Film Capacitors

Metallized Polypropylene Film Capacitors (MKP)

Series/Type: **B32754 ... B32758**

Date: May 2017

Typical applications
- Output AC filtering for power converters, UPS, motor drives

Climatic
- Max. operating temperature: 105 °C
- Climatic category (IEC 60068-1): 40/85/56

Construction
- Dielectric: Polypropylene (PP)
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-0)

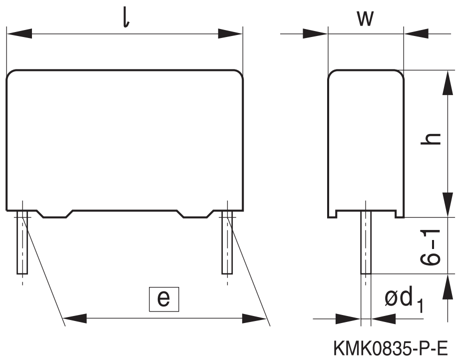
Features
- Optimized AC voltage performance
- High ripple current/frequency handling capability
- For PCB mounting

Terminals
- Parallel wire leads, lead-free tinned
- 2-pin and 4-pin versions
- Standard lead lengths: 6 −1 mm
- Special lead lengths available on request

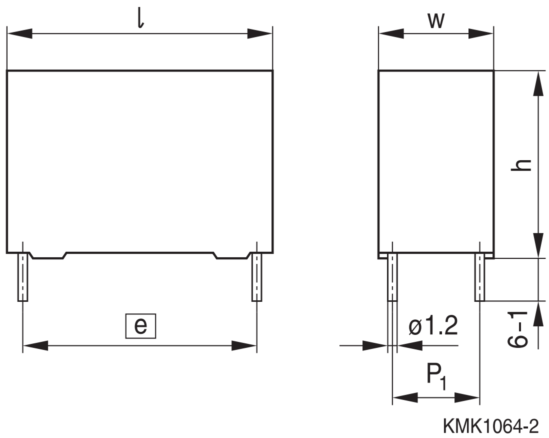
Marking
Manufacturer's logo, lot number, series number, rated capacitance (code), capacitance tolerance (code with letter), rated AC voltage, date of manufacture (code)

Delivery mode
Bulk (untaped, lead length 6 −1 mm)

Dimensional drawings
2-pin version



4-pin version



Dimensions in mm

Version	Lead spacing e ±0.4	Lead diameter d_1 ±0.05	Type
2-pin	27.5	0.8	B32754C
2-pin	37.5	1.0	B32756C
4-pin	37.5	1.2	B32756G
4-pin	52.5	1.2	B32758G

Overview of available types

Lead spacing	27.5 mm			37.5 mm			52.5 mm		
Type	B32754			B32756			B32758		
Page	4			5			7		
V_{RMS} (V AC)	250	275	310	250	275	310	250	275	310
C_R (µF)									
1.0									
1.5									
2.0									
2.5									
3.0									
3.5									
4.0									
4.5									
5.0									
6.0									
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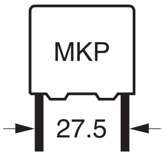


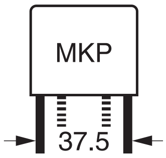
Ordering codes and packing units (lead spacing 27.5 mm)

V_{RMS} V AC	V_R V DC	C_R µF	Max. dimensions w × h × l mm	P_1 mm	Ordering code (composition see below)	I_{RMS} 70 °C 10 kHz A	ESR_{typ} 10 kHz mΩ	Untaped pcs./ MOQ
250	500	1.0	11.0 × 19.0 × 31.5	–	B32754C2105+000	2.5	26.8	2352
		2.0	12.5 × 21.5 × 31.5	–	B32754C2205+000	4.0	15.1	2100
		3.0	14.0 × 24.5 × 31.5	–	B32754C2305K000	5.0	10.5	1848
		4.0	16.0 × 32.0 × 31.5	–	B32754C2405+000	6.4	7.3	1064
		5.0	16.0 × 32.0 × 31.5	–	B32754C2505+000	7.0	6.9	1064
		6.0	18.0 × 33.0 × 31.5	–	B32754C2605+000	7.5	6.0	952
		7.0	22.0 × 36.5 × 31.5	–	B32754C2705+000	8.0	5.2	784
		8.0	22.0 × 36.5 × 31.5	–	B32754C2805+000	9.0	4.9	784
		9.0	22.0 × 36.5 × 31.5	–	B32754C2905+000	11.0	4.5	784
		10.0	22.0 × 36.5 × 31.5	–	B32754C2106K000	12.0	4.2	784
275	560	1.0	11.0 × 19.0 × 31.5	–	B32754C7105+000	2.5	26.8	2352
		1.5	12.5 × 21.5 × 31.5	–	B32754C7155+000	3.8	18.1	2100
		2.0	13.5 × 23.0 × 31.5	–	B32754C7205+000	4.5	13.8	1932
		2.5	15.0 × 24.5 × 31.5	–	B32754C7255+000	5.0	11.3	1680
		3.0	16.0 × 32.0 × 31.5	–	B32754C7305+000	6.0	8.7	1064
		4.0	18.0 × 33.0 × 31.5	–	B32754C7405+000	7.0	6.8	952
		5.0	18.0 × 33.0 × 31.5	–	B32754C7505K000	8.0	6.0	952
		6.0	22.0 × 36.5 × 31.5	–	B32754C7605+000	9.0	4.9	784
		7.0	22.0 × 36.5 × 31.5	–	B32754C7705+000	10.0	4.6	784
310	630	1.0	11.0 × 21.0 × 31.5	–	B32754C3105+000	3.0	24.6	2352
		1.5	13.5 × 23.0 × 31.5	–	B32754C3155+000	3.8	16.7	1932
		2.0	14.0 × 24.5 × 31.5	–	B32754C3205K000	5.0	12.8	1848
		2.5	16.0 × 32.0 × 31.5	–	B32754C3255K000	5.2	10.3	1064
		3.0	18.0 × 27.5 × 31.5	–	B32754C3305+000	6.5	8.9	1428
		3.5	18.0 × 33.0 × 31.5	–	B32754C3355+000	7.0	7.6	952
		4.0	19.0 × 30.0 × 31.5	–	B32754C3405K000	7.5	7.0	896
		4.5	21.0 × 31.0 × 31.5	–	B32754C3455+000	8.5	6.0	784
		5.0	22.0 × 36.5 × 31.5	–	B32754C3505+000	9.0	5.6	784
		6.0	22.0 × 36.5 × 31.5	–	B32754C3605K000	10.0	4.8	784

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

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



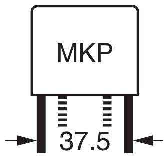
Ordering codes and packing units (lead spacing 37.5 mm)

V_{RMS} V AC	V_R V DC	C_R µF	Max. dimensions w × h × l mm	P_1 mm	Ordering code (composition see below)	I_{RMS} 70 °C 10 kHz A	ESR_{typ} 10 kHz mΩ	Untaped pcs./ MOQ
250	500	5.0	18.0 × 32.5 × 42.0	–	B32756C2505+000	7.0	12.5	720
		6.0	18.0 × 32.5 × 42.0	–	B32756C2605+000	7.0	10.6	720
		7.0	18.0 × 32.5 × 42.0	–	B32756C2705+000	7.0	10.0	720
		8.0	18.0 × 32.5 × 42.0	–	B32756C2805+000	8.3	9.7	720
		9.0	18.0 × 32.5 × 42.0	–	B32756C2905+000	8.5	8.7	720
		10	20.0 × 39.5 × 42.0	10.2	B32756G2106+000	10.0	6.8	640
		12	20.0 × 39.5 × 42.0	10.2	B32756G2126+000	11.0	6.3	640
		15	22.0 × 45.0 × 42.0	10.2	B32756G2156+000	12.0	5.2	560
		20	28.0 × 42.5 × 42.0	10.2	B32756G2206+000	14.0	4.0	440
		22	30.0 × 45.0 × 42.0	20.3	B32756G2226+000	16.0	3.7	400
		25	33.0 × 48.0 × 42.0	20.3	B32756G2256+000	17.0	3.3	180
		30	33.0 × 48.0 × 42.0	20.3	B32756G2306K000	18.0	3.0	180
275	560	5.0	18.0 × 32.5 × 42.0	–	B32756C7505+000	7.0	12.5	720
		6.0	18.0 × 32.5 × 42.0	–	B32756C7605+000	7.0	10.6	720
		7.0	18.0 × 32.5 × 42.0	–	B32756C7705+000	8.0	10.0	720
		8.0	20.0 × 39.5 × 42.0	10.2	B32756G7805+000	9.0	7.7	640
		9.0	20.0 × 39.5 × 42.0	10.2	B32756G7905+000	10.0	6.9	640
		10	20.0 × 39.5 × 42.0	10.2	B32756G7106+000	11.0	6.8	640
		12	22.0 × 45.0 × 42.0	10.2	B32756G7126+000	12.0	5.7	560
		15	28.0 × 42.5 × 42.0	10.2	B32756G7156+000	14.0	4.7	440
		20	30.0 × 45.0 × 42.0	20.3	B32756G7206K000	17.0	3.6	400
		22	33.0 × 48.0 × 42.0	20.3	B32756G7226+000	18.0	3.4	180

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

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



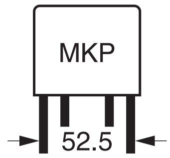
Ordering codes and packing units (lead spacing 37.5 mm)

V_{RMS} V AC	V_R V DC	C_R µF	Max. dimensions w × h × l mm	P_1 mm	Ordering code (composition see below)	I_{RMS} 70 °C 10 kHz A	ESR_{typ} 10 kHz mΩ	Untaped pcs./ MOQ
310	630	5.0	18.0 × 32.5 × 42.0	–	B32756C3505+000	7.0	12.5	720
		6.0	18.0 × 32.5 × 42.0	–	B32756C3605+000	9.0	10.5	720
		7.0	20.0 × 39.5 × 42.0	10.2	B32756G3705+000	10.0	8.7	640
		8.0	20.0 × 39.5 × 42.0	10.2	B32756G3805+000	11.0	7.7	640
		9.0	20.0 × 39.5 × 42.0	10.2	B32756G3905K000	11.0	6.9	640
		10	22.0 × 45.0 × 42.0	10.2	B32756G3106+000	12.0	6.2	560
		12	22.0 × 45.0 × 42.0	10.2	B32756G3126K000	12.5	5.3	560
		14	28.0 × 42.5 × 42.0	10.2	B32756G3146K000	13.5	4.7	440
		15	30.0 × 45.0 × 42.0	20.3	B32756G3156+000	16.0	4.3	400
		20	33.0 × 48.0 × 42.0	20.3	B32756G3206K000	17.0	3.6	180

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

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



Ordering codes and packing units (lead spacing 52.5 mm)

V_{RMS} V AC	V_R V DC	C_R µF	Max. dimensions w × h × l mm	P_1 mm	Ordering code (composition see below)	I_{RMS} 70 °C 10 kHz A	ESR_{typ} 10 kHz mΩ	Untaped pcs./ MOQ
250	500	20	30.0 × 45.0 × 57.5	20.3	B32758G2206+000	13.0	6.2	280
		22	30.0 × 45.0 × 57.5	20.3	B32758G2226+000	13.0	5.7	280
		25	30.0 × 45.0 × 57.5	20.3	B32758G2256+000	14.0	5.6	280
		30	30.0 × 45.0 × 57.5	20.3	B32758G2306+000	16.0	5.2	280
		35	30.0 × 45.0 × 57.5	20.3	B32758G2356K000	17.0	4.5	280
		40	35.0 × 50.0 × 57.5	20.3	B32758G2406+000	20.0	4.0	108
		45	35.0 × 50.0 × 57.5	20.3	B32758G2456K000	21.0	3.6	108
		50	38.0 × 57.5 × 57.5	20.3	B32758G2506+000	22.0	3.4	96
		55	38.0 × 57.5 × 57.5	20.3	B32758G2556+000	24.0	3.1	96
		60	38.0 × 57.5 × 57.5	20.3	B32758G2606K000	25.0	3.0	96
		65	45.0 × 57.0 × 57.5	20.3	B32758G2656+000	26.0	2.7	140
		70	45.0 × 57.0 × 57.5	20.3	B32758G2706K000	26.0	2.6	140
275	560	20	30.0 × 45.0 × 57.5	20.3	B32758G7206+000	13.0	6.2	280
		22	30.0 × 45.0 × 57.5	20.3	B32758G7226+000	14.0	5.7	280
		25	30.0 × 45.0 × 57.5	20.3	B32758G7256+000	16.0	5.6	280
		30	35.0 × 50.0 × 57.5	20.3	B32758G7306+000	17.0	4.5	108
		35	35.0 × 50.0 × 57.5	20.3	B32758G7356+000	20.0	4.1	108
		40	38.0 × 57.5 × 57.5	20.3	B32758G7406+000	21.0	3.7	96
		45	38.0 × 57.5 × 57.5	20.3	B32758G7456+000	23.0	3.4	96
		50	45.0 × 57.0 × 57.5	20.3	B32758G7506+000	24.0	3.1	140
		55	45.0 × 57.0 × 57.5	20.3	B32758G7556K000	25.0	2.8	140
310	630	20	30.0 × 45.0 × 57.5	20.3	B32758G3206+000	15.0	6.2	280
		22	30.0 × 45.0 × 57.5	20.3	B32758G3226+000	16.5	5.7	280
		25	35.0 × 50.0 × 57.5	20.3	B32758G3256+000	18.0	5.1	108
		30	35.0 × 50.0 × 57.5	20.3	B32758G3306+000	21.0	4.3	108
		35	38.0 × 57.5 × 57.5	20.3	B32758G3356+000	22.0	3.8	96
		40	38.0 × 57.5 × 57.5	20.3	B32758G3406K000	24.0	3.4	96
		45	45.0 × 57.0 × 57.5	20.3	B32758G3456K000	26.0	3.1	140

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

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

Technical data

Reference standard: IEC 61071. All data given at T = 20 °C unless otherwise specified.

Operating temperature range (case)	Max. operating temperature, $T_{op,max}$ +105 °C Upper category temperature T_{max} +85 °C Lower category temperature T_{min} –40 °C Note: At T > 85 °C derating for V_{RMS} (V AC) should be 1.5%/°C
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)	1.0 (1 kHz)
Insulation resistance R_{ins} after 1min, given as time constant $\tau = C_R \cdot R_{ins}$, rel. humidity ≤ 65% (minimum as-delivered values) Measuring voltage: 500 V DC	10 000 s
Test voltage between terminals	$1.5 \cdot V_R$ for 10 s
DC Test voltage terminal to case	2000 V AC at 50 Hz, 10 s
Self-inductance (LS)	< 1 nH per mm of lead spacing
Maximum peak current (A)	$I_{P,max} = C_R \cdot \frac{dV}{dt}$
Damp heat test Limit values after damp heat test	1. 56 days/40 °C/93% relative humidity Capacitance change |ΔC/C| ≤ 5% Dissipation factor change Δ tan δ ≤ $1.5 \cdot 10^{-3}$ (at 1 kHz) Insulation resistance R_{ins} ≥ 50% of minimum as-delivered values 2. 1000 hrs/60 °C/95% relative humidity $V_{R,\ AC}$ Capacitance change |ΔC/C| ≤ 10% Dissipation factor change Δ tan δ ≤ 5 · upper limit values Insulation resistance R_{ins} ≥ 50% of minimum as-delivered values
Change of temperature	In accordance with IEC 60068-2-14 (Test Nb)
Reliability: Failure rate λ Service life t_{SL} Failure criteria: Total failure Failure due to variation of parameters	 10 fit (≤10×10^{-9}/h) at $0.5 \times U_N$, 40 °C > 60 000 h at 0.9 V_R, 70 °C For conversion to other operating conditions and temperatures, refer to chapter "Quality, 2 Reliability". Short/open circuit Capacitance change |ΔC/C| ≥ 10% Dissipation factor change Δ tan δ > 4 · upper limit values Insulation resistance R_{ins} or time constant $\tau = C_R \cdot R_{ins}$ < 500 s

Pulse handling capability

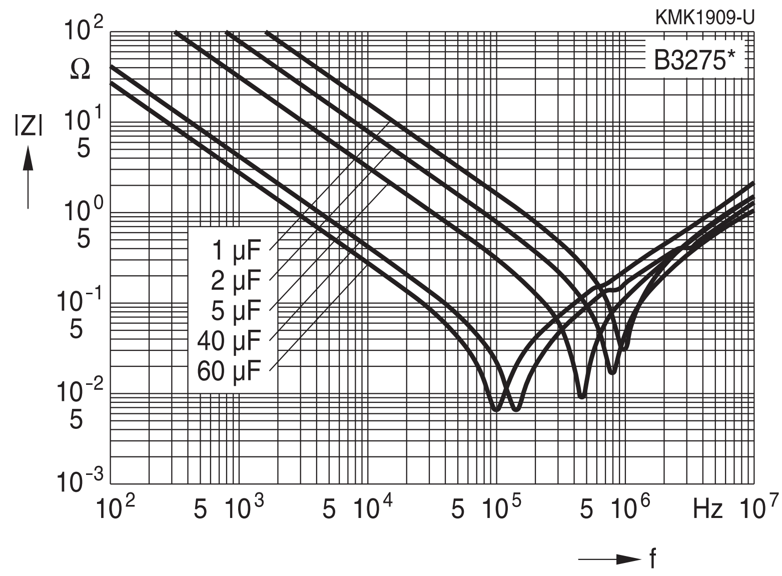
"dV/dt" represents the maximum permissible voltage change per unit of time for non-sinusoidal voltages, expressed in V/µs.

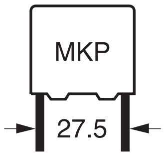
"k0" represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in V^2/µs.

Note:
The values of dV/dt and k0 provided below must not be exceeded in order to avoid damaging the capacitor. These parameters are given for isolated pulses in such a way that the heat generated by one pulse will be completely dissipated before applying the next pulse. For a train of pulses, please refer to the curves of permissible AC voltage-current versus frequency

Lead spacing	27.5 mm			37.5 mm			52.5 mm		
Type	B32754			B32756			B32758		
V_R (V DC)	500	560	630	500	560	630	500	560	630
V_{RMS} (V AC)	250	275	310	250	275	310	250	275	310
	dV/dt in V/µs								
	50	55	68	25	30	35	13	15	17

Impedance Z versus frequency f
(typical values)



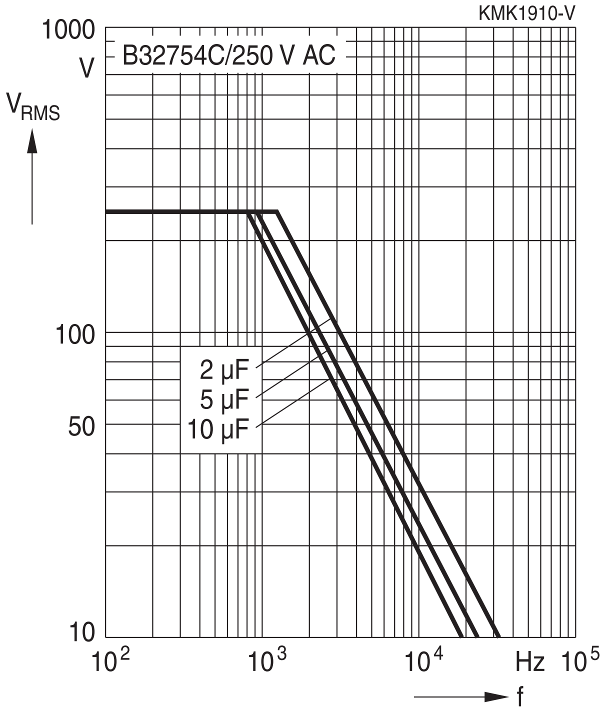


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, T_{op} ≤85 °C)

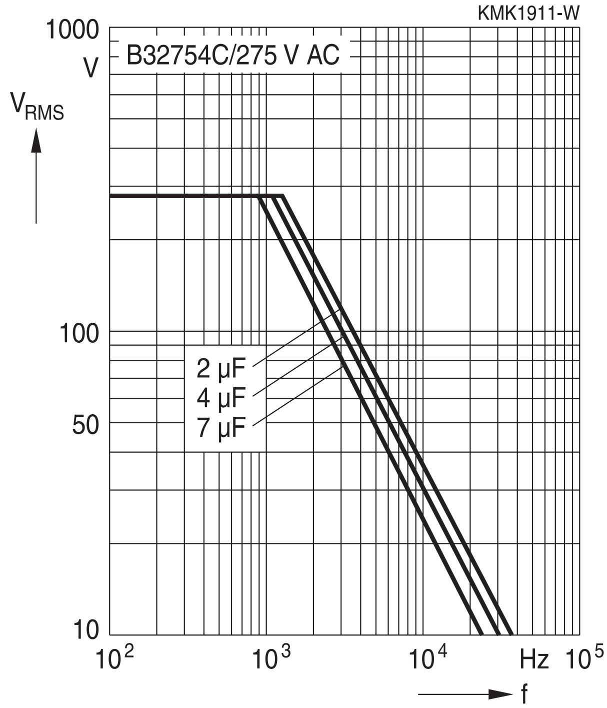
For T_{op} >85 °C, please refer to derating curve. The maximum component surface temperature must be lower than 105 °C and maximum temperature rise between case and free ambient shall be lower than 15 °C.

Lead spacing 27.5 mm (2 pins)

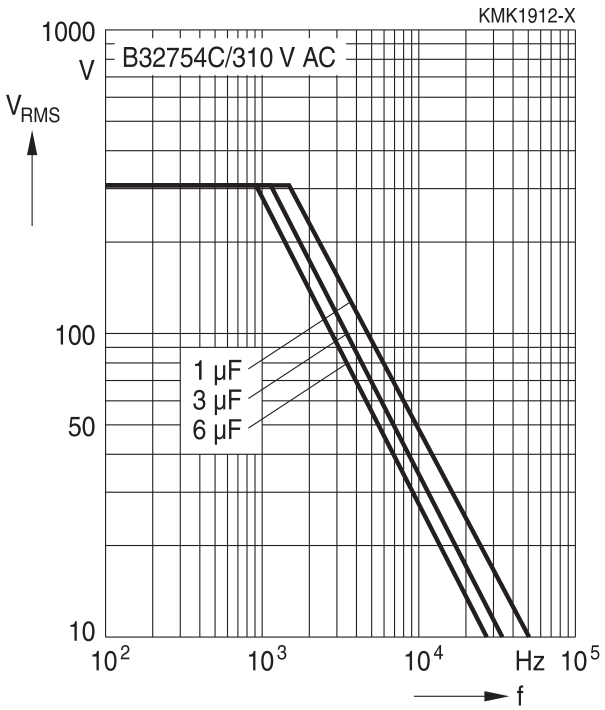
500 V DC/250 V AC



560 V DC/275 V AC



630 V DC/310 V AC

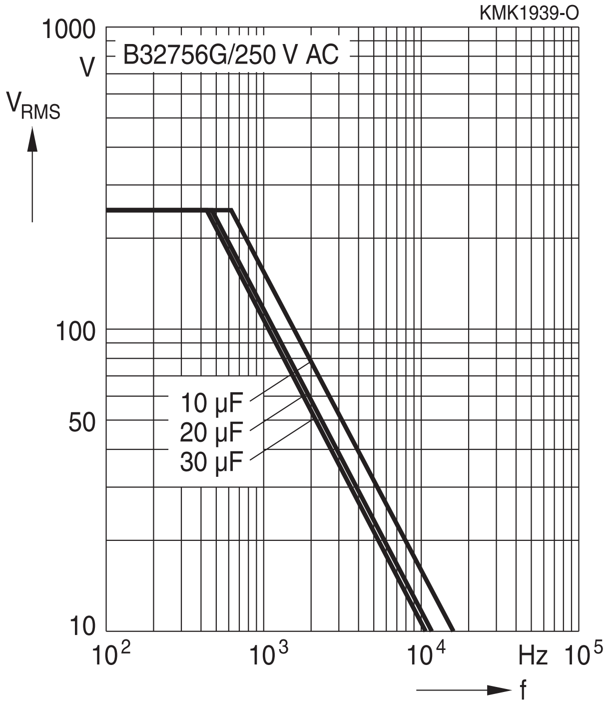


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, T_{op} ≤85 °C)

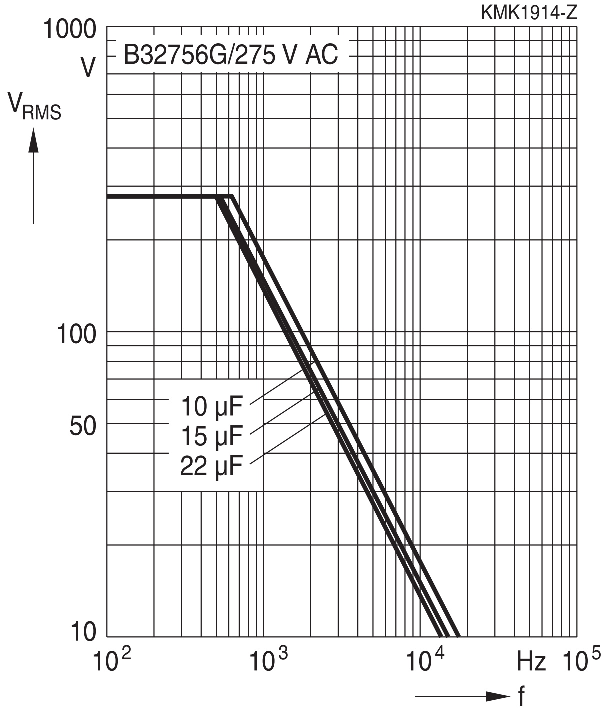
For T_{op} >85 °C, please refer to derating curve. The maximum component surface temperature must be lower than 105 °C and maximum temperature rise between case and free ambient shall be lower than 15 °C.

Lead spacing 37.5 mm (2 pins, 4 pins)

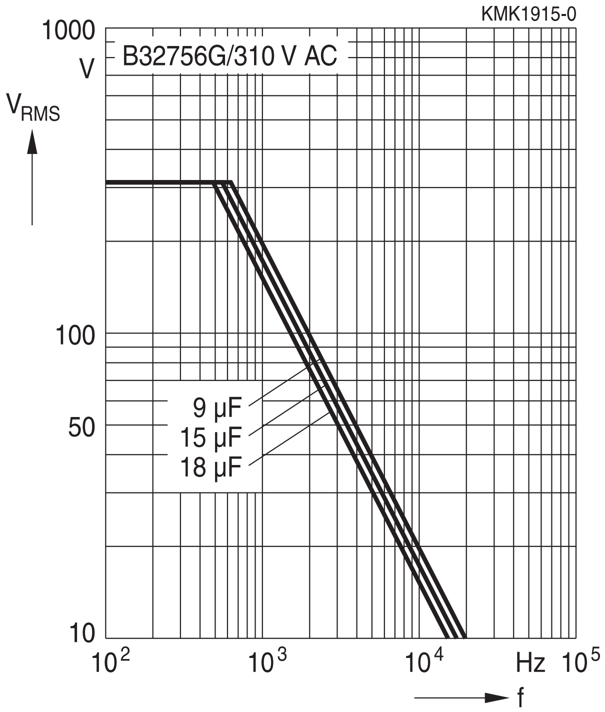
500 V DC/250 V AC

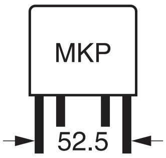


560 V DC/275 V AC



630 V DC/310 V AC



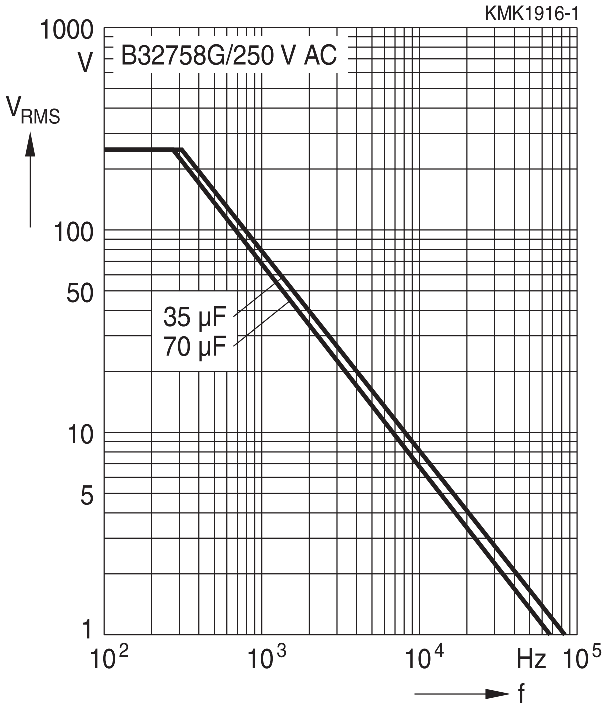


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, T_{op} ≤85 °C)

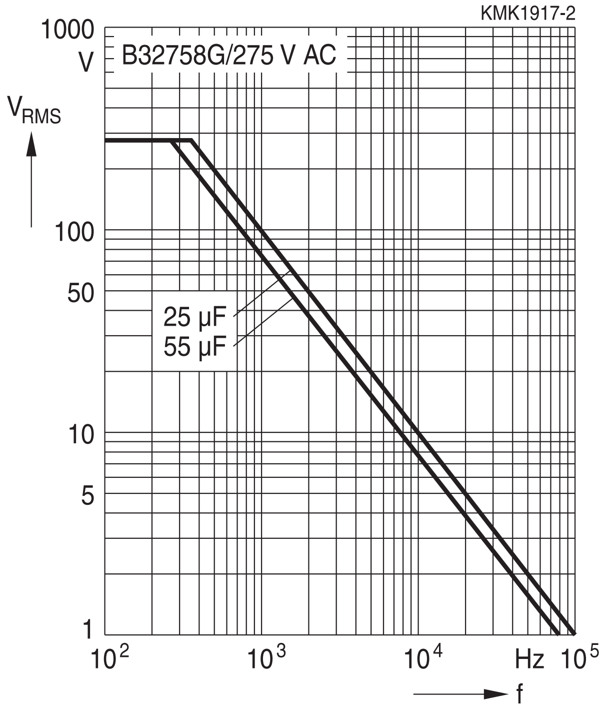
For T_{op} >85 °C, please refer to derating curve. The maximum component surface temperature must be lower than 105 °C and maximum temperature rise between case and free ambient shall be lower than 15 °C.

Lead spacing 52.5 mm (4 pins)

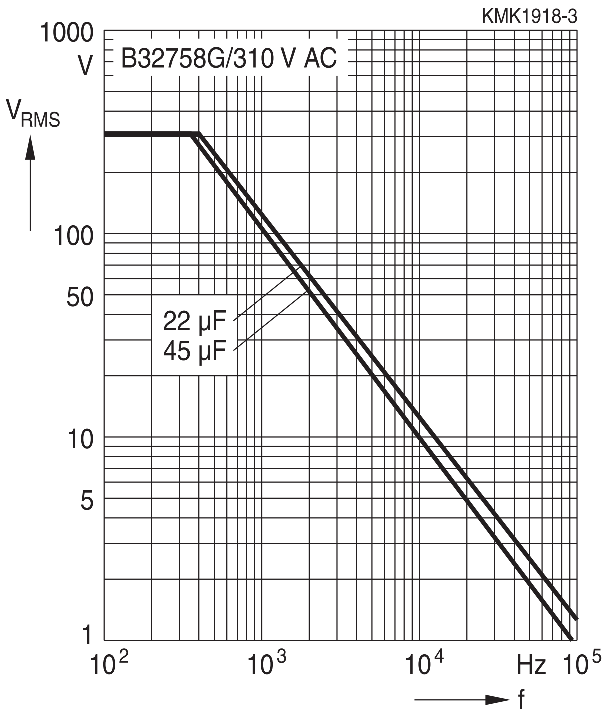
500 V DC/250 V AC



560 V DC/275 V AC



630 V DC/310 V AC

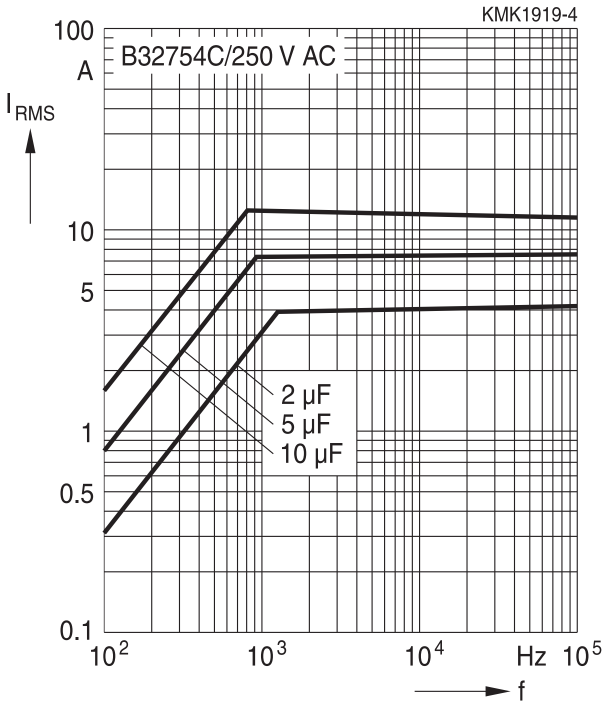


Permissible current I_{RMS} versus frequency f (for sinusoidal waveforms T_{op} ≤85 °C)

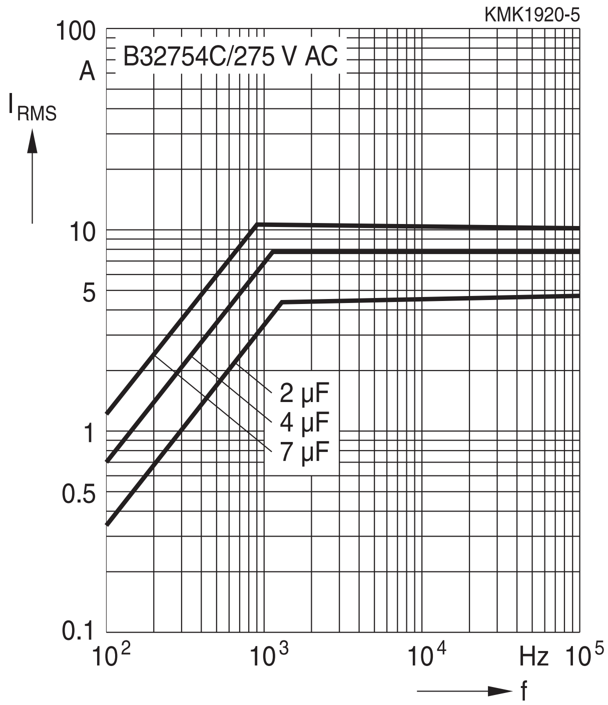
For T_{op} >85 °C, please use the derating curve. The maximum component surface temperature must be lower than 105 °C and maximum temperature rise between case and free ambient shall be lower than 15 °C.

Lead spacing 27.5 mm (2 pins)

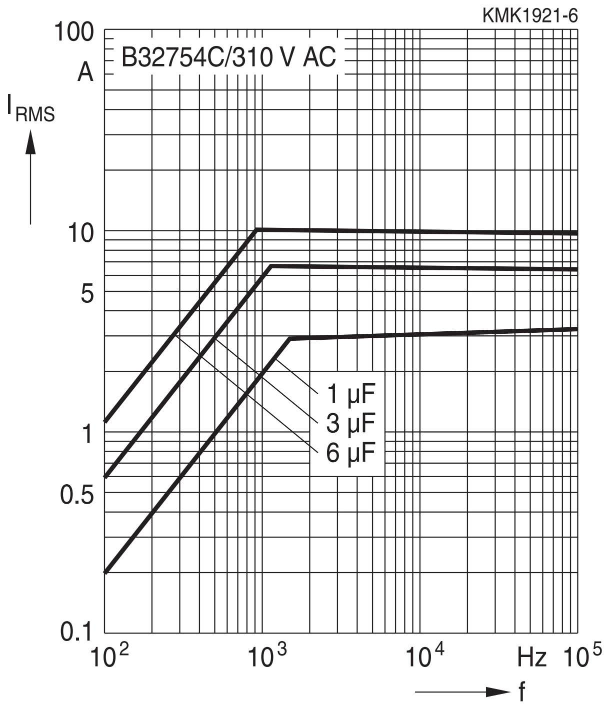
500 V DC/250 V AC



560 V DC/275 V AC



630 V DC/310 V AC

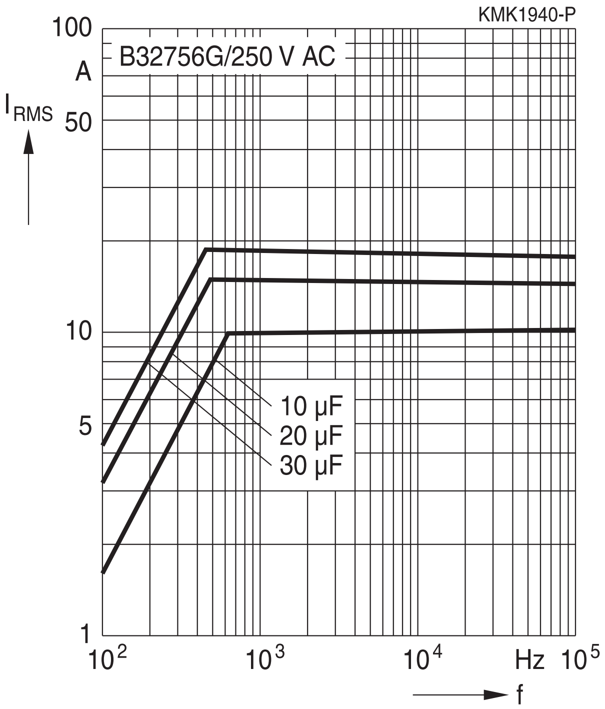


Permissible current I_{RMS} versus frequency f (for sinusoidal waveforms T_{op} ≤85 °C)

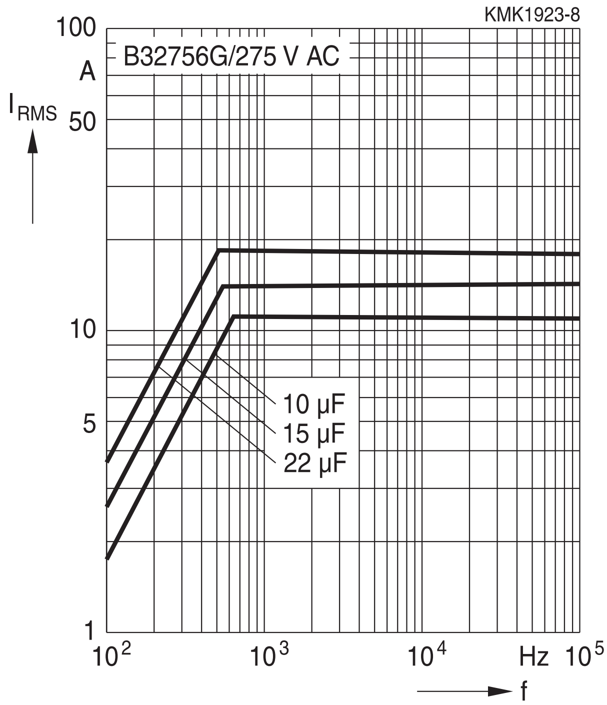
For T_{op} >85 °C, please use the derating curve. The maximum component surface temperature must be lower than 105 °C and maximum temperature rise between case and free ambient shall be lower than 15 °C.

Lead spacing 37.5 mm (2 pins, 4 pins)

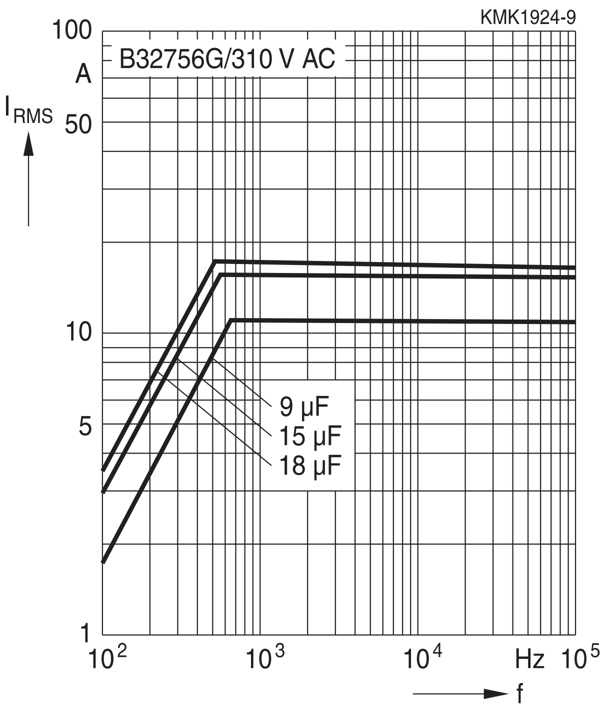
500 V DC/250 V AC

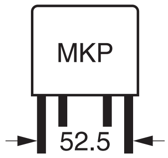


560 V DC/275 V AC



630 V DC/310 V AC



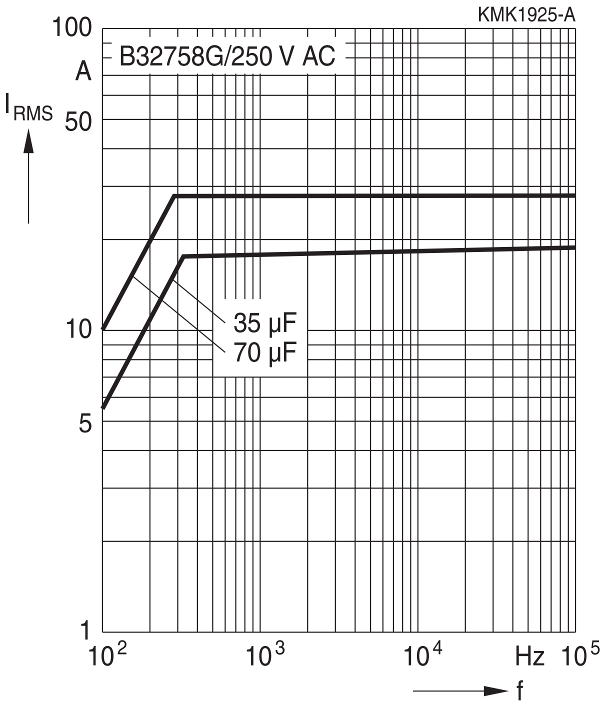


Permissible current I_{RMS} versus frequency f (for sinusoidal waveforms T_{op} ≤85 °C)

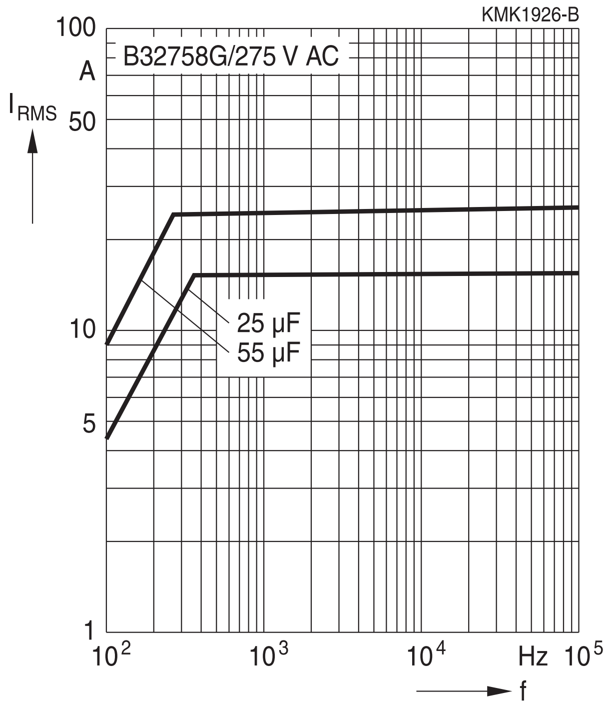
For T_{op} >85 °C, please use the derating curve. The maximum component surface temperature must be lower than 105 °C and maximum temperature rise between case and free ambient shall be lower than 15 °C.

Lead spacing 52.5 mm (4 pins)

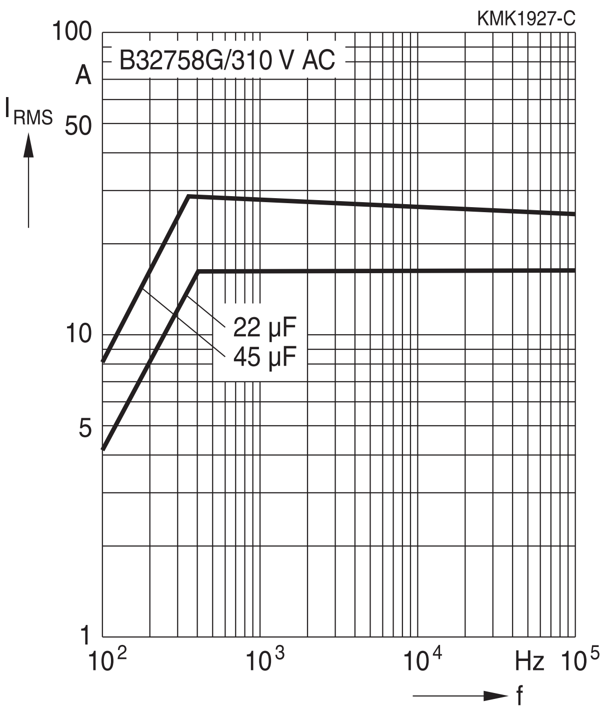
500 V DC/250 V AC



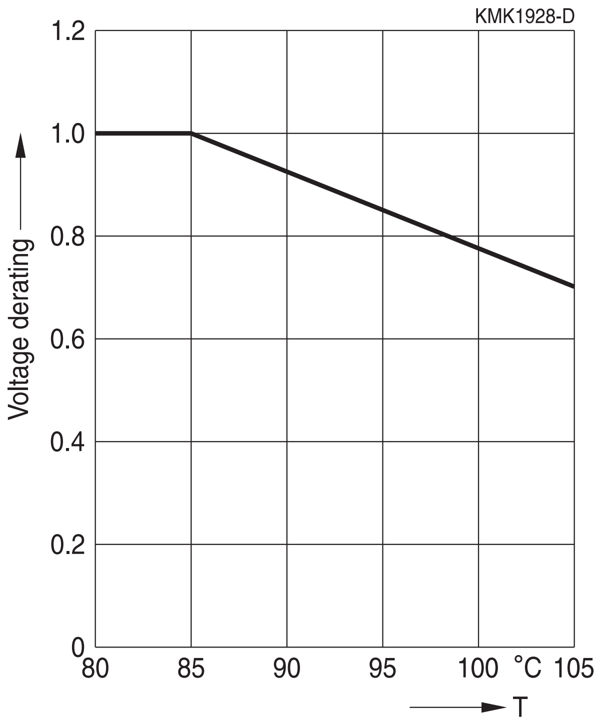
560 V DC/275 V AC



630 V DC/310 V AC



Maximum permissible continues DC voltage vs. temperature T



Maximum AC voltage (V_{RMS}) vs. temperature T_{op} ≤85 °C

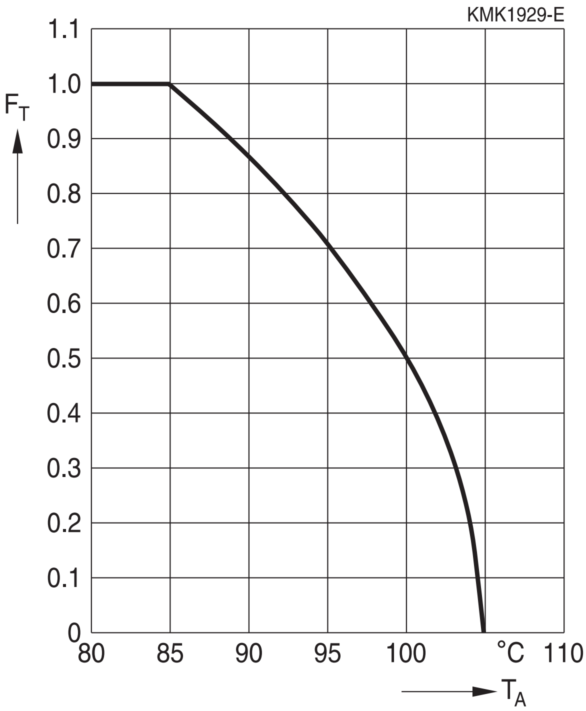
The graphs described in the previous section for the maximum AC voltage vs. frequency are valid for moderate temperature: T_{op} ≤85 °C in MKP. For temperatures higher than these limits, we have to consider additional effects depending on the frequency and dielectric:

Low frequency (f < f1)

For frequency below f1 (the frequency is the V_{RMS} begin to derating vs. frequency), a derating of the V_{RMS} versus the working temperature has to be applied, following the rules defined above.

High frequencies (f1 ≤ f)

For frequency below f1 (The frequency is the V_{RMS} begin to derating vs. frequency), a derating of the V_{RMS} versus the working temperature has to be applied, following the rules defined as below:



Derating factor F_T for V_{RMS} vs. T_A

Testing and Standards

<table>
<tr><th>Test</th><th>Reference</th><th colspan="3">Conditions of test</th><th>Performance requirements</th></tr>
<tr><td>Electrical parameters</td><td>IEC 61071</td><td colspan="3">Voltage between terminals:
1.5 V_R, 60 s
Terminals and enclosure: 2000 V AC
Insulation resistance R_{INS}
Capacitance C_R
Dissipation factor tan δ</td><td>Within specified limits
No visible damage
No flashover</td></tr>
<tr><td rowspan="6">Robustness of termina-tions</td><td rowspan="6">IEC 60068-2-21</td><td colspan="3">Tensile strength (test U_a1)</td><td rowspan="6">Within specified specification</td></tr>
<tr><td>Wire diameter</td><td>Section</td><td>Tensile force</td></tr>
<tr><td>$0.5 < d_1 \le 0.8$ mm
$0.8 < d_1 \le 1.25$ mm</td><td>≤0.5m²
≤1.2m²</td><td>10 N
20 N</td></tr>
<tr><td colspan="3">Duration: 10 s +/−1s
Bending U_b method 1</td></tr>
<tr><td>Wire diameter</td><td>Section</td><td>Tensile force</td></tr>
<tr><td>$0.5 < d_1 \le 0.8$ mm
$0.8 < d_1 \le 1.25$ mm
4 × 90 °C
Duration: 2 s to 3 s / bend</td><td>≤0.5m²
≤1.2m²</td><td>10 N
20 N</td></tr>
<tr><td>Resistance to soldering heat</td><td>IEC 60068-2-20</td><td colspan="3">Solder bath temperature at 260 ±5 °C, immersion for 10 seconds</td><td>$\Delta C/C_0 \le 0.5\%$
Increase of
tan δ ≤0.005</td></tr>
<tr><td>Vibration</td><td>IEC 60068-2-6</td><td colspan="3">10 Hz to 55 Hz:
Amplitude ±0.35 mm or
acceleration 98 m/s²
Test duration: 10 frequency cycles,
3 axes offset from each other by 90°,
1 octave/min,
Visual examination</td><td>No visible damage</td></tr>
<tr><td>Bump</td><td>IEC 60068-2-6</td><td colspan="3">Pulse shape: half sine
Acceleration: 490 m/s²
Duration of pulse: 11 ms
Visual examination</td><td>No visible damage
$|\Delta C/C_0| \le 0.5\%$
Increase of
tan δ ≤0.005 compared to initial value</td></tr>
<tr><td>Damp heat test</td><td></td><td colspan="3">60 °C / 95% RH / $V_{R, AC}$ / 1000 h</td><td>$|\Delta C/C_0| \le 10\%$
$|\Delta \tan \delta| \le 500\%$ (10 kHz)
R_{INS} ≥50% of minimum as delivered value</td></tr>
</table>

Test	Reference	Conditions of test	Performance requirements
Surge test	IEC 61071	$1.1 \cdot V_R$ or $I_{test} = 1.1\ I_{max.}$ Number of discharges: 5 Time lapse: every 2 min (10 min total) within 5 min after the surge discharge test Duration: 10 s; $1.5 \cdot V_R$ at T_A	No visible damage $\|\Delta C/C_0\| \leq 1\%$ tan δ (10 kHz) ≤1.2 initial tan δ +0.0001
Self-healing	IEC 61071	$1.5 \cdot V_R$; duration 10 s Number of clearings: ≤5 Clearing = voltage drop of 5% Increase the voltage at 100 V/s till 5 clearings occur with a maximum of $2.5 \cdot V_R$ for a duration of 10 s	$\|\Delta C/C_0\| \leq 0.5\%$ tan δ (10 kHz) ≤1.12 initial tan δ +0.0001
Environ-mental	IEC 61071	1. Change of temperature acc. to IEC 60068-2-14, test N_b $T_{max.}$ = 85 °C, $T_{min.}$ = −40 °C, Transition time: 1 h, equiv. to 1 °C/min, 5 cycles 2. Damp heat steady state acc. to IEC 60068-2-78, test C_a T = 40 °C ±2 °C, RH = 93% ±3 %, Duration: 56 days 3. DC voltage between terminal, $1.5 \cdot V_R$ at ambient temperature Duration: 10 s	No puncturing or flashover Self-healing punctures permitted $\|\Delta C/C_0\| \leq 2\%$ Increase of tan δ (10 kHz) ≤0.015
Thermal stability test under overload conditions	IEC 61071	Natural cooling T_A ±5 °C $1.21 \cdot P_{max.} = (V_2/2) \cdot W_2 \cdot C \cdot \tan\delta =$ $1.21 \cdot (I^2_{max.}/W_2 \cdot C) \cdot \tan\delta_2$ with $W_2 = 2 \cdot \pi \cdot f_2$ for $I_{max.}$ (see specific reference data) f_2 = 10 kHz, duration 48 h Measure the temperature every 1.5 h during the last 6 h	Temperature rise <1 °C $\|\Delta C/C_0\| \leq 2\%$ Increase of tan δ (10 kHz) ≤1.2 initial tan δ +0.015
Endurance test between terminal	IEC 61071	Sequence: $1.25 \cdot V_R$ at $T_{max.}$ = 85 °C $1.0 \cdot V_R$ at $T_{max.}$ = 105 °C Duration: 500 h 1000 × discharge at 1.4 · I (max.repetitive peak current in continuous operation) $1.25 \cdot V_R$ at $T_{max.}$ = 85 °C $1.0 \cdot V_R$ at $T_{max.}$ = 105 °C Duration: 500 h	$\|\Delta C/C_0\| \leq 3\%$ Increase of tan δ ≤0.015 compared to initial value

Mounting guidelines

1 Soldering

1.1 Solderability of leads

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

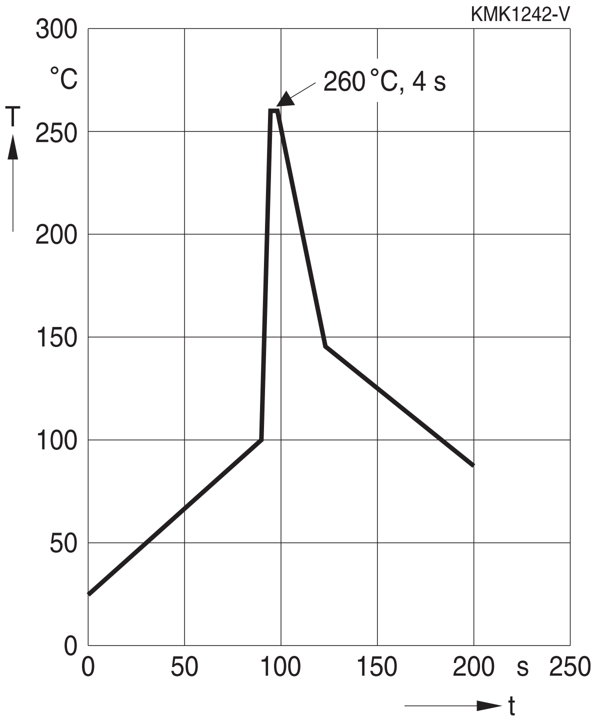
Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor 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, test Tb, method 1A.
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

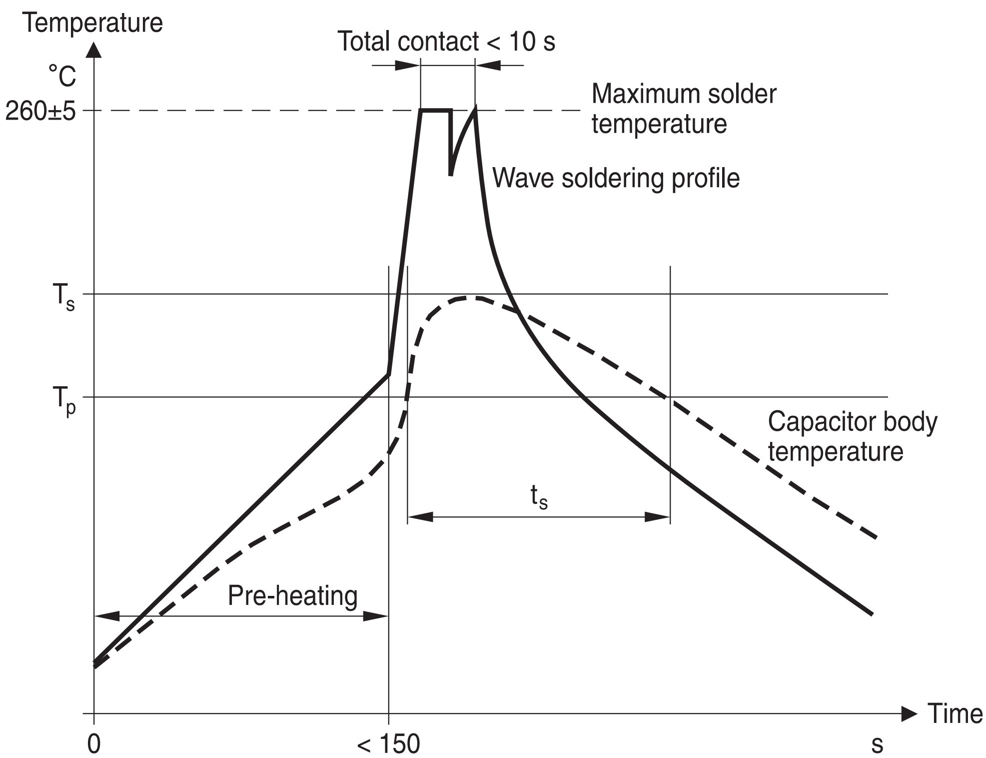
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature T_{max}. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics.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

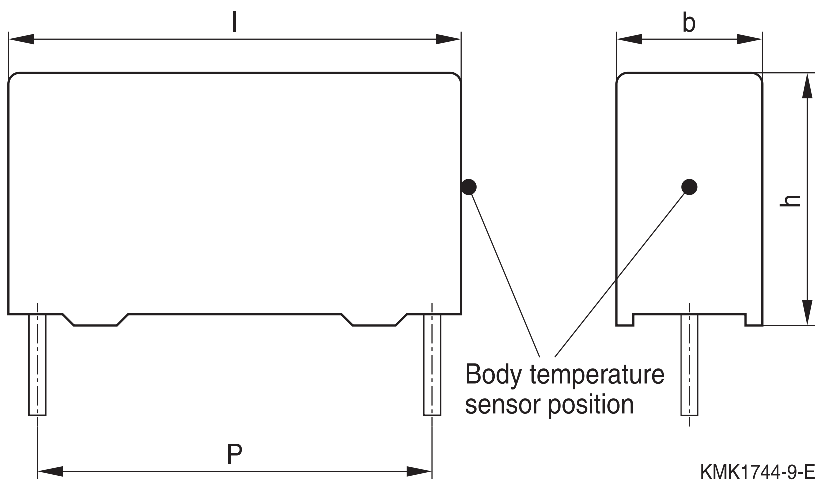
The overheating associated with some of these factors can usually be reduced by suitable countermeasures. For example, if a pre-heating step cannot be avoided, an additional or reinforced cooling process may possibly have to be included.

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



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.

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. 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"
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
$\tan \delta$	Dissipation factor	Verlustfaktor
$\tan \delta_D$	Dielectric component of dissipation factor	Dielektrischer Anteil des Verlustfaktors
$\tan \delta_P$	Parallel component of dissipation factor	Parallelanteil des Verlfustfaktors
$\tan \delta_S$	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	Ausgangssspannung
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

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
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