: 600 V_{dc}, 1 s V_R = 400 V_{ac}: 800 V_{dc}, 1 s	
AC test voltage	V_R= 250 V_{ac}: 500 V_{ac}, 1 s V_R = 400 V_{ac}: 700 V_{ac}, 1 s	
Dissipation factor tan δ at 20 °C (upper limit values)	$2{,}0 \cdot 10^{-3}$ at 1 kHz	
Time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	2500 s	
Pulse handling capability (Rate of voltage rise V_{pp}/τ)	≤ 10 V/µs	

Permissible ac voltage V_{rms} versus frequency *f*

Values can be obtained upon request. In specific cases, please provide a scaled voltage/time graph and state operating conditions.

MFP pulse capacitors
with highest possible contact reliability

Construction

- Dielectric: polypropylene
- Film metallized on one side and metal foils internally connected in series
- Plastic case (UL 94 V-0)
- Epoxy resin sealing

Features

- Very high pulse strength
- Highest possible contact reliability
- Self-healing properties

Typical applications

- Pulse circuits with steep voltage rise rates
- High-frequency ac loads
- Snubbering of power semiconductors

Terminals

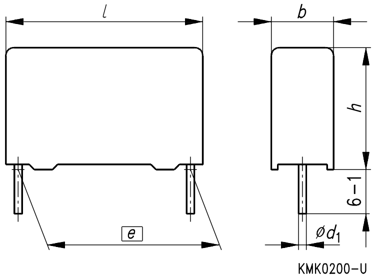
- Parallel wire leads, tinned
- Also available with (3,2 ± 0,3) mm lead length

Marking

Manufacturer's logo,
lot number for lead spacing ≤ 27,5 mm
style (MFP),
rated capacitance (coded),
capacitance tolerance (code letter),
rated dc voltage,
date of manufacture (coded)

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reels)
For notes on taping refer to page 252.

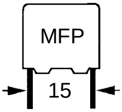


Dimensions in mm

Lead spacing e ± 0,4	Diameter d_1	Type
15,0	0,8	B 32 682
22,5	0,8	B 32 683
27,5	0,8	B 32 684
37,5	1,0	B 32 686

Overview of available types

Lead spacing	15 mm					22,5 mm					27,5 mm					37,5 mm			
Type	B 32 682					B 32 683					B 32 684					B 32 686			
Page	142					144					145					146			
	630 V_{dc}	1000 V_{dc}	1250 V_{dc}	1600 V_{dc}	2000 V_{dc}	630 V_{dc}	1000 V_{dc}	1250 V_{dc}	1600 V_{dc}	2000 V_{dc}	630 V_{dc}	1000 V_{dc}	1250 V_{dc}	1600 V_{dc}	2000 V_{dc}	1000 V_{dc}	1250 V_{dc}	1600 V_{dc}	2000 V_{dc}
0,47 nF					■														
0,68 nF				■	■														
1,0 nF			■	■	■														
1,5 nF		■	■	■	■														
2,2 nF	■	■	■	■	■					■									
3,3 nF	■	■	■	■	■					■									
4,7 nF	■	■	■	■	■					■									
6,8 nF	■	■	■	■					■	■									
10 nF	■	■	■				■	■	■	■									
15 nF	■	■					■	■	■	■					■				
22 nF	■						■	■	■						■				■
33 nF	■					■	■	■						■	■				■
47 nF	■					■	■					■	■	■	■			■	■
68 nF						■						■	■	■			■	■	■
0,10 µF						■						■	■	■		■	■	■	
0,15 µF						■					■	■	■			■	■	■	
0,22 µF											■					■	■		
0,33 µF											■					■	■		
0,47 µF											■					■			

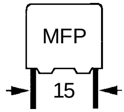


B 32 682

Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
630 V_{dc} (300 V_{ac})	2,2 nF	5,0 × 10,5 × 18,0	B32682-A6222-+***	1180	1300	1000
	3,3 nF	5,0 × 10,5 × 18,0	B32682-A6332-+***	1180	1300	1000
	4,7 nF	5,0 × 10,5 × 18,0	B32682-A6472-+***	1180	1300	1000
	6,8 nF	5,0 × 10,5 × 18,0	B32682-A6682-+***	1180	1300	1000
	10 nF	5,0 × 10,5 × 18,0	B32682-A6103-+***	1180	1300	1000
	15 nF	6,0 × 11,0 × 18,0	B32682-A6153-+***	1000	1100	1000
	22 nF	7,0 × 12,5 × 18,0	B32682-A6223-+***	840	900	1000
	33 nF	8,5 × 14,5 × 18,0	B32682-A6333-+***	690	700	500
	47 nF	9,0 × 17,5 × 18,0	B32682-A6473-+***	660	700	500
1000 V_{dc} (400 V_{ac})	1,5 nF	5,0 × 10,5 × 18,0	B32682-A152-+***	1180	1300	1000
	2,2 nF	5,0 × 10,5 × 18,0	B32682-A222-+***	1180	1300	1000
	3,3 nF	5,0 × 10,5 × 18,0	B32682-A332-+***	1180	1300	1000
	4,7 nF	6,0 × 11,0 × 18,0	B32682-A472-+***	1000	1100	1000
	6,8 nF	7,0 × 12,5 × 18,0	B32682-A682-+***	840	900	1000
	10 nF	8,5 × 14,5 × 18,0	B32682-A103-+***	690	700	500
	15 nF	9,0 × 17,5 × 18,0	B32682-A153-+***	660	700	500
1250 V_{dc} (450 V_{ac})	1,0 nF	5,0 × 10,5 × 18,0	B32682-A7102-+***	1180	1300	1000
	1,5 nF	5,0 × 10,5 × 18,0	B32682-A7152-+***	1180	1300	1000
	2,2 nF	5,0 × 10,5 × 18,0	B32682-A7222-+***	1180	1300	1000
	3,3 nF	6,0 × 11,0 × 18,0	B32682-A7332-+***	1000	1100	1000
	4,7 nF	7,0 × 12,5 × 18,0	B32682-A7472-+***	840	900	1000
	6,8 nF	8,5 × 14,5 × 18,0	B32682-A7682-+***	690	700	500
	10 nF	9,0 × 17,5 × 18,0	B32682-A7103-+***	660	700	500
1600 V_{dc} (450 V_{ac})	0,68 nF	5,0 × 10,5 × 18,0	B32682-A1681-+***	1180	1300	1000
	1,0 nF	5,0 × 10,5 × 18,0	B32682-A1102-+***	1180	1300	1000
	1,5 nF	5,0 × 10,5 × 18,0	B32682-A1152-+***	1180	1300	1000
	2,2 nF	6,0 × 11,0 × 18,0	B32682-A1222-+***	1000	1100	1000
	3,3 nF	7,0 × 12,5 × 18,0	B32682-A1332-+***	840	900	1000
	4,7 nF	8,5 × 14,5 × 18,0	B32682-A1472-+***	690	700	500
	6,8 nF	9,0 × 17,5 × 18,0	B32682-A1682-+***	660	700	500

1) For instructions on how to determine the ordering code, refer to page 143.

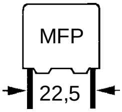


Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms}, $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
2000 V_{dc} (500 V_{ac})	0,47 nF	5,0 × 10,5 × 18,0	B32682-A2471-+***	1180	1300	1000
	0,68 nF	5,0 × 10,5 × 18,0	B32682-A2681-+***	1180	1300	1000
	1,0 nF	5,0 × 10,5 × 18,0	B32682-A2102-+***	1180	1300	1000
	1,5 nF	6,0 × 11,0 × 18,0	B32682-A2152-+***	1000	1100	1000
	2,2 nF	7,0 × 12,5 × 18,0	B32682-A2222-+***	840	900	1000
	3,3 nF	8,5 × 14,5 × 18,0	B32682-A2332-+***	690	700	500
	4,7 nF	9,0 × 17,5 × 18,0	B32682-A2472-+***	660	700	500

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number "3" to the tolerance code, e.g.: B32682-A2471-K3



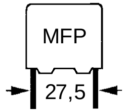
B 32 683

Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms}, $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
630 V_{dc} (300 V_{ac})	33 nF	6,0 × 15,0 × 26,5	B32683-A6333-+***	690	700	720
	47 nF	7,0 × 16,0 × 26,5	B32683-A6473-+***	590	600	630
	68 nF	8,5 × 16,5 × 26,5	B32683-A6683-+***	500	500	510
	0,10 µF	10,5 × 16,5 × 26,5	B32683-A6104-+***	400	400	540
	0,15 µF	11,0 × 20,5 × 26,5	B32683-A6154-+***	380	350	510
1000 V_{dc} (400 V_{ac})	10 nF	6,0 × 15,0 × 26,5	B32683-A103-+***	690	700	720
	15 nF	6,0 × 15,0 × 26,5	B32683-A153-+***	690	700	720
	22 nF	7,0 × 16,0 × 26,5	B32683-A223-+***	590	600	630
	33 nF	8,5 × 16,5 × 26,5	B32683-A333-+***	500	500	510
	47 nF	10,5 × 18,5 × 26,5	B32683-A473-+***	400	400	540
1250 V_{dc} (450 V_{ac})	10 nF	6,0 × 15,0 × 26,5	B32683-A7103-+***	690	700	720
	15 nF	7,0 × 16,0 × 26,5	B32683-A7153-+***	590	600	630
	22 nF	8,5 × 16,5 × 26,5	B32683-A7223-+***	500	500	510
	33 nF	10,5 × 18,5 × 26,5	B32683-A7333-+***	400	400	540
1600 V_{dc} (450 V_{ac})	6,8 nF	6,0 × 15,0 × 26,5	B32683-A1682-+***	690	700	720
	10 nF	7,0 × 16,0 × 26,5	B32683-A1103-+***	590	600	630
	15 nF	8,5 × 16,5 × 26,5	B32683-A1153-+***	500	500	510
	22 nF	10,5 × 18,5 × 26,5	B32683-A1223-+***	400	400	540
2000 V_{dc} (500 V_{ac})	2,2 nF	6,0 × 15,0 × 26,5	B32683-A2223-+***	690	700	720
	3,3 nF	6,0 × 15,0 × 26,5	B32683-A2332-+***	690	700	720
	4,7 nF	7,0 × 16,0 × 26,5	B32683-A2472-+***	590	600	630
	6,8 nF	8,5 × 16,5 × 26,5	B32683-A2682-+***	500	500	510
	10 nF	10,5 × 16,5 × 26,5	B32683-A2103-+***	400	400	540
	15 nF	11,0 × 20,5 × 26,5	B32683-A2153-+***	380	350	510

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32683-A2472-K3

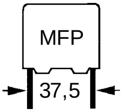


Ordering codes and packing units, lead spacing 27,5 mm

V_R (V_{rms}, $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
630 V_{dc}	0,15 µF	11,0 × 21,0 × 31,5	B32684-A6154-+***	–	350	320
(300 V_{ac})	0,22 µF	12,5 × 21,5 × 31,5	B32684-A6224-+***	–	300	280
	0,33 µF	15,0 × 24,5 × 31,5	B32684-A6334-+	–	–	240
	0,47 µF	18,0 × 27,5 × 31,5	B32684-A6474-+	–	–	200
1000	47 nF	11,0 × 21,0 × 31,5	B32684-A473-+***	–	350	320
V_{dc}	68 nF	11,0 × 21,0 × 31,5	B32684-A683-+***	–	350	320
(400 V_{ac})						
	0,10 µF	12,5 × 21,5 × 31,5	B32684-A104-+***	–	300	280
	0,15 µF	18,0 × 27,5 × 31,5	B32684-A154-+	–	–	200
1250	47 nF	11,0 × 21,0 × 31,5	B32684-A7473-+***	–	350	320
V_{dc}	68 nF	13,5 × 23,0 × 31,5	B32684-A7683-+***	–	250	260
(450 V_{ac})						
	0,10 µF	15,0 × 24,5 × 31,5	B32684-A7104-+	–	–	240
	0,15 µF	19,0 × 30,0 × 31,5	B32684-A7154-+	–	–	180
1600	33 nF	11,0 × 21,0 × 31,5	B32684-A1333-+***	–	350	320
V_{dc}	47 nF	12,5 × 21,5 × 31,5	B32684-A1473-+***	–	300	280
(450 V_{ac})						
	68 nF	15,0 × 24,5 × 31,5	B32684-A1683-+	–	–	240
	0,10 µF	19,0 × 30,0 × 31,5	B32684-A1104-+	–	–	180
2000	15 nF	11,0 × 21,0 × 31,5	B32684-A2153-+***	–	350	320
V_{dc}	22 nF	11,0 × 21,0 × 31,5	B32684-A2223-+***	–	350	320
(500 V_{ac})						
	33 nF	14,0 × 24,5 × 31,5	B32684-A2333-+	–	–	260
	47 nF	18,0 × 27,5 × 31,5	B32684-A2473-+	–	–	200

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32684-A6154-K3



B 32 686

Ordering codes and packing units, lead spacing 37,5 mm

V_R (V_{rms}, $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing unit (pcs) Untaped
1000 V_{dc} (400 V_{ac})	0,10 µF	12,0 × 22,0 × 41,5	B32686-A104-+	45
	0,15 µF	14,0 × 25,0 × 41,5	B32686-A154-+	40
	0,22 µF	16,0 × 28,5 × 41,5	B32686-A224-+	35
	0,33 µF	20,0 × 39,5 × 41,5	B32686-A334-+	30
	0,47 µF	20,0 × 39,5 × 41,5	B32686-A474-+	30
1250 V_{dc} (450 V_{ac})	68 nF	12,0 × 22,0 × 41,5	B32686-A7683-+	45
	0,10 µF	14,0 × 25,0 × 41,5	B32686-A7104-+	40
	0,15 µF	16,0 × 28,5 × 41,5	B32686-A7154-+	35
	0,22 µF	18,0 × 32,5 × 41,5	B32686-A7224-+	30
	0,33 µF	20,0 × 39,5 × 41,5	B32686-A7334-+	30
1600 V_{dc} (450 V_{ac})	47 nF	12,0 × 22,0 × 41,5	B32686-A1473-+	45
	68 nF	14,0 × 25,0 × 41,5	B32686-A1683-+	40
	0,10 µF	18,0 × 32,5 × 41,5	B32686-A1104-+	30
	0,15 µF	20,0 × 39,5 × 41,5	B32686-A1154-+	30
2000 V_{dc} (500 V_{ac})	22 nF	12,0 × 22,0 × 41,5	B32686-A2223-+	45
	33 nF	14,0 × 25,0 × 41,5	B32686-A2333-+	40
	47 nF	16,0 × 28,5 × 41,5	B32686-A2473-+	35
	68 nF	18,0 × 32,5 × 41,5	B32686-A2683-+	30
	0,10 µF	20,0 × 39,5 × 41,5	B32686-A2104-+	30

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

1) Replace the + by the code letter for the required capacitance tolerance.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32686-A104-K3

Technical data

Climatic category in accordance with IEC 68-1	55/085/56
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 85 °C
Damp heat test	56 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ $\leq$ 2 % Dissipation factor change Δ tan δ $\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} $\geq$ 50 % of minimum or time constant $\tau = C_R \cdot R_{is}$ as-delivered values
Reliability: Reference conditions Failure rate Service life Failure criteria: Total failure Failure due to variation of parameters	 $0{,}5 \cdot V_R$; 40 °C $1 \cdot 10^{-9}$/h = 1 fit For a conversion table for other operating conditions and temperatures refer to page 247. 200 000 h Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ > 10 % Dissipation factor tan δ 4 · upper limit values Insulation resistance R_{is} < 1500 MΩ ($C_R \leq$ 0,33 µF) or time constant $\tau = C_R \cdot R_{is}$ < 500 s ($C_R >$ 0,33 µF)
DC test voltage	$2{,}0 \cdot V_R$, 2 s
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 1 kHz	$T \leq$ 85 °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)	see table below
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity $\leq$ 65 % (minimum as-delivered values)	see table below

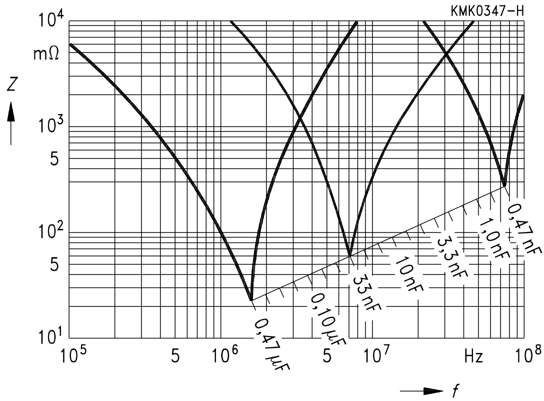
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values):

	$C_R \leq$ 0,1 µF	$C_R >$ 0,1 µF
at 1 kHz	–	0,4
10 kHz	0,4	0,5
100 kHz	1,0	–

Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ (minimum as-delivered values):

$C_R \leq$ 0,33 µF	$C_R >$ 0,33 µF
100 GΩ	30 000 s

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)			
	Lead spacing			
	15 mm	22,5 mm	27,5 mm	37,5 mm
630 V_{dc}	5000	3000	2000	1300
1000 V_{dc}	9000	5000	3800	2000
1250 V_{dc}	12000	7000	4500	2800
1600 V_{dc}	14000	9000	5500	3500
2000 V_{dc}	17000	12000	7000	4500

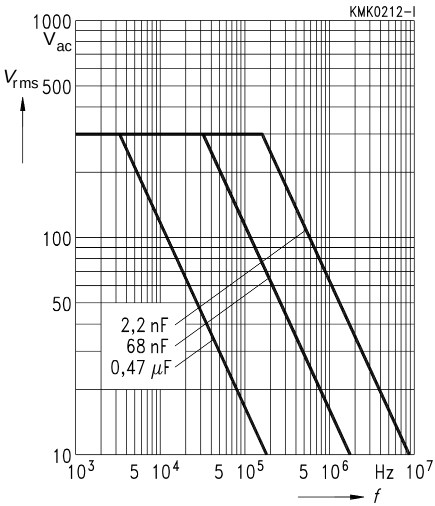
For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 220.

V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)			
	Lead spacing			
	15 mm	22,5 mm	27,5 mm	37,5 mm
630 V_{dc}	6300000	3800000	2500000	1600000
1000 V_{dc}	18000000	10000000	7500000	4000000
1250 V_{dc}	30000000	17500000	11000000	7000000
1600 V_{dc}	45000000	29000000	17500000	11000000
2000 V_{dc}	68000000	48000000	28000000	18000000

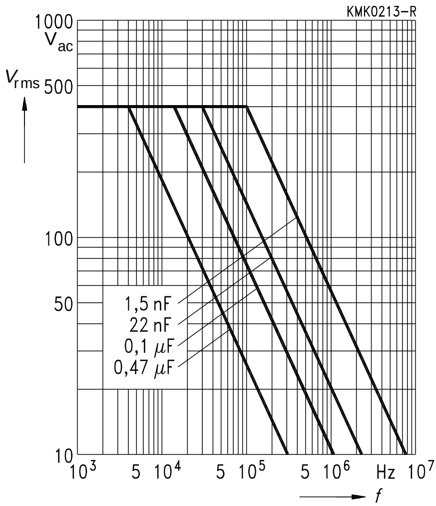
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 … 37,5 mm

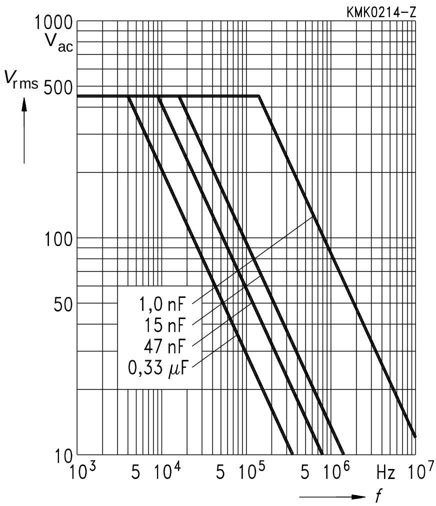
630 V_{dc} / 300 V_{ac}



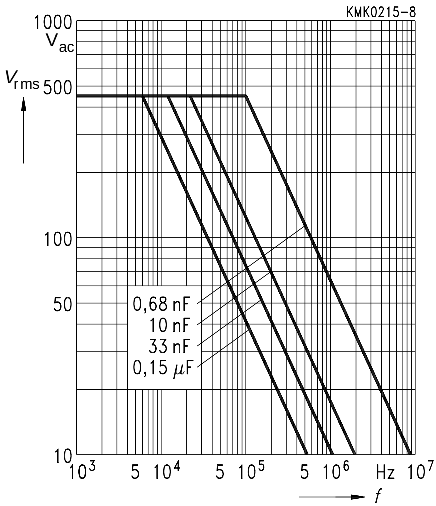
1000 V_{dc} / 400 V_{ac}



1250 V_{dc} / 450 V_{ac}



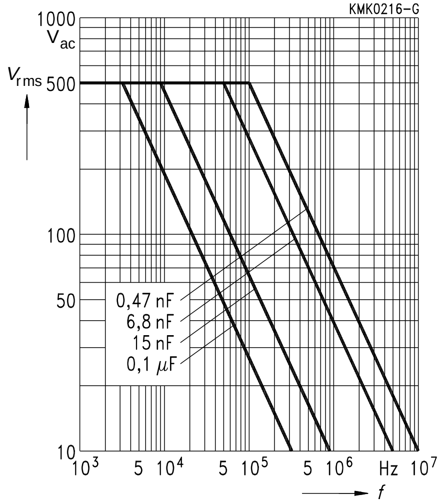
1600 V_{dc} / 450 V_{ac}



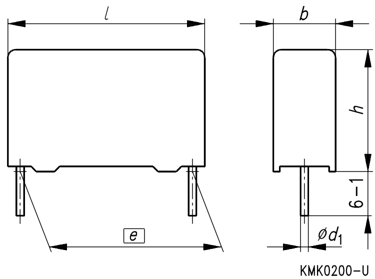
Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 15 … 37,5 mm

2000 V_{dc} / 500 V_{ac}



MFP pulse capacitors for highest possible current loads



Dimensions in mm

Lead spacing e ± 0,4	Diameter d_1	Type
15,0	0,8	B 32 642
22,5	0,8	B 32 643
27,5	0,8	B 32 644

Construction

- Dielectric: polypropylene
- Film metallized on both sides and metal foils internally connected in series
- Plastic case (UL 94 V-0)
- Epoxy resin sealing

Features

- Highest possible pulse strength
- Highest possible contact reliability
- Self-healing properties

Typical applications

- Pulse circuits with very steep voltage rise rates
- High-frequency ac current loads

Terminals

- Parallel wire leads, tinned
- Also available with (3,2 ± 0,3) mm lead length

Marking

Manufacturer's logo,
lot number,
style (MFP),
rated capacitance (coded),
capacitance tolerance (code letter),
rated dc voltage,
date of manufacture (coded)

Delivery mode

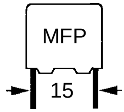
Bulk (untaped)
Taped (Ammo pack or reels)
For notes on taping refer to page 252.

MFP

B 32 642 … B 32 644

Overview of available types

<table>
<tr><td>Lead spacing</td><td colspan="2">15 mm</td><td colspan="2">22,5 mm</td><td colspan="2">27,5 mm</td></tr>
<tr><td>Type</td><td colspan="2">B 32 642</td><td colspan="2">B 32 643</td><td colspan="2">B 32 644</td></tr>
<tr><td>Page</td><td colspan="2">153</td><td colspan="2">154</td><td colspan="2">155</td></tr>
<tr><td>0,10 nF</td><td rowspan="9">1600 V_{dc}</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,15 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,22 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,33 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,47 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,68 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,0 nF</td><td></td><td rowspan="7">1600 V_{dc}</td><td rowspan="5">2000 V_{dc}</td><td></td><td></td></tr>
<tr><td>1,5 nF</td><td></td><td></td><td></td></tr>
<tr><td>2,2 nF</td><td></td><td></td><td></td></tr>
<tr><td>3,3 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4,7 nF</td><td></td><td></td><td></td><td rowspan="3">2000 V_{dc}</td></tr>
<tr><td>6,8 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>10 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>15 nF</td><td></td><td></td><td></td><td></td><td rowspan="3">1600 V_{dc}</td><td></td></tr>
<tr><td>22 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>33 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

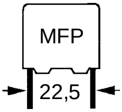


Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms} $f \leq 10$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
1600 V_{dc} (500 V_{ac})	0,10 nF	5,0 × 10,5 × 18,0	B32642-C1101-+***	1180	1300	1000
	0,15 nF	5,0 × 10,5 × 18,0	B32642-C1151-+***	1180	1300	1000
	0,22 nF	5,0 × 10,5 × 18,0	B32642-C1221-+***	1180	1300	1000
	0,33 nF	5,0 × 10,5 × 18,0	B32642-C1331-+***	1180	1300	1000
	0,47 nF	5,0 × 10,5 × 18,0	B32642-C1471-+***	1180	1300	1000
	0,68 nF	5,0 × 10,5 × 18,0	B32642-C1681-+***	1180	1300	1000
	1,0 nF	6,0 × 11,0 × 18,0	B32642-C1102-+***	1000	1100	1000
	1,5 nF	7,0 × 12,5 × 18,0	B32642-C1152-+***	840	900	1000
	2,2 nF	8,5 × 14,5 × 18,0	B32642-C1222-+***	690	700	500

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32642-C1101-K3

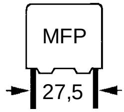


Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms} $f \leq$ 10 kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
1600 V_{dc} (500 V_{ac})	1,0 nF	6,0 × 15,0 × 26,5	B32643-C1102-+***	690	700	720
	1,5 nF	6,0 × 15,0 × 26,5	B32643-C1152-+***	690	700	720
	2,2 nF	6,0 × 15,0 × 26,5	B32643-C1222-+***	690	700	720
	3,3 nF	7,0 × 16,0 × 26,5	B32643-C1332-+***	590	600	630
	4,7 nF	8,5 × 16,5 × 26,5	B32643-C1472-+***	500	500	510
	6,8 nF	10,5 × 16,5 × 26,5	B32643-C1682-+***	400	400	540
	10 nF	11,0 × 20,5 × 26,5	B32643-C1103-+***	380	350	510
2000 V_{dc} (600 V_{ac})	1,0 nF	6,0 × 15,0 × 26,5	B32643-C2102-+***	690	700	720
	1,5 nF	6,0 × 15,0 × 26,5	B32643-C2152-+***	690	700	720
	2,2 nF	7,0 × 16,0 × 26,5	B32643-C2222-+***	590	600	630
	3,3 nF	8,5 × 16,5 × 26,5	B32643-C2332-+***	500	500	510
	4,7 nF	8,5 × 16,5 × 26,5	B32643-C2472-+***	500	500	510

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J

1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Ammo pack = 289, reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number “3” to the tolerance code, e.g.: B32643-C1102-K3

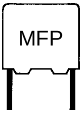


Ordering codes and packing units, lead spacing 27,5 mm

V_R (V_{rms} $f \leq 10$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
1600 V_{dc} (500 V_{ac})	15 nF	11,0 × 21,0 × 31,5	B32644-C1153-+***	–	350	320
	22 nF	12,5 × 21,5 × 31,5	B32644-C1223-+***	–	300	280
	33 nF	15,0 × 24,5 × 31,5	B32644-C1333-+	–	–	240
2000 V_{dc} (600 V_{ac})	4,7 nF	11,0 × 21,0 × 31,5	B32644-C2472-+***	–	350	320
	6,8 nF	11,0 × 21,0 × 31,5	B32644-C2682-+***	–	350	320
	10 nF	11,0 × 21,0 × 31,5	B32644-C2103-+***	–	350	320

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J

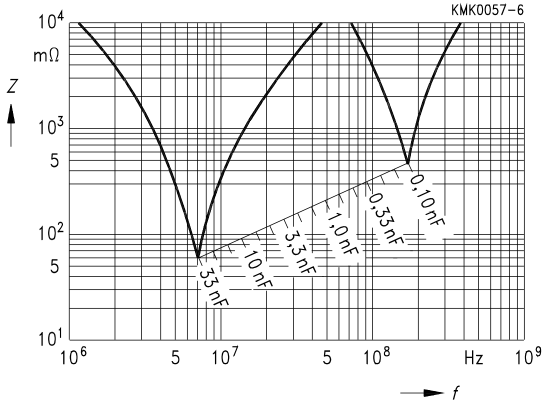
1) Replace the + by the code letter for the required capacitance tolerance.
Replace the *** by the code number for the required packing: Reel = 189 (taping cf. p. 252)
The ordering code for untaped components ends after the tolerance code letter.
For capacitors with 3,2 mm lead length, append code number "3" to the tolerance code, e.g.: B32644-C2472-K3



B 32 642 … B 32 644

Technical data

Climatic category in accordance with IEC 68-1	55/085/56	
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 85 °C	
Damp heat test	56 days/40 °C/93 % relative humidity	
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ Dissipation factor change $\Delta \tan \delta$ Insulation resistance R_{is}	$\leq$ 1 % $\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz) $\geq$ 50 % of minimum as-delivered values
Reliability:		
Reference conditions Failure rate	$0{,}5 \cdot V_R$; 40 °C $1 \cdot 10^{-9}$/h = 1 fit	
	For a conversion table for other operating conditions and temperatures refer to page 247.	
Service life	200 000 h	
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ Dissipation factor $\tan \delta$ Insulation resistance R_{is}	 > 10 % 4 · upper limit values < 1500 MΩ
DC test voltage	$2{,}0 \cdot V_R$, 2 s	
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 10 kHz	$T \leq$ 85 °C: $V_C = 1{,}0 \cdot V_R$ or $1{,}0 \cdot V_{rms}$	
Dissipation factor $\tan \delta$ at 20 °C (upper limit values)	$0{,}4 \cdot 10^{-3}$ (at 10 kHz) $1{,}0 \cdot 10^{-3}$ (at 100 kHz)	
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity $\leq$ 65 % (minimum as-delivered values)	100 GΩ	

Impedance *Z* versus frequency *f* (typical values)	

Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)		
	Lead spacing		
	15 mm	22,5 mm	27,5 mm
1600 V_{dc}	16 000	11 000	6 000
2000 V_{dc}	–	15 000	8 000

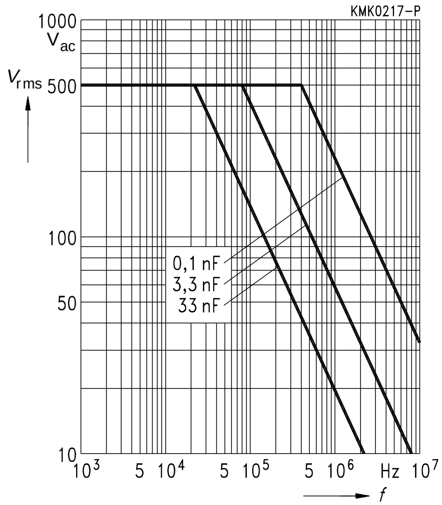
For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}. Also refer to the calculation example on page 220.

V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)		
	Lead spacing		
	15 mm	22,5 mm	27,5 mm
1600 V_{dc}	51 000 000	35 000 000	19 000 000
2000 V_{dc}	–	60 000 000	32 000 000

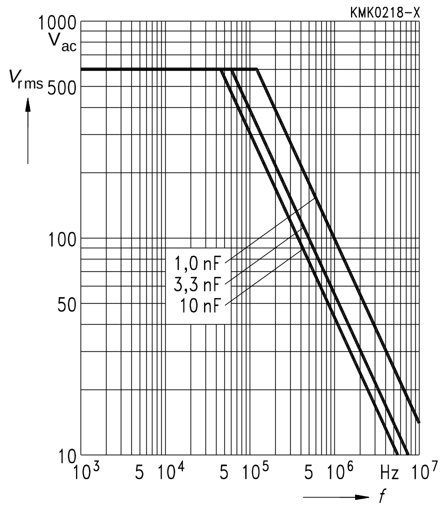
Permissible ac voltage V_{rms} versus frequency f

Lead spacing 15 … 27,5 mm

1600 V_{dc} / 500 V_{ac}



2500 V_{dc} / 600 V_{ac}



MFP pulse capacitors with very high contact reliability

Construction

- Dielectric: polypropylene
- Film metallized on one side and metal foils internally connected in series
- Wound capacitor technology
- Epoxy resin coating (UL 94 V-0)

Features

- Very high pulse strength
- Very high contact reliability
- Self-healing properties

Typical applications

- Pulse circuits with steep voltage rise rates
- High-frequency ac current loads

Terminals

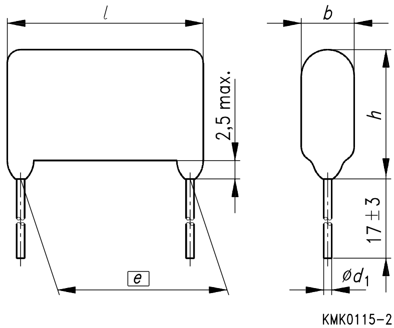
- Parallel wire leads, tinned

Marking

Manufacturer's logo,
style (MFP),
rated capacitance,
capacitance tolerance (code letter),
rated dc voltage

Delivery mode

Bulk (untaped)



Dimensions in mm

Lead spacing e ±0,8	Diameter d_1	Type
15,0	0,8	B 32 692
22,5	0,8	B 32 693
27,5	0,8	B 32 694

Overview of available types

<table>
<tr><td>Lead spacing</td><td colspan="2">15 mm</td><td colspan="2">22,5 mm</td><td colspan="2">27,5 mm</td></tr>
<tr><td>Type</td><td colspan="2">B 32 692</td><td colspan="2">B 32 693</td><td colspan="2">B 32 694</td></tr>
<tr><td>Page</td><td colspan="2">161</td><td colspan="2">162</td><td colspan="2">162</td></tr>
<tr><td>0,33 nF</td><td></td><td rowspan="8">1600 V_{dc}</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,47 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,68 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,0 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1,5 nF</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2,2 nF</td><td rowspan="8">630 V_{dc}</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3,3 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4,7 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>6,8 nF</td><td></td><td></td><td rowspan="4">1600 V_{dc}</td><td></td><td></td></tr>
<tr><td>10 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>15 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>22 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>33 nF</td><td></td><td></td><td></td><td></td><td rowspan="4">1600 V_{dc}</td></tr>
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<tr><td>68 nF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,10 µF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0,15 µF</td><td></td><td></td><td></td><td></td><td rowspan="3">630 V_{dc}</td><td></td></tr>
<tr><td>0,22 µF</td><td></td><td></td><td></td><td></td><td></td></tr>
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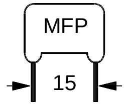


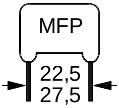
Ordering codes and packing units, lead spacing 15 mm

V_R (V_{rms} $f \leq 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing unit (pcs) Untaped
630 V_{dc} (300 V_{ac})	2,2 nF	6,0 × 11,5 × 18,0	B32692-A6222-+	1000
	3,3 nF	6,0 × 11,5 × 18,0	B32692-A6332-+	1000
	4,7 nF	6,0 × 11,5 × 18,0	B32692-A6472-+	1000
	6,8 nF	6,0 × 11,5 × 18,0	B32692-A6682-+	1000
	10 nF	6,0 × 11,5 × 18,0	B32692-A6103-+	1000
	15 nF	7,0 × 12,0 × 18,0	B32692-A6153-+	1000
	22 nF	8,0 × 13,5 × 18,0	B32692-A6223-+	1000
	33 nF	9,5 × 15,5 × 18,0	B32692-A6333-+	500
1600 V_{dc} (450 V_{ac})	330 pF	6,0 × 11,5 × 18,0	B32692-A1331-+	1000
	470 pF	6,0 × 11,5 × 18,0	B32692-A1471-+	1000
	680 pF	6,0 × 11,5 × 18,0	B32692-A1681-+	1000
	1,0 nF	6,0 × 11,5 × 18,0	B32692-A1102-+	1000
	1,5 nF	6,0 × 11,5 × 18,0	B32692-A1152-+	1000
	2,2 nF	7,0 × 12,0 × 18,0	B32692-A1222-+	1000
	3,3 nF	8,0 × 13,5 × 18,0	B32692-A1332-+	1000
	4,7 nF	9,5 × 15,5 × 18,0	B32692-A1472-+	500

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

Customized capacitance ratings and lead spacings available upon request.

1) Replace the + by the code letter for the required capacitance tolerance.



B 32 693
B 32 694

Ordering codes and packing units, lead spacing 22,5 mm

V_R (V_{rms} $f \le 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing unit (pcs) Untaped
630 V_{dc} (300 V_{ac})	47 nF	8,0 × 17,0 × 26,5	B32693-A6473-+	500
	68 nF	9,5 × 17,5 × 26,5	B32693-A6683-+	250
	100 nF	11,5 × 19,5 × 26,5	B32693-A6104-+	250
1600 V_{dc} (450 V_{ac})	6,8 nF	7,0 × 16,0 × 26,5	B32693-A1682-+	500
	10 nF	8,0 × 17,0 × 26,5	B32693-A1103-+	500
	15 nF	9,5 × 17,5 × 26,5	B32693-A1153-+	250
	22 nF	11,5 × 19,5 × 26,5	B32693-A1223-+	250

Ordering codes and packing units, lead spacing 27,5 mm

V_R (V_{rms} $f \le 1$ kHz)	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing unit (pcs) Untaped
630 V_{dc} (300 V_{ac})	0,15 µF	12,0 × 22,0 × 31,5	B32694-A6154-+	200
	0,22 µF	13,5 × 22,5 × 31,5	B32694-A6224-+	200
	0,33 µF	16,0 × 25,5 × 31,5	B32694-A6334-+	150
1600 V_{dc} (450 V_{ac})	33 nF	12,0 × 22,0 × 31,5	B32694-A1333-+	200
	47 nF	13,5 × 22,5 × 31,5	B32694-A1473-+	200
	68 nF	16,0 × 25,5 × 31,5	B32694-A1683-+	150

Capacitance tolerance: ±10 % ≙ K, ±5 % ≙ J, (±3,5 % upon request)

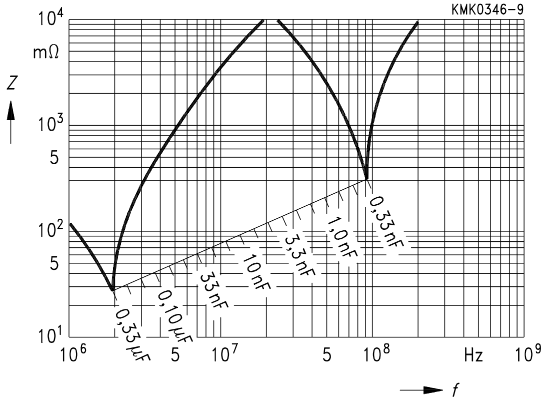
Customized capacitance ratings and lead spacings available upon request.

1) Replace the + by the code letter for the required capacitance tolerance.

Technical data

Climatic category in accordance with IEC 68-1	55/085/56	
Lower category temperature T_{min} Upper category temperature T_{max}	– 55 °C + 85 °C	
Damp heat test	56 days/40 °C/93 % relative humidity	
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ Dissipation factor change $\Delta \tan \delta$ Insulation resistance R_{is}	$\leq$ 2 % $\leq 1,0 \cdot 10^{-3}$ (at 10 kHz) $\geq$ 50 % of minimum as-delivered values
Reliability: Reference conditions Failure rate	 $0,5 \cdot V_R$; 40 °C $2 \cdot 10^{-9}$/h = 2 fit For a conversion table for other operating conditions and temperatures refer to page 247.	
Service life	200 000 h	
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change $\|\Delta C/C\|$ Dissipation factor tan δ Insulation resistance R_{is}	 > 10 % 4 · upper limit values < 1500 MΩ
DC test voltage	$2,0 \cdot V_R$, 2 s	
Category voltage V_C Operation with dc voltage or ac voltage V_{rms} up to 1 kHz	$T \leq 85$ °C: $V_C = 1,0 \cdot V_R$ or $1,0 \cdot V_{rms}$	
Dissipation factor tan δ at 20 °C (upper limit values)	$1,0 \cdot 10^{-3}$ (at 10 kHz)	
Insulation resistance R_{is} at 20 °C, rel. humidity $\leq$ 65 % (minimum as-delivered values)	100 GΩ	

Impedance Z
versus
frequency f
(typical values)



Pulse handling capability

Maximum permissible voltage change per unit of time for non-sinusoidal voltages (pulse, sawtooth)

V_R	Max. rate of voltage rise V_{pp}/τ in V/µs (for $V_{pp} = V_R$)		
	Lead spacing		
	15 mm	22,5 mm	27,5 mm
630 V_{dc}	5 000	3 000	2 000
1600 V_{dc}	14 000	9 000	5 500

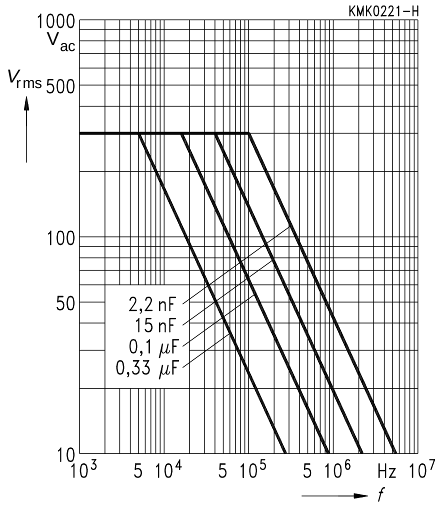
For $V_{pp} < V_R$, the permissible voltage rise rate value V_{pp}/τ may be multiplied by the factor V_R/V_{pp}.
Also refer to the calculation example on page 220.

V_R	Pulse characteristic k_0 in V^2/µs (for $V_{pp} \leq V_R$)		
	Lead spacing		
	15 mm	22,5 mm	27,5 mm
630 V_{dc}	6 300 000	3 800 000	2 500 000
1600 V_{dc}	45 000 000	29 000 000	17 500 000

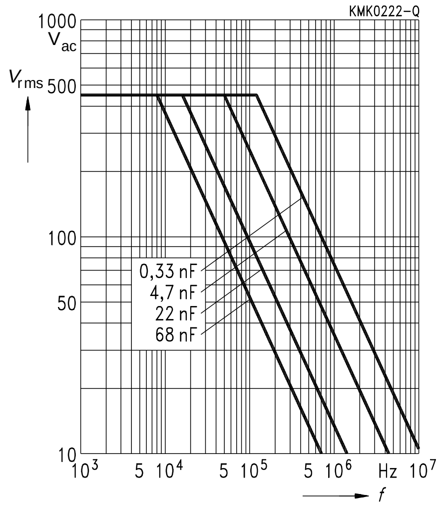
Permissible ac voltage V_{rms} versus frequency *f*

Lead spacing 15 … 27,5 mm

630 V_{dc} / 300 V_{ac}



1600 V_{dc} / 450 V_{ac}

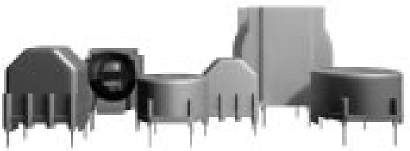


Siemens Matsushita Components

A whole lot of ring core chokes

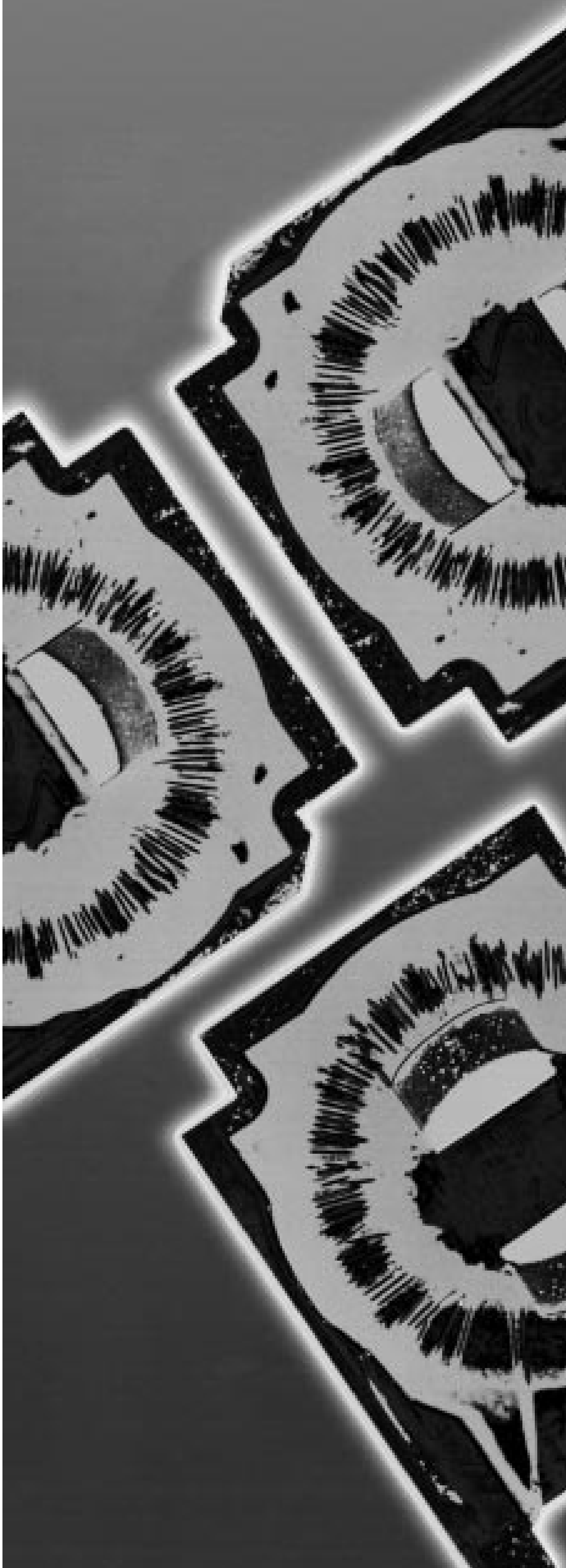
Chokes to your choice

You urgently need particular ring core chokes? That's no problem, we have 200,000 pieces in stock and deliver reliably through SCS. Our automated production guarantees



the best of reliability too. It turns out chokes in different versions: flat and upright, with current rated from 0.4 to 16 A. UL and VDE approved, and complying with the latest EMC standards of course.

SCS – dependable, fast and competent



Overview, EMI suppression capacitors

Class	Leads	Rated voltage	Frequency	Type	Description	Page
X 1		440 V_{ac}	50 ... 400 Hz	B 81 141	MKP capacitor	171
X 2	Radial leads	250 V_{ac}	50 … 400 Hz	B 81 121	MKP standard	174
X 2	Radial leads	275 V_{ac}	50/60 Hz	B 81 133	MKT small size	177
X 2	Radial leads	300 V_{ac}	50/60 Hz	B 81 131	MKT SAFE-X	180
X 2	Radial leads	300 V_{ac}	50/60 Hz	B 81 121	MKT capacitor	183
X 2	Radial leads	400 V_{ac}	50…1000 Hz	B 81 121	MKP capacitor	186
X 2	Axial leads	250 V_{ac}	50/60 Hz	B 81 191	MKT with axial leads	189
Y 2		250 V_{ac}	50/60 Hz	B 81 122	MKT with lead spacing 10	192
Y 2		250 V_{ac}	50…1000 Hz	B 81 121	MKP with lead spacing ≥ 15	195

EMI Suppression Capacitors (MKT and MKP)

1 General / Standards

EMI suppression capacitors are used to reduce electromagnetic interference. They are connected directly to line and are therefore exposed to overvoltages and transients which could damage the capacitors. For this reason, the following safety standards have been introduced for EMI suppression capacitors:

Region	Standard	Marks of conformity
Europe	VDE 0565, Part 1 SEV 1055 IEC 384-14	
USA	UL 1414 UL 1283	
Canada	CSA 22.2, No. 0;1 CSA 22.2, No. 0;8	

Within the framework of harmonization of European standards, all the European safety standards are to be replaced by a single standard which is to apply throughout Europe: the European standard EN 132400. EN 132400 is identical in content to IEC 384-14 (2nd edition) and CECC 32 400 with additional testing of "active flammability".

The future introduction of a single mark of conformity valid for the whole of Europe is still being discussed. The UL and CSA standards are to remain unchanged.

1.1 X capacitors

These are capacitors for applications in which the failure of the capacitor will not lead to a dangerous electrical shock. In accordance with EN 132400, X capacitors are divided into three sub-classes according to the peak pulse voltage to which they are exposed in operation, in addition to the rated voltage. This kind of impulse can be caused by lightning in overhead cables, switching surges in neighbouring equipment or in the device in which the capacitor is being used to suppress interferences.

Sub-class	Peak pulse voltage V_p in operation	Application	Peak values of surge voltage V_p (before endurance test)
X1	2,5 kV < V_p ≤ 4,0 kV	High pulse application	for C_R ≤ 1,0 μF: V_p = 4,0 kV for C_R > 1,0 μF: $V_p = \frac{4}{\sqrt{C_R}}\ \mathrm{kV}$ [1)]
X2	V_p ≤ 2,5 kV	General purpose	for C_R ≤ 1,0 μF: V_p = 2,5 kV for C_R > 1,0 μF: $V_p = \frac{2,5}{\sqrt{C_R}}\ \mathrm{kV}$ [1)]
X3	V_p ≤ 1,2 kV	General purpose	no test

Note: Sub-class X3 corresponds to sub-class X2 as described in IEC 384-14 (1st edition).

1.2 Y capacitors

These capacitors are intended for use where the failure of the capacitor could result in a dangerous electrical shock. In accordance with EN 132400, Y capacitors are divided into the following sub-classes.:

Sub-class	Type of bridged insulation	Rated ac voltage	Peak values of surge voltage V_p (before endurance test)
Y1	Double or reinforced insulation	V_R ≤ 250 V	8,0 kV
Y2	Basic or supplementary insulation	150 V ≤ V_R ≤ 250 V	5,0 kV
Y3	Basic or supplementary insulation	150 V ≤ V_R ≤ 250 V	no test
Y4	Basic or supplementary insulation	V_R < 150 V	2,5 kV

Note: Sub-class Y3 corresponds to class Y as described in IEC 384-14 (1st edition).

Y capacitors are capacitors with increased electrical and mechanical reliability and limited capacitance. The increased electrical and mechanical reliability are intended to eliminate short circuits in the capacitor. Limitation of the capacitance is intended to reduce the current passing through the capacitor when an ac voltage is applied and to reduce the energy content of the capacitor to a limit which is not dangerous when dc voltage is applied.

Y capacitors are used in electrical equipment and machines to bridge operational insulation which provides safety, in connection with additional protective measures, in order to avert danger to humans and animals. They cause a considerable amount of the leakage current occurring in a piece

1) Enter C_R in μF .

of equipment. The safety regulations for the individual device families, e.g. VDE 0805 for EDP equipment, VDE 0750 for medical equipment or VDE 0700 for household appliances, require a limitation of the leakage current for safety reasons and thus indirectly limit the maximum capacitance of Y capacitors.

1.3 Definitions and explanations

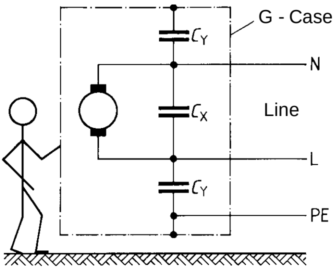


Figure 1 Example of EMI suppression with X and Y capacitors

Depending on the way they are connected, X and Y capacitors are effective against different kinds of electromagnetic interference. X capacitors which are connected between the line phases are effective against symmetrical interference (differential mode). Y capacitors which are connected between a phase and neutral (zero potential) are effective against asymmetrical interference (common mode).

Rated voltage

The rated voltage is the root-mean-square value of the operating ac voltage, at the rated frequency, which may be applied to the capacitor within the entire temperature range between the upper and lower category temperatures.

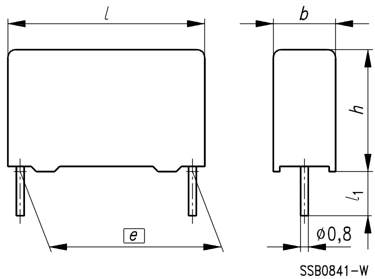
Non-sinusoidal ac voltages (continuous operating voltages)

For non-sinusoidal ac voltages in continuous operation, the specific load on the capacitors has to be determined for each individual application. If you require this information, please contact us, if possible enclosing a voltage oscillogram.

Active flammability

According to EN 132400 EMI suppression capacitors have to be tested for active flammability. This test is to ensure that the capacitors and the surrounding gauze do not ignite at a defined electrical overload.

X1 capacitors
Rated ac voltage 440 V, 50 … 400 Hz



Lead length l_1 mm	6 – 1	26 ±2

Construction

- Dielectric: polypropylene (MKP)
- Internal series connection
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant

Features

- Capacitors meet the requirements of IEC 384-14, 2nd edition
- Self-healing properties

Terminals

- Parallel wire leads, tinned
- Two standard lead lengths available: 6 mm and 26 mm
  Other lead lengths available upon request

Marking

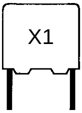
Manufacturer's logo, lot number, date of manufacture (year/week), rated capacitance (coded), capacitance tolerance (code letter), rated ac voltage, type number, interference suppression sub-class (X1), style (MKP), climatic category, awarded marks of conformity

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping refer to page 252.

Marks of conformity

Marks of conformity	Standards
Ⓢ	EN 132 400, IEC 384-14, 2nd edition (applied for)



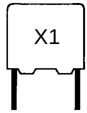
B 81 141
440 V_{ac}

Ordering codes and packing units

Lead spacing e ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)			
				Ammo pack	Reel	Untaped Lead length 6 mm	26 mm
15	10 nF	7,0 × 12,5 × 18,0	B81141-A1103-M***	840	900	1000	1000
	22 nF	8,5 × 14,5 × 18,0	B81141-A1223-M***	690	700	500	500
22,5	33 nF	7,0 × 16,0 × 26,5	B81141-A1333-M***	590	600	630	500
	47 nF	8,5 × 16,5 × 26,5	B81141-A1473-M***	500	500	510	500
	68 nF	10,5 × 20,5 × 26,5	B81141-A1683-M***	400	400	540	400
	0,10 µF	10,5 × 20,5 × 26,5	B81141-A1104-M***	400	400	540	400
27,5	0,15 µF	11,0 × 21,0 × 31,5	B81141-A1154-M***	–	350	320	250
	0,22 µF	14,0 × 24,5 × 31,5	B81141-A1224-M***	–	250	260	250
	0,33 µF	19,0 × 30,0 × 31,5	B81141-A1334-M***	–	–	180	180

Capacitance tolerance: ± 20 % ≙ M (closer tolerances upon request)

1) Replace the *** by the code number for the required lead length or packing.
000 = lead length 6 mm (untaped)
026 = lead length 26 mm (untaped)
289 = taped, Ammo pack (taping refer to page 252)
189 = taped, reel (taping refer to page 252)



Technical data

Climatic category in accordance with IEC 68-1	40/085/21
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 85 °C
Damp heat test	21 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\lvert\Delta C/C\rvert$ $\leq$ 3 % Dissipation factor change Δ tan δ $\leq 0{,}5 \cdot 10^{-3}$ (at 1 kHz) $\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ $\geq$ 50 % of minimum as-delivered values
Permissible continuous ac voltage	440 V (50 to 400 Hz)
Permissible continuous dc voltage	1000 V
DC test voltage	2400 V, 2 s
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)	see table below
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity $\leq$ 65 % (minimum as-delivered values)	see table below

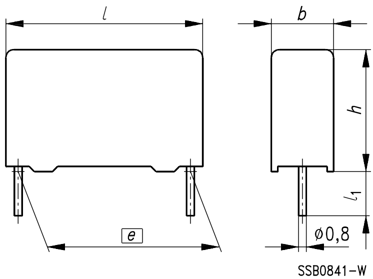
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values):

	$C_R \leq 0{,}1$ µF	0,1 µF < $C_R \leq 1$ µF	$C_R > 1$ µF
at 1 kHz	–	0,5	0,5
10 kHz	–	0,8	1,5

Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ (minimum as-delivered values):

$C_R \leq 0{,}33$ µF	$C_R > 0{,}33$ µF
30 000 MΩ	10 000 s

X2 capacitors, standard version
Rated ac voltage 250 V, 50 ... 400 Hz



Construction

- Dielectric: polypropylene (MKP)
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant

Features

- The capacitors meet the requirements of IEC 384-14, 2nd edition
- Self-healing properties

Terminals

- Parallel wire leads, tinned
- Two standard lead lengths available:
  6 mm and 26 mm
  Other lead lengths available upon request

Lead length l_1 mm	6 – 1	26 ±2

Marking

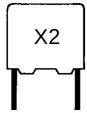
Manufacturer’s logo, lot number, date of manufacture (year/week), rated capacitance (coded), capacitance tolerance (code letter), rated ac voltage, type number, interference suppression sub-class (X2), style (MKP), climatic category, awarded marks of conformity

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping **refer to page 252**.

Marks of conformity

Marks of conformity	Standards	Marks of conformity	Standards
	VDE 0565 part 1 / 12.79		IEC 384-14 / 1981
	SEV 1055 / 1978 (applied for)		IEC 384-14 / 1981
	Stærkstrømreglementets Afsnit 21		CEI 40-7 / VI-1980
			UL 1283
	NEMKO 132 / 85		EN 132400 / IEC 384-14, 2nd edition (applied for)
	SEN 432901		

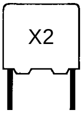


Ordering codes and packing units

Lead spacing e ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)			
				Ammo pack	Reel	Untaped Lead length 6 mm	Untaped Lead length 26 mm
15	22 nF	5,0 × 10,5 × 18,0	B81121-C-∗121	1180	1300	1000	1000
	33 nF	5,0 × 10,5 × 18,0	B81121-C-∗122	1180	1300	1000	1000
	47 nF	7,0 × 12,5 × 18,0	B81121-C-∗123	840	900	1000	1000
	68 nF	8,5 × 14,5 × 18,0	B81121-C-∗124	690	700	500	500
	0,10 µF	8,5 × 14,5 × 18,0	B81121-C-∗125	690	700	500	500
22,5	0,15 µF	8,5 × 16,5 × 26,5	B81121-C-∗126	500	500	510	500
	0,22 µF	10,5 × 16,5 × 26,5	B81121-C-∗127	400	400	540	500
	0,33 µF	10,5 × 20,5 × 26,5	B81121-C-∗128	400	400	540	400
27,5	0,47 µF	11,0 × 21,0 × 31,5	B81121-C-∗129	–	350	320	250
	0,68 µF	13,5 × 23,0 × 31,5	B81121-C-∗130	–	250	260	250
	1,0 µF	18,0 × 27,5 × 31,5	B81121-C-∗132	–	–	200	200

Capacitance tolerance: ± 20 % (closer tolerances upon request)

1) Replace the ∗ by the code letter for the required lead length or packing
B = lead length 6 mm (untaped)
C = lead length 26 mm (untaped)
P = taped, Ammo pack (taping refer to page 252)
H = taped, reel (taping refer to page 252)

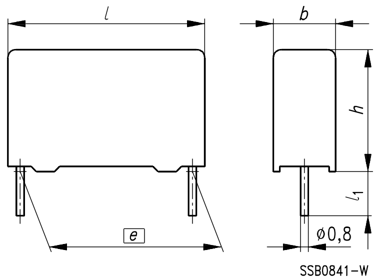


B 81 121
250 V_{ac}

Technical data

<table>
<tr><td>Climatic category
in accordance with IEC 68-1</td><td>40/085/21</td></tr>
<tr><td>Lower category temperature T_{min}
Upper category temperature T_{max}</td><td>– 40 °C
+ 85 °C</td></tr>
<tr><td>Damp heat test</td><td>21 days/40 °C/93 % relative humidity</td></tr>
<tr><td>Limit values after damp heat test</td><td><table>
<tr><td>Capacitance change $|\Delta C/C|$</td><td>≤ 3 %</td></tr>
<tr><td>Dissipation factor change $\Delta \tan \delta$</td><td>$\leq 0{,}5 \cdot 10^{-3}$ (at 1 kHz)
$\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz)</td></tr>
<tr><td>Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$</td><td>≥ 50 % of minimum
as-delivered values</td></tr>
</table></td></tr>
<tr><td>Permissible
continuous ac voltage</td><td>250 V (50 to 400 Hz)</td></tr>
<tr><td>Permissible continuous dc voltage</td><td>630 V</td></tr>
<tr><td>DC test voltage</td><td>1400 V, 2 s</td></tr>
<tr><td>Dissipation factor tan δ (in 10^{-3})
at 20 °C
(upper limit values)</td><td><table>
<tr><th></th><th>$C_R \leq 0{,}1$ µF</th><th>0,1 µF < $C_R \leq 1$ µF</th><th>$C_R > 1$ µF</th></tr>
<tr><td>at 1 kHz</td><td>–</td><td>0,5</td><td>0,5</td></tr>
<tr><td>10 kHz</td><td>–</td><td>0,8</td><td>1,5</td></tr>
</table></td></tr>
<tr><td>Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$
at 20 °C, rel. humidity ≤ 65 %
(minimum as-delivered values)</td><td><table>
<tr><th>$C_R \leq 0{,}33$ µF</th><th>$C_R > 0{,}33$ µF</th></tr>
<tr><td>30 000 MΩ</td><td>10 000 s</td></tr>
</table></td></tr>
</table>

X2 capacitors with small dimensions
Rated ac voltage 275 V, 50/60 Hz



Lead length l_1 mm	6 – 1	26 ±2

Construction

- Dielectric: polyester (MKT)
- Internal series connection
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant

Features

- The capacitors meet the requirements of IEC 384-14, 2nd edition
- Self-healing properties

Terminals

- Parallel wire leads, tinned
- Two standard lead lengths available:
  6 mm und 26 mm
  Other lead lengths available upon request

Marking

Manufacturer's logo, lot number, date of manufacture (year/week), rated capacitance (coded), capacitance tolerance (code letter), rated ac voltage, type number, interference suppression sub-class (X2), style (MKT), climatic category, awarded marks of conformity

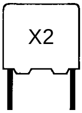
Delivery mode

Bulk (untaped)
Taped (Ammo and reel)
For notes on taping refer to page 252.

Marks of conformity

Marks of conformity	Standards	Marks of conformity	Standards
ÖVE (VDE)	VDE 0565 part 1 / 12.79[1]	FI	IEC 384-14 / 1981[1]
S	SEV 1055 / 1978[1]	ÖVE	IEC 384-14 / 1981[1]
D	Stærkstrømreglementets Afsnit 21[1]	IMQ	CEI 40-7 / VI-1980[1]
		UL	UL 1283[1]
N	NEMKO 132 / 85[1]		UL 1414 (application made for V_R = 125 V$_{ac}$)
S	SEN 432901[1]	CSA	CSA C22.2 No. 0; 8[1]
		S	EN 132400 / IEC 384-14, 2nd edition (application made for V_R = 275 V$_{ac}$)

1) Approved for V_R = 250 V$_{ac}$

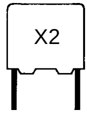


Ordering codes and packing units

Lead spacing e ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)			
				Ammo pack	Reel	Untaped Lead length 6 mm	Untaped Lead length 26 mm
15	22 nF	5,0 × 10,5 × 18,0	B81133-C1223-M***	1180	1300	1000	1000
	33 nF	5,0 × 10,5 × 18,0	B81133-C1333-M***	1180	1300	1000	1000
	47 nF	6,0 × 11,0 × 18,0	B81133-C1473-M***	1000	1100	1000	1000
	68 nF	7,0 × 12,5 × 18,0	B81133-C1683-M***	840	900	1000	1000
	0,10 µF	8,5 × 14,5 × 18,0	B81133-D1104-M***	690	700	500	500
	0,15 µF	8,5 × 14,5 × 18,0	B81133-D1154-M***	690	700	500	500
22,5	0,10 µF	6,0 × 15,0 × 26,5	B81133-C1104-M***	690	700	720	500
	0,15 µF	7,0 × 16,0 × 26,5	B81133-C1154-M***	590	600	630	500
	0,22 µF	8,5 × 16,5 × 26,5	B81133-C1224-M***	500	500	510	500
	0,33 µF	10,5 × 16,5 × 26,5	B81133-D1334-M***	400	400	540	500
	0,47 µF	11,0 × 20,5 × 26,5	B81133-D1474-M***	380	350	510	400
27,5	0,33 µF	11,0 × 21,0 × 31,5	B81133-C1334-M***	–	350	320	250
	0,47 µF	11,0 × 21,0 × 31,5	B81133-C1474-M***	–	350	320	250
	0,68 µF	12,5 × 21,5 × 31,5	B81133-C1684-M***	–	300	280	250
	1,0 µF	14,0 × 24,5 × 31,5	B81133-C1105-M***	–	–	260	250
	1,5 µF	18,0 × 27,5 × 31,5	B81133-C1155-M***	–	–	200	200
32,5	2,2 µF	20,0 × 31,0 × 36,5	B81133-C1225-M***	–	–	125	125

Capacitance tolerance: ± 20 % ≙ M (closer tolerances upon request)

1) Replace the *** by the code number for the required lead length or packing.
000 = lead length 6 mm (untaped)
026 = lead length 26 mm (untaped)
289 = taped, Ammo pack (taping refer to page 252)
189 = taped, reel (taping refer to page 252)



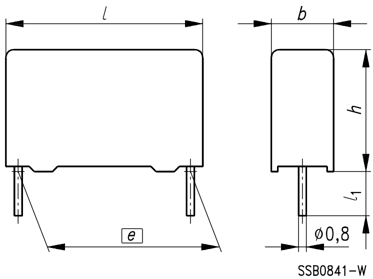
Technical data

<table>
<tr><td>Climatic category
in accordance with IEC 68-1</td><td>40/100/21</td></tr>
<tr><td>Lower category temperature T_{min}
Upper category temperature T_{max}</td><td>– 40 °C
+ 100 °C</td></tr>
<tr><td>Damp heat test</td><td>21 days/40 °C/93 % relative humidity</td></tr>
<tr><td>Limit values after damp
heat test</td><td><table><tr><td>Capacitance change $|\Delta C/C|$</td><td>≤ 5 %</td></tr><tr><td>Dissipation factor change Δ tan δ</td><td>≤ 5 · 10^{-3} (at 1 kHz)</td></tr><tr><td>Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$</td><td>≥ 50 % of minimum
as-delivered values</td></tr></table></td></tr>
<tr><td>Permissible
continuous ac voltage</td><td>275 V (50/60 Hz)</td></tr>
<tr><td>Permissible continuous dc voltage</td><td>630 V</td></tr>
<tr><td>DC test voltage</td><td>1700 V, 2 s</td></tr>
<tr><td>Dissipation factor tan δ (in 10^{-3})
at 20 °C
(upper limit values)</td><td><table><tr><td></td><td>C_R ≤ 0,1 µF</td><td>0,1 µF < C_R ≤ 1 µF</td><td>C_R > 1 µF</td></tr><tr><td>at 1 kHz</td><td>8</td><td>8</td><td>10</td></tr><tr><td>10 kHz</td><td>15</td><td>15</td><td>–</td></tr></table></td></tr>
<tr><td>Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$
at 20 °C, rel. humidity ≤ 65 %
(minimum as-delivered values)</td><td><table><tr><td>C_R ≤ 0,33 µF</td><td>C_R > 0,33 µF</td></tr><tr><td>30 000 MΩ</td><td>10 000 s</td></tr></table></td></tr>
</table>

X2 capacitors SAFE-X
Rated ac voltage 300 V, 50/60 Hz

Construction

- Dielectric: polyester (MKT)
- Internal series connection and structured metallization
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant



Lead length l_1 mm	6 – 1	26 ±2

Features

- The capacitors are considerably better than the requirements of IEC 384-14, 2nd edition
- Best possible safety in terms of active flammability
- Self-healing properties
- Substitute for the MP version

Terminals

- Parallel wire leads, tinned
- Two standard lead lengths available: 6 mm and 26 mm
  Other lead lengths available upon request

Marking

Manufacturer's logo, lot number, date of manufacture (year/week), rated capacitance (coded), capacitance tolerance (code letter), rated ac voltage, type number, interference suppression sub-class (X2), style (MKT), climatic category, awarded marks of conformity

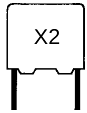
Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping refer to page 252.

Marks of conformity

Marks of conformity	Standards	Marks of conformity	Standards
	VDE 0565 part 1 / 12.79[1]		IEC 384-14 / 1981[1]
	SEV 1055 / 1978[1]		CEI 40-7 / VI-1980[1]
	Stærkstrømreglementets Afsnit 21[1]		UL 1414 (125 V_{ac})
			CSA C22.2 No. 0; 8[1]
	NEMKO 132 / 85[1]		
	SEN 432901[1]		EN 132400 / IEC 384-14, 2nd edition
	IEC 384-14 / 1981[1]		

1) Approved for V_R = 250 V_{ac}

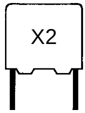


Ordering codes and packing units

Lead spacing e ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs) Ammo pack	Reel	Untaped Lead length 6 mm	26 mm
15,0	10 nF	5,0 × 10,5 × 18,0	B81131-C1103-M***	1180	1300	1000	1000
	22 nF	6,0 × 11,0 × 18,0	B81131-C1223-M***	1000	1100	1000	1000
	33 nF	7,0 × 12,5 × 18,0	B81131-C1333-M***	840	900	1000	1000
	47 nF	8,5 × 14,5 × 18,0	B81131-C1473-M***	690	700	500	500
	68 nF	9,0 × 17,5 × 18,0	B81131-C1683-M***	660	700	500	500
	0,10 µF	9,0 × 17,5 × 18,0	B81131-D1104-M***	660	700	500	500
22,5	0,10 µF	7,0 × 16,0 × 26,5	B81131-C1104-M***	590	600	630	500
	0,15 µF	8,5 × 16,5 × 26,5	B81131-C1154-M***	500	500	510	500
	0,22 µF	10,5 × 16,5 × 26,5	B81131-C1224-M***	400	400	540	500
	0,33 µF	11,0 × 20,5 × 26,5	B81131-D1334-M***	380	350	510	400
27,5	0,33 µF	11,0 × 21,0 × 31,5	B81131-C1334-M***	–	350	320	250
	0,47µF	13,5 × 23,0 × 31,5	B81131-C1474-M***	–	250	260	250
	0,68 µF	15,0 × 24,5 × 31,5	B81131-C1684-M***	–	–	240	200
	1,0 µF	19,0 × 30,0 × 31,5	B81131-C1105-M***	–	–	180	180
32,5	1,5 µF	20,0 × 31,0 × 36,5	B81131-C1155-M***	–	–	125	125

Capacitance tolerance: ± 20 % ≙ M (closer tolerances upon request)

1) Replace the *** by the code number for the required lead length or packing.
000 = lead length 6 mm (untaped)
026 = lead length 26 mm (untaped)
289 = taped, Ammo pack (taping refer to page 252)
189 = taped, reel (taping refer to page 252)



B 81 131
300 V_{ac}

Technical data

Climatic category in accordance with IEC 68-1	40/100/21
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 100 °C
Damp heat test	21 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ ≤ 5 % Dissipation factor change $\Delta \tan \delta$ ≤ $5 \cdot 10^{-3}$ (at 1 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ ≥ 50 % of minimum as-delivered values
Permissible continuous ac voltage	300 V (50/60 Hz)
Permissible continuous dc voltage	800 V
DC test voltage	2100 V, 2 s
Dissipation factor $\tan \delta$ (in 10^{-3}) at 20 °C (upper limit values)	see table below
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	see table below

Dissipation factor $\tan \delta$ (in 10^{-3}) at 20 °C (upper limit values):

	$C_R \leq 0{,}1$ µF	$0{,}1$ µF $< C_R \leq 1$ µF	$C_R > 1$ µF
at 1 kHz	8	8	10
10 kHz	15	15	–
100 kHz	30	–	–

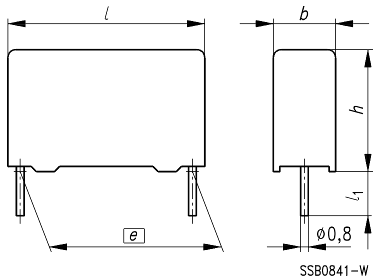
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values):

$C_R \leq 0{,}33$ µF	$C_R > 0{,}33$ µF
30 000 MΩ	10 000 s

X2 capacitors
Rated ac voltage 300 V, 50/60 Hz

Construction

- Dielectric: polyester (MKT)
- Internal series connection
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant



Lead length l_1 mm	6 – 1	26 ± 2

Features

- The capacitors meet the requirements of IEC 384-14, 2nd edition
- Self-healing properties

Terminals

- Parallel wire leads, tinned
- Two standard lead lengths available:
  6 mm and 26 mm
  Other lead lengths available upon request

Marking

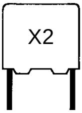
Manufacturer's logo, lot number, date of manufacture (year/week), rated capacitance (coded), capacitance tolerance (code letter), rated ac voltage, type number, interference suppression sub-class (X2), style (MKT), climatic category, awarded marks of conformity

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping **refer to page 252**.

Marks of conformity

Marks of conformity	Standards	Marks of conformity	Standards
	VDE 0565 part 1 / 12.79		CEI 40-7 / VI-1980
	SEV 1055 / 1978		UL 1283
	Stærkstrømreglementets Afsnit 21		UL 1414 (125 V_{ac})
			CSA C22.2 No. 0; 1 (for V_R = 125 V_{ac}, $C_R \leq 0{,}47$ µF)
	NEMKO 132 / 85		
	SEN 432901		
	IEC 384-14 / 1981		EN 132400 / IEC 384-14, 2nd edition (applied for)
	IEC 384-14 / 1981		



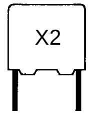
Ordering codes and packing units

Lead spacing e ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs) Ammo pack	Reel	Untaped Lead length 6 mm	26 mm
15	22 nF	5,0 × 10,5 × 18,0	B81121-C-*104	1180	1300	1000	1000
	33 nF	7,0 × 12,5 × 18,0	B81121-C-*105	840	900	1000	1000
	47 nF	8,5 × 14,5 × 18,0	B81121-C-*106	690	700	500	500
	68 nF	8,5 × 14,5 × 18,0	B81121-C-*107	690	700	500	500
	0,10 µF	9,0 × 17,5 × 18,0	B81121-C-*108[2]	660	700	500	500
22,5	0,10 µF	7,0 × 16,0 × 26,5	B81121-C-*108	590	600	630	500
	0,15 µF	8,5 × 16,5 × 26,5	B81121-C-*109	500	500	510	500
	0,22 µF	10,5 × 18,5 × 26,5	B81121-C-*110	400	400	540	500
27,5	0,33 µF	11,0 × 21,0 × 31,5	B81121-C-*111	–	350	320	250
	0,47 µF	12,5 × 21,5 × 31,5	B81121-C-*112	–	300	280	250
	0,68 µF	15,0 × 24,5 × 31,5	B81121-C-*113	–	–	240	200
	1,0 µF	18,0 × 27,5 × 31,5	B81121-C-*114	–	–	200	200

Capacitance tolerance: ± 20 % ≙ M (closer tolerances upon request)

1) Replace the * by the code letter for the required lead length or packing.
B = lead length 6 mm (untaped)
C = lead length 26 mm (untaped)
P = taped, Ammo pack (taping refer to page 252)
H = taped, reel (taping refer to page 252)

2) Replace the * by the code letter for the required lead length or packing.
D = lead length 6 mm (untaped)
E = lead length 26 mm (untaped)
Q = taped, Ammo pack (taping refer to page 252)
J = taped, reel (taping refer to page 252)



Technical data

Climatic category in accordance with IEC 68-1	40/085/21
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 85 °C
Damp heat test	21days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ ≤ 5 % Dissipation factor change Δ tan δ ≤ 5 · 10^{-3} (at 1 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ ≥ 50 % of minimum as-delivered values
Permissible continuous ac voltage	300 V (50/60 Hz)
Permissible continuous dc voltage	800 V
DC test voltage	1800 V, 2 s

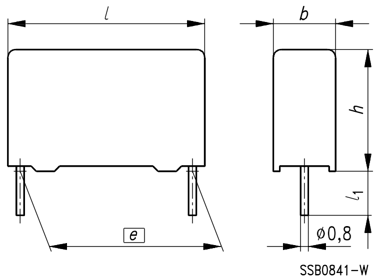
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)

	$C_R \leq 0{,}1\ \mu F$	$0{,}1\ \mu F < C_R \leq 1\ \mu F$	$C_R > 1\ \mu F$
at 1 kHz	8	8	10
10 kHz	15	15	–
100 kHz	30	–	–

Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)

$C_R \leq 0{,}33\ \mu F$	$C_R > 0{,}33\ \mu F$
30 000 MΩ	10 000 s

X2 capacitors
Rated ac voltage 400 V, 50 … 1000 Hz



Lead length l_1 mm	6 – 1	26 ±2

Construction

- Dielectric: polypropylene (MKP)
- Internal series connection
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant

Features

- The capacitors meet the requirements of IEC 384-14, 2nd edition
- Self-healing properties

Terminals

- Parallel wire leads, tinned
- Two standard lead lengths available: 6 mm and 26 mm
  Other lead lengths available upon request

Marking

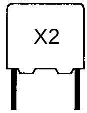
Manufacturer's logo, lot number, date of manufacture (year/week), rated capacitance (coded), capacitance tolerance (code letter), rated ac voltage, type number, interference suppression sub-class (X2), style (MKP), climatic category, awarded marks of conformity

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping **refer to page 252**.

Marks of conformity

Marks of conformity	Standards
	VDE 0565 part 1 / 12.79
	SEV 1055 / 1978
	UL 1283

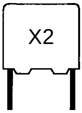


Ordering codes and packing units

Lead spacing *e* ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)			
				Ammo pack	Reel	Untaped Lead length 6 mm	Untaped Lead length 26 mm
15	10 nF	6,0 × 11,0 × 18,0	B81121-C-*92	1000	1100	1000	1000
	22 nF	8,5 × 14,5 × 18,0	B81121-C-*93	690	700	500	500
22,5	33 nF	7,0 × 16,0 × 26,5	B81121-C-*94	590	600	630	500
	47 nF	8,5 × 16,5 × 26,5	B81121-C-*95	500	500	510	500
	68 nF	10,5 × 16,5 × 26,5	B81121-C-*96	400	400	540	540
	0,10 µF	10,5 × 20,5 × 26,5	B81131-C-*97	400	400	540	400
27,5	0,15 µF	11,0 × 21,0 × 31,5	B81121-C-*98	–	350	320	250
	0,22 µF	14,0 × 24,5 × 31,5	B81121-C-*99	–	–	260	250
	0,33 µF	18,0 × 27,5 × 31,5	B81121-C-*100	–	–	200	200

Capacitance tolerance: ± 10 %

1) Replace the * by the code letter for the required lead length or packing.
B = lead length 6 mm (untaped)
C = lead length 26 mm (untaped)
P = taped, Ammo pack (taping refer to page 252)
H = taped, reel (taping refer to page 252)



B 81 121
400 V_{ac}

Technical data

<table>
<tr><td>Climatic category
in accordance with IEC 68-1</td><td>40/085/21</td></tr>
<tr><td>Lower category temperature T_{min}
Upper category temperature T_{max}</td><td>– 40 °C
+ 85 °C</td></tr>
<tr><td>Damp heat test</td><td>21 days/40 °C/93 % relative humidity</td></tr>
<tr><td>Limit values after damp heat test</td><td>
<table>
<tr><td>Capacitance change $|\Delta C/C|$</td><td>≤ 3 %</td></tr>
<tr><td>Dissipation factor change Δ tan δ</td><td>$\leq 0{,}5 \cdot 10^{-3}$ (at 1 kHz)
$\leq 1{,}0 \cdot 10^{-3}$ (at 10 kHz)</td></tr>
<tr><td>Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$</td><td>≥ 50 % of minimum
as-delivered values</td></tr>
</table>
</td></tr>
<tr><td>Permissible
continuous ac voltage</td><td>450 V (50 to 1000 Hz)</td></tr>
<tr><td>Permissible continuous dc voltage</td><td>1000 V</td></tr>
<tr><td>DC test voltage</td><td>2400 V, 2 s</td></tr>
<tr><td>Dissipation factor tan δ (in 10^{-3})
at 20 °C
(upper limit values)</td><td>
<table>
<tr><td></td><td>$C_R \leq 0{,}1$ µF</td><td>$0{,}1$ µF $< C_R \leq 1$ µF</td><td>$C_R > 1$ µF</td></tr>
<tr><td>at 1 kHz</td><td>–</td><td>0,5</td><td>0,5</td></tr>
<tr><td>10 kHz</td><td>–</td><td>0,8</td><td>1,5</td></tr>
</table>
</td></tr>
<tr><td>Insulation resistance R_{is}
or time constant $\tau = C_R \cdot R_{is}$
at 20 °C, rel. humidity ≤ 65 %
(minimum as-delivered values)</td><td>
<table>
<tr><td>$C_R \leq 0{,}33$ µF</td><td>$C_R > 0{,}33$ µF</td></tr>
<tr><td>30 000 MΩ</td><td>10 000 s</td></tr>
</table>
</td></tr>
</table>

X2 capacitors, axial leads
Rated ac voltage 250 V, 50/60 Hz

Construction

- Dielectric: polyester (MKT)
- Internal series connection
- Cylindrical winding
- Insulating sleeve
- Face ends sealed with epoxy resin

Features

- The capacitors meet the requirements of IEC 384-14,2nd edition
- Self-healing properties

Terminals

- Central axial wire leads, tinned

Marking

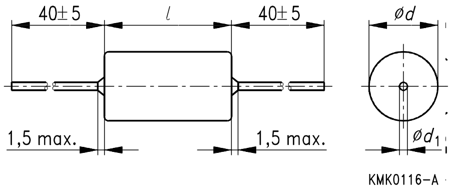
Manufacturer's logo, style (MKT),
interference suppression subclass (X2),
rated capacitance,
capacitance tolerance (code letter),
rated ac voltage

Delivery mode

Bulk (untaped)

Marks of conformity

Marks of conformity	Standards
Ⓢ	EN 132 400, IEC 384-14, 2nd edition (applied for)



Dimensions in mm

Diameter *d* (max)	Diameter d_1
≤ 7,0	0,6
> 7,0	0,8

Ordering codes and packing units

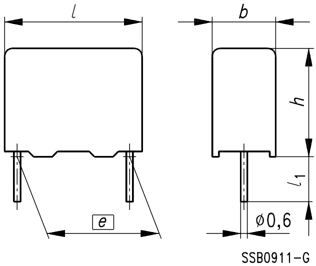
C_R	Maximum dimensions $d \times l$ (mm)	Ordering code	Packing unit (pcs) Untaped
10 nF	7,0 × 19,0	B81191-C1103-M	500
15 nF	7,0 × 19,0	B81191-C1153-M	500
22 nF	7,0 × 19,0	B81191-C1223-M	500
33 nF	8,0 × 19,0	B81191-C1333-M	500
47 nF	8,0 × 19,0	B81191-C1473-M	500
68 nF	9,0 × 19,0	B81191-C1683-M	500
0,10 µF	11,0 × 19,0	B81191-C1104-M	500
0,15 µF	9,0 × 26,5	B81191-C1154-M	250
0,22 µF	11,0 × 26,5	B81191-C1224-M	250
0,33 µF	13,0 × 26,5	B81191-C1334-M	250
0,47 µF	15,0 × 26,5	B81191-C1474-M	250
0,68 µF	16,0 × 31,5	B81191-C1684-M	200
1,0 µF	19,0 × 31,5	B81191-C1105-M	200
1,5 µF	19,0 × 41,5	B81191-C1155-M	150
2,2 µF	23,0 × 41,5	B81191-C1225-M	150

Capacitance tolerance: ±20 % ≙ M

Technical data

Climatic category in accordance with IEC 68-1	40/100/21
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 100 °C
Damp heat test	21 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\lvert \Delta C/C \rvert$ ≤ 5 % Dissipation factor change $\Delta \tan \delta$ ≤ $5 \cdot 10^{-3}$ (at 1 kHz) Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ ≥ 50 % of minimum as-delivered values
Permissible continuous ac voltage	250 V (50/60 Hz)
Permissible continuous dc voltage	600 V
DC test voltage	1075 V, 2 s
Dissipation factor tan δ at 20 °C (upper limit value)	$10 \cdot 10^{-3}$ at 1 kHz
Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	$C_R \leq 0{,}33$ µF: 30 000 MΩ $C_R > 0{,}33$ µF: 10 000 s

Y2 capacitors with 10 mm lead spacing
Rated ac voltage 250 V, 50/60 Hz



Lead length l_1 mm	6 –1

Construction

- Dielectric: polyester (MKT)
- Impregnated
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant

Features

- The capacitors meet the requirements of IEC 384-14, 2nd edition
- Self-healing properties

Terminals

- Parallel wire leads, tinned
- Standard lead length 6 mm
  Other lead lengths available upon request

Marking

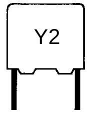
Manufacturer's logo, date of manufacture (year/week),
rated capacitance (coded), capacitance tolerance (code letter),
rated ac voltage, type number, interference suppression sub-class (Y2),
style (MKT), climatic category, awarded marks of conformity

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping **refer to page 252**.

Marks of conformity

Marks of conformity	Standards	
VDE	EN 132 400, IEC 384-14, 2nd edition	
UL	UL 1414	(application made for V_R = 125 V)
CSA	CSA C22.2 No. 0; 1	(application made for V_R = 125 V)

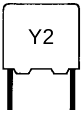


Ordering codes and packing units

Lead spacing e ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1)]	Packing units (pcs)		
				Ammo pack	Reel	Untaped
10	1,0 nF	4,0 × 9,0 × 13,0	B81122-C1102-M***	1000	1700	1000
	1,5 nF	4,0 × 9,0 × 13,0	B81122-C1152-M***	1000	1700	1000
	2,2 nF	4,0 × 9,0 × 13,0	B81122-C1222-M***	1000	1700	1000
	3,3 nF	5,0 × 11,0 × 13,0	B81122-C1332-M***	800	1300	1000
	4,7 nF	5,0 × 11,0 × 13,0	B81122-C1472-M***	800	1300	1000
	5,6 nF	6,0 × 12,0 × 13,0	B81122-C1562-M***	600	1100	1000
	6,8 nF	6,0 × 12,0 × 13,0	B81122-C1682-M***	600	1100	1000

Capacitance tolerance: ±20 % ≙ M (closer tolerances upon request)

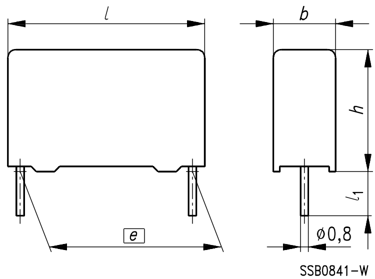
1) Replace the *** by the code number for the required lead length or packing.
000 = lead length 6 mm (untaped)
289 = taped, Ammo pack (taping refer to page 252)
189 = taped, reel (taping refer to page 252)



B 81 122
250 V_{ac}

Technical data

Climatic category in accordance with IEC 68-1	40/100/21
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 100 °C
Damp heat test	21 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ ≤ 5 % Dissipation factor change Δ tan δ ≤ $5 \cdot 10^{-3}$ (bei 1 kHz) Insulation resistance R_{is} ≥ 50 % of minimum as-delivered values
Permissible continuous ac voltage	275 V (50/60 Hz)
Permissible continuous dc voltage	1200 V
DC test voltage	2500 V, 2 s
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)	1 kHz: 8 10 kHz: 15 100 kHz: 30
Insulation resistance R_{is} at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)	30 000 MΩ



Lead length l_1 mm	6 – 1	26 ±2

Y2 capacitors
Rated ac voltage 250 V, 50 … 1000 Hz

Construction

- Dielectric: polypropylene (MKP)
- Internal series connection
- Plastic case (UL 94 V-0)
- Epoxy resin sealing, flame-retardant

Features

- The capacitors meet the requirements of IEC 384-14, 2nd edition
- Self-healing properties

Terminals

- Parallel wire leads, tinned
- Two standard lead lengths available:
  6 mm und 26 mm
  Other lead lengths available upon request

Marking

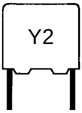
Manufacturer's logo, lot number, date of manufacture (year/week), rated capacitance (coded), capacitance tolerance (code letter), rated ac voltage, type number, interference suppression sub-class (Y2), style (MKP), climatic category, awarded marks of conformity

Delivery mode

Bulk (untaped)
Taped (Ammo pack or reel)
For notes on taping refer to page 252.

Marks of conformity

Marks of conformity	Standards	Marks of conformity	Standards
(ÖVE)	VDE 0565 part 1 / 12.79	(FI)	IEC 384-14 / 1981
(S)	SEV 1055 / 1978	(ÖVE)	IEC 384-14 / 1981
(D)	Stærkstrømreglementets Afsnit 21		CEI 40-7 / VI-1980
		(UR)	UL 1283
(N)	NEMKO 132 / 85		UL 1414 (125 V_{ac})
(S)	SEN 432901	(SA)	CSA C22.2 No. 0; 8
		(S)	EN 132400 / IEC 384-14, 2nd edition (applied for)



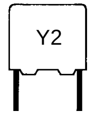
B 81 121
250 V_{ac}

Ordering codes and packing units

Lead spacing *e* ±0,4 mm	C_R	Maximum dimensions $b \times h \times l$ (mm)	Ordering code[1]	Packing units (pcs)			
				Ammo pack	Reel	Untaped Lead length	
						6 mm	26 mm
15	2,5 nF	6,0 × 11,0 × 18,0	B81121-C-*141	1000	1100	1000	1000
	3,3 nF	7,0 × 12,5 × 18,0	B81121-C-*142	840	900	1000	1000
	4,7 nF	8,5 × 14,5 × 18,0	B81121-C-*143	690	700	500	500
22,5	6,8 nF	6,0 × 15,0 × 26,5	B81121-C-*144	690	700	720	500
	10 nF	7,0 × 16,0 × 26,5	B81121-C-*145	590	600	630	500
	15 nF	8,5 × 16,5 × 26,5	B81121-C-*146	500	500	510	500
	22 nF	10,5 × 18,5 × 26,5	B81121-C-*147	400	400	540	500
	27 nF	10,5 × 20,5 × 26,5	B81121-C-*148	400	400	540	400
27,5	33 nF	11,0 × 21,0 × 31,5	B81121-C-*149	–	350	320	250

Capacitance tolerance: ± 20 % (closer tolerances upon request)

1) Replace the * by the code letter for the required lead length or packing.
B = lead length 6 mm (untaped)
C = lead length 26 mm (untaped)
P = taped, Ammo pack (taping refer to page 252)
H = taped, reel (taping refer to page 252)



Technical data

Climatic category in accordance with IEC 68-1	40/085/21
Lower category temperature T_{min} Upper category temperature T_{max}	– 40 °C + 85 °C
Damp heat test	21 days/40 °C/93 % relative humidity
Limit values after damp heat test	Capacitance change $\|\Delta C/C\|$ ≤ 3 % Dissipation factor change $\Delta \tan \delta$ ≤ 0,5 · 10^{-3} (at 1 kHz) ≤ 1,0 · 10^{-3} (at 10 kHz) Insulation resistance R_{is} ≥ 50 % of minimum or time constant $\tau = C_R \cdot R_{is}$ as-delivered values
Permissible continuous ac voltage	500 V (50…1000 Hz)
Permissible continuous dc voltage	2000 V
DC test voltage	2700V_{dc}, 2s

Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)

	$C_R \leq 0{,}1$ µF	0,1 µF < $C_R \leq$ 1 µF	C_R > 1 µF
at 1 kHz	–	0,5	0,5
10 kHz	–	0,8	1,5
100 kHz	5	–	–

Insulation resistance R_{is} or time constant $\tau = C_R \cdot R_{is}$ at 20 °C, rel. humidity ≤ 65 % (minimum as-delivered values)

$C_R \leq 0{,}33$ µF	C_R > 0,33 µF
30 000 MΩ	10 000 s

Siemens Matsushita Components

New lab assortments in film capacitors

Five at a stroke

To save you the trouble of inquiring for individual ratings to put into your design, there are now five practical sets of film capacitors:

- ▶ Lead spacing 5: 525 types, 50 to 400 V, 1 nF to 3.3 µF
- ▶ SilverCaps: the lowest-cost models, low in volume, 63 to 400 V, 1 nF to 10 µF
- ▶ MKPs in wound technology: for RF applications, 250 to 2000 V, 1.5 nF to 0.68 µF
- ▶ MKPs in stacked-film technology: 300 types, 160 to 1000 V, 1.5 nF to 1 µF
- ▶ Interference suppression: 150 types with a wide choice of ratings for different applications – X2 with small dimensions, Safe-X for maximum security against active flammability (X2) and Y for suppressing common-mode interference (Y2)

SCS – dependable, fast and competent

Note

KS and KP capacitors are no longer available for delivery.

Siemens Matsushita Components

Ceramic chip capacitors from stock

Small in size, big in performance

Our selection of capacitors ranges from standard sizes down to a miniature highlight in 0402 style. Measuring only 1 x 0.5 x 0.5 mm, it's an ideal solution for applications where space is tight, like in handies and cardiac pacemakers. At the same time all our chips can boast excellent soldering characteristics, with special terminal variants for conductive adhesion. And we also thought about the right packing for automatic placement. You get all sizes down to 1206 in bulk case for example, plus voltage ratings from 16 to 500 V. By the way, our leaded models have CECC approval of course, in fact they were certified more than ten years ago.

More in the new short form catalog!

SCS – dependable, fast and competent

1 Introduction

This data book describes fixed capacitors with plastic film dielectrics. The characteristics and application possibilities of such film capacitors, which are also termed
FK capacitors,
are effected so strongly by the dielectric used that the capacitors are grouped and designated according to the type of dielectric.

1.1 Classification of film capacitors

Short identification codes for the type of construction, describing the dielectric and the basic technology applied, are defined in DIN 41 379.
The last character in the short code indicates the type of dielectric:
T = Polyethylene terephthalate (PET)
P = Polypropylene (PP)
S = Polystyrene (PS)
Furthermore, a distinction is made between electrodes consisting of solid metal foils and those consisting of thin metal coatings deposited on the plastic films. An M (= Metallization) is prefixed to the short identification code of capacitors with metallized films.

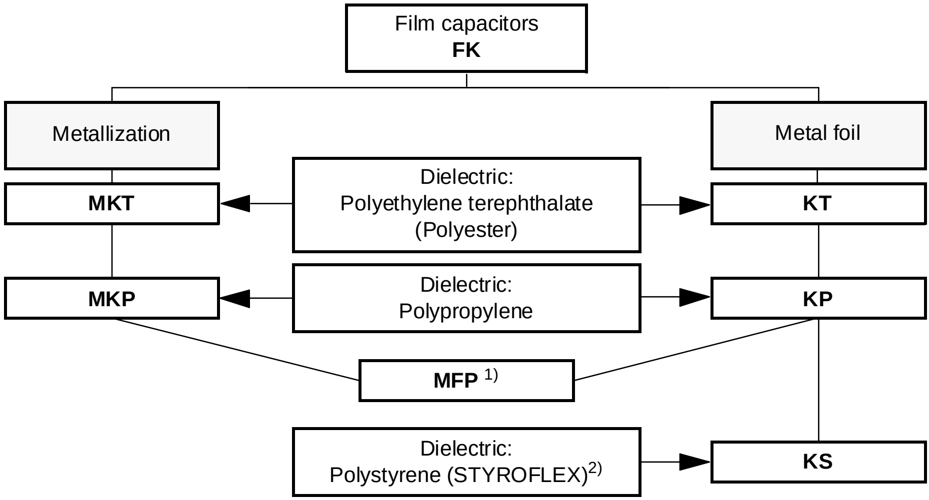


Fig. 1 Classification of film capacitors according to DIN 41 379

Our product range covers all capacitor types shown in **figure 1**, with the exception of KT capacitors.

1) MFP capacitors (with polypropylene dielectric) are constructed using a combination of metal foils and metallized plastic films. They are not covered by DIN 41 379.
2) STYROFLEX® is a registered trademark of the Norddeutsche Seekabelwerke Aktiengesellschaft, Nordenham.

1.2 Basic construction

FK capacitors are produced using either winding methods or stacking methods.

1.2.1 Capacitor winding technology

In the conventional production process, the capacitors are made by individually rolling the metallized films or the film/ foils into cylindrical rolls and then covering them with an insulating sleeve or coating.

In the MKT, MKP and MFP type series, our production range includes capacitors with space-saving flat wound bodies with insulating coatings or in plastic cases, as well as cylindrical wound capacitors. Flat windings are produced by compressing the cylindrical rolls before they are placed in the casings, so that the casing form is optimally used.

In order to be able to maintain the close ex-factory tolerances (down to $\Delta C/C_R = \pm$ 0,5 %) of KS and KP high-precision capacitors, the individual rolls are already adjusted to the required capacitance rating in the course of the rolling process. Special heat treatment and thermal cycling are used to stabilize the long-term mechanical and electrical characteristics, so that even the types without protective encapsulation have extremely constant characteristics.

1.2.2 Stacked-film technology

In stacked-film production technology, which has been developed by Siemens, large rings of metallized film are wound onto core wheels (with diameters of up to 60 cm). In this way, the "master capacitors" are produced under well-defined and constant conditions.

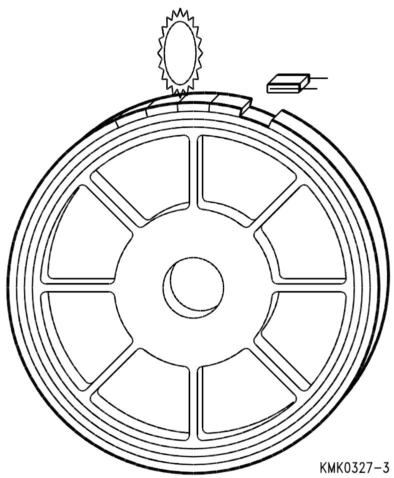


Fig. 2 Stacked-film production technology

As a result, the capacitor production lots obtained when the rings are sawed apart to produce the actual stacked-film capacitor bodies are especially homogenous.

The pulse handling capabilities of stacked-film capacitors are of particular advantage. Since each individual layer acts as a separate capacitor element, any damage to the contacts due to overloading is restricted to the respective capacitor element and does not affect the entire capacitor, as is the case for wound capacitors.

1.2.3 Foil and film arrangements

To provide a better understanding of the differences in the internal structure of the capacitors, figure 3 shows some typical foil and film arrangements.

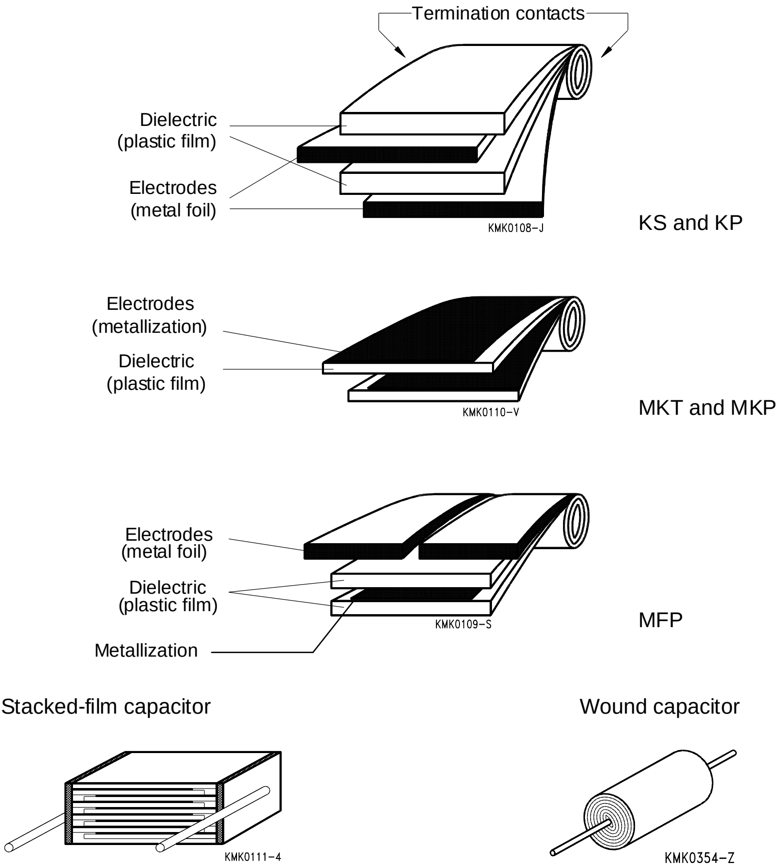
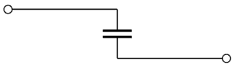
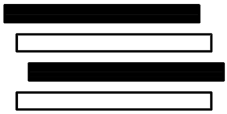
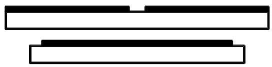
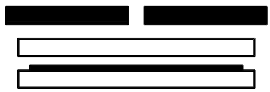
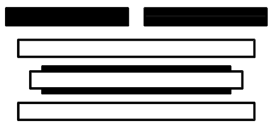


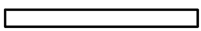
Fig. 3 Examples of typical foil and film arrangements of KS/KP capacitors, as well as of MKT, MKP and MFP capacitors

The relation between various foil and film arrangements and the capacitor types is shown in figure 4.

Simple connection	Internal series connection	Types
		
		KS B 31 *** KP B 33 ***
		MKT B 32 5** B 32 2** MKP B 32 61* B 32 62* B 32 65* B 32 669 EMI suppression capacitors
		MFP B 32 68* B 32 69*
		MFP B 32 64*

Metal foil

Metallized plastic film



Plastic film without metallization

Fig. 4 Schematic foil and film arrangements of various capacitor types

1.2.4 Metallized film capacitors

Capacitors with metallized plastic film have a decisive advantage over capacitors with metal foil electrodes: they have self-healing properties.

- These self-healing properties permit utilization of the full dielectric strength of the dielectric materials of metallized film capacitors, whereas metal-foil electrode capacitors must always be designed with a safety margin to allow for any possible faults in the dielectric.
- Metallized types thus have a distinct size advantage, which is particularly apparent with the larger capacitance ratings.
- With metallized-film designs, it is also possible to implement even complicated capacitor arrangements, e.g. multiple internal series connection to cope with high dc voltages coupled with high ac load capabilities.

1.2.5 Self-healing

The metal coatings, which are vacuum-deposited directly onto the plastic film, have a thickness of only 20 … 50 nm. If the dielectric breakdown field strength is exceeded locally at weak points, at pores or impurities in the dielectric, a dielectric breakdown occurs. The energy released by the arc discharge in the breakdown channel is sufficient to totally evaporate the thin metal coating in the vicinity of the channel. The rapid expansion of the plasma in the breakdown channel causes it to cool after a few microseconds, thus quenching the discharge. The insulated region thus resulting around the former faulty area will cause the capacitor to regain its full operation ability.

Since the absence of any form of pressure in the individual dielectric layers and a good homogeneity improves the self-healing properties, stacked-film capacitors have better self-healing properties than wound capacitors.

Note:

At low voltages, anodic oxidation of the metal coatings leads to an electrochemical self-healing process.

1.3 Characteristic properties

Different dielectrics and various foil and film arrangements enable a wide variety of characteristics to be achieved. A table of general typical values for comparison purposes is shown on page 10.

1.4 Capacitor designs and types of terminal

A variety of standard designs with corresponding types of terminal are available to suit different applications and operating environments. (Special designs such as capacitors with terminal tabs are available upon special request).

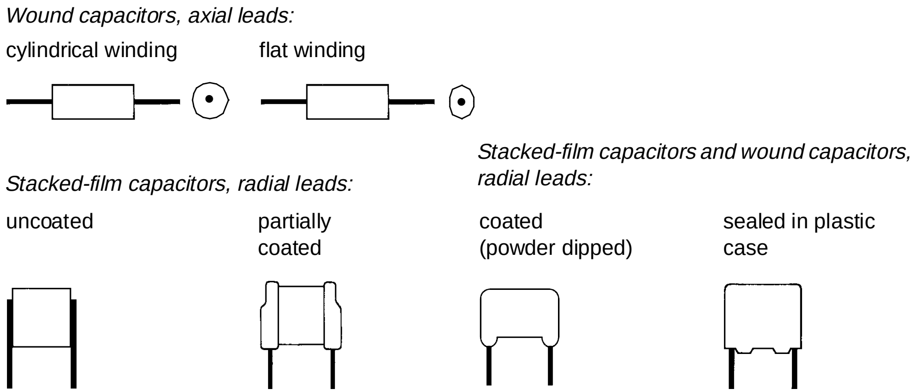


Fig. 5 Capacitor designs

Stacked-film capacitors (partially coated or uncoated) with special dimensions

These components have the special advantage that they can be adapted to the customer's design requirements in an almost unlimited range of sizes without having to take consideration of case size standards or provide special tools for special casings.

Design rules:
The lead spacing (capacitor length *l*) is determined by the dielectric film cut-off width. However, the width *b* and height *h* can be adjusted within the following value range :

Lead spacing		7,5	10	15	22,5	27,5
Width (*b*)	min.	1,5	1,5	2,5	4	4
	max.	11	11	16	18	18
Height (*h*)	min.	3,5	3,5	4	6	6
	max.	13	13	20	25	25

In so doing the volume must remain approximately the same.

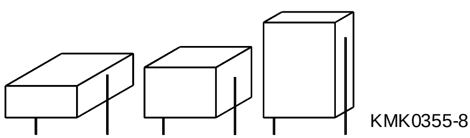


Fig. 6 Examples of special capacitors dimensions for same capacitance and voltage rating

2 Capacitance

2.1 Rated capacitance / measuring conditions

The rated capacitance C_R of a capacitor is the value which is indicated upon it.

The capacitance is measured under standard ambient conditions in accordance with IEC 68-1, section 5.3. In case of doubt, the measurements have to be carried out under the referee climate conditions in accordance with IEC 68-1, section 5.2.

The measuring frequency is chosen in accordance with section 4.2.2 of the respective sectional specification. The reference temperature is 20 °C (according to IEC 68-1, section 5.1).

Measuring conditions	Standard conditions	Referee conditions
Temperature	15 °C … 35 °C	(23 ± 1) °C
Relative humidity	45 % … 75 %	(50 ± 2) %
Ambient atmos. pressure	86 kPa … 106 kPa	86 kPa … 106 kPa
Frequency		
KS, KP: $C_R \leq 1$ nF	100 kHz or 1 MHz	1 MHz
$C_R > 1$ nF	1 kHz or 10 kHz	1 kHz
MKT, MKP, MFP:	1 kHz	1 kHz
Voltage	$0{,}03 \cdot V_R$ (max. 5 V)	$0{,}03 \cdot V_R$ (max. 5 V)

Prior to being measured, a capacitor must be stored under measuring conditions until the entire capacitor has reached the measuring temperature and humidity.

2.2 Available capacitance and tolerance ratings

The rated capacitance values C_R and the tolerance ranges that can be supplied are listed for each type. For rated capacitances between 10 pF and 100 pF, only integer values in accordance with the corresponding E series are permissible. Capacitors with less than 10 pF can be ordered with any integer capacitance value.

The following capacitance tolerances are usual:

Capacitance tolerance	± 20 %	± 10 %	± 5 %	± 2,5 %	± 2 %	± 1 %	± 0,5 %
Code letter, according to IEC 62	M	K	J	H	G	F	D
Threshold value[1]			20 pF	40 pF	50 pF	100 pF	200 pF
Tolerance for cap. below threshold values			± 1 pF = F				

1) The tolerances stated as a percentage are only valid for rated capacitances down to a lower threshold value. For all capacitance values below the threshold value, a uniform tolerance of ± 1 pF applies.

In the standard product range of MKT, MKP and MFP capacitors, only the first two significant figures of the rated capacitance value may differ from zero.
Only the first four significant figures of the rated capacitance values of KS and KP capacitors may differ from zero.

E series in accordance with IEC 63

The following E series values are to be multiplied by the required positive or negative integer powers of 10.

E6	E12	E24	E48	E96
100	100	100	100	100
				102
			105	105
				107
		110	110	110
				113
			115	115
				118
	120	120	121	121
				124
			127	127
		130		130
			133	133
				137
			140	140
				143
			147	147
150	150	150		150
			154	154
				158
		160	162	162
				165
			169	169
				174
			178	178
	180	180		182
			187	187
				191
			196	196
		200		200
			205	205
				210
			215	215
220	220	220		221
			226	226
				232
			237	237
		240		243
			249	249
				255
			261	261
				267
	270	270	274	274
				280
			287	287
				294
		300	301	301
				309

E6	E12	E24	E48	E96
			316	316
				324
330	330	330	332	332
				340
			348	348
				357
		360	365	365
				374
			383	383
	390	390		392
			402	402
				412
			422	422
		430		432
			442	442
				453
			464	464
470	470	470		475
			487	487
				499
		510	511	511
				523
			536	536
				549
	560	560	562	562
				576
			590	590
				604
		620	619	619
				634
			649	649
				665
680	680	680	681	681
				698
			715	715
				732
		750	750	750
				768
			787	787
				806
	820	820	825	825
				845
			866	866
				887
		910	909	909
				931
			953	953
				976

2.3 Variation of capacitance with temperature

The capacitance of an FK capacitor will undergo a reversible change within a range of temperatures between the upper and lower category temperatures. The gradient of the capacitance/temperature curve is given by the temperature coefficient α_c of the capacitance. This is essentially determined by the properties of the dielectric and of the electrode foils, as well as by the capacitor construction and the manufacturing parameters. Capacitor types KS, KP, MKP and MFP have negative temperature coefficients, i.e. the capacitance decreases with increasing temperature. MKT capacitors have positive temperature coefficients.

The temperature coefficient α_c is defined as the average capacitance change, in relation to the capacitance measured at (20 ± 2) °C, occurring within the temperature range T_1 … T_2. It is expressed in units of 10^{-6}/K.

$$\alpha_C = \frac{C_2 - C_1}{C_3 \cdot (\;)}$$

C_1 Capacitance measured at temperature T_1

C_2 Capacitance measured at temperature T_2

C_3 Reference capacitance measured at (20 ± 2) °C[1)]

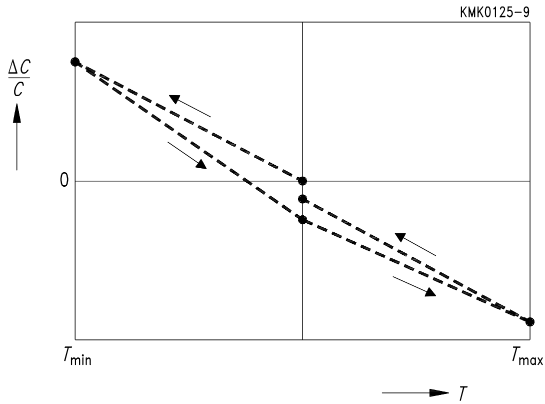


Fig. 7 Capacitance change versus temperature (schematic curve)

1) In accordance with IEC 384-1, section 4.24.1 and CECC 30 000, section 4.24.1

In the data sheets for KS and KP capacitors, typical values of the temperatur coefficients α_c between the temperatures T_{min} and T_{max} (lower and upper category temperature) are given. If measurements are carried out in narrower temperature ranges, deviating α_c values may be determined.

If a capacitor is subjected to a temperature cycle from the reference temperature to T_{min}, up to T_{max} and back to the reference temperature, small differences may be observed between the initial and the final capacitance (cf. figure 7).

This temperature-curve deviation is designated as the capacitance drift in sections 4.24.3 of both IEC 384-1 and CECC 30000. The sectional specifications IEC 384-7 and IEC 384-13, corresponding to CECC 30 900 and CECC 31 800, set down strict limits for the capacitance drift in connection with the stability classes for KS and KP capacitors.

Generally, when making the measurements, it must be taken into consideration that every temperature change is accompanied by a relative humidity change, which will affect the measurement with the humidity effect time constant, depending on the capacitor type (also refer to chapter 2.4). The change in α_c caused by the humidity variations remain within the scatter limits specified for α_c if measurements are carried out under standard conditions and the temperature cycles are not too long.

Figure 8 shows typical temperature characteristics of the capacitances of different capacitor styles.

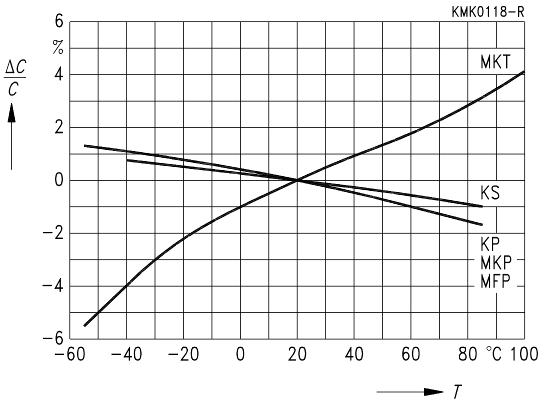


Fig. 8 Relative capacitance change ΔC/C versus temperature T (typical values)

2.4 Variation of capacitance with humidity

The capacitance of a plastic film capacitor will undergo a reversible change of value in relation to any change in the ambient humidity. Depending on the type of capacitor design, both the dielectric and the effective air gap between the films will react to changes in the ambient humidity and will thus affect the measured capacitance.

The humidity coefficient β_c is defined as the relative capacitance change determined for a 1 % change in the humidity (at a constant temperature).

$$\beta_c = \frac{2 \cdot (\quad)}{(\quad) \cdot (\quad)}$$

C_1 capacitance value at relative humidity F_1

C_2 capacitance value at relative humidity F_2

The following typical values apply to the humidity coefficients:

Style	Relative humidity range	Humidity coefficient β_c
KS capacitors	50% … 85%	+ (60…200) $\cdot 10^{-6}$/% rel. hum.
KP, MKP, MFP capacitors	50% … 95%	+ (40…100) $\cdot 10^{-6}$/% rel. hum.
MKT capacitors	50% … 95%	+ (500…700) $\cdot 10^{-6}$/% rel. hum.

Figure 9 shows typical capacitance/humidity characteristics of the different capacitor styles.

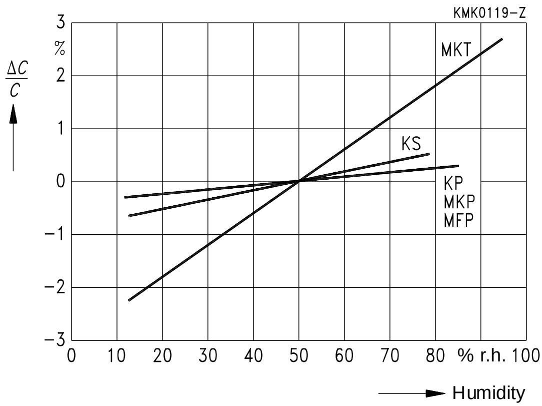


Fig. 9 Relative capacitance change $\Delta C/C$ versus relative humidity (typical values)

The rate of the moisture absorption and drying processes will vary with time, depending on the water vapor diffusion. The time constant depends on the capacitor type and varies between 1/2 a day (e.g. for capacitors without coating) and several weeks (e.g. for capacitors with plastic cases).

At relative humidities below 30 % , the humidity coefficient is relatively low. Wide variations are to be expected at relative humidities above 85 %.

2.5 Variation of capacitance with frequency

MKT capacitors:

Due to the relationship between the permittivity of the dielectric and frequency, the capacitance of this capacitor style decreases with increasing frequencies.

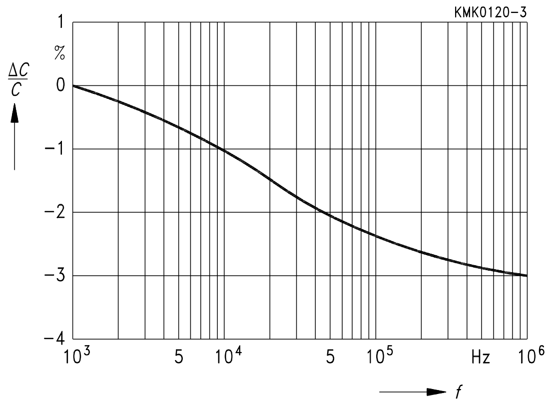


Fig. 10 Relative capacitance change $\Delta C/C$ versus frequency f for MKT capacitors (typical example)

KS ,KP, MKP and MFP capacitors:

Up to a frequency of 1 MHz, the capacitance remains virtually unaffected by the frequency.

In the vicinity of the natural resonance frequency of the capacitors, the self-inductance leads to an additional decrease of the impedance. This has the same effect as an increase in the capacitance (also refer to the equivalent circuit diagram in **Chapter 4**).

2.6 Variation of capacitance with time

The values stated for the time instability of the capacitance, the capacitance drift $i_z = |\Delta C/C|$, in the data sheets for KS and KP capacitors are typical values. They are expressed in terms of a percentage of the rated capacitance and usually also include an additive component stated in pF.

The capacitance drift values i_z apply to capacitance ratings ≥100 pF and do not take into consideration the reversible effects of temperature changes (α_c) and changes in relative humidity (β_c) .

The values refer to tests at + 40 °C and the service life stated in the data sheets for long-life grade KS and KP capacitors. No service life is specified for general-purpose grade capacitors; in these cases the capacitance drift values are based on a two-year period.

The capacitance drift may exceed the specified values if the capacitor is subjected to frequent, large temperature changes in the vicinity of the upper category temperature and relative humidity limits.

The following i_z values can be applied as typical values for the various capacitor styles:

Style	MKT	MKP	MFP	KS/KP
Capacitance drift i_z (typical values)	3 %	2 %	2 %	0,3 % + 0,4 pF

3 Voltage and current

3.1 Rated voltage

The rated voltage V_R is the maximum dc voltage which may be applied continuously to the terminals of a capacitor at any temperature between the lower category temperature T_{min} and the rated temperature T_R .

3.2 DC test voltage

The dc test voltage to which the capacitor is subjected in the course of the final inspection test in production (100% electrical inspection) is stated for each type. The test may be repeated once as an incoming goods inspection test.

This dc test voltage also applies to the qualification approval test (duration: 60 s) and to the lot-by-lot quality conformance inspection (duration ≤ 2 s). An exception is made in the case of EMI suppression capacitors, for which the (lower) test voltages specified in the respective standards apply.

For details on the test circuit and equipment, refer to CECC 30 000 or IEC 384-1, section 4.6 in both documents.

3.3 Maximum continuous voltage (category voltage)

The maximum voltage which may be applied continuously to a capacitor in the temperature range between the lower category temperature T_{min} and the rated temperature T_R is equal to the rated dc voltage V_R . In the temperature range between the rated temperature T_R and the upper category temperature T_{max} a voltage derating as shown in figure 11 must be applied. At the upper category temperature, the maximum continuous voltage is equal to the category voltage V_C. Only KS capacitors are not subjected to voltage derating since their rated temperature is equal to the upper category temperature.

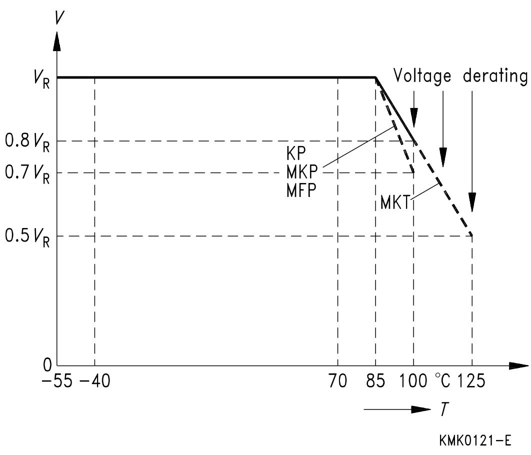


Fig. 11 Maximum permissible continuous voltage in relation to the temperature T

3.4 Alternating voltage, alternating current

The ability of a capacitor to withstand a continuous (sine-wave) alternating voltage load V_{rms} or alternating current I_{rms} is a function of the frequency and is limited by three different factors (refer to figure 12):

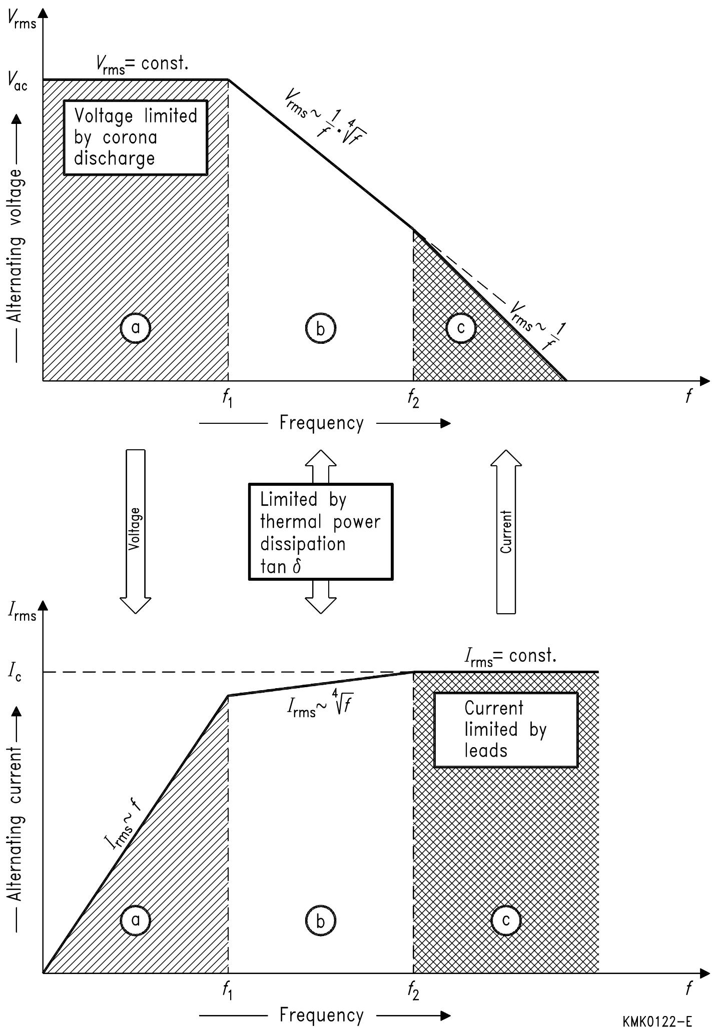


Fig. 12 Alternating voltage and alternating current load limits

Region ⓐ: Limit at which corona discharges start to occur, V_{CD}:

Below a certain frequency limit f_1 the applied ac voltage V_{rms} should not exceed the threshold voltage V_{CD} at which corona discharges (partial discharges) would start to occur with some intensity in air pockets in the capacitor and thus eventually endanger its dielectric strength. The following relation must be taken into consideration:

$V_{rms} \leq V_{CD}$ i.e. $I_{rms} \leq V_{CD} \cdot 2\Pi \cdot f \cdot C$

This voltage limit is determined, above all, by the internal construction of the capacitors (which determines the field strength at the edges); it also depends, to a lesser extent, on the thickness of the dielectric. This voltage limit can be raised, in particular, by using internal series connection designs.

Region ⓑ: Limit due to thermal power dissipation:

Above the frequency limit f_1 the permissible alternating voltage load must be reduced with increasing frequency in order to keep the power dissipation P_E resulting in the capacitor body:

$P_E = V_{rms}{}^2 \cdot 2\Pi \cdot f \cdot C \cdot \tan\delta$

below the power P_A which can be dissipated in the form of thermal energy by the surface area A of the capacitor:

$P_A = \alpha \cdot A \cdot \Delta T$

where: α = heat transfer coefficient.

In order to prevent permanent damage to the capacitor, the steady-state overtemperature ΔT attained at the hottest part of the capacitor surface in relation to the surrounding atmosphere must not exceed a certain value.

By equating the power generated and the power that can be dissipated as thermal energy:

$P_E = P_A$

the conditions for the maximum permissible alternating voltages and alternating currents in this region can be deduced as:

$$V_{rms} \leq \sqrt{\frac{\alpha \cdot A \cdot \Delta T}{2\Pi \cdot f \cdot C \cdot \tan\delta}} \text{ or } I_{rms} \leq \sqrt{\frac{2\Pi \cdot f \cdot C \cdot \alpha \cdot A \cdot \Delta T}{\tan\delta}}$$

This can be simplified by the following close approximation:

$$V_{rms,\,max} \sim \frac{1}{f} \cdot \sqrt[4]{f} \text{ or } I_{rms,\,max} \sim \sqrt[4]{f}$$

The frequency limit f_1 is the maximum frequency at which the full permissible ac voltage V_{ac} may be applied to the capacitor without the maximum permissible power dissipation being exceeded.

$$f_1 = \frac{\alpha \cdot A \cdot \Delta T}{V^2_{rms,\,max} \cdot 2\Pi \cdot C \cdot \tan\delta} \text{ or } f_1 = \frac{I^2_{rms,max} \cdot \tan\delta}{2\Pi \cdot C \cdot \alpha \cdot A \cdot \Delta T}$$

Thus, within a certain voltage series, the frequency limit f_1 is inversely proportional to the respective capacitance value:

$$f_1 \sim \frac{1}{C}$$

Region Ⓒ: Limit due to maximum current handling capability

Above the frequency limit f_2 the permissible ac voltage load is limited by the current limit I_C which is the maximum current that can pass through the terminals effective electrical cross-section of the leads, the metal layers, the sprayed-on metal terminations, contact resistance of soldered and welded joints etc.) without causing overheating due to associated resistive losses.

$$V_{rms} \leq \frac{I_C}{2\Pi \cdot f \cdot C} \text{ or } I_{rms} \leq I_C$$

The frequency limit f_2 is calculated by applying the limit condition:

$$f_2 = \frac{I_C^2 \cdot \tan\delta}{2\Pi \cdot C \cdot \alpha \cdot A \cdot \Delta T}$$

In the data sheets for the individual types, several exemplary graphs of the permissible ac loads are shown for various voltage ranges and capacitor sizes.

No graphs are shown for the capacitor types where frequency-dependent ac loads are of secondary importance, e.g. KS and KP capacitors. If required, however, they can be supplied.

Usually, practical applications will not involve loads with perfect sine-wave functions. In most cases, however, it is possible to estimate the loads accurately enough by approximating them to sine waves. In extreme cases, the voltage or current curves must be assessed by means of Fourier-analyses. If we are to assist in such cases, please send us scaled graphs.

It must be stated here, though, that the ac load capability figures given in the data sheets are based on very generalized assumptions which do not enable any clear statements to be deduced in critical cases, where this is especially important. In such cases the final decision should always be based on practical testing in the particular circuit.

Note:

Even if the graphs shown for the ac load capability of the capacitors cover the line voltage range, standard film capacitors are basically not suitable for operation in direct connection to public power networks. In this context, we would like to point out the EMI suppression capacitors of the type series B81***, which are specially designed for power line applications (refer to chapter on “EMI suppression capacitors”).

3.5 Pulse handling capability, pulse characteristic

Voltage pulses with rapid voltage changes dV/d*t* (i.e. high rates of voltage rise) will lead to strong currents *i* (peak current) in the capacitor.

Rate of voltage rsie: $\frac{\mathrm{d}V}{\mathrm{d}t} \approx \frac{V_{pp}}{\tau}$

Peak current: $i = C \cdot \frac{\mathrm{d}V}{\mathrm{d}t}$

V_{pp} Peak-to-peak voltage
τ Voltage rise or decay time
C Capacitance of capacitor

This current will generate heat in the contact regions between the sprayed-on metal terminations and the metal layers. The heat energy *Q* generated is calculated by the equation:

$$Q = \int i^2 \cdot R_i \cdot \mathrm{d}t$$

R_i Internal resistance

Pulse characteristic k_0

By inserting construction-related parameters of the respective capacitor, a characteristic factor k_0 can be deduced for the capacitor. This so-called pulse characteristic k_0 is:

$$k_0 = 2\int\left(\ldots \right)^2 \mathrm{d}t$$

A good approximation is provided by:

$$k_0 \approx 2\left(\quad \Delta V \quad \Delta V \quad \right)$$

From this equation, it is clear that the thermal load on the contact areas does not depend on the rate of voltage rise $\Delta V/\Delta t$ alone, but is determined by the product of $\Delta V/\Delta t$ and ΔV.

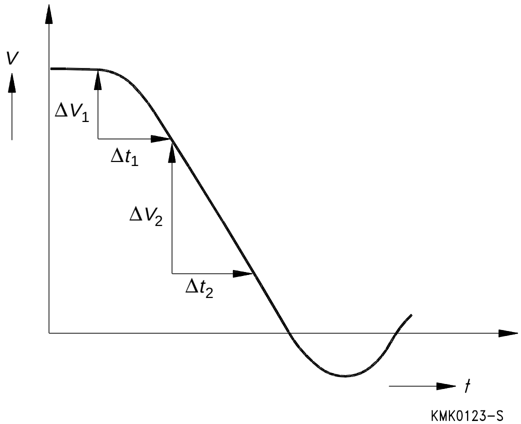


Fig. 13 Voltage-time curve across capacitor

ΔV_1, Δt_1, etc. are the related voltage and time stages of a straight-line polygon approximation of the voltage pulse.

It is also possible to use oscillograms to calculate the pulse characteristic for the respective pulse load waveform to be analysed, as follows:

For pulse-type voltages with straight-line transients (trapezoidal, sawtooth pulses):

$$k_0' = 2 \cdot \frac{V_{pp}^2}{\tau}$$

V_{pp} Peak-to-peak voltage
τ Rise time or decay time of the voltage

For passive and short-circuit-type discharging:

$$k_0' = \frac{V_{ch}^2}{R \cdot C}$$

V_{ch} Charging voltage
R Ohmic resistance of discharge circuit
C Capacitance

The pulse characteristic calculated in this way, k_0', can now be compared to the maximum permissible pulse characteristic k_0 given in the data sheets.

Maximum rate of voltage rise V_{pp}/τ

For the special application case where the capacitor is discharged from the full rated voltage, the maximum permissible rate of voltage rise V_{pp}/τ is given in addition to the respective pulse characteristic k_0.

Example:

MKT stacked-film capacitor B 32 520/lead spacing 7,5 with $V_R = 250\ V_{dc}$:
The maximum permissible pulse characteristic is given as: $k_0 = 100\ 000\ V^2/\mu s$

The maximum permissible rate of voltage rise (rise rate or decay rate) for discharge from the full rated voltage ($V_{pp} = V_R$) is then:

$$\frac{V_{pp}}{\tau} = \frac{k_0}{2 \cdot V_{pp}} = \frac{100\,000\,V^2/\mu s}{2 \cdot 250\,V} = 200\ V/\mu s$$

From the pulse characteristic k_0, it is also possible to calculate the (higher) permissible rate of voltage rise for lower peak-to-peak voltages.

For a lower peak-to-peak voltage, of e.g. $V_{pp} = 100\ V_{dc}$, we obtain:

$$\frac{V_{pp}}{\tau} = \frac{k_0}{2 \cdot V_{pp}} = \frac{100\,000\,V^2/\mu s}{2 \cdot 100\,V} = 500\,V/\mu s$$

Both types of discharge have the same pulse load effect (i.e. the same pulse characteristic k_0!), although the maximum permissible rates of voltage rise are clearly different.

The pulse handling capability of a capacitor is determined, in particular, by the internal structure of the capacitor element. (Construction variants are shown in **figure 4**.)

Apart from the layer structure variants, stacked-film capacitors have basic advantages over wound capacitors in terms of pulse-handling capabilities. Since, in principle, a stacked-film capacitor comprises a large number of independent capacitors in parallel, any contact weakness occurring can only affect the individual capacitor element.

Note:

KS and KP capacitors may also be operated with pulses and non-sinusoidal alternating voltages. As long as the self-heating effect is negligible there is no other limitation to this type of pulse load. The maximum permissible rates of voltage rise for discharge from rated voltage are in the region of 1000 V/µs.

3.6 Dielectric strength at low air pressure (altitude safety)

The flashover safety at the capacitor terminations is reduced as the atmospheric pressure drops.

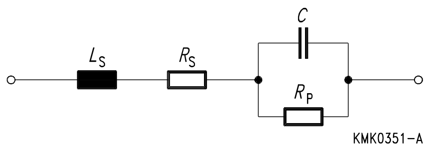
The capacitors can be used at pressures down to 40 kPa without a voltage derating being necessary. This corresponds to an altitude of 7000 m (approx. 23 000 ft) above mean sea level.

Capacitors for use at altitudes above 7000 m are available upon special request.

4 Dissipation factor

The dissipation factor tan δ is the ratio of the equivalent series resistance to the capacitive resistance in the equivalent series circuit or of effective power (power dissipation) to reactive power for sine-wave loads.

Equivalent circuit diagram



L_S Series inductance
R_S Series resistance (leads and contacts)
R_p Parallel resistance (insulation resistance)
C Capacitance

4.1 Measuring conditions

The generic standards and the sectional standards specify the same measuring conditions for measuring the dissipation factor tan δ as for measuring the capacitance (refer to chapter 2.1). For MKT, MFP and MKP capacitors, an additional measuring frequency of 10 kHz is used for determining the dissipation factor for capacitors with $C_R \leq 1\mu F$.

4.2 Variation of dissipation factor with frequency

If the inductance L_S is neglected and for frequencies $f \ll f_r$ where $f_r = 1/(2\Pi\sqrt{L_S \cdot C})$ is the natural resonance frequency) the dissipation factor tan δ is a combination of a parallel component $\tan\delta_P$, a series component $\tan\delta_S$ and a dielectric component $\tan\delta_D$:

$$\tan\delta = \tan\delta_P + \tan\delta_S + \tan\delta_D$$

$$\tan\delta_P = \frac{1}{R_P \cdot 2\Pi f \cdot C}$$

$$\tan\delta_S = R_S \cdot 2\Pi f \cdot C$$

$\tan\delta_D$ = a characteristic of the dielectric

The parallel component $\tan\delta_P$ is negligible in the entire frequency range since it contributes virtually nothing to the overall dissipation factor even at very low frequencies (f << 1 kHz) due to the extremely high insulation resistance (parallel resistance R_P). Because of this, the dissipation factor tan δ at low frequencies is solely determined by the dielectric component $\tan\delta_D$, which, for KS, KP, MKP and MFP capacitors is independent of the frequency up to frequencies far into the multi-MHz-range and will typically result in a value of approximately 10^{-4}.

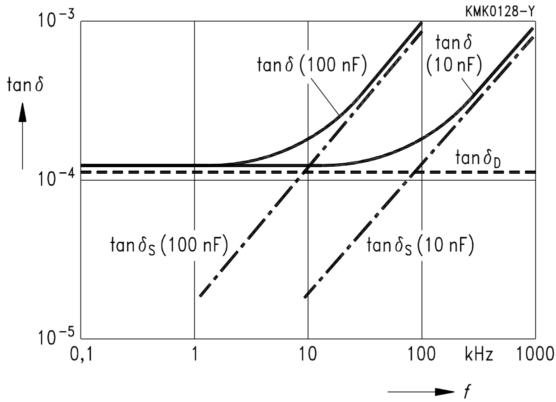


Fig. 14 Dissipation factor versus measuring frequency (schematic representation using two polypropylene or polystyrene capacitors of different capacitances as examples)

However, with rising frequency (f >1 kHz), the series component tan δ_S of the dissipation factor, which is proportional to the capacitance, increases more and more rapidly, until it is the dominating component in the dissipation factor curve. The measured value of the series component is determined by the series resistance R_S, which represents the sum of the contact resistances (terminations) and the resistances of leads, metal layers and electrode foils.

Because the dielectric of MKT capacitors contributes a considerably greater dielectric component tan δ_D , MKT capacitors display a noticeably higher overall dissipation factor, especially at lower frequencies, than, for example, MKP capacitors (cf. figure 15).

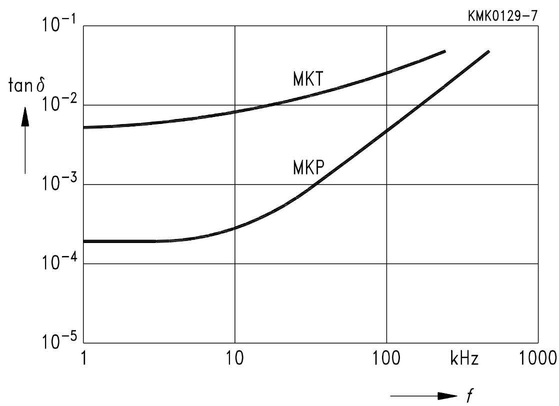


Fig. 15 Frequency dependence of the dissipation factor, e.g. for C_R = 0,10 µF (typical behavior)

The dissipation factors shown for the various measuring frequencies for the individual KS and KP capacitor types may be exceeded by a factor of up to 1.5 for a maximum of 10 % of the measured lot.

4.3 Variation of dissipation factor with temperature, humidity and voltage

The dissipation factor of capacitors with polypropylene dielectrics is largely unaffected by the temperature, whereas MKT capacitors show a characteristic dissipation factor minimum at approximately 70 °C.

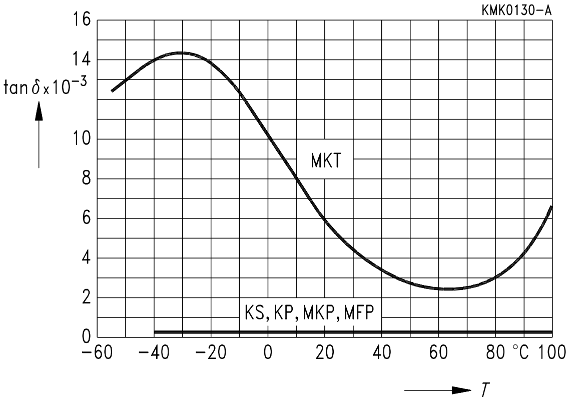


Fig. 16 Dissipation factor tan δ versus temperature *T* for *f* = 1 kHz (typical values)

The dissipation factor values may increase under humid conditions. It is virtually impossible to detect any variation of the dissipation factor with voltage.

5 Insulation resistance

The high-precision capacitors (both polypropylene and STYROFLEX) , in particular, are characterised by very high insulation resistances in the TΩ-region. To measure such extreme values, exact measuring conditions and a precisely reproducible measuring setup are required (shielded and protected measurements).

5.1 Measuring conditions

The insulation resistance R_{is} is measured by determining the ratio of the applied dc voltage to the current flowing through the capacitor after a period of 1 min ± 5 s.

As specified by section 4.5.2. of both CECC 30 000 and IEC 384-1, the measuring voltage is:

Rated voltage V_R of capacitor	Measuring voltage
$10\ V \leq V_R < 100\ V$	(10 ± 1) V[1)]
$100\ V \leq V_R < 500\ V$	(100 ± 15) V
$500\ V \leq V_R$	(500 ± 50) V

1) When it can be demonstrated that the voltage has no influence on the measuring result, or that a known relationship exists, measurements can be carried out at any voltages up to the rated voltage V_R. (In case of referee measurements, 10 V shall be used).

If the measurement is made at temperatures other than 20 °C a correction shall be made to the measured value to obtain the equivalent value for 20 °C by multiplying the measurement result by the appropriate correction factor.

Measuring temperature in °C	Correction factors (average values) according to the sectional specification	
	KS, KP, MKP, MFP	MKT
15	0,75	0,79
20	1,00	1,00
23	1,25	1,15
27	1,50	1,38
30	1,75	1,59
35	2,00	2,00

In case of doubt a referee measurement at 20 °C and (50 ± 2) % relative humidity is decisive.

In the data sheets for the individual types, the insulation resistance R_{is} is given as a minimum as-delivered value and as a limit value attained after the “damp heat, steady-state” test.

For MKT, MKP and MFP capacitors with capacitance ratings > 0,33 µF and for KS/KP capacitors with capacitances ratings >0,1 µF the insulation is given in terms of a time constant $\tau = R_{is} \cdot C_R$ in s.
(Conversion tip: 1 MΩ · µF = 1 s)

5.2 Factors affecting the insulation resistance

As could already be deduced from the correction factor tables (**Chapter 5.1**), the insulation resistance is affected by the temperature. In **figure 17** the typical behavior of individual types is shown.

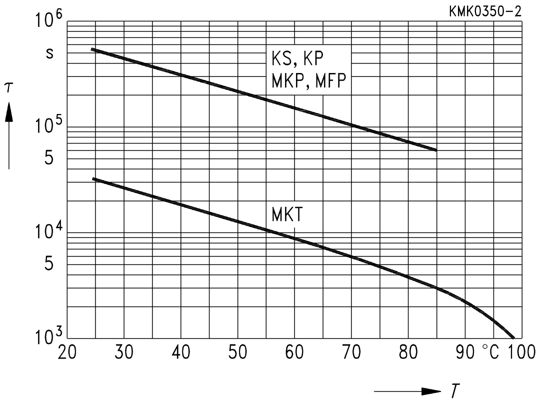


Fig. 17 Insulation as self-discharge time constant τ (= $R_{is} \cdot C_R$) in s (= MΩ · µF) versus temperature T (typical values)

The insulation resistance is also affected by humidity (the humidity coefficient of the insulation resistance is negative).

6 Climatic stress

6.1 Upper and lower category temperature

In the respective generic specification, the upper category temperature T_{max} and the lower category temperature T_{min} are defined as the maximum and the minimum ambient temperature for which a capacitor has been designed to operate continuously.

Note:

Due to the associated self-heating, a capacitor's surface temperature may be higher than the ambient temperature when it is operated with ripple current loads.

6.2 Rated temperature

The rated temperature T_R is defined as the maximum ambient temperature at which the rated voltage V_R may be applied continuously.

In the respective sectional specifications, a single rated temperature is specified for all MKT, MKP, MFP and KP capacitors listed in this data book:

T_R = 85 °C

The sectional specification for KS capacitors states that the rated temperature is to be equal to the upper category temperature:

$T_R = T_{max}$

For the KS capacitor type listed in this book, this is :

KS capacitor type	Rated temperature T_R i.e. upper category temperature T_{max}
B31063 B31861	70 °C
B31521 B31531	85 °C

6.3 Reference temperature for measurements

According to IEC 68-1, Section 5.1, the reference temperature for all electrical measurements is defined as 20 °C . If required, measurement results obtained at different temperatures can be converted to the reference temperature. Conversion factors:

Capacitance: see temperature coefficients

Insulation resistance: see table on **Seite 224**

6.4 Reference temperature for reliability specifications

In the reference conditions for reliability specifications, DIN 40 039 (draft version, May 1988) an ambient temperature of 40 °C is defined as the reference temperature. For a table of conversion factors for the failure rate, refer to the chapter on quality.

6.5 Storage temperature

All capacitors listed in this data book can be stored at any temperature within the entire category temperature range.

For axial-lead KS capacitors type B 31 063 which have a lower category temperature T_{min} = –25 °C, the lowest permissible storage temperature is –40 °C.

6.6 Climatic category

The climatic category is identified by three groups of figures, separated by slashes, as specified in IEC 68 - 1, Appendix A.

Example: 55/085/56

–55 °C

+85 °C

56 days

1st group of figures:

Absolute value of the lower category temperature T_{min} as test temperature for
test Aa (cold) in accordance with IEC 68- 2-1

2nd group of figures:

Upper category temperature T_{max} as test temperature for
test Ba (dry heat) in accordance with IEC 68- 2-2
duration of test: 16 h

3rd group of figures:

Number of days, duration of
test Ca (damp heat, steady state) in accordance with IEC 68- 2-3
at (93 +2/–3) % rel. humidity and 40 °C ambient temperature

The limit values permissible after the damp heat test are given in the data sheets for the respective capacitor types. Capacitance changes due to the effects of humidity are reversible.

7 Notes on processing and applications

7.1 Soldering

Solderability

The solderability of the terminal leads is tested in accordance with IEC 68-2-20, test Ta, method 1.

Before the solderability test is carried out, the terminals are subjected to an accelerated ageing procedure (in accordance with IEC 68-2-2, test Ba: 4 hours exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure in order to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

Solder bath temperature:	(235 ± 5) °C
Immersion time:	(2,0 ± 0,5) s
Immersion depth:	distance from standoff surface or capacitor body: (2,0+0/-0,5) mm
Evaluation criterion:	wetting of wire surface by new solder ≥ 90%, free-flowing solder.

Resistance to soldering heat

The resistance to soldering heat is tested in accordance with IEC 68-2-20, test Tb, method 1A.

Solder bath temperature:	(260 ± 5) °C
Shield:	heat-absorbing board, (1,5 ± 0,5) mm thick, betweeen capacitor body and liquid solder
Soldering time:	MKT capacitors, except types with case (2,5×6,5×7,2) mm: (10 ± 1) s all others: (5 ± 1) s
Immersion depth:	(2,0+0/-0,5) mm from standoff surface or capacitor body
Evaluation critera:	No visible damage tan δ as specified in sectional specification

Permissible capacitance change	Type
2 %	MKT/MKP/MFP
0,8 % + 0,8 pF	KS, axial leads
0,5 % + 0,5 pF	KP, axial leads
0,3 % + 0,3 pF	KS / KP in case
5 %	EMI suppression capacitors

General notes on soldering

Permissible heat exposure loads on film capacitors are characterized by the upper category temperature T_{max}. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change a capacitor's electrical characteristics irreversibly.

High temperatures are encountered during soldering, but these are only applied briefly.

Apart from being dependent on the solder bath temperature and the soldering time, the thermal load is also affected by the initial (pre-heating) and the post-soldering (cooling) temperatures.

Shadowing by neighboring components or subsequent heating due to heat dissipation by these has a similar effect.

Since the soldering heat is transmitted into the components mainly via the leads, the thermal resistance of the terminals is the deciding factor for the heat transmitted, especially for smaller capacitor sizes. Thus a poor thermal conductivity is desirable from this aspect, however, this is contrary to the good electrical conductivity required in order to achieve low dissipation factors (refer to explanation of series resistance R_S in section 4), since the electrical conductivity is generally proportional to the thermal conductivity.

Usually, the utilization of suitable measures, e.g.
- maximum possible distance from the solder bath,
- cooling by forced ventilation,
- use of solder-resist coatings, etc.

enables even sensitive types such as KS capacitors to be soldered for the solder periods stated above at solder bath temperatures of up to 265 °C. If pre-heating cannot be avoided, the soldering conditions may possibly have to be re-adjusted (especially the cooling process immediately following soldering).

For uncoated and partially coated MKT capacitors with lead spacings ≤ 10 mm
(B 32 560/B 32 561, B 32 510/B 32 511) the following measures are recommended:

– pre-heating to not more than 80 °C in the preheater phase,
– maximum solder bath temperature 245 °C,
– maximum soldering time 4 s
– rapid cooling after soldering.

7.2 Cleaning

To determine whether the following solvents, often used to remove flux residues and other substances, are suitable for the capacitors described, refer to the table below:

Type	Ethanol, isopropanol, n-propanol	n-propanol-water mixtures, water with surface tension-reducing tensides (neutral)	Solvent from table A	Solvent from table B
MKT, uncoated, partially coated	suitable	unsuitable	in part suitable	unsuitable
MKT, MKP, MFP in plastic case	suitable	suitable	suitable	unsuitable
KS uncoated	suitable	unsuitable	unsuitable	unsuitable
KP uncoated	suitable	unsuitable	in part suitable	unsuitable
KS, KP in plastic case	suitable	suitable	suitable	unsuitable

Table A
Manufacturers' designations for trifluoro-trichloro-ethane -based cleaning solvents (selection)

Trifluoro-trichloro-ethane	Mixtures of trifluoro-trichloro-ethane with ethanol and isopropanol	Manufacturer
Freon TF	Freon TE 35; Freon TP 35; Freon TES	Du Pont
Frigen 113 TR	Frigen 113 TR-E; Frigen 113 TR-P; Frigen TR-E 35	Hoechst
Arklone P	Arklone A; Arklone L; Arklone K	ICI
Kaltron 113 MDR	Kaltron 113 MDA; Kaltron 113 MDI; Kaltron 113 MDI 35	Kali-Chemie
Flugene 113	Flugene 113 E; Flugene 113 IPA	Rhone-Progil

Table B
Manufacturers' designations of unsuitable cleaning solvents (selection)

Mixtures of chlorinated hydrocarbons and ketones with fluorated hydrocarbons	Manufacturer
Freon TMC; Freon TA; Freon TC	Du Pont
Arklone E	ICI
Kaltron 113 MDD; Kaltron 113 MDK	Kali-Chemie
Flugene 113 CM	Rhone-Progil

Even when suitable solvents are used, a reversible change of the electrical characteristics may occur in uncoated capacitors immediately after they are washed.
Such capacitors should be dried (e.g. 4 hours at 70°C) before being subjected to subsequent electrical testing.

Note:

The use of all chlorinated and fluorated hydrocarbons, as well as mixtures containing these (tables A and B), should be avoided for environmental reasons. The use of these substances is no longer permitted in Germany.

7.3 Mechanical robustness of leads

The mechanical robustness of the leads is tested in accordance with IEC 68-2-21.

Tensile strength: (Test Ua1)	Wire diameter d_1 in mm	Tensile force
	$0{,}3 < d_1 \leq 0{,}5$	5 N
	$0{,}5 < d_1 \leq 0{,}8$	10 N
	$0{,}8 < d_1 \leq 1{,}25$	20 N
Bending strength: (Test Ub)	Procedure 1: 2 consecutive bends by 90°, in opposite directions	
	wire diameter d_1 in mm	Bending force
	$0{,}3 < d_1 \leq 0{,}5$	2,5 N
	$0{,}5 < d_1 \leq 0{,}8$	5 N
	$0{,}8 < d_1 \leq 1{,}25$	10 N
Torsional strength: (Test Uc)	Procedure A, severity 2: 2 successive rotations of 180° each	

Tests Ub and Uc are only carried out on types having axial wire leads, however, test Uc is not applied to KS and KP capacitors with axial leads.

7.4 Resistance to vibration

The capacitor's ability to withstand vibration e.g. as occurs in applications involving rotating machinery, is tested in accordance with IEC 68-2-6 .

The test procedure used here involves continuous vibration with continuously varying frequency and the following severities:

Test Fc: vibration, sinusoidal	Test conditions
Amplitude of displacement (below the 57,6 Hz transition frequency)	0,75 mm
Amplitude of acceleration (above the 57,6 Hz transition frequency)	98 m/s^2 (≙ 10 g)
Frequency range	10 Hz … 500 Hz
Test duration (in three orthogonal axes)	3 · 120 minutes

7.5 Flammability

7.5.1 Passive flammability

The passive flammability test is applied to ensure that components bearing the corresponding qualification contribute less energy to the combustion behavior of their immediate vicinity than is required to ignite them. This measure is meant to contain any localized fire which may occur.

In the respective tests, the capacitors are subjected to a standardized flame in order to be able to evaluate the combustion behavior by checking whether the flame persists longer than a maximum permissible period or not. The test severity is essentially determined by the test flame and the exposure time. In principle, the smaller the capacitor, the more easily flammable it is (see table: this fact is taken into consideration in the IEC 40 (CO) 752 flammability categories). The following tests are used :

Specifications	Flame height mm	Severity: time of exposure to flame s				Flame persistence s
UL 1414 7. Enclosure Test	19	Three-stage flame test: 1st period: 15 2nd period: 15 3rd period: 15				 15 15 60
IEC 695-2-2	12 ± 1	Preferred values: 5, 10, 20, 30, 60, 120				30
IEC 40 (CO) 752 (Amendment to IEC 384-1)	12 ± 1	Capacitor volume mm^3				
		≤ 250	> 250	> 500	> 1750	
Category A		15	30	60	120	3
Category B		10	20	30	60	10
Category C		5	10	20	30	30

Unless the detail specifications specifiy otherwise, EMI suppression capacitors are tested in accordance with CECC 32 400, section 4.17, test severity category C.

7.5.2 Active flammability

For an explanation of the active flammability of EMI suppression capacitors, **refer to page 170**.

7.5.3 Flammability of materials

In some cases, specifications regarding the flammability of materials in accordance with UL 94 are requested in addition to the results of capacitor flammability tests. The UL 94 safety standards describe a material test carried out on test specimens for classifying the flammability of plastics. In the test according to UL 94 V, the test specimens (length 127 mm / 5” , 12,7 mm / 0.5”) are arranged vertically and exposed to a flame twice; they are then classified into flammability categories:

Flammability category	UL 94 V-0	UL 94 V-1	UL 94 V-2
Material burning persistence (s): Individual flame exposure Total of ten flame exposures (5 specimens)	 ≤ 10 ≤ 50	 ≤ 30 ≤ 250	 ≤ 30 ≤ 250
Ignition of supporting layer by dropping burning particles	not permitted		permitted

The thickness of the test specimens must always be stated in order to enable evaluation of the flammability category!
E.g.: UL 94 V-0 (3,2 mm) does not imply that the material will also comply with UL 94 V-1 (1,6 mm).

The sole object of UL 94 is to enable comparison of the relative flammability of various materials. It does not provide any information on the actual combustion characteristics of a capacitor.

7.6 Embedding of capacitors in finished assemblies

In many applications, finished circuit assemblies are embedded in plastic resins. When this is the case, both chemical and thermal influences of the embedding (“potting”) and curing processes must be taken into account.

Our experience has shown that the following potting materials can be recommended: non-flexible epoxy resins with acid-anhydride hardeners; chemically inert, non-conducting fillers; maximum curing temperature 100 °C.

Caution:

Please consult us first if you wish to also embed other uncoated component types!

8 Self-inductance, resonant frequency

At high frequencies the self-inductance of a capacitor causes it to have a natural resonance which can have an undesirable effect when designing circuits. The self-inductance is influenced by the contact paths to the electrodes and the structure of the windings. As far as possible, all capacitors described in this data book are constructed with low-inductance bifilar electrode current paths or extended-foil contacts. A general rule for deducing the self-inductance states that the maximum value is 1 nH per mm lead length and capacitor length.

The frequency range of the natural resonance (also termed self-resonance) as a function of the capacitance can be read off the following diagram.

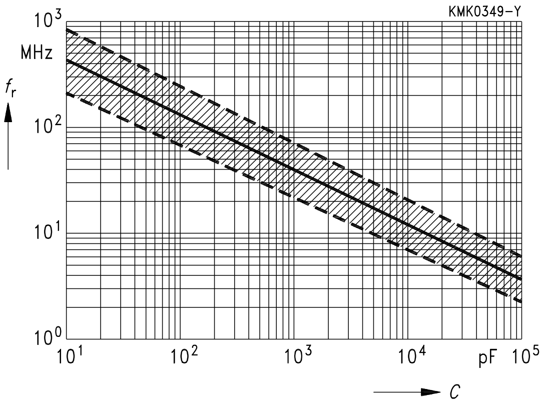


Fig. 18 Resonant frequency versus capacitance (typical values)

9 Shielding (outer foil)

In accordance with DIN 41 313 the location of the outer foil of KS and KP capacitors is indicated by a colored ring or symbol. In applications where the outer foil is connected to earth, it serves as a shield.

10 Capacitor markings

The individual data sheets state what information is provided by the identification markings on the capacitors. Depending on the capacitor size, the markings are positioned either on the side and/or the top of the component. The coded forms specified in IEC 62 are used to indicate the rated capacitance, capacitance tolerance and date of manufacture.

All MKT, MKP and MFP cased capacitors (including EMI suppression capacitors) with lead spacings 15 to 32,5 mm are also marked with a lot number (production batch number). This ensures unique identification of a particular capacitor and allows, together with the date of manufacture, exact assignment to the process data of the entire production run.(Traceability).

Codes for rated capacitance

Rated capacitance	In accordance with IEC 62	Short code
1 pF	1p0	
10 pF	10p	
100 pF	100p	n1
150 pF	150p	n15
1 nF	1n0	1n
1,5 nF	1n5	
10 nF	10n	
100 nF	100n	µ1
150 nF	150n	µ15
1 µF	1µ0	1µ
1,5 µF	1µ5	
10 µF	10µ	

Codes for capacitance tolerance

Capacitance tolerance	Code letter
–[1]	A
± 0,5 %	D
± 1 %	F[2]
± 2 %	G
± 2,5 %	H[3]
± 5 %	J
± 10 %	K
± 20 %	M

1) Capacitance tolerances for which no code letter is defined can be indicated by an A . The meaning of code A must then be mutually specified in other documentation.
2) For rated capacitances below the threshold values (refer to page 207) F implies a tolerance of ± 1 pF.
3) Not covered by IEC 62 .

Codes for date of manufacture

Year	Code letter	Month	Code numeral	Month	Code numeral/ letter
1992	C	January	1	July	7
1993	D	February	2	August	8
1994	E	March	3	September	9
1995	F	April	4	October	O
1996	H	May	5	November	N
1997	J	June	6	December	D

E.g.: E9 ≙ 1994 September

11 How to determine the ordering code

A component and the packing in which it is to be delivered are unambiguously defined by the ordering code (part number), which has up to 15 digits.

For MKT, MKP, MFP and EMI suppression capacitors, the ordering codes are explicitly stated (together with the corresponding tolerance and/or packing variants) in the data sheets.

Because of the immense range of capacitance values covered, this is not possible for KS and KP capacitors; the procedure for determining the required ordering codes (especially the method of coding the capacitance value) for these components is described on the following pages.

Should there be any doubt about the coding system, however, then it is bettter to order the capacitor using a plain text description (i.e. without a code). In this case, the translation into the part number, which is required for internal handling of the order, will be done by us. The components are delivered by part numbers only.

Basic structure of the ordering code:

Digit	1	2	3	4	5	6		7	8	9	10	11		12	13	14	15
	B						—						—				
	Block 1							Block 2						Block 3			

Digit	Meaning
1	B = Passive components
2, 3	31 = KS capacitors 32 = Metallized film capacitors (MKT, MKP, MFP) 33 = KP capacitors 81 = EMI suppression capacitors
4 … 6	Type (Block 1 is termed the “type number”)
7	Revision status
8	Rated dc voltage, coded (not for EMI suppression capacitors)
9 … 11; 13, 14	Rated capacitance (coding method for value in pF) Examples: Digit 9 10 11 B 3 3 5 3 1 - A 5 [15] [3] – K = $\underline{15} \cdot 10^{\underline{3}}$ pF = 15 nF Digit 9 10 11 13 14 B 31 5 2 1 - C 5 [12] [4] – H [70] 5 = $\underline{12},\underline{7} \cdot 10^{\underline{4}}$ pF = 127 nF 1st and 2nd significant figure of capacitance value (digits 9, 10) Exponent (digit 11) 3rd and 4th significant figure of capacitance values with more than two significant figures (only for KS and KP capacitors, see examples on next page), otherwise left vacant (digits 13, 14)
12	Capacitance tolerance, code letter
13 … 15	KS and KP capacitors: 13, 14: rated capacitance, coded, if not required, these places are left vacant; 15: packing MKT, MKP, MFP capacitors: Codes for lead lengths, and taping parameters (refer to respective data sheet)

Structure of ordering codes for KS and KP capacitors

B31861-C1 34 2 -F 80 7

Packing (7)

axial leads	radial leads
6 ≙ reel	0 ≙ bulk (untaped)
7 ≙ Ammo pack	5 ≙ magazine
	6 ≙ reel (H = 18,5 mm)
	8 ≙ reel (H = 16,5 mm)

Rated capacitance, coded (80)
third and fourth significant figure of capacitance value.
Left vacant if there are less than 3 significant figures

Capacitance tolerance (code letter in acc. with IEC 62) (-F)
F ≙ ± 1 pF (C_R ≤ 100 pF)
± 1 % (C_R > 100 pF)
G ≙ ± 2 %
H ≙ ± 2,5 %

Exponent b of capacitance (2)
(C_R = a · 10^b; C_R given in pF, decimal point (comma) is set after 2 digits in a)
0: C_R < 100 pF
1: 100 pF ≤ C_R < 1000 pF
2: 1000 pF ≤ C_R < 10000 pF
3: 10000 pF ≤ C_R < 0,1 µF
4: 0,1 µF ≤ C_R < 1 µF
5: 1 µF ≤ C_R < 10 µF

Rated capacitance, coded (34)
first and second significant figure of capacitance value pF
(The first digit is zero for values below 10 pF).

Type and rated dc voltage	General-purpose grade		Long-life grade		
	V_R = 160 V_{dc}	V_R = 630 V_{dc}	V_R = 63 V_{dc}	V_R = 160 V_{dc}	V_R = 630 V_{dc}
KS, axial leads	B31063-B1	–	–	B31861-C1	B31861-B6
KS, rectangular case	–	–	B31521-C5	B31521-B1	B31521-A6
KS, Tower Block	–	–	B31531-B5	–	–
KP, axial leads	B33063-B1	B33063-B6		–	–
KP, Tower Block	–	–	B33531-A5	–	–

Examples of capacitance coding (significant digits shown in bold print)

C_R	Example of ordering code	C_R	Example of ordering code
6 pF	B31861-B60**6**0-F7	**3**,**15** nF	B31861-C1**31**2-F**5**07
12 pF	B31861-C1**12**0-F7	**8765**0 pF	B31521-C5**87**3-F**65**7
150 pF	B31861-C1**15**1-G7	0,**1** µF	B31521-C5**1**04-G7

12 Standards and specifications

The capacitors described in this data book largely comply with German and international standards and regulations. For all specifications listed (DIN, CECC, IEC) the editions or issues valid on the 1st October 1994 apply.

12.1 Generic specifications

DIN 45 910	Generic specification: Fixed capacitors September 1985 (only available in German)
CECC 30 000	Generic specification: Fixed capacitors Issue 3, 1983
IEC 384-1	Fixed capacitors for use in electronic equipment Part 1: Generic specification. Second edition 1982

12.2 Sectional specifications

Style	DIN	CECC	IEC
MKT	DIN 45 910-11 September 1985	CECC 30 400 Issue 2 1984	IEC 384-2 2nd edition 1982
MKP	DIN 45 910-23 January 1983	CECC 31 200 Issue 1 1981	IEC 384-16 1st edition 1982
MFP	—	CECC 31 900 WG3 (Secr) 239A	IEC 384-17 1st edition 1987
KS	DIN 45 910-22 November 1985	CECC 30 900 Issue 2 1985	IEC 384 -7 2nd edition 1991
KP	DIN 45 910-27 April 1986	CECC 31 800 Issue 1 1985	IEC 384-13 2nd edition 1991
EMI suppress- ion capacitors	—	CECC 32 400 Issue 1 1992 EN 132400	IEC 384-14 2nd edition 1993

12.3 Detail specifications

Style	Type	Specification
MKT	B 32 231	DIN 44 113 (August 1967): Metallized polyethylene terephthalate film capacitors 100 to 1000 V dc
	B 32 232	DIN 45910-112 (September 1991), CECC 30401-051 (September 1991): Metallized polyethylene terephthalate film capacitors, DC 63 to 630 V
	B 32510 -513 B 32560 - 564	CECC 30401-007 (Issue 4 / February 1983) Manufacturer’s detail specification: Metallized polyethylene terephthalate film capacitors, DC 100 to 400 V, general-purpose grade, climatic category 55/100/21

Style	Type	Specification
MKT	B 32520 - 529	DIN 44 112 (August 1989), DIN 45 910 - 113 (September 1991), CECC 30401 - 052 (September 1991): Metallized polyethylene terephthalate film capacitors, DC 50 to 1000 V, general-purpose grade, climatic category 55/100/21 CECC 30401-043 (Issue 2/November 1989) Manufacturer's detail specification: Metallized polyethylene terephthalate film capacitors, DC 63 to 630V, general purpose-grade, climatic category 55/100/56
	B 32530 - 539	DIN 44 122 (August 1989), DIN 45 910-115 (September 1991), CECC 30401-054 (September 1991): Metallized polyethylene terephthalate film capacitors, DC 63 to 400 V, long-life grade, climatic category 55/100/56 CECC 30401-026 (Issue 4/November 1989) Manufacturer's detail specification: Metallized polyethylene terephthalate film capacitors, DC 63 to 400 V, long-life grade, climatic category 55/100/56
KS	B 31063	DIN 44 126-1 (December 1974): Polystyrene film dielectric capacitors, 160 to 630 V_{dc}, cylindric form
	B 31861	DIN 41393 (February 1984): Polystyrene film dielectric capacitors, 160 to 630 V_{dc} for extended life, cylindrical case
	B 31521	DIN 45910 - 224 (April 1993), CECC 30901-011 (April 1993): Polystyrene film dielectric metal foil capacitors, DC 63 V to 160 V, long-life grade, climatic category 40/085/21
	B 31531	DIN 45 910-223 (April 1993), CECC 30901-010 (April 1993): Polystyrene film dielectric metal foil capacitors, DC 63 V, long-life grade, climatic category 40/085/21 CECC 30901-006 (Issue 3 /May 1987) Manufacturer's detail specification: Polystyrene film dielectric metal foil capacitors, DC 63 V, long-life grade, climatic category 40/085/21
KP	B 33531	DIN 45910-272 (July 1992), CECC 31801-003 (July 1992): Polypropylene film dielectric metal foil capacitors, DC 63 V, long-life grade, climatic category 55/085/56, stability class 1

1 General

The high demands made by the world market on the quality of products and services to be supplied by us have made a thorough and global quality assurance system indispensible.

The quality assurance system enforced in our film / foil capacitor division is certified in accordance with ISO 9001. It is based on quality directives binding at all company levels and for all departments. It is described in the quality assurance manual and takes into consideration:
- national and international standards (DIN, CECC, IEC),
- specifications harmonized with our customers' requirements,
- our own performance goals.

1.1 Total Quality Management and Zero Defects Concept

The strategic aim of Total Quality Management (TQM) is to satisfy the demands made by customers on products or services in terms of function, quality, punctuality and price/performance ratios.

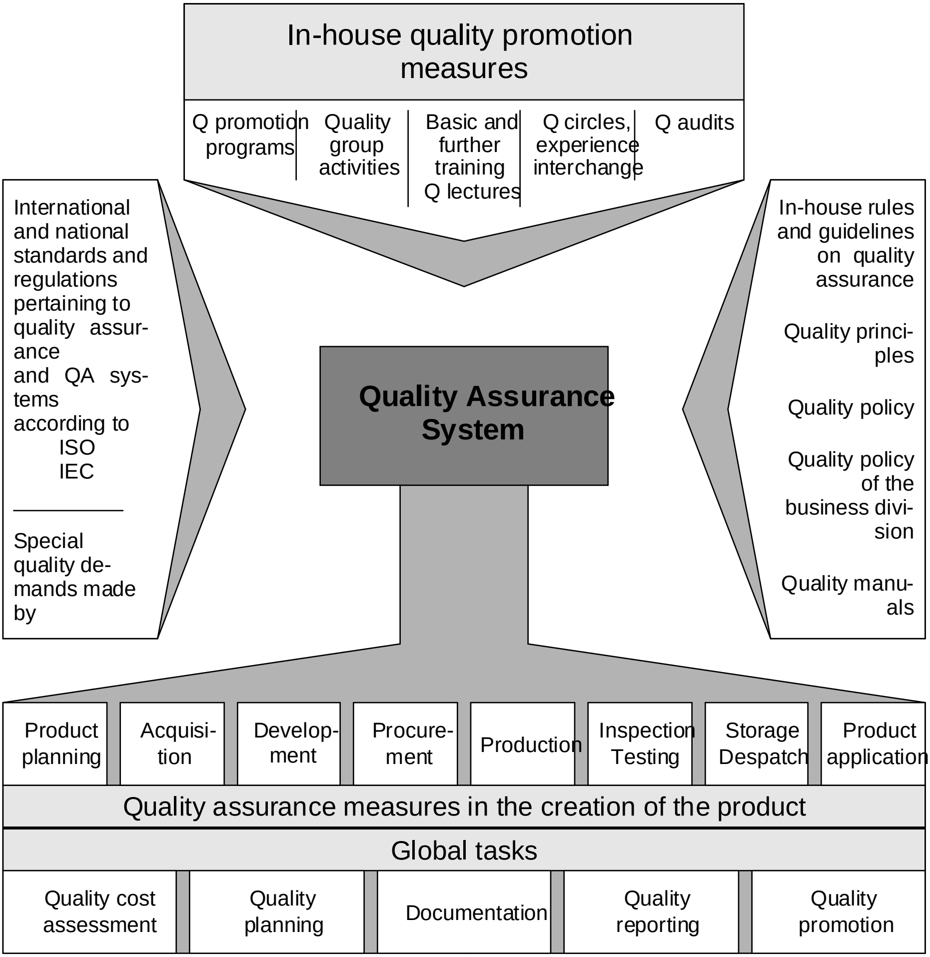
Working on the principle of "quality right from the very start", all instances and persons at S + M Components are involved in implementing this aim. Systematic planning, careful selection of suppliers and sure mastery of design and manufacturing processes are the major factors guaranteeing a constant high quality standard.

Internal quality promotion measures, such as training, quality groups, quality assurance circles and Q audits reinforce the feeling of responsibility in each employee, helping them to realize the significance of defects and thus avoid them.

Modern quality tools such as FMEA, SPC and Zero Defect Programs with CEDAC[1] diagrams supplement and support measures for quality assurance and enhancement.

1) FMEA — Failure Mode and Effects Analyses
SPC — Statistical Process Control
CEDAC diagram — Cause and Effect Diagram with Addition of Cards

1.2 Quality assurance system



2 Quality assurance procedure

The quality department examines capacitors and approves them for production according to the following criteria:

– compliance with type specifications,
– process capability of production equipment,
– measuring and test engineering.

The entire production process - from procurement of parts and materials, through the fabrication process to final inspection - is accompanied by quality assurance measures. The flow chart (**refer to section 2.5**) shows the quality inspections stipulated for each individual step.

2.1 Material procurement

The high quality of parts and materials required for the manufacture of high-grade products is attained through close cooperation with suppliers. Focal aspects of these quality assurance measures are the choice and qualification of suppliers, harmonization of specifications, incoming-goods inspection, quality assessment and problem management.

2.2 Product quality assurance

All essential manufacturing processes are subjected to permanent monitoring. Critical parameters, in particular, are subjected to statistical process control (SPC).

So-called “QC gates” are planned into the manufacturing process, i.e. there is an inspection for release at the end of the corresponding step. The permanent monitoring and evaluation of the test results are used to assess procedures and to determine how well the processes are mastered.

2.3 Final inspection

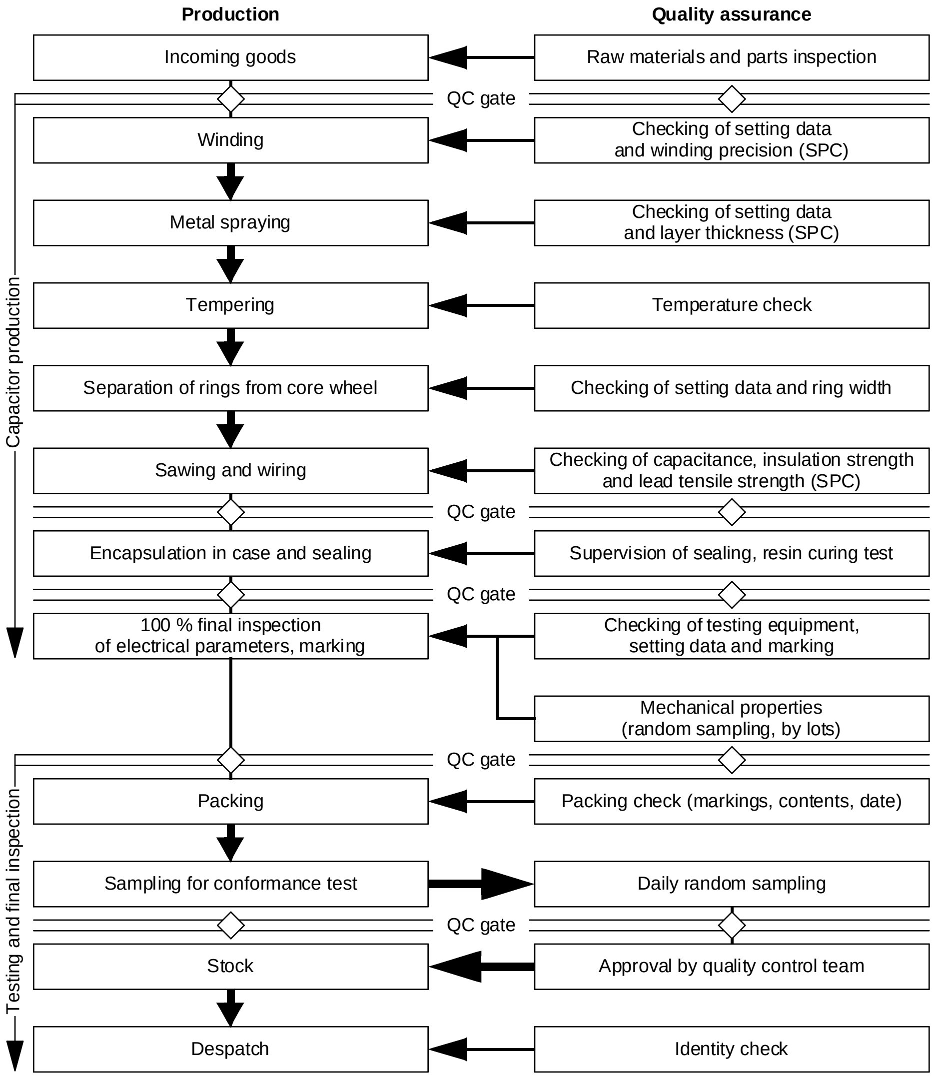
The capacitors are subjected to a specification-based final inspection. The parameters capacitance tolerance, dissipation factor, insulation resistance, dielectric strength and finish are checked.

2.4 Product monitoring

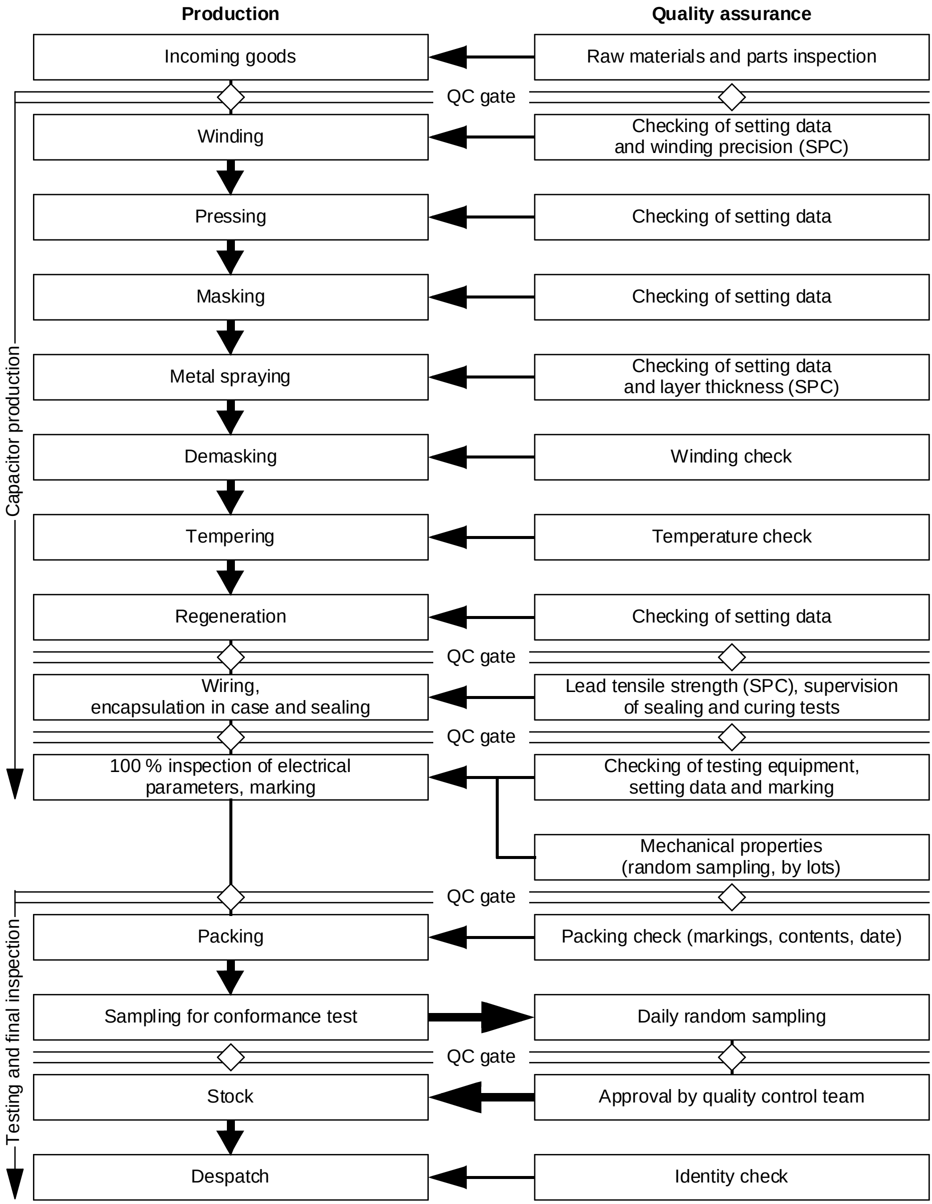
Our quality assurance department periodically carries out tests on random samples taken from current production lots to check the ability to survive certain climatic conditions, operational reliability, solderability and resistance to soldering heat in accordance with DIN, CECC and IEC specifications.

2.5 Manufacturing and quality assurance procedures

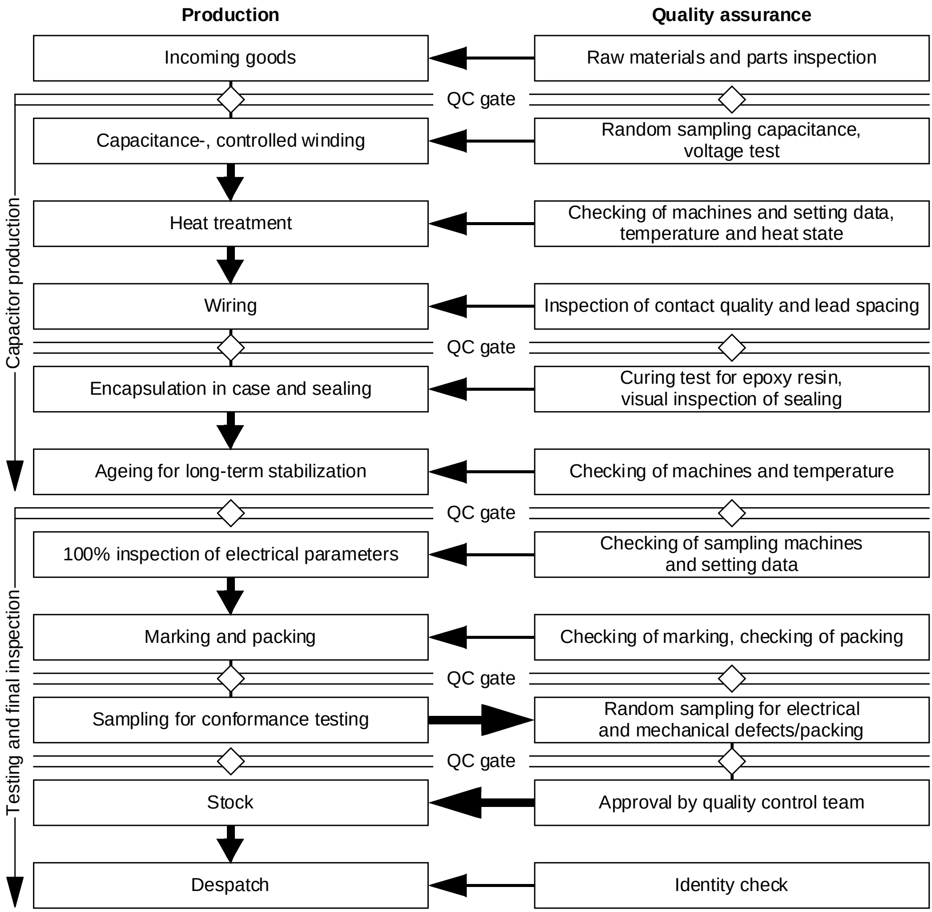
Example: MKT and MKP stacked-film capacitors



Example: MKT, MKP and MFP wound capacitors



Example: High-precision capacitors (KS and KP)



3 Delivery quality

The term “delivery quality” is used to indicate conformance with the mutually agreed specifications at the time of delivery.

3.1 Random sampling

The AQL (AQL = acceptable quality level) values given in **section 3.3** are based on random sample inspection specification ISO 2859 - 1, single sampling plan for normal inspection, inspection level II. The contents of this standard correspond to MIL STD105 D and IEC 410.

The sampling instructions of this standard are such that a delivered lot will be accepted with a probability of ≥ 90 % if the percentage of defects does not exceed the stated AQL value.

As a rule, the percentage of defects in deliveries from S+M Components is significantly below the AQL value. The acceptance value we apply to inoperatives, i.e. unusable components is c = 0.

3.2 Classification of defects

A defect exists if a component characteristic fails to meet the data sheet specifications or an agreed delivery specification. A distinction is made between inoperatives (totally unusable components) and other defectives.

Inoperatives:

– short circuit or open circuit

– broken case, terminals or coating

– wrong or missing identification of rated capacitance, rated voltage or part number

– mixing with other component types in one lot

Other defectives:

– defects in electrical characteristics (electrical characteristics outside of specified limits)

– defects in mechanical properties, e.g. wrong dimensions, damaged case, illegible marking, bent terminals.

3.3 AQL values

The following AQL values apply to the defects listed above:

– inoperatives (electrical and mechanical)	0,065
– sum of electrical defectives	0,25
– sum of mechanical defectives	0,25

3.4 Incoming goods inspection

We recommend the use of a random sampling plan according to ISO 2859-1 (the contents correspond to MIL STD 105 D and IEC 410) for incoming good inspection.
The customer and the supplier should mutually agree upon the test engineering that is to be used.

The following details are required for judging any possible claims:

test circuit, sample size, number of defectives found, sample defectives, packing slip.

Single sampling plan for normal inspection – inspection level II

Excerpt from ISO 2859 -1:

Sampling plan / N = Lot size	AQL 0,065	AQL 0,10	AQL 0,15	AQL 0,25
2 … 50	N-0	N-0	N-0	N-0
51 … 90	N-0	N-0	N or 80-0	50-0
91 … 150	N-0	N or 125-0	80-0	50-0
151 … 280	N or 200-0	125-0	80-0	50-0
281 … 500	200-0	125-0	80-0	50-0
501 … 1 200	200-0	125-0	80-0	50-0
1 201 … 3 200	200-0	125-0	80-0	200-1
3 201 … 10 000	200-0	125-0	315-1	200-1
10 001 … 35 000	200-0	500-1	315-1	315-2
35 001 … 150 000	800-1	500-1	500-2	500-3
150 001 … 500 000	800-1	800-2	800-3	800-5
> 500 000	1250-2	1250-3	1250-5	1250-7

Columns 2 to 5: Left-hand figure n = sample size
Right-hand figure c = acceptable defects

Defect classification: refer to section 3.2

4 Reliability

Data on long-term reliability under severe or moderate operating conditions are gained from endurance tests which are carried out continuously. The data are based on the failures registered for capacitors under a defined load, and long-term reliability of the individual types tested is based on a confidence level of 60 %. Our reliability data result from very large numbers of component operating hours.

4.1 Service life

The service life stated for the individual component types is the sum of operating hours, operating breaks, storage, measuring and testing times at the user's facility, together with transport times.

4.2 Reference reliability / reference load

The reference reliability describes a component-defined fraction failure under a defined load (so-called reference load). This fraction failure will not be exceeded within a specified operating period. The reference load refers to an ambient temperature of 40 °C at 30 % relative humidity. The electrical reference load is 0,5 times the rated dc voltage.

4.3 Failure rate (long-term failure rate)

The failure rate is defined as the fraction failure divided by a specified operating period. The failure rate is expressed in fit (**fit** = **f**ailure **i**n **t**ime).

1 fit = $1 \cdot 10^{-9}$/h (1 failure per 10^9 component hours)

The failure rate for each component type is stated in the respective data sheet together with the corresponding failure rate criteria. In the case of general-purpose grade KS and KP capacitors (B 31 063 and B 33 063) the failure rate is 2 fit.

Normally, no failure rate is stated for EMI suppression capacitors.

The following conversion factors may be used to assess deviating load conditions and temperatures (from IEC 56 (Secr) 383 / July 1993):

Reference load (V/V_R)	Conversion factor	
	MKT, MKP, MFP	KS, KP
100 %	6	11
75 %	2,5	3
50 %	1	1
25 %	0,4	0,4
10 %	0,2	0,2

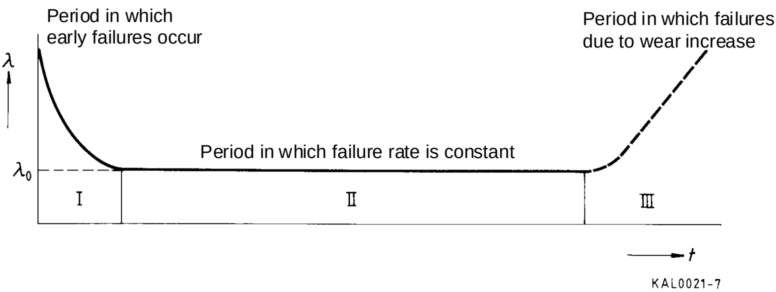
Temperature	Conversion factor
≤ 40 °C	1
55 °C	2
70 °C	5
85 °C	12

Example of a failure rate λ_{test} determined by an endurance test:

1) Number of components tested N = 8 000
2) Operating hours (duration of test) t = 25 000 h
3) Number of failures n = 2

$$\lambda_{test} = \frac{n}{N} \cdot \frac{1}{t} = \frac{2}{8000} \cdot \frac{1}{25000\ h} = 10\ \text{fit}$$

The failure rate of components, when plotted against time, shows the following characteristic curve with the three periods
I: early failure period, II: service period, III: wear-out failure period



During phase II, an approximately constant failure rate λ_0 can be assumed.

The failure rates stated in this data book refer to the service period (phase II). They apply to the reference load.

5 Supplementary information

The specification of quality data - which refers to a fairly large number of components - does not constitute a guarantee of characteristics or properties in the legal sense. However, agreement on these specifications does not mean that the customer may not claim for replacement of individual defective capacitors within the terms of delivery. S+M Components cannot, however, assume any further liability beyond the replacement of defective components. This applies in particular to any further consequences of component failure.

Furthermore, it must be taken into consideration that the figures stated for service life and failure rate refer to the average production status and are therefore to be understood as mean values (statistical expectations) for a large number of delivery lots of identical capacitors. These figures are based on application experience and on data obtained from preceding tests under normal conditions or, for purposes of accelerated ageing, more severe conditions.

6 Handling of claims and complaints

A main aim of our quality assurance system is to prevent any defects occurring. The following details will help us to respond quickly to any complaints which you may need to make:

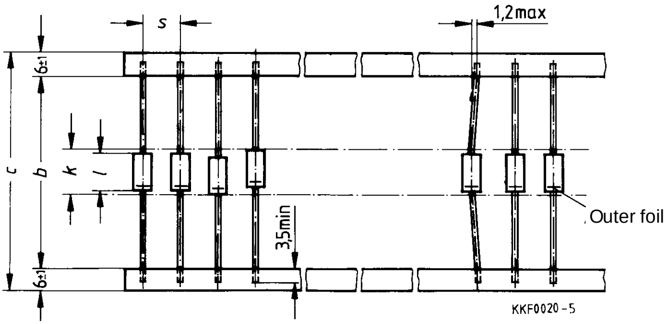
– description of fault
– when and how the fault was detected
– operating conditions
– length of operation before the fault occurred

If transport damage has occurred, please describe it in detail and, if possible, mark it so that it can be distinguished from any other damage that may occur when the articles are returned. The original packaging should also be examined and damage discovered should be described. To avoid further damage, wherever possible, use the original packaging to return the articles being claimed for.

Film capacitors are excellently suited for processing on automatic placement/insertion machines. For this reason we also offer a large number of the capacitor types described in this data book on tape.

1 Capacitors with axial leads

All axial KS and KP capacitors are available on tape.
Taping in accordance with IEC 286-1



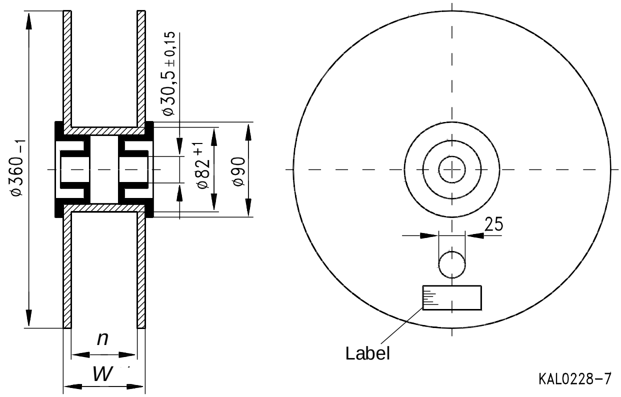
Rated capacitance range (pF)				Component spacing s (mm)	Tolerance over 10 spac-es Δs (mm)
B 31 063, B 31 861	B 31 861	B 33 063			
V_R = 160 V_{dc}	V_R = 630 V_{dc}	V_R = 160 V_{dc}	V_R = 630 V_{dc}		
10 ... 1000	–	330 ... 1200	2 ... 330	5 ± 0,5	± 1
1001 ... 20000	2 ... 1000	1201... 24000 27001... 33000	331 ... 6500 7501 ... 8500	10 ± 0,5	± 1
20001 ... 27000	–	24001... 27000 33001... 82000	6501 ... 7500 8501 ... 22000	15 ± 0,5	± 2
–	–	82001...100000	–	20 ± 1,0	± 2,5

Tape dimensions (mm)

Capacitor length l –1,5	11,0; 11,5	16,5	21,5
Body location k	l_{max} + 1,4		
Inner tape spacing b	63 ± 2	68 ± 2	73 ± 2
Total tape width c	75	80	85

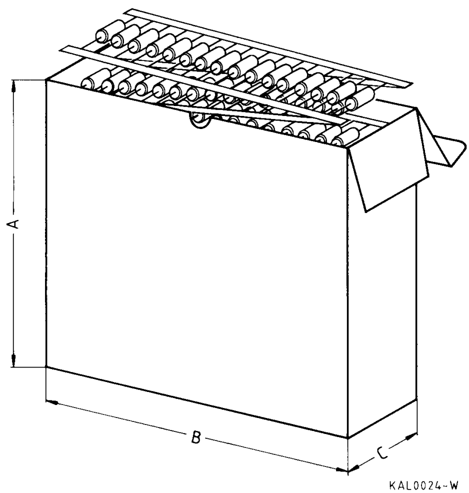
Types of packing

Reel pack
(with paper separation)



Tape width *c*	Reel pack	
	Outer reel width *W*	Inner reel width *n*
75	87 +1	78 +1
80	92 +1	83 +1
85	100 +1	91 +1

Ammo pack



A = 355 +3 mm
B = 355 +3 mm
C = ca. 90 mm

Outer dimensions

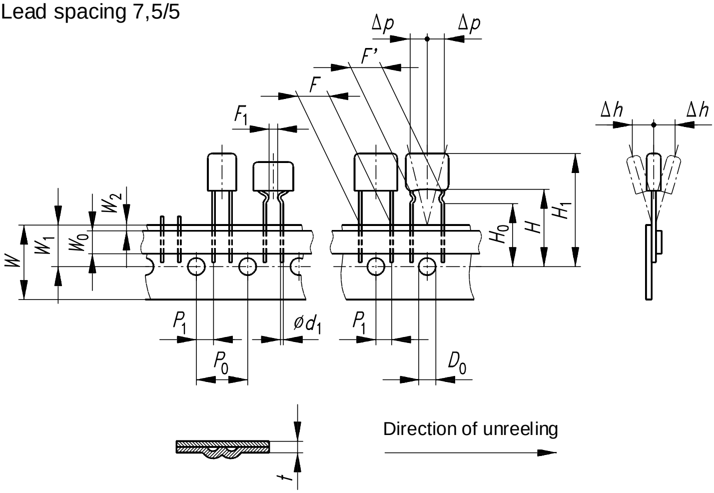
2 Capacitors with radial leads

Taping in accordance with IEC 286-2

2.1 MKT, MKP and MFP capacitors

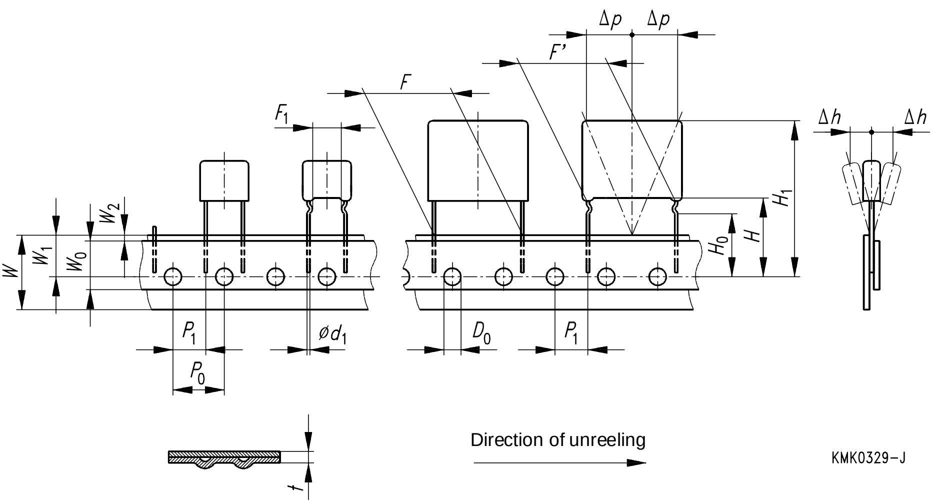
Lead spacing 5
Lead spacing 7,5/5

Lead spacing 7,5



Lead spacing 10 and 15

Lead spacing 22,5 and 27,5



Taped versions normally have straight leads; in addition, capacitors with the following lead styles are available on tape:

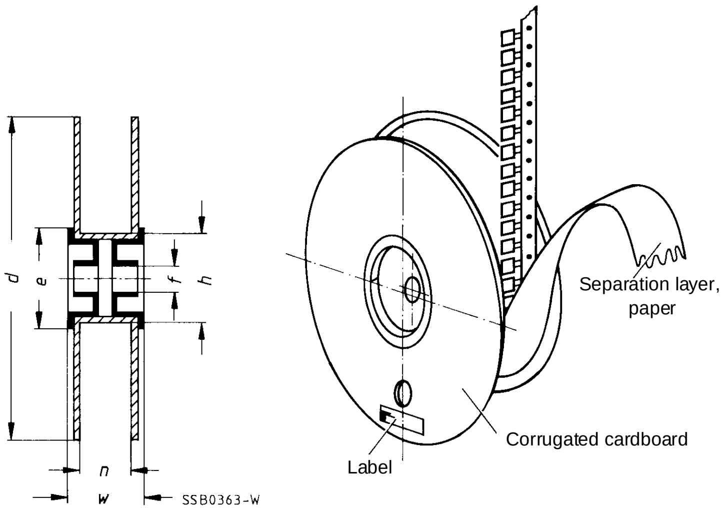
B 32 590 Capacitors with leads bent to reduce the spacing from 7,5 to 5 mm.
B 32 510 … B 32 513 All lead spacings can be supplied optionally with crimped leads. In addition, for type B 32 510, the leads can be bent to reduce the spacing from 7,5 to 5 mm. The dimensions for crimped-lead versions are given in brackets.

<table>
<tr><td rowspan="9">Types</td><td colspan="4"></td><td colspan="3">B 32 642 ... 644</td><td rowspan="9"></td></tr>
<tr><td colspan="4"></td><td colspan="3">B 32 652 ... 654</td></tr>
<tr><td colspan="4"></td><td colspan="3">B 32 682 ... 684</td></tr>
<tr><td colspan="3"></td><td colspan="3">B 81 121 ... 141</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="3">B 32 620 ... 622</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="4">B 32 510 ... 513</td><td></td></tr>
<tr><td></td><td colspan="6">B 32 520 ... 529/B 32 530 ... 539</td></tr>
<tr><td>B 32590</td><td colspan="6"></td></tr>
<tr><td>B 32510</td><td></td><td colspan="4">B 32 510 ... 513 (crimped leads)</td><td></td></tr>
<tr><td rowspan="2">Size (mm)[1]</td><td colspan="7">Lead spacing</td><td rowspan="2">Tolerance (mm)</td></tr>
<tr><td>7,5/5[2]</td><td>5</td><td>7,5</td><td>10</td><td>15</td><td>22,5</td><td>27,5</td></tr>
<tr><td>Diameter d_1</td><td>0,5</td><td>0,5</td><td>0,5</td><td>0,6[3] (0,5)</td><td>0,8[4] (0,6)</td><td>0,8</td><td>0,8</td><td>+10 %/–0,05</td></tr>
<tr><td>F</td><td>5,0</td><td>5,0</td><td>7,5</td><td>10,0</td><td>15,0</td><td>22,5</td><td>27,5</td><td>+0,6/-0,1</td></tr>
<tr><td>F'</td><td>7,5</td><td>5,0</td><td>7,5</td><td>10,0</td><td>15,0</td><td>22,5</td><td>27,5</td><td>± 0,4[5]</td></tr>
<tr><td>F_1</td><td>2,1</td><td>–</td><td>4,6</td><td>7,1</td><td>12,1</td><td>19,6</td><td>–</td><td>± 0,1</td></tr>
<tr><td>P_1</td><td>3,8</td><td>3,8</td><td>3,8</td><td>7,7</td><td>5,2</td><td>7,8</td><td>5,3</td><td>± 0,7</td></tr>
<tr><td>H_1</td><td>32,2</td><td>32,2</td><td>32,2</td><td>32,2 (35,0)</td><td>36,5 (35,0)</td><td>39,5 (37,5)</td><td>40,5</td><td>max.</td></tr>
<tr><td>H</td><td colspan="7">18,5 (20,0)</td><td>± 0,5</td></tr>
<tr><td>H_0</td><td colspan="7">(16,0)</td><td>± 0,5</td></tr>
<tr><td>P_0</td><td colspan="7">12,7</td><td>± 0,2
± 1 per 20×P_0</td></tr>
<tr><td>D_0</td><td colspan="7">4,0</td><td>± 0,2</td></tr>
<tr><td>W</td><td colspan="7">18,0</td><td>± 0,5</td></tr>
<tr><td>W_0</td><td colspan="3">6,0</td><td colspan="4">12,0</td><td>± 0,5</td></tr>
<tr><td>W_1</td><td colspan="7">9,0</td><td>± 0,5</td></tr>
<tr><td>W_2</td><td colspan="7">0,5</td><td>+ 2,5</td></tr>
<tr><td>t</td><td colspan="7">0,7</td><td>± 0,2</td></tr>
<tr><td>Δh</td><td colspan="7">0</td><td>± 2,0</td></tr>
<tr><td>Δp</td><td colspan="7">0</td><td>± 1,3</td></tr>
</table>

1) For an explanation of the symbols refer to page 266
2) Leads bent from 7,5 mm spacing to 5 mm.
3) 0,5 mm for B32511 and generally for capacitor width < 5 mm
4) ∩ 6 mm for B32512
5) ± 0,8 for B32590

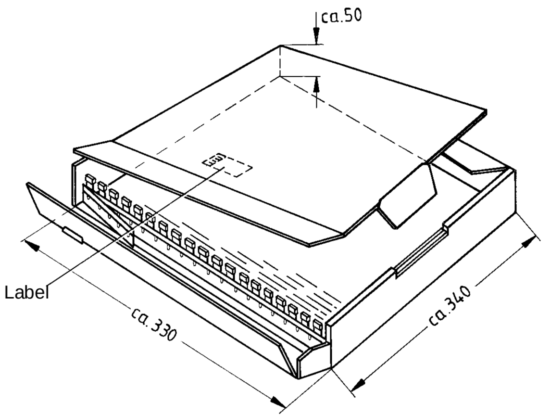
2.2 Types of packing

Reel pack



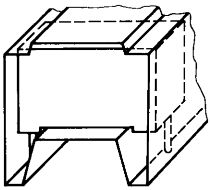
Dimensions (mm)	*n*	*w*	*d*	*e*	*f*	*h*
MKT, MKP, MFP capacitors						
Lead spacing ≤ 7,5	42 +1	52 max.	dia. 360 –1	dia. 90	dia. 30,5 ±0,2	dia. 82 +1
Lead spacing ≥ 10	54 +1	70 max.	dia.500 –1	dia. 130	dia.30,5 ±0,2	dia. 126 +1
KS, KP capacitors						
B 3* 531	42 +1	52 max.	dia. 360 –1	dia. 90	dia. 30,5 ±0,2	dia. 82 +1
B 31 521	42 +1	52 max.	dia.500 –1	dia. 130	dia.30,5 ±0,2	dia. 126 +1

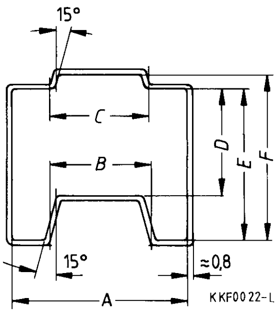
Ammo pack



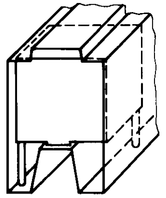
3 Magazines

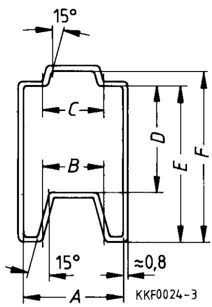
B 31 521





B 31 531; B 33 531





Type	Capacitor dimensions $b \times h \times l$ (mm)	Lead spacing mm	Magazine dimensions (mm)						
			A	*B* +0,5	*C* –0,5	*D* ±0,2	*E* ±0,2	*F*	Length
B 31 521	5,0 × 7,2 × 12,5	10	13,2	6,0	6,0	7,2	14,2	16,2	580
	7,5 × 10,0 × 12,5	10	13,2	6,0	6,0	10,2	17,2	19,2	
	10,0 × 11,5 × 12,5	10	13,2	6,0	6,0	13,7	20,7	22,7	
	10,0 × 11,5 × 17,5	15	18,2	10,0	10,0	12,2	19,2	21,2	
	11,5 × 12,5 × 22,5	20	23,2	15,0	15,0	13,2	20,2	22,2	
	11,5 × 12,5 × 27,5	25	28,2	20,0	20,0	13,2	20,2	22,2	
	$a \times h$	Lead spacing *r* (diag.)							
B 31 531 B 33 531	6,3 × 11,0	7,2	7,2	2,7	2,7	11,5	18,5	20,5	580
	7,5 × 13,0	7,2	8,2	3,2	3,2	13,7	20,7	22,7	
	10,0 × 13,0	10,8	10,7	4,0	4,0	13,7	20,7	22,7	
	12,5 × 13,0	14,4	13,2	6,0	6,0	13,7	20,7	22,7	

4 General notes on packing

When packing our products, we pay attention to the needs of the environment by reducing the amount of packing to an absolute minimum and using environmentally compatible materials for packing. In doing so we are also complying with the German packaging legislation which came into force on the 1st December 1991.

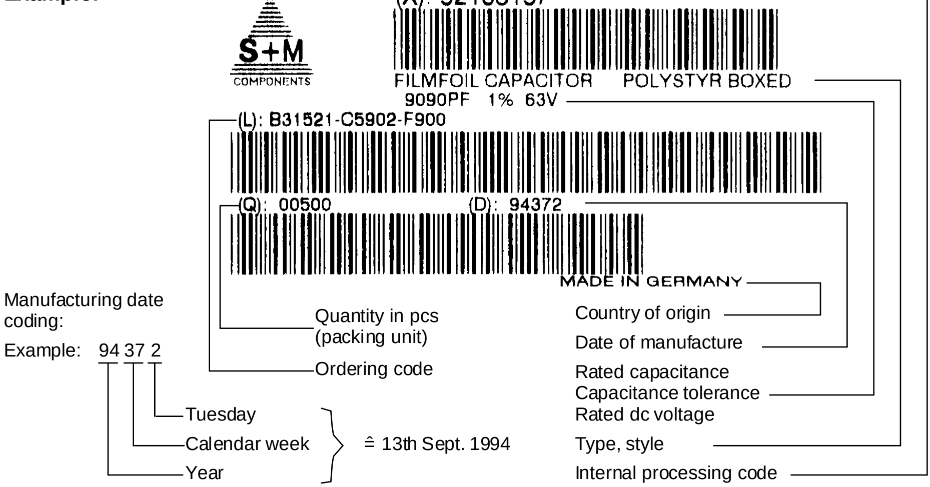
In order to further comply with the aims of this legislation concerning the reduction of commercial waste, we have implemented the following measures:

– The use of “Euro” pallets.
– Goods are secured on the pallets using straps and edge protectors made of environmentally compatible plastics (PE or PP).
– The shipping cartons (transport packing) qualify for and carry the RESY logo.
– Separating layers are of paper.
– The shipping cartons are sealed with paper adhesive tape in order to ensure that only a single, uniform material needs to be disposed of.
– We are prepared, on principle, to take back the packing material (especially product-specific plastic packages, e.g. magazines). However, we ask our customers to send cardboard cartons, corrugated cardboard, paper etc. to recycling or disposal companies in order to avoid unnecessary transportation of empty packing materials.

5 Standard barcode label

The standard product package label (standard label) provides barcode information as well as the usual text information. This provides advantages in the internal goods flow, but, above all, it allows faster and more correct identity monitoring by the customer. The standard label contains the following information (barcode 39, medium density):

Example:



Weights

The following table contains the weights for all radial-lead capacitors with plastic casings. Deviations of up to approximately ± 30 % are possible.

Lead spacing/ Type number	Dimensions *b* × *h* × *l* mm	Weight g
Lead spacing 5 mm		
B 32 529	2,5 × 6,5 × 7,2	0,20
	3,0 × 6,5 × 7,2	0,25
	3,5 × 8,0 × 7,2	0,32
	4,5 × 9,5 × 7,2	0,46
	5,0 × 10,0 × 7,2	0,54
	6,0 × 10,5 × 7,2	0,65
	7,2 × 13,0 × 7,8	0,88
	7,8 × 13,0 × 7,8	0,93
Lead spacing 7,5 mm		
B 32 520, B 32 620	2,5 × 7,0 × 10,0	0,30
	3,0 × 8,0 × 10,0	0,40
	4,0 × 8,5 × 10,0	0,52
	5,0 × 10,5 × 10,0	0,80
	6,0 × 12,0 × 10,0	1,1
Lead spacing 10 mm		
B 32 521, B 32 621, B 81 122	4,0 × 7,0 × 13,0	0,52
	4,0 × 9,0 × 13,0	0,70
	5,0 × 11,0 × 13,0	1,1
	6,0 × 12,0 × 13,0	1,4
B 31 521	5,0 × 7,2 × 12,5	0,48
	7,5 × 10,0 × 12,5	1,2
	10,0 × 11,5 × 12,5	1,9
Lead spacing 15 mm		
B 32 522, B 32 622 B 32 642, B 32 652 B 32 682 B81 121, B 81 131 B 81 133, B 81 141	5,0 × 10,5 × 18,0	1,5
	6,0 × 11,0 × 18,0	1,9
	7,0 × 12,5 × 18,0	2,5
	8,5 × 14,5 × 18,0	3,3
	9,0 × 17,5 × 18,0	4,5
B 31 521	10,0 × 11,5 × 17,5	3,1
Lead spacing 20 mm (KS capacitors)		
B 31 521	11,5 × 12,5 × 22,5	5,0
Lead spacing 25 mm (KS capacitors)		
B 31 521	11,5 × 12,5 × 27,5	6,5

Lead spacing/ Type number	Dimensions *b* × *h* × *l* mm	Weight g
Lead spacing 22,5 mm		
B 32 523, B 32 643 B 32 653, B 32 683 B 81 121, B 81 131 B 81 133, B 81 141	6,0 × 15,0 × 26,5	4,0
	7,0 × 16,0 × 26,5	4,8
	8,5 × 16,5 × 26,5	5,5
	10,5 × 16,5 × 26,5	7,5
	10,5 × 18,5 × 26,5	8,0
	10,5 × 20,5 × 26,5	8,5
	11,0 × 20,5 × 26,5	9,0
Lead spacing 27,5 mm		
B 32 524, B 32 644 B 32 654, B 32 684 B 81 121, B 81 131 B 81 133, B 81 141	11,0 × 21,0 × 31,5	10
	12,5 × 21,5 × 31,5	13
	13,5 × 23,0 × 31,5	15
	14,0 × 24,5 × 31,5	16
	15,0 × 24,5 × 31,5	16
	18,0 × 27,5 × 31,5	20
	19,0 × 30,0 × 31,5	23
Lead spacing 32,5 mm		
B 81 131, B 81 133	20,0 × 31,0 × 36,5	33
Lead spacing 37,5 mm		
B 32 656, B 32 686	12,0 × 22,0 × 41,5	16
	14,0 × 25,0 × 41,5	22
	16,0 × 28,5 × 41,5	28
	18,0 × 32,5 × 41,5	36
	20,0 × 39,5 × 41,5	49

KS and KP capacitors (Tower Block)

Lead spacing 5,08 mm		
B 31 531, B 33 531	6,3 × 6,3 × 11,0	0,65
	7,5 × 7,5 × 13,0	1,1
Lead spacing 7,62 mm		
B 31 531, B 33 531	10,0 × 10,0 × 13,0	2,0
Lead spacing 10,16 mm		
B 31 531, B 33 531	12,5 × 12,5 × 13,0	3,2

Siemens Matsushita Components

SAW resonators for radio remote control

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The key to convenience and security: radio remote controls for keyless entry in automobiles and opening the garage gate. Or in the household, for cordless headphones or metering heating costs for example. Here the evaporation pipe is replaced by a sensor that signals consumption by

a transmitter to a receiver outside the domicile, thus doing away with readings on all the radiators. Transmitter and receiver are both fitted with a SAW resonator.

SCS – dependable, fast and competent

Z

Symbols and Terms

Symbols	Meaning
A	Capacitor surface area
α	Heat transfer coefficient
α_c	Temperature coefficient of the capacitance
β_c	Humidity coefficient of the capacitance
C	Capacitance
C_R	Rated capacitance
ΔC	Absolute capacitance change
$\Delta C/C$	Relative capacitance change (relative deviation of actual value)
$\Delta C/C_R$	Capacitance tolerance (relative deviation from rated capacitance)
dt	Time differential
dV/dt	Time differential of voltage function (rate of voltage rise)
e	Lead spacing
F	Relative humidity
f	Frequency
f_r	Resonant frequency
f_1	Frequency limit for reducing the permissible ac voltage due to thermal limits
f_2	Frequency limit for reducing the permissible ac voltage due to current limit
λ	Failure rate
λ_{test}	Failure rate, determined by tests
λ_0	Constant failure rate during useful service life
i	Current (peak)
I_C	Category current (max. continuous current)
I_{rms}	(Sinusoidal) alternating current, root-mean-square value
i_z	Capacitance drift
k_0	Pulse characteristic
L_S	Series inductance
P_A	Dissipated power
P_E	Generated power
Q	Heat energy
R	Ohmic resistance of discharge circuit
R_i	Internal resistance
R_{is}	Insulation resistance
R_P	Parallel resistance
R_S	Series resistance
t	Time
T	Temperature

Symbols	Meaning
Δt	Time interval
ΔT	Absolute temperature change
$\tan \delta$	Dissipation factor
$\Delta\tan \delta$	Absolute change of dissipation factor
$\tan \delta_D$	Dielectric component of dissipation factor
$\tan \delta_P$	Parallel component of dissipation factor
$\tan \delta_S$	Series component of dissipation factor
T_{max}	Upper category temperature
T_{min}	Lower category temperature
T_R	Rated temperature
τ	Time constant
V	Voltage
V_{ac}	Alternating voltage
ΔV	Absolute voltage change
$\Delta V/\Delta t$	Voltage change per time interval
V_{rms}	(Sinusoidal) alternating voltage, root-mean-square value
V_C	Category voltage
V_{ch}	Charging voltage
V_{CD}	Corona-discharge onset voltage
V_R	Rated voltage
V_p	Peak pulse voltage
V_{pp}	Peak-to-peak voltage
Z	Impedance

Decimal points are indicated by commas.

Explanation of the tape dimension symbols for capacitors with radial leads

Symbols	Meaning
D_0	Diameter of sprocket holes
$\varnothing d_1$	Nominal diameter of leads
F	Lead center spacing at tape edge
F'	Lead center spacing at capacitor standoff surface
F_1	Distance between crimp bends of leads
H	Distance between sprocket hole center and bottom edge of capacitor body (standoff surface)
H_0	Distance between sprocket hole center and crimp stops
H_1	Distance between sprocket hole center and top edge of capacitor body
Δh	Permissible deviation from tape center plane, measured at right angles to it
P_0	Sprocket hole center spacing
P_1	Distance between sprocket hole center and lead center
Δp	Permissible amount of tilt of capacitor body in the tape plane
t	Overall tape thickness
W	Width of carrier tape
W_0	Width of hold-down tape
W_1	Distance between sprocket hole center and top edge of carrier tape
W_2	Distance between top edge of carrier tape and top edge of hold-down tape

Ferrite inductors from SCS stock

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- **U interface transformer RM 6** for ISDN applications
- **Planar inductor RM 7** with high power density and extremely flat for DC/DC applications

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