Film Capacitors

Metallized Polypropylene Film Capacitors (MFP)

Series/Type: **B32682 ... B32686**

Date: June 2018

EPCOS AG is a TDK Group Company.

Very high pulse (wound)

Typical applications
- Smoothing
- Snubbering
- Electronic ballast
- Switch mode power supplies
- High-frequency AC loads
- High voltages and very high currents

Climatic
- Max. operating temperature: 110 °C
- Climatic category (IEC 60068-1:2013): 55/100/56

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

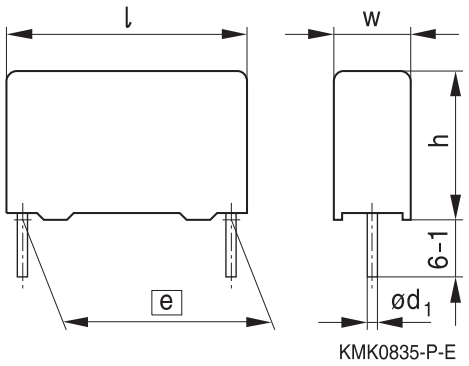
Features
- Very high pulse strength
- Highest possible contact reliability
- Self-healing properties
- RoHS-compatible

Terminals
- Parallel wire leads, lead-free tinned
- Special lead lengths available on request

Marking
Manufacturer's logo, lot number, type number, rated capacitance (coded), capacitance tolerance (code letter), rated DC voltage, date of manufacture (coded)

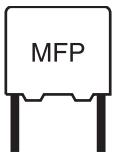
Delivery mode
Bulk (untaped), Taped (Ammo pack or reels)

Dimensional drawing



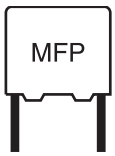
Dimensions in mm

Lead spacing e ±0.4	Lead diameter d_1 ±0.05	Type
15.0	0.8	B32682
22.5	0.8	B32683
27.5	0.8	B32684
37.5	1.0	B32686



Overview of available types

Lead spacing	15.0 mm						22.5 mm						
Type	B32682						B32683						
Page	5						7						
V_R (V DC)	400	630	1000	1250	1600	2000	400	630	1000	1250	1600	2000	2500
C_R (nF)													
0.47													
0.68													
1.0													
1.5													
2.2													
3.3													
4.7													
6.8													
10													
15													
22													
33													
47													
68													
100													
150													

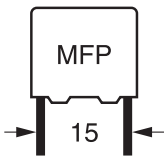


B32682 ... B32686

Very high pulse (wound)

Overview of available types

Lead spacing	27.5 mm						37.5 mm				
Type	B32684						B32686				
Page	9						10				
V_R (V DC)	400	630	1000	1250	1600	2000	630	1000	1250	1600	2000
C_R (nF)											
15											
22											
33											
47											
68											
100											
150											
220											
330											
470											
680											
1000											
1500											



Ordering codes and packing units (lead spacing 15 mm)

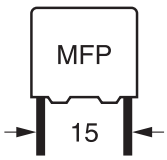
V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R nF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Ammo pack pcs./MOQ	Reel pcs./MOQ	Untaped pcs./MOQ
400	250	15.0	5.0 × 10.5 × 18.0	B32682A4153+***	4680	5200	4000
		22.0	6.0 × 11.0 × 18.0	B32682A4223+***	3840	4400	4000
		33.0	7.0 × 12.5 × 18.0	B32682A4333+***	3320	3600	4000
		47.0	8.5 × 14.5 × 18.0	B32682A4473+***	2720	2800	2000
630	300	4.7	5.0 × 10.5 × 18.0	B32682A6472+***	4680	5200	4000
		6.8	5.0 × 10.5 × 18.0	B32682A6682+***	4680	5200	4000
		10.0	5.0 × 10.5 × 18.0	B32682A6103+***	4680	5200	4000
		15.0	6.0 × 11.0 × 18.0	B32682A6153+***	3840	4400	4000
		22.0	7.0 × 12.5 × 18.0	B32682A6223+***	3320	3600	4000
		33.0	8.5 × 14.5 × 18.0	B32682A6333+***	2720	2800	2000
		47.0	9.0 × 17.5 × 18.0	B32682A6473+***	2560	2800	2000
1000	400	3.3	5.0 × 10.5 × 18.0	B32682A0332+***	4680	5200	4000
		4.7	5.0 × 10.5 × 18.0	B32682A0472+***	4680	5200	4000
		6.8	6.0 × 12.0 × 18.0	B32682A0682+***	3840	4400	4000
		10.0	7.0 × 12.5 × 18.0	B32682A0103+***	3320	3600	4000
		15.0	8.5 × 14.5 × 18.0	B32682A0153+***	2720	2800	2000
1250	450	2.2	5.0 × 10.5 × 18.0	B32682A7222+***	4680	5200	4000
		3.3	5.0 × 10.5 × 18.0	B32682A7332+***	4680	5200	4000
		4.7	6.0 × 12.0 × 18.0	B32682A7472+***	3840	4400	4000
		6.8	7.0 × 12.5 × 18.0	B32682A7682+***	3320	3600	4000
		10.0	8.5 × 14.5 × 18.0	B32682A7103+***	2720	2800	2000

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Intermediate capacitances values on request.

Composition of ordering code

+ = Capacitance tolerance code:
- M = ±20%
- K = ±10%
- J = ±5%

*** = Packaging code:
- 289 = Straight terminals, Ammo pack
- 189 = Straight terminals, Reel
- 000 = Straight terminals, untaped (lead length 6 −1 mm)



B32682

Very high pulse (wound)

Ordering codes and packing units (lead spacing 15 mm)

V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R nF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Ammo pack pcs./MOQ	Reel pcs./MOQ	Untaped pcs./MOQ
1600	500	1.5	5.0 × 10.5 × 18.0	B32682A1152+***	4680	5200	4000
		2.2	6.0 × 11.0 × 18.0	B32682A1222+***	3840	4400	4000
		3.3	7.0 × 12.5 × 18.0	B32682A1332+***	3320	3600	4000
		4.7	8.5 × 14.5 × 18.0	B32682A1472+***	2720	2800	2000
		6.8	9.0 × 17.5 × 18.0	B32682A1682+***	2560	2800	2000
2000	550	0.47	5.0 × 10.5 × 18.0	B32682A2471M***	4680	5200	4000
		0.68	5.0 × 10.5 × 18.0	B32682A2681M***	4680	5200	4000
		1.0	5.0 × 10.5 × 18.0	B32682A2102+***	4680	5200	4000
		1.5	6.0 × 12.0 × 18.0	B32682A2152+***	3840	4400	4000
		2.2	7.0 × 12.5 × 18.0	B32682A2222+***	3320	3600	4000
		3.3	8.5 × 14.5 × 18.0	B32682A2332+***	2720	2800	2000

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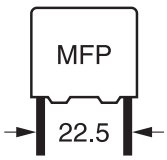
- 000 = Straight terminals, untaped (lead length 6 −1 mm)



Ordering codes and packing units (lead spacing 22.5 mm)

V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R nF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Ammo pack pcs./MOQ	Reel pcs./MOQ	Untaped pcs./MOQ
400	250	33.0	6.0 × 15.0 × 26.5	B32683A4333+***	2720	2800	2880
		47.0	6.0 × 15.0 × 26.5	B32683A4473+***	2720	2800	2880
		68.0	7.0 × 16.0 × 26.5	B32683A4683+***	2320	2400	2520
		100.0	8.5 × 16.5 × 26.5	B32683A4104+***	1920	2000	2040
		150.0	10.5 × 18.5 × 26.5	B32683A4154+***	1560	1600	2160
630	300	33.0	6.0 × 15.0 × 26.5	B32683A6333+***	2720	2800	2880
		47.0	7.0 × 16.0 × 26.5	B32683A6473+***	2320	2400	2520
		68.0	8.5 × 16.5 × 26.5	B32683A6683+***	1920	2000	2040
		100.0	10.5 × 18.5 × 26.5	B32683A6104+***	1560	1600	2160
		150.0	12.0 × 22.0 × 26.5	B32683A6154+***	–	–	1800
1000	400	10.0	6.0 × 15.0 × 26.5	B32683A0103+***	2720	2800	2880
		15.0	6.0 × 15.0 × 26.5	B32683A0153+***	2720	2800	2880
		22.0	7.0 × 16.0 × 26.5	B32683A0223+***	2320	2400	2520
		33.0	8.5 × 16.5 × 26.5	B32683A0333+***	1920	2000	2040
		47.0	10.5 × 18.5 × 26.5	B32683A0473+***	1560	1600	2160
		68.0	12.0 × 22.0 × 26.5	B32683A0683+***	–	–	1800
1250	450	10.0	6.0 × 15.0 × 26.5	B32683A7103+***	2720	2800	2880
		15.0	7.0 × 16.0 × 26.5	B32683A7153+***	2320	2400	2520
		22.0	8.5 × 16.5 × 26.5	B32683A7223+***	1920	2000	2040
		33.0	10.5 × 18.5 × 26.5	B32683A7333+***	1560	1600	2160
1600	500	6.8	6.0 × 15.0 × 26.5	B32683A1682+***	2720	2800	2880
		10.0	7.0 × 16.0 × 26.5	B32683A1103+***	2320	2400	2520
		15.0	8.5 × 16.5 × 26.5	B32683A1153+***	1920	2000	2040
		22.0	10.5 × 18.5 × 26.5	B32683A1223+***	1560	1600	2160

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Intermediate capacitances values on request.

Composition of ordering code

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- K = ±10%
- J = ±5%

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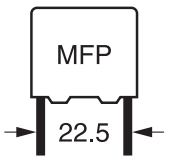


B32683

Very high pulse (wound)

Ordering codes and packing units (lead spacing 22.5 mm)

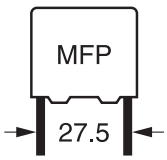
V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R nF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Ammo pack pcs./MOQ	Reel pcs./MOQ	Untaped pcs./MOQ
2000	550	3.3	6.0 × 15.0 × 26.5	B32683A2332+***	2720	2800	2880
		4.7	6.0 × 15.0 × 26.5	B32683A2472+***	2720	2800	2880
		6.8	7.0 × 16.0 × 26.5	B32683A2682+***	2320	2400	2520
		10.0	8.5 × 16.5 × 26.5	B32683A2103+***	1920	2000	2040
		15.0	10.5 × 18.5 × 26.5	B32683A2153+***	1560	1600	2160
2500	750	1.5	6.0 × 15.0 × 26.5	B32683A3152+***	2720	2800	2880
		2.2	7.0 × 16.0 × 26.5	B32683A3222+***	2320	2400	2520
		3.3	8.5 × 16.5 × 26.5	B32683A3332+***	1920	2000	2040
		4.7	10.5 × 18.5 × 26.5	B32683A3472+***	1560	1600	2160
		6.8	12.0 × 22.0 × 26.5	B32683A3682+***	–	–	1800

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Intermediate capacitances values on request.

Composition of ordering code

+ = Capacitance tolerance code:
- M = ±20%
- K = ±10%
- J = ±5%

*** = Packaging code:
- 289 = Straight terminals, Ammo pack
- 189 = Straight terminals, Reel
- 000 = Straight terminals, untaped (lead length 6 −1 mm)



Ordering codes and packing units (lead spacing 27.5 mm)

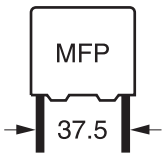
V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R nF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Untaped pcs./MOQ
400	250	150.0	11.0 × 19.0 × 31.5	B32684A4154+000	1280
		220.0	11.0 × 21.0 × 31.5	B32684A4224+000	1280
		330.0	13.5 × 23.0 × 31.5	B32684A4334+000	1040
		470.0	18.0 × 27.5 × 31.5	B32684A4474+000	800
		680.0	19.0 × 30.0 × 31.5	B32684A4684+000	720
630	300	100.0	11.0 × 19.0 × 31.5	B32684A6104+000	1280
		150.0	11.0 × 21.0 × 31.5	B32684A6154+000	1280
		220.0	13.5 × 23.0 × 31.5	B32684A6224+000	1040
		330.0	15.0 × 24.5 × 31.5	B32684A6334+000	960
		470.0	19.0 × 30.0 × 31.5	B32684A6474+000	720
1000	400	47.0	11.0 × 19.0 × 31.5	B32684A0473+000	1280
		68.0	11.0 × 21.0 × 31.5	B32684A0683+000	1280
		100.0	13.5 × 23.0 × 31.5	B32684A0104+000	1040
		150.0	18.0 × 27.5 × 31.5	B32684A0154+000	800
		220.0	21.0 × 31.0 × 31.5	B32684A0224+000	784
1250	450	33.0	11.0 × 19.0 × 31.5	B32684A7333+000	1280
		47.0	11.0 × 21.0 × 31.5	B32684A7473+000	1280
		68.0	13.5 × 23.0 × 31.5	B32684A7683+000	1040
		100.0	15.0 × 24.5 × 31.5	B32684A7104+000	960
		150.0	19.0 × 30.0 × 31.5	B32684A7154+000	720
1600	500	22.0	11.0 × 19.0 × 31.5	B32684A1223+000	1280
		33.0	11.0 × 21.0 × 31.5	B32684A1333+000	1280
		47.0	13.5 × 23.0 × 31.5	B32684A1473+000	1040
		68.0	15.0 × 24.5 × 31.5	B32684A1683+000	960
		100.0	19.0 × 30.0 × 31.5	B32684A1104+000	720
2000	550	15.0	11.0 × 19.0 × 31.5	B32684A2153+000	1280
		22.0	11.0 × 21.0 × 31.5	B32684A2223+000	1280
		33.0	13.5 × 23.0 × 31.5	B32684A2333+000	1040
		47.0	18.0 × 27.5 × 31.5	B32684A2473+000	800
		68.0	19.0 × 30.0 × 31.5	B32684A2683+000	720

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Intermediate capacitances values on request.

Composition of ordering code

+ = Capacitance tolerance code:
M = ±20%
K = ±10%
J = ±5%

Packaging code:
000 = Untaped (lead length 6 − 1 mm)



B32686

Very high pulse (wound)

Ordering codes and packing units (lead spacing 37.5 mm)

V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R nF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Untaped pcs./MOQ
630	300	680.0	18.0 × 32.5 × 42.0	B32686A6684+000	192
		1000.0	20.0 × 39.5 × 42.0	B32686A6105+000	128
		1500.0	28.0 × 42.5 × 42.0	B32686A6155+000	216
1000	400	68.0	12.0 × 22.0 × 42.0	B32686A0683+000	288
		100.0	12.0 × 22.0 × 42.0	B32686A0104+000	288
		150.0	14.0 × 25.0 × 42.0	B32686A0154+000	224
		220.0	16.0 × 28.5 × 42.0	B32686A0224+000	192
		330.0	20.0 × 39.5 × 42.0	B32686A0334+000	128
		470.0	28.0 × 37.0 × 42.0	B32686A0474+000	128
1250	450	68.0	12.0 × 22.0 × 42.0	B32686A7683+000	288
		100.0	14.0 × 25.0 × 42.0	B32686A7104+000	224
		150.0	16.0 × 28.5 × 42.0	B32686A7154+000	192
		220.0	18.0 × 32.5 × 42.0	B32686A7224+000	192
		330.0	20.0 × 39.5 × 42.0	B32686A7334+000	128
1600	500	47.0	12.0 × 22.0 × 42.0	B32686A1473+000	288
		68.0	14.0 × 25.0 × 42.0	B32686A1683+000	224
		100.0	18.0 × 32.5 × 42.0	B32686A1104+000	192
		150.0	20.0 × 39.5 × 42.0	B32686A1154+000	192
		220.0	28.0 × 37.0 × 42.0	B32686A1224+000	216
2000	550	22.0	12.0 × 22.0 × 42.0	B32686A2223+000	288
		33.0	12.0 × 22.0 × 42.0	B32686A2333+000	288
		47.0	14.0 × 25.0 × 42.0	B32686A2473+000	224
		68.0	16.0 × 28.5 × 42.0	B32686A2683+000	192
		100.0	18.0 × 32.5 × 42.0	B32686A2104+000	192

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Intermediate capacitances values on request.

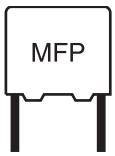
Composition of ordering code

+ = Capacitance tolerance code:
M = ±20%
K = ±10%
J = ±5%

Packaging code:
000 = Untaped (lead length 6 − 1 mm)

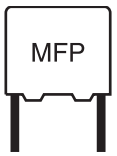
Technical data

Operating temperature range	Max. operating temperature $T_{op,max}$	+110 °C		
	Upper category temperature T_{max}	+100 °C		
	Lower category temperature T_{min}	−55 °C		
	Rated DC temperature T_{RDC}	+85 °C		
	Rated AC temperature T_{RAC}	+75 °C		
Voltage Derating	The rated voltage is decreased with 1.25%/°C between rated temperature and +100 °C			
Dissipation factor tan δ at 20 °C (upper limit values)	at	$C_R \leq 0.1$ µF	0.1 µF < $C_R \leq 1$ µF	$C_R > 1$ µF
	1 kHz	0.0004	0.0004	0.0004
	10 kHz	0.0004	0.0006	–
	100 kHz	0.001	–	–
Insulation resistance R_{ins} or time constant $t = C_R \times R_{ins}$ at 20 °C, rel. humidity ≤ 65% (minimum as-delivered values)	$C_R \leq 0.33$ µF 100 GΩ		$C_R > 0.33$ µF 30000 s	
DC test voltage	2.0 · V_R, 2 s			
Category voltage V_C	T_{op} (°C)	DC voltage derating	AC voltage derating	
V_{DC} continuous operation	$T_{op} \leq 85$	$V_C = V_R$		
	$85 < T_{op} \leq 100$	$V_C = V_R \cdot (165 - T_{op})/80$		
V_{AC} continuous operation at f ≤ 1 kHz	$T_{op} \leq 85$		$V_C = V_{RMS}$	
	$75 < T_{op} \leq 100$		$V_{C,RMS} = V_{RMS} \cdot (155 - T_{op})/80$	
Damp heat test	56 days/40 °C/93% relative humidity			
Limit values after damp heat test	Capacitance change $\lvert\Delta C/C\rvert$	≤ 2%		
	Dissipation factor change Δ tan δ	$\leq 1.0 \cdot 10^{-3}$ (at 10 kHz)		
	Insulation resistance R_{ins}	≥ 50% of minimum as delivered values		
Reliability:				
Endurance test AC	1.25 · V_C / 85 °C / 1000 h			
Endurance test DC	1.25 · V_C / 85 °C / 100 °C / 1000 h			
Failure rate λ	1 fit (≤ $2 \cdot 10^{-3}$ at 0.5 · V_R, 40 °C			
Service life t_{SL}	200 000 h at 1.0 · V_R, 85 °C For conversion to other operating conditions and temperatures, refer to chapter "Quality, 2 Reliability".			
Failure criteria:				
Total failure	Short circuit or open circuit			
Failure due to variation of parameters	Capacitance change $\lvert\Delta C/C\rvert$	> 10%		
	Dissipation factor tan δ	> 4 · upper limit value		
	Insulation resistance R_{ins} or time constant $t = C_R \cdot R_{ins}$	< 1500 MΩ ($C_R \leq 0.33$ µF < 500 s ($C_R > 0.33$ µF)		



B32682 ... B32686

Very high pulse (wound)



Pulse handling capability

"dV/dt" represents the maximum permissible voltage change per unit of time for non-sinusoidal voltages, expressed in V/µs.

"k_0" represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in $V^2/\mu s$.

Note:
The values of dV/dt and k_0 provided below must not be exceeded in order to avoid damaging the capacitor.

dV/dt values

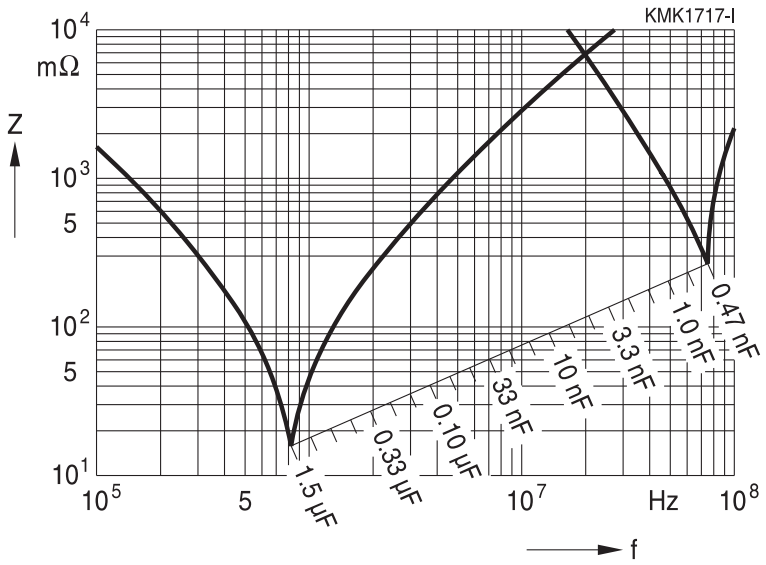
Lead spacing		15 mm	22.5 mm	27.5 mm	37.5 mm
V_R V DC	V_{RMS} V AC	dV/dt in V/µs			
400	250	7 000	5 000	4 000	–
630	300	12 000	7 000	5 000	3 000
1000	400	15 000	11 000	9 000	5 000
1250	450	27 000	11 000	9 000	6 000
1600	500	27 000	17 000	11 000	9 000
2000	550	39 000	21 000	11 000	9 000
2500	750	–	21 000	–	–

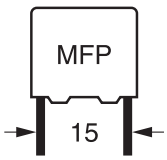
k_0 values

Lead spacing		15 mm	22.5 mm	27.5 mm	37.5 mm
V_R V DC	V_{RMS} V AC	k_0 in $V^2/\mu s$			
400	250	5 600 000	4 000 000	3 200 000	–
630	300	15 120 000	8 820 000	6 300 000	3 780 000
1000	400	30 000 000	22 000 000	18 000 000	10 000 000
1250	450	67 500 000	27 500 000	22 500 000	15 000 000
1600	500	86 400 000	54 400 000	35 200 000	28 800 000
2000	550	156 000 000	84 000 000	44 000 000	36 000 000
2500	750	–	105 000 000	–	–

Impedance Z versus frequency f

(typical values)



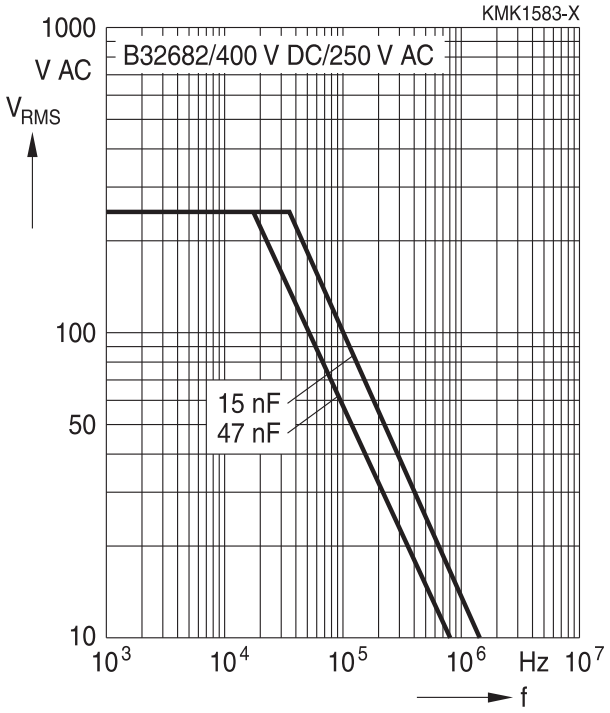


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

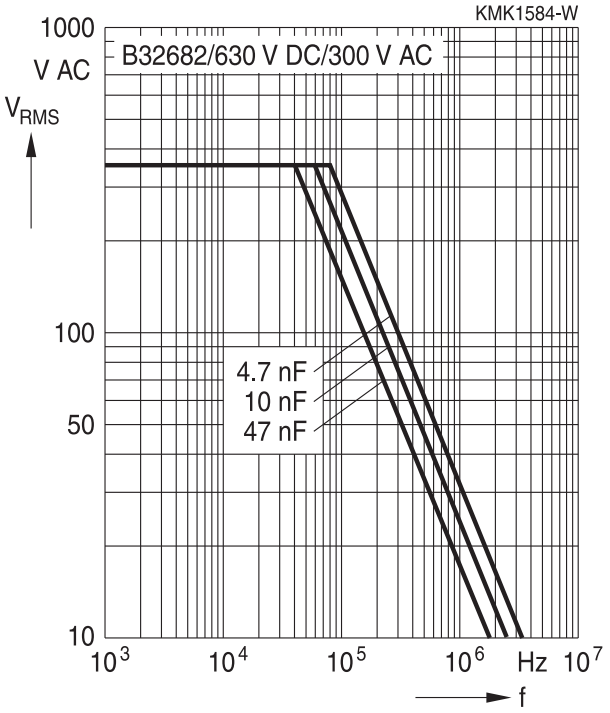
For T_A >90 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 15 mm

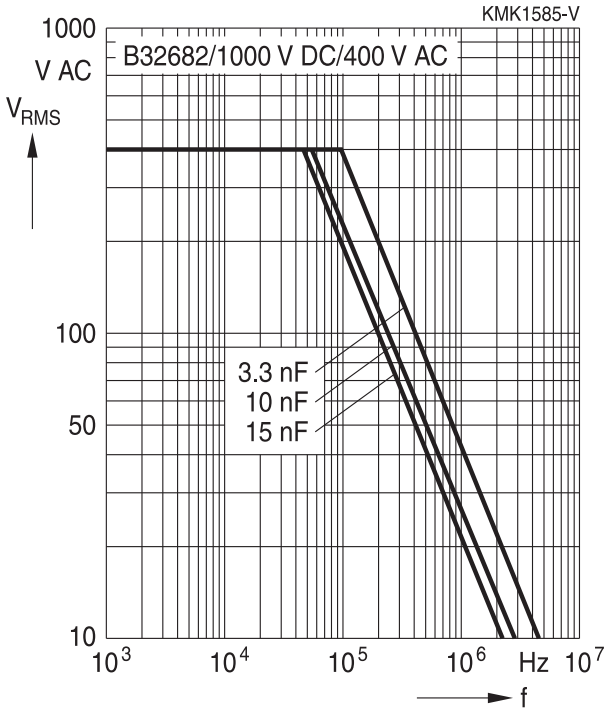
400 V DC/250 V AC



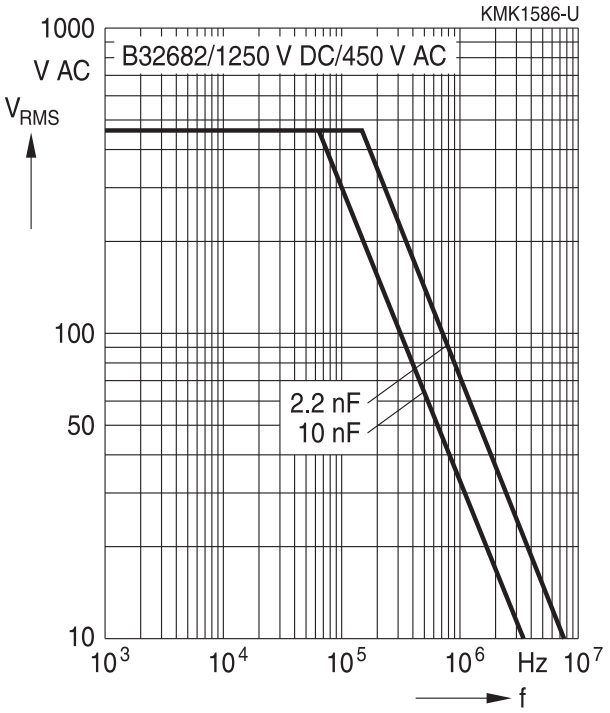
630 V DC/300 V AC

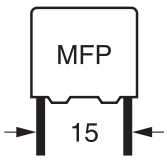


1000 V DC/400 V AC



1250 V DC/450 V AC





B32682

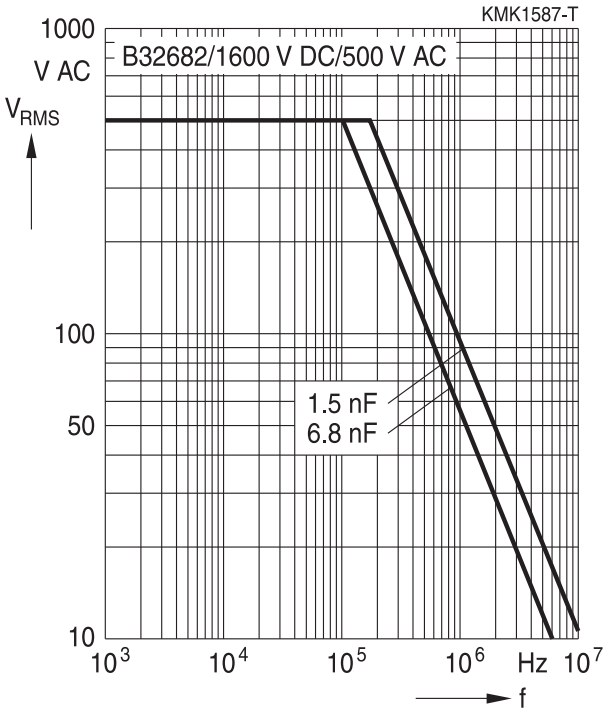
Very high pulse (wound)

Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

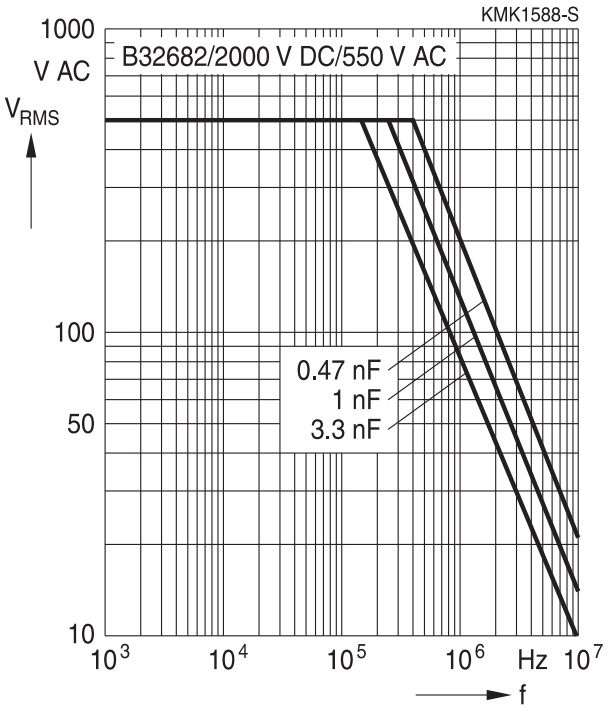
For T_A >90 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 15 mm

1600 V DC/500 V AC



2000 V DC/550 V AC

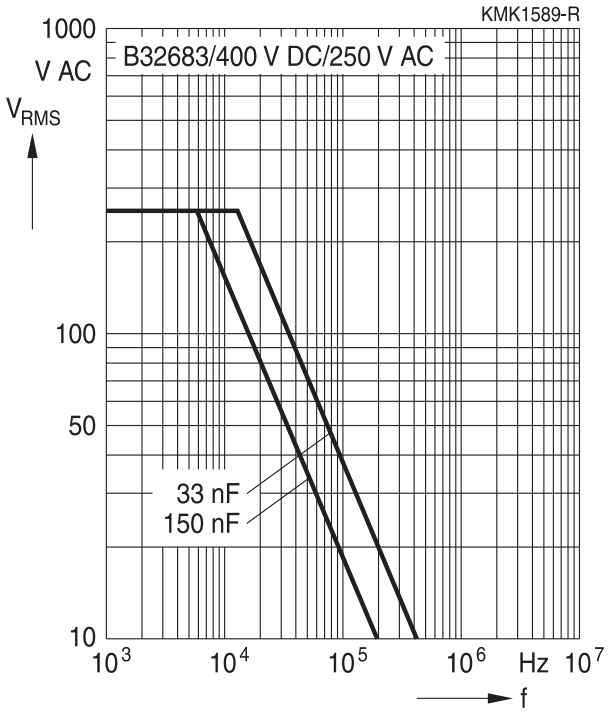


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

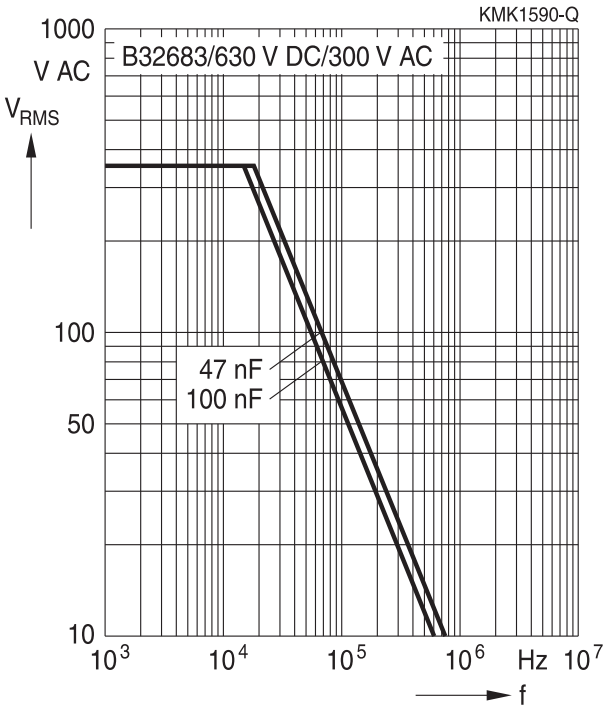
For T_A >90 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 22.5 mm

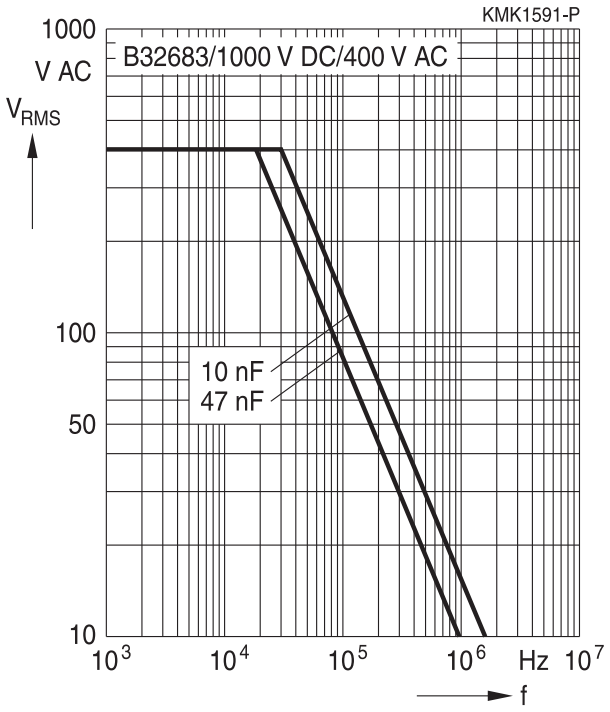
400 V DC/250 V AC



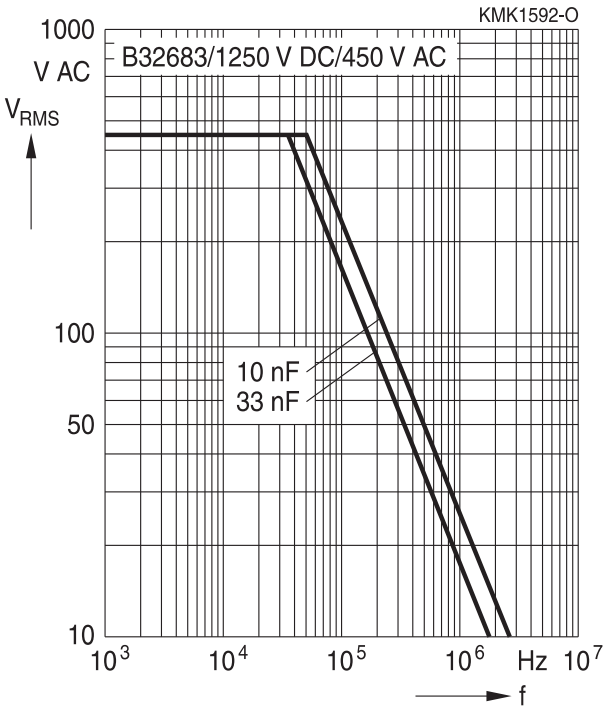
630 V DC/300 V AC

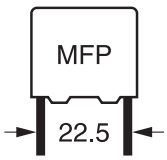


1000 V DC/400 V AC



1250 V DC/450 V AC





B32683

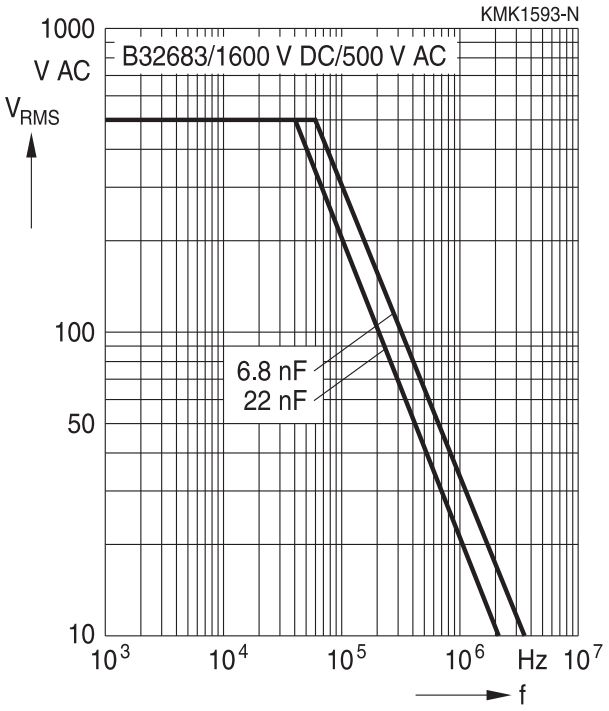
Very high pulse (wound)

Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

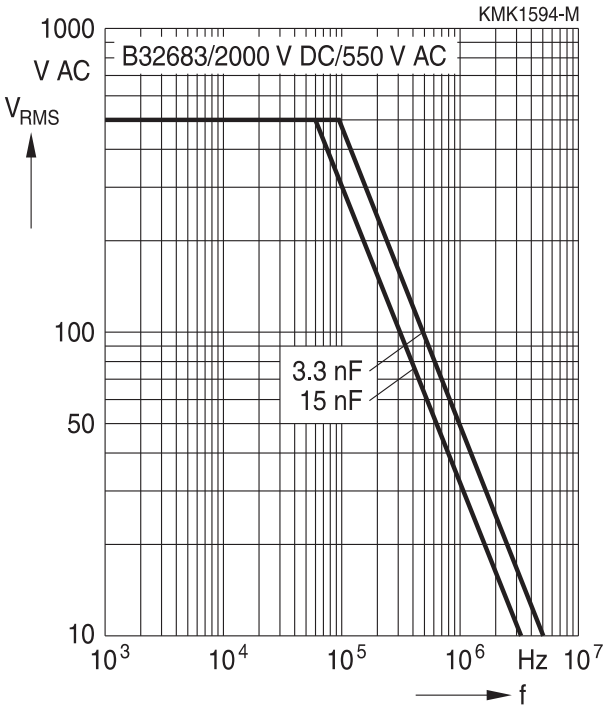
For T_A >90 °C, please refer to "General technical information", section 3.2.3.

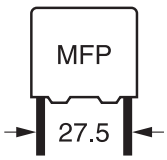
Lead spacing 22.5 mm

1600 V DC/500 V AC



2000 V DC/550 V AC



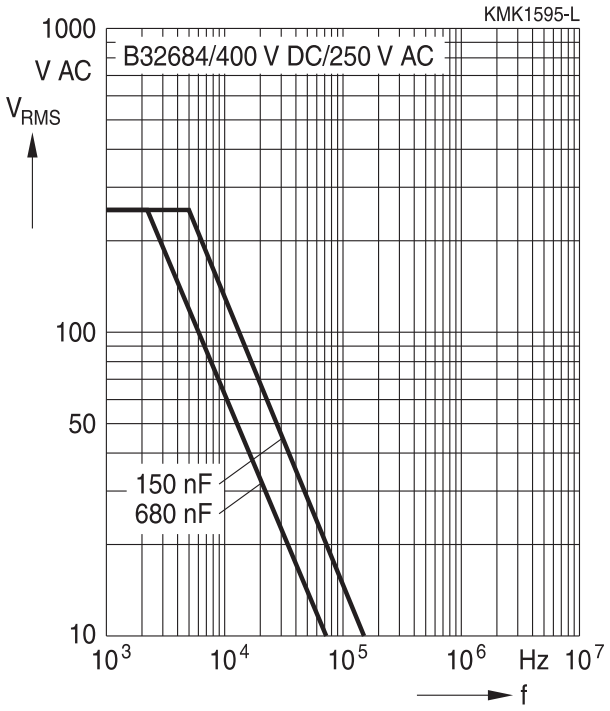


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

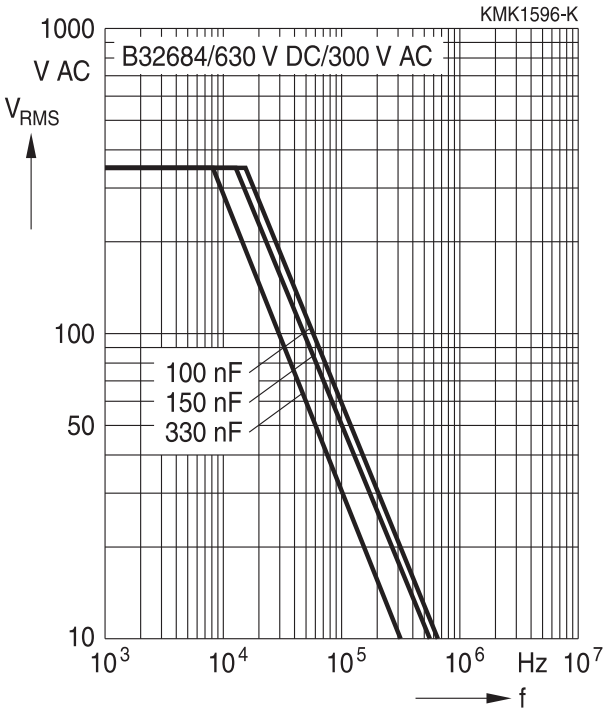
For T_A >90 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 27.5 mm

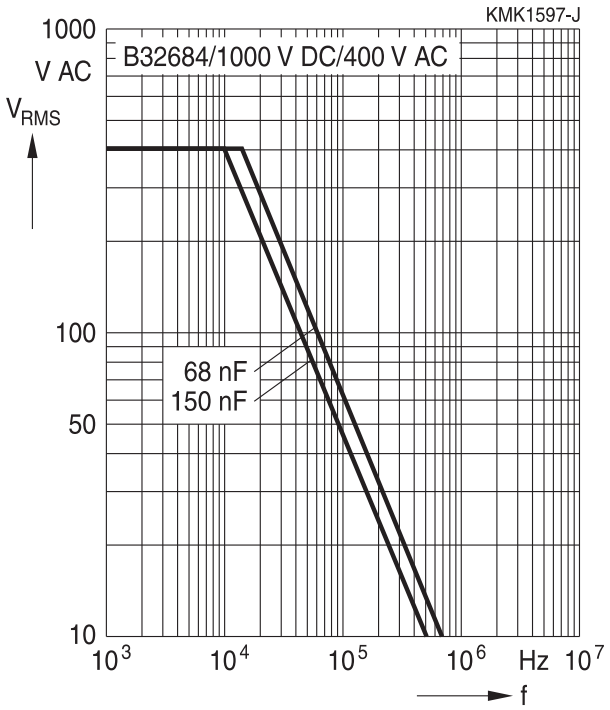
400 V DC/250 V AC



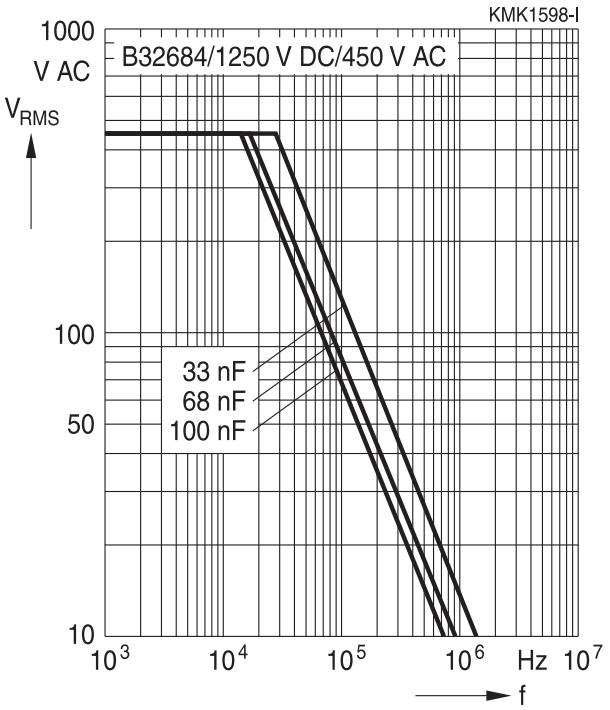
630 V DC/300 V AC

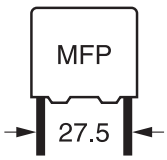


1000 V DC/400 V AC



1250 V DC/450 V AC





B32684

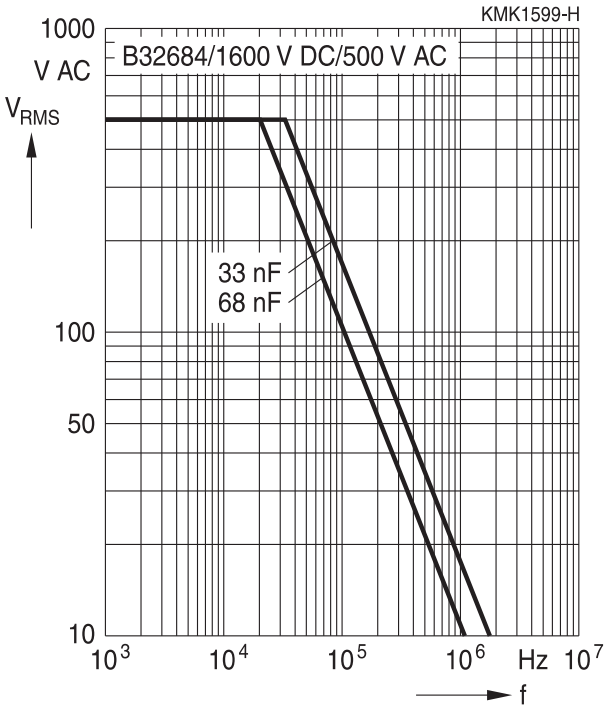
Very high pulse (wound)

Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

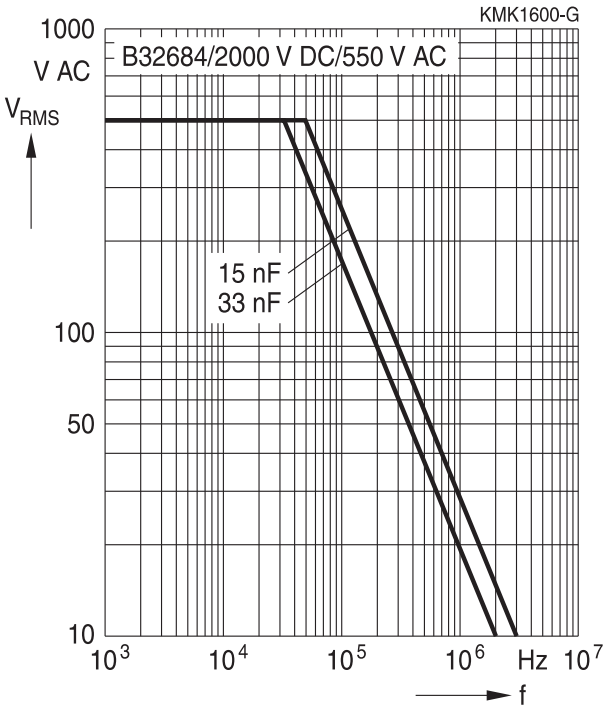
For T_A >90 °C, please refer to "General technical information", section 3.2.3.

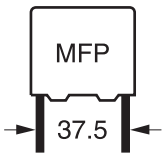
Lead spacing 27.5 mm

1600 V DC/500 V AC



2000 V DC/550 V AC



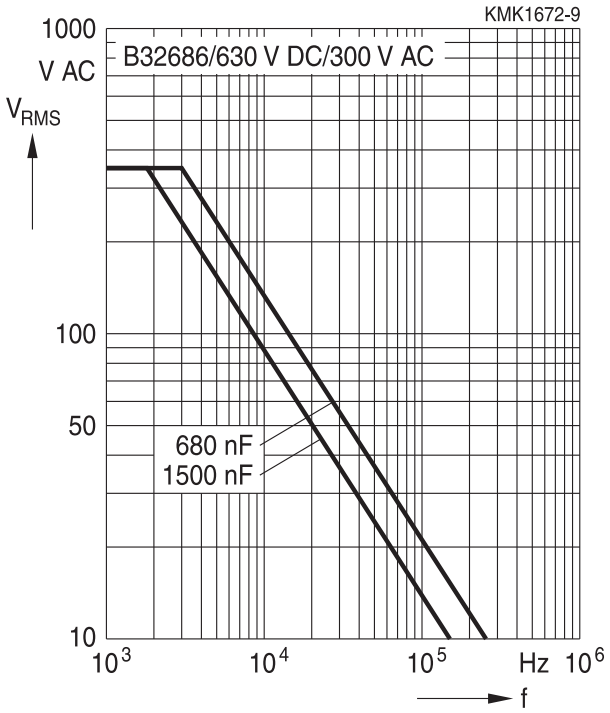


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

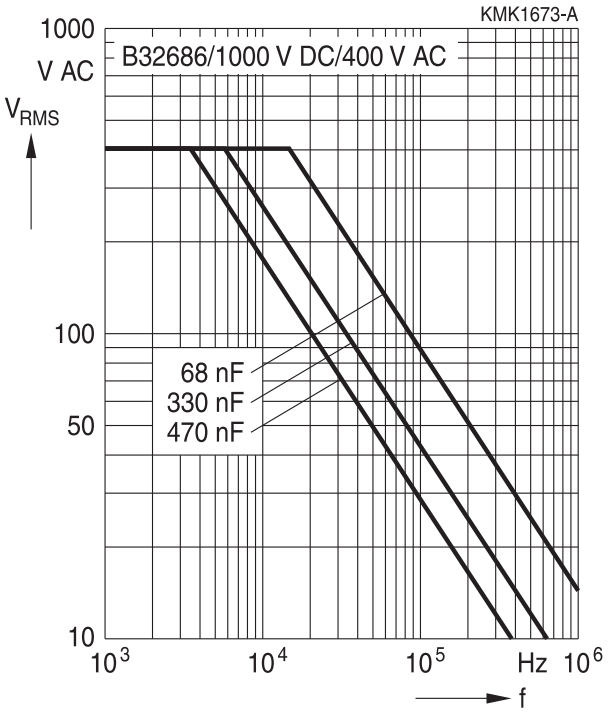
For T_A >90 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 37.5 mm

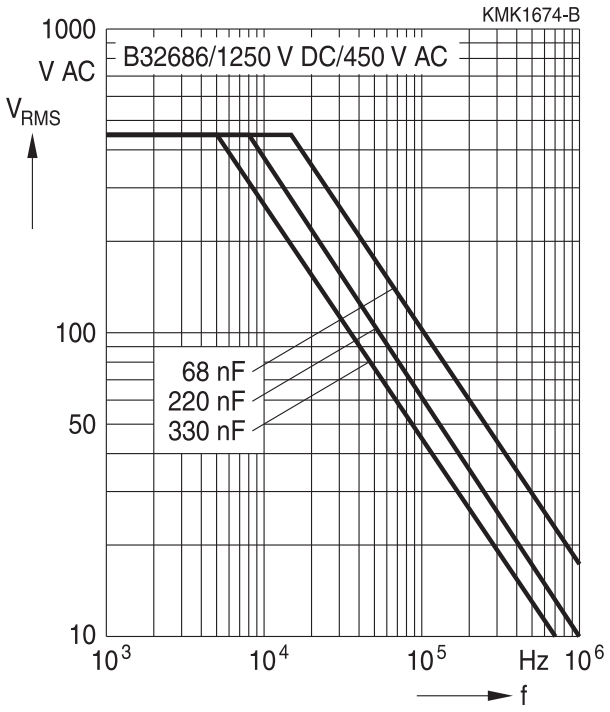
630 V DC/300 V AC



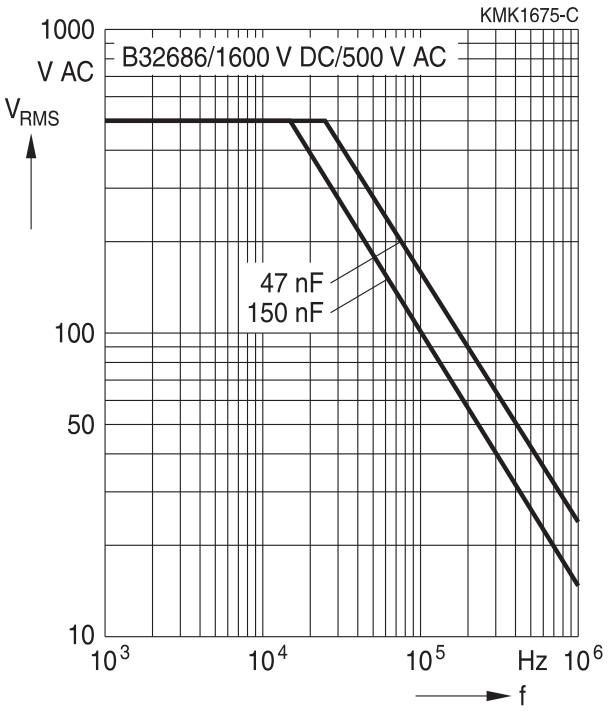
1000 V DC/400 V AC

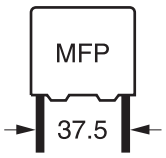


1250 V DC/450 V AC



1600 V DC/500 V AC





B32686

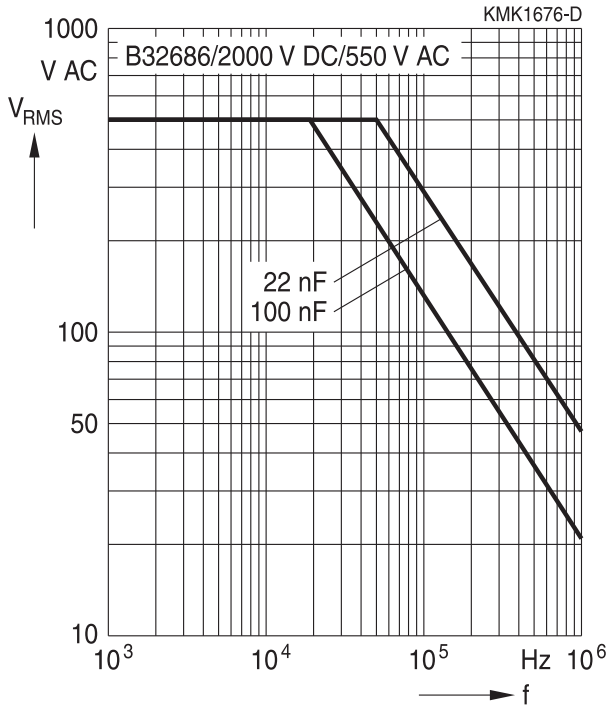
Very high pulse (wound)

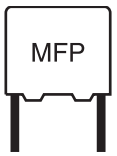
Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

For T_A >90 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 37.5 mm

2000 V DC/550 V AC





Mounting guidelines

1 Soldering

1.1 Solderability of leads

The solderability of terminal leads is tested to IEC 60068-2-20:2008, test Ta, method 1.

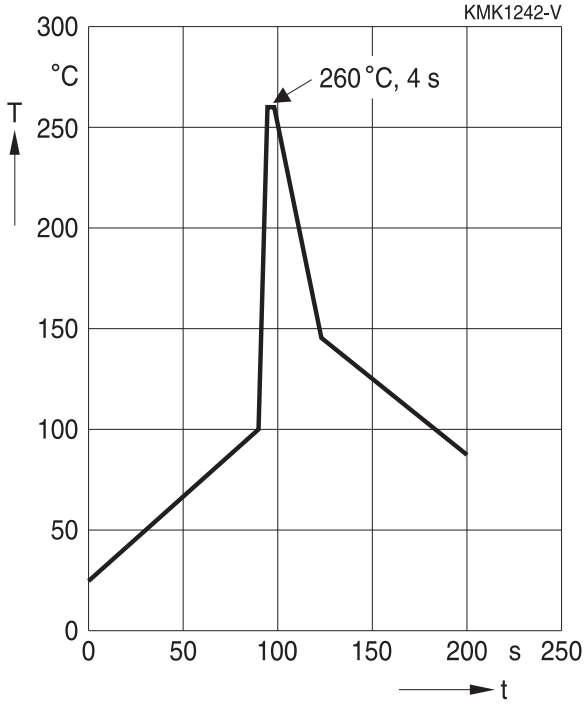
Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2:2007, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

Solder bath temperature	235 ±5 °C
Soldering time	2.0 ±0.5 s
Immersion depth	2.0 +0/−0.5 mm from capacitor body or seating plane
Evaluation criteria: Visual inspection	Wetting of wire surface by new solder ≥90%, free-flowing solder

1.2 Resistance to soldering heat

Resistance to soldering heat is tested to IEC 60068-2-20:2008, test Tb, method 1.
Conditions:

Series		Solder bath temperature	Soldering time
MKT	boxed (except 2.5 × 6.5 × 7.2 mm) coated uncoated (lead spacing >10 mm)	260 ±5 °C	10 ±1 s
MFP MKP	(lead spacing >7.5 mm)		
MKT	boxed (case 2.5 × 6.5 × 7.2 mm)		5 ±1 s
MKP MKT	(lead spacing ≤7.5 mm) uncoated (lead spacing ≤10 mm) insulated (B32559)		<4 s recommended soldering profile for MKT uncoated (lead spacing ≤ 10 mm) and insulated (B32559)



Immersion depth	2.0 +0/−0.5 mm from capacitor body or seating plane
Shield	Heat-absorbing board, (1.5 ±0.5) mm thick, between capacitor body and liquid solder
Evaluation criteria:	
Visual inspection	No visible damage
$\Delta C/C_0$	2% for MKT/MKP/MFP 5% for EMI suppression capacitors
tan δ	As specified in sectional specification

1.3 General notes on soldering

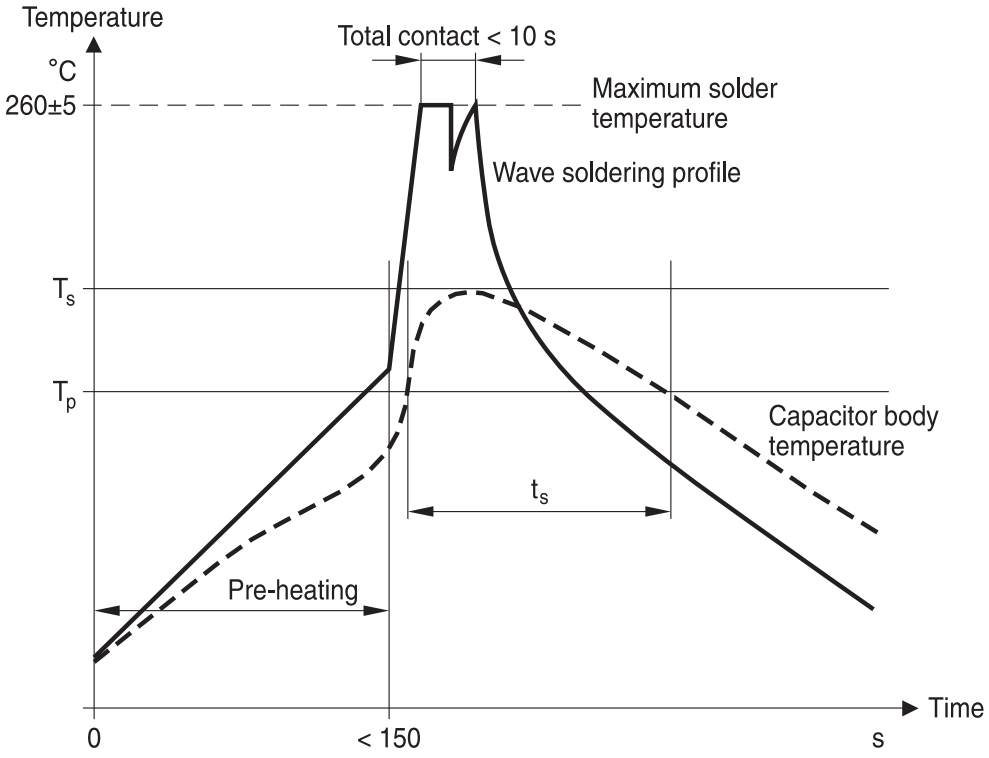
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature T_{max}. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics. For short exposures (as in practical soldering processes) the heat load (and thus the possible effects on a capacitor) will also depend on other factors like:

- Pre-heating temperature and time
- Forced cooling immediately after soldering
- Terminal characteristics:
  diameter, length, thermal resistance, special configurations (e.g. crimping)
- Height of capacitor above solder bath
- Shadowing by neighboring components
- Additional heating due to heat dissipation by neighboring components
- Use of solder-resist coatings

The overheating associated with some of these factors can usually be reduced by suitable countermeasures. For example, if a pre-heating step cannot be avoided, an additional or reinforced cooling process may possibly have to be included.

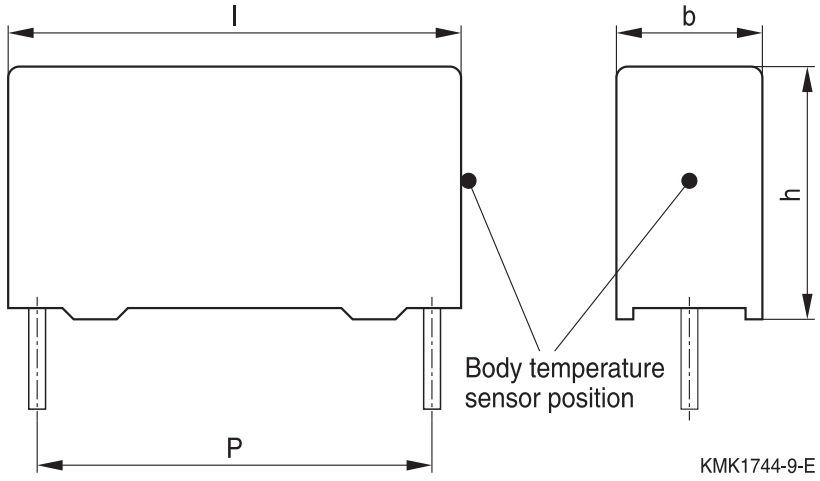
EPCOS recommendations

As a reference, the recommended wave soldering profile for our film capacitors is as follows:

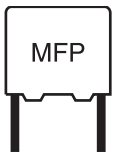


T_s: Capacitor body maximum temperature at wave soldering
T_p: Capacitor body maximum temperature at pre-heating

KMK1745-A-E



KMK1744-9-E



Body temperature should follow the description below:

- MKP capacitor
  During pre-heating: $T_p \leq 110$ °C
  During soldering: $T_s \leq 120$ °C, $t_s \leq 45$ s
- MKT capacitor
  During pre-heating: $T_p \leq 125$ °C
  During soldering: $T_s \leq 160$ °C, $t_s \leq 45$ s

When SMD components are used together with leaded ones, the film capacitors should not pass into the SMD adhesive curing oven. The leaded components should be assembled after the SMD curing step.

Leaded film capacitors are not suitable for reflow soldering.

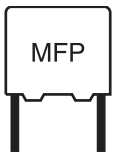
In order to ensure proper conditions for manual or selective soldering, the body temperature of the capacitor (T_s) must be ≤120 °C.

One recommended condition for manual soldering is that the tip of the soldering iron should be <360 °C and the soldering contact time should be no longer than 3 seconds.

For uncoated MKT capacitors with lead spacings ≤10 mm (B32560/B32561) the following measures are recommended:

- pre-heating to not more than 110 °C in the preheater phase
- rapid cooling after soldering

Please refer to EPCOS Film Capacitor Data Book in case more details are needed.



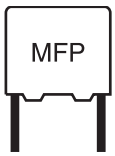
Cautions and warnings

- Do not exceed the upper category temperature (UCT).
- Do not apply any mechanical stress to the capacitor terminals.
- Avoid any compressive, tensile or flexural stress.
- Do not move the capacitor after it has been soldered to the PC board.
- Do not pick up the PC board by the soldered capacitor.
- Do not place the capacitor on a PC board whose PTH hole spacing differs from the specified lead spacing.
- Do not exceed the specified time or temperature limits during soldering.
- Avoid external energy inputs, such as fire or electricity.
- Avoid overload of the capacitors.
- Consult us if application is with severe temperature and humidity condition.
- There are no serviceable or repairable parts inside the capacitor. Opening the capacitor or any attempts to open or repair the capacitor will void the warranty and liability of EPCOS.
- Please note that the standards referred to in this publication may have been revised in the meantime.

The table below summarizes the safety instructions that must always be observed. A detailed description can be found in the relevant sections of the chapters "General technical information" and "Mounting guidelines".

Topic	Safety information	Reference chapter "General technical information"
Storage conditions	Make sure that capacitors are stored within the specified range of time, temperature and humidity conditions.	4.5 "Storage conditions"
Flammability	Avoid external energy, such as fire or electricity (passive flammability), avoid overload of the capacitors (active flammability) and consider the flammability of materials.	5.3 "Flammability"
Resistance to vibration	Do not exceed the tested ability to withstand vibration. The capacitors are tested to IEC 60068-2-6:2007. EPCOS offers film capacitors specially designed for operation under more severe vibration regimes such as those found in automotive applications. Consult our catalog "Film Capacitors for Automotive Electronics".	5.2 "Resistance to vibration"

Topic	Safety information	Reference chapter "Mounting guidelines"
Soldering	Do not exceed the specified time or temperature limits during soldering.	1 "Soldering"
Cleaning	Use only suitable solvents for cleaning capacitors.	2 "Cleaning"



B32682 ... B32686

Very high pulse (wound)

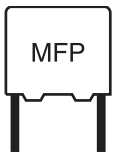
Topic	Safety information	Reference chapter "Mounting guidelines"
Embedding of capacitors in finished assemblies	When embedding finished circuit assemblies in plastic resins, chemical and thermal influences must be taken into account. Caution: Consult us first, if you also wish to embed other uncoated component types!	3 "Embedding of capacitors in finished assemblies"

Display of ordering codes for EPCOS products

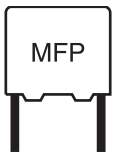
The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of EPCOS, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products**. Detailed information can be found on the Internet under www.epcos.com/orderingcodes.

Symbols and terms

Symbol	English	German
α	Heat transfer coefficient	Wärmeübergangszahl
α_C	Temperature coefficient of capacitance	Temperaturkoeffizient der Kapazität
A	Capacitor surface area	Kondensatoroberfläche
β_C	Humidity coefficient of capacitance	Feuchtekoeffizient der Kapazität
C	Capacitance	Kapazität
C_R	Rated capacitance	Nennkapazität
ΔC	Absolute capacitance change	Absolute Kapazitätsänderung
$\Delta C/C$	Relative capacitance change (relative deviation of actual value)	Relative Kapazitätsänderung (relative Abweichung vom Ist-Wert)
$\Delta C/C_R$	Capacitance tolerance (relative deviation from rated capacitance)	Kapazitätstoleranz (relative Abweichung vom Nennwert)
dt	Time differential	Differentielle Zeit
Δt	Time interval	Zeitintervall
ΔT	Absolute temperature change (self-heating)	Absolute Temperaturänderung (Selbsterwärmung)
$\Delta \tan \delta$	Absolute change of dissipation factor	Absolute Änderung des Verlustfaktors
ΔV	Absolute voltage change	Absolute Spannungsänderung
dV/dt	Time differential of voltage function (rate of voltage rise)	Differentielle Spannungsänderung (Spannungsflankensteilheit)
$\Delta V/\Delta t$	Voltage change per time interval	Spannungsänderung pro Zeitintervall
E	Activation energy for diffusion	Aktivierungsenergie zur Diffusion
ESL	Self-inductance	Eigeninduktivität
ESR	Equivalent series resistance	Ersatz-Serienwiderstand
f	Frequency	Frequenz
f_1	Frequency limit for reducing permissible AC voltage due to thermal limits	Grenzfrequenz für thermisch bedingte Reduzierung der zulässigen Wechselspannung
f_2	Frequency limit for reducing permissible AC voltage due to current limit	Grenzfrequenz für strombedingte Reduzierung der zulässigen Wechselspannung
f_r	Resonant frequency	Resonanzfrequenz
F_D	Thermal acceleration factor for diffusion	Therm. Beschleunigungsfaktor zur Diffusion
F_T	Derating factor	Deratingfaktor
i	Current (peak)	Stromspitze
I_C	Category current (max. continuous current)	Kategoriestrom (max. Dauerstrom)



Symbol	English	German
I_{RMS}	(Sinusoidal) alternating current, root-mean-square value	(Sinusförmiger) Wechselstrom
i_z	Capacitance drift	Inkonstanz der Kapazität
k_0	Pulse characteristic	Impulskennwert
L_S	Series inductance	Serieninduktivität
λ	Failure rate	Ausfallrate
λ_0	Constant failure rate during useful service life	Konstante Ausfallrate in der Nutzungsphase
λ_{test}	Failure rate, determined by tests	Experimentell ermittelte Ausfallrate
P_{diss}	Dissipated power	Abgegebene Verlustleistung
P_{gen}	Generated power	Erzeugte Verlustleistung
Q	Heat energy	Wärmeenergie
ρ	Density of water vapor in air	Dichte von Wasserdampf in Luft
R	Universal molar constant for gases	Allg. Molarkonstante für Gas
R	Ohmic resistance of discharge circuit	Ohmscher Widerstand des Entladekreises
R_i	Internal resistance	Innenwiderstand
R_{ins}	Insulation resistance	Isolationswiderstand
R_P	Parallel resistance	Parallelwiderstand
R_S	Series resistance	Serienwiderstand
S	severity (humidity test)	Schärfegrad (Feuchtetest)
t	Time	Zeit
T	Temperature	Temperatur
τ	Time constant	Zeitkonstante
tan δ	Dissipation factor	Verlustfaktor
tan δ_D	Dielectric component of dissipation factor	Dielektrischer Anteil des Verlustfaktors
tan δ_P	Parallel component of dissipation factor	Parallelanteil des Verlfustfaktors
tan δ_S	Series component of dissipation factor	Serienanteil des Verlustfaktors
T_A	Temperature of the air surrounding the component	Temperatur der Luft, die das Bauteil umgibt
T_{max}	Upper category temperature	Obere Kategorietemperatur
T_{min}	Lower category temperature	Untere Kategorietemperatur
t_{OL}	Operating life at operating temperature and voltage	Betriebszeit bei Betriebstemperatur und -spannung
T_{op}	Operating temperature, $T_A + \Delta T$	Beriebstemperatur, $T_A + \Delta T$
T_R	Rated temperature	Nenntemperatur
T_{ref}	Reference temperature	Referenztemperatur
t_{SL}	Reference service life	Referenz-Lebensdauer



Symbol	English	German
V_{AC}	AC voltage	Wechselspannung
V_C	Category voltage	Kategoriespannung
$V_{C,RMS}$	Category AC voltage	(Sinusförmige) Kategorie-Wechselspannung
V_{CD}	Corona-discharge onset voltage	Teilentlade-Einsatzspannung
V_{ch}	Charging voltage	Ladespannung
V_{DC}	DC voltage	Gleichspannung
V_{FB}	Fly-back capacitor voltage	Spannung (Flyback)
V_i	Input voltage	Eingangsspannung
V_o	Output voltage	Ausgangsspannung
V_{op}	Operating voltage	Betriebsspannung
V_p	Peak pulse voltage	Impuls-Spitzenspannung
V_{pp}	Peak-to-peak voltage Impedance	Spannungshub
V_R	Rated voltage	Nennspannung
$\hat{v}_R$	Amplitude of rated AC voltage	Amplitude der Nenn-Wechselspannung
V_{RMS}	(Sinusoidal) alternating voltage, root-mean-square value	(Sinusförmige) Wechselspannung
V_{SC}	S-correction voltage	Spannung bei Anwendung "S-correction"
V_{sn}	Snubber capacitor voltage	Spannung bei Anwendung "Beschaltung"
Z	Impedance	Scheinwiderstand
e	Lead spacing	Rastermaß

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