Film Capacitors

Metallized Polyester Film Capacitors (MKT)

Series/Type: **B32593, B32594**

Date: December 2018

Typical applications
- Compact fluorescent lamps (CFL)
- Blocking
- Coupling, decoupling
- Bypassing

Climatic
- Max. operating temperature: 125 °C
- Climatic category (IEC 60068-1:2013): 55/100/56

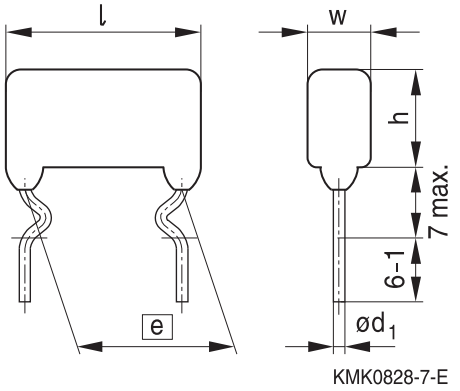
Features
- High pulse strength
- High contact reliability
- RoHS-compatible

Construction
- Dielectric: polyethylene terephthalate (polyester, PET)
- Wound capacitor technology
- Epoxy resin coating (UL 94 V-0)

Terminals
- Crimped wire leads, lead-free tinned, lead length 6 −1 mm or min. 20 mm
- Straight wire leads, lead-free tinned, lead length 17 ±3 mm
- Different lead spacings (reduced and enlarged) available, lead length 6 −1 mm

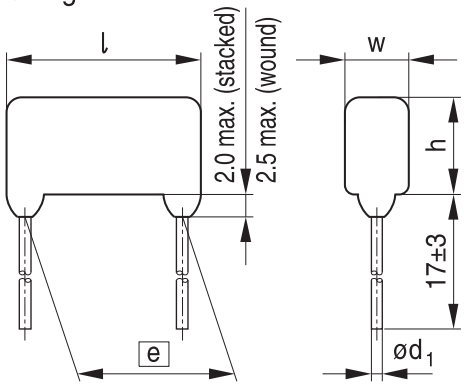
Marking
Manufacturer's logo,
rated capacitance (coded),
capacitance tolerance (code letter),
rated DC voltage,
additional for lead spacing ≥15 mm:
style, type, date of manufacture (coded)

Dimensional drawing
Crimped leads



KMK0828-7-E

Straight leads

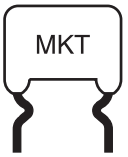


KMK0829-F-E

Dimensions in mm

Lead spacing e ±0.8	Lead diameter d_1 ±0.05	Type
22.5	0.8	B32593
27.5	0.8	B32594

Delivery mode
Bulk (untaped)
Taped (Ammo pack or reel) for lead spacing ≤22.5 mm.
For notes on taping, refer to chapter "Taping and packing“.

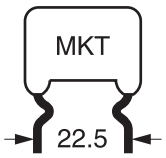


Overview of available types

Lead spacing	22.5 mm				27.5 mm			
Type	B32593				B32594			
Page	4				5			
V_R (V DC)	100	250	400	630	100	250	400	630
V_{RMS} (V AC)	63	160	200	200	63	160	200	220
C_R (µF)								
0.10								
0.15								
0.22								
0.33								
0.47								
0.68								
1.0								
1.5								
2.2								
3.3								
4.7								
6.8								
10								

Lead configurations

Series	Standard	Reduced	Enlarged	Straight
				
B32593	22.5 mm	17.5 / 20 mm	25 mm	22.5 mm
B32594	27.5 mm	25 mm	–	27.5 mm



B32593

General purpose (wound)

Ordering codes and packing units (lead spacing 22.5 mm)

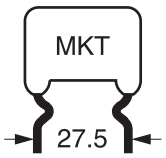
V_R V DC	V_{RMS} f ≤60 Hz V AC	C_R µF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Ammo pack pcs./MOQ	Reel pcs./MOQ	Untaped pcs./MOQ
100	63	1.5	7.0 × 14.0 × 26.5	B32593C1155+***	2000	2800	2000
		2.2	8.5 × 15.0 × 26.5	B32593C1225+***	1800	2400	2000
		3.3	10.0 × 16.5 × 26.5	B32593C1335+***	1520	2160	800
		4.7	11.5 × 18.5 × 26.5	B32593C1475+***	1200	1800	800
		6.8	13.0 × 21.5 × 26.5	B32593C1685+***	1120	1520	800
250	160	0.68	7.0 × 13.0 × 26.5	B32593C3684+***	2000	2800	2000
		1.0	7.0 × 15.5 × 26.5	B32593C3105+***	2000	2800	2000
		1.5	8.5 × 17.0 × 26.5	B32593C3155+***	1600	2320	800
		2.2	10.0 × 18.5 × 26.5	B32593C3225+***	1400	2000	800
400	200	0.22	6.5 × 13.0 × 26.5	B32593C6224+***	2020	3200	2000
		0.33	7.0 × 14.0 × 26.5	B32593C6334+***	2020	3200	2000
		0.47	7.0 × 16.5 × 26.5	B32593C6474+***	2000	2800	2000
630	200	0.10	7.0 × 14.0 × 26.5	B32593C8104+***	2000	2800	2000
		0.15	7.5 × 16.0 × 26.5	B32593C8154+***	1800	2600	1000
		0.22	8.5 × 17.0 × 26.5	B32593C8224+***	1600	2320	1000

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:
- M = ±20%
- K = ±10%
- J = ±5%

*** = Packaging code:
- 289 = Ammo pack
- 189 = Reel
- 010 = Untaped (standard lead length 6 −1 mm)
- 008 = Untaped straight (lead length 17±3 mm)



Ordering codes and packing units (lead spacing 27.5 mm)

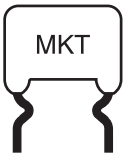
V_R V DC	V_{RMS} f ≤60 Hz V AC	C_R µF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Untaped pcs./MOQ
100	63	4.7	10.5 × 18.5 × 31.5	B32594C1475+***	800
		6.8	12.5 × 21.0 × 31.5	B32594C1685+***	800
		10	17.0 × 22.0 × 31.5	B32594C1106+***	800
250	160	1.5	8.5 × 16.0 × 31.5	B32594C3155+***	2000
		2.2	10.0 × 17.5 × 31.5	B32594C3225+***	2000
		3.3	12.0 × 19.5 × 31.5	B32594C3335+***	800
		4.7	14.0 × 21.5 × 31.5	B32594C3475+***	800
		6.8	15.0 × 25.0 × 31.5	B32594C3685+***	800
400	200	0.68	8.0 × 16.0 × 31.5	B32594C6684+***	1000
		1.0	9.5 × 18.0 × 31.5	B32594C6105+***	1000
		1.5	11.5 × 20.0 × 31.5	B32594C6155+***	1000
		2.2	13.5 × 22.0 × 31.5	B32594C6225+***	800
630	220	0.33	8.0 × 15.0 × 31.5	B32594C8334+***	1000
		0.47	10.0 × 16.0 × 31.5	B32594C8474+***	800
		0.68	10.5 × 18.0 × 31.5	B32594C8684+***	800

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:
- M = ±20%
- K = ±10%
- J = ±5%

*** = Packaging code:
- 010 = Untaped (standard lead length 6 −1 mm)
- 008 = Untaped straight (lead length 17±3 mm)



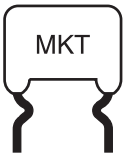
B32593, B32594

General purpose (stacked/wound)

Technical data

Reference standard: IEC 60384-2:2005. All data given at T = 20 °C, unless otherwise specified.

Operating temperature range	Max. operating temperature $T_{op,max}$	+125 °C		
	Upper category temperature T_{max}	+100 °C		
	Lower category temperature T_{min}	−55 °C		
	Rated temperature T_R	+85 °C		
Dissipation factor tan δ (in 10^{-3}) 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	8	10	10
	10 kHz	15	20	–
	100 kHz	30	–	–
Insulation resistance R_{ins} or time constant $\tau = C_R \cdot R_{ins}$ 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	
DC test voltage	1.4 · V_R, 2 s			
Category voltage V_C (continuous operation with V_{DC} or V_{AC} at f ≤ 60 Hz)	T_{op} (°C)	DC voltage derating	AC voltage derating	
	$T_{op} \leq 85$	$V_C = V_R$	$V_{C,RMS}=V_{RMS}$	
	$85<T_{op}\leq100$	$V_C = V_R \cdot (165-T_{op})/80$	$V_{C,RMS}=V_{RMS} \cdot (165-T_{op})/80$	
Operating voltage V_{op} for short operating periods (V_{DC} or V_{AC} at f ≤ 60 Hz)	T_{op} (°C)	DC voltage (max. hours)	AC voltage (max. hours)	
	$T_{op} \leq 100$	$V_{op} = 1.25 \cdot V_C$ (2000 h)	$V_{op} = 1.0 \cdot V_{C,RMS}$ (2000 h)	
	$100<T_{op}\leq125$	$V_{op} = 1.25 \cdot V_C$ (1000 h)	$V_{op} = 1.0 \cdot V_{C,RMS}$ (1000 h)	
Reliability:				
Failure rate λ	2 fit (≤ 1 · 10^{-9}/h) at 0.5 · V_R, 40 °C			
Service life t_{SL}	100 000 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	> 2 · upper limit value		
	Insulation resistance R_{ins}	< 150 MΩ ($C_R \leq 0.33$ µF)		
	or time constant $\tau = C_R \cdot R_{ins}$	< 50 s ($C_R > 0.33$ µF)		



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.
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.

dV/dt values

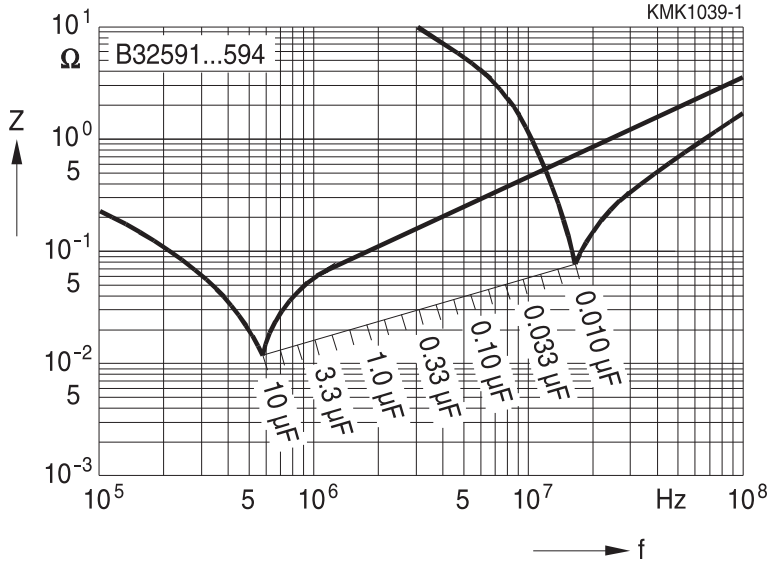
Lead spacing		22.5 mm	27.5 mm
Technology		Wound	Wound
V_R V DC	V_{RMS} V AC	dV/dt in V/µs	
100	63	2.5	2
250	160	4	3
400	200	7	5
630	200	10	–
630	220	–	8

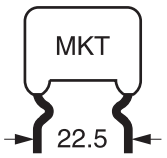
k_0 values

Lead spacing		22.5 mm	27.5 mm
Technology		Wound	Wound
V_R V DC	V_{RMS} V AC	k_0 in $V^2/\mu s$	
100	63	500	400
250	160	2 000	1 500
400	200	5 600	4 000
630	200	12 600	–
630	220	–	10 000

Impedance Z versus frequency f

(typical values)



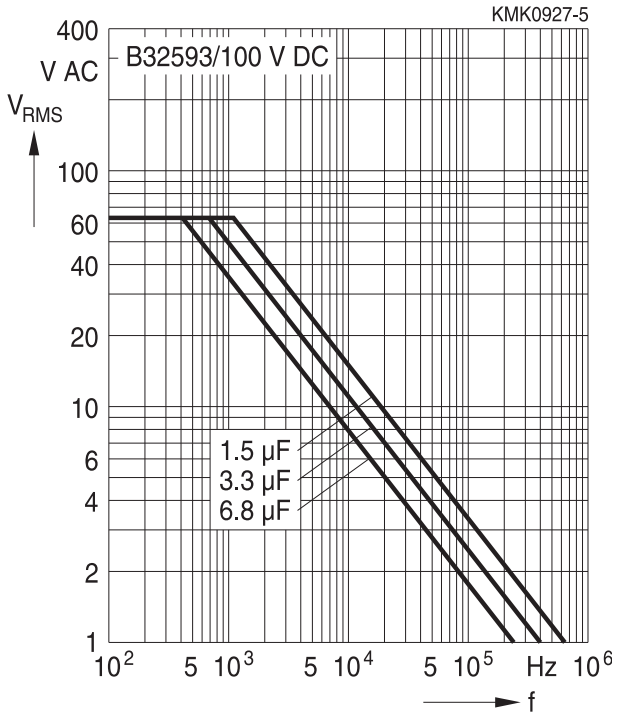


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 55$ °C)

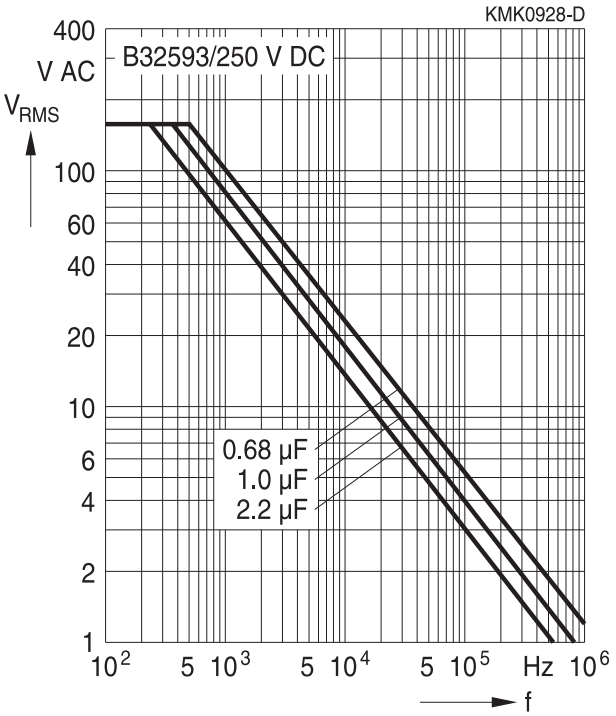
For T_A >55 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 22.5 mm

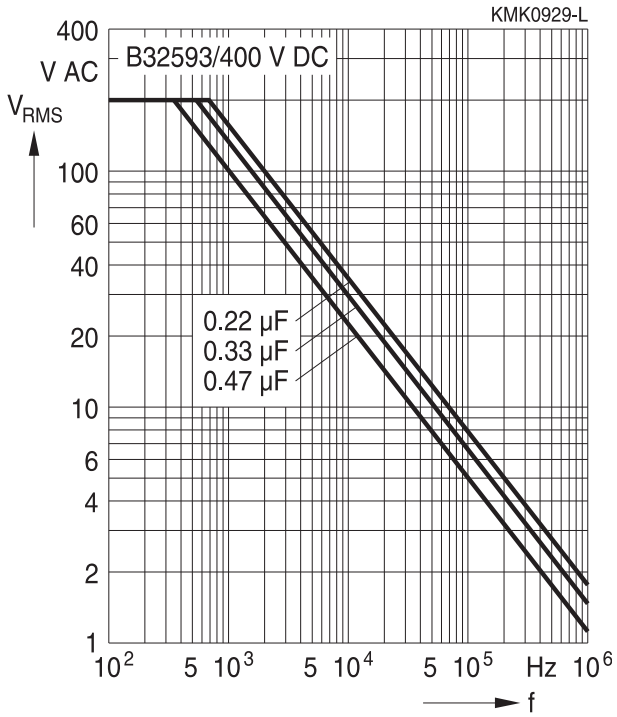
100 V DC/63 V AC



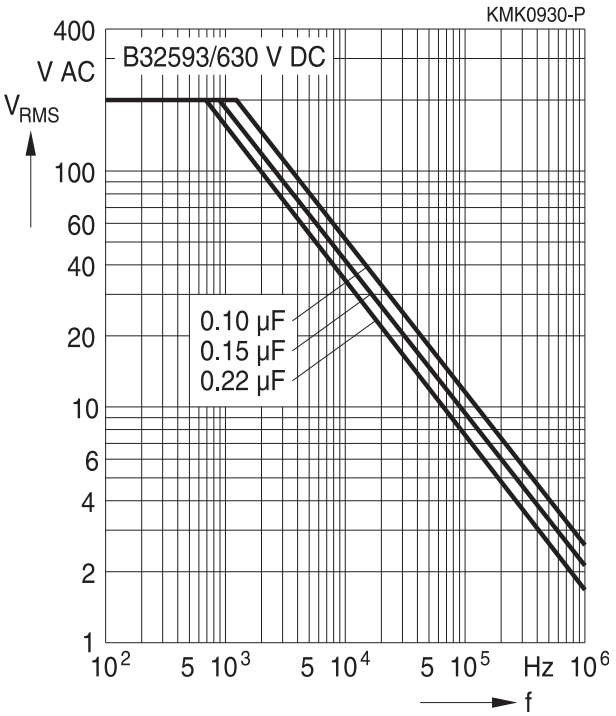
250 V DC/160 V AC

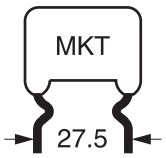


400 V DC/200 V AC



630 V DC/200 V AC





B32594

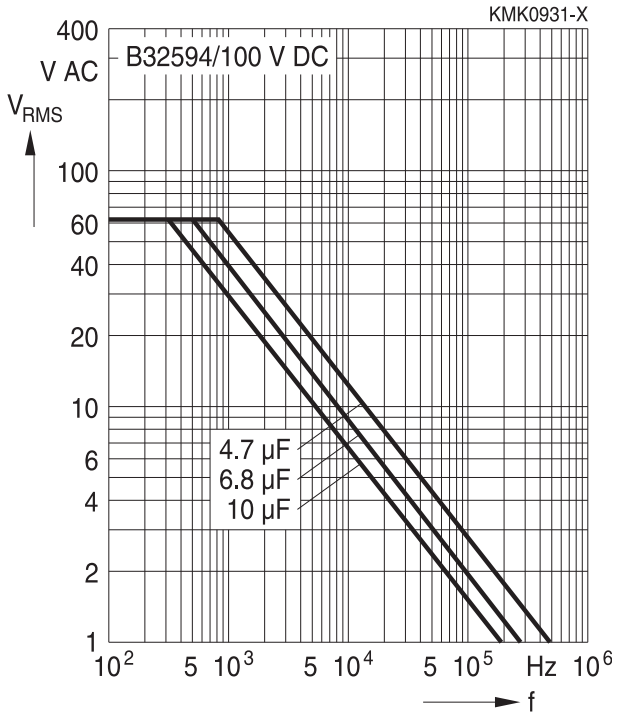
General purpose (wound)

Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 55$ °C)

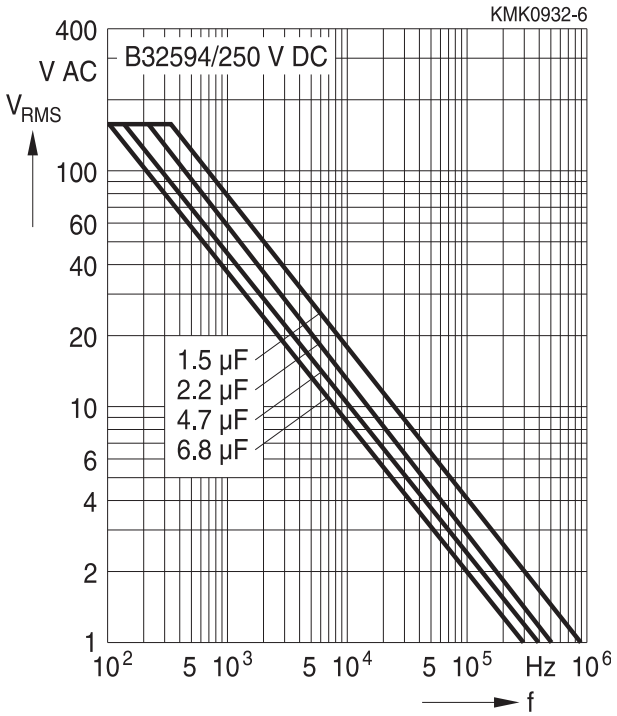
For T_A >55 °C, please refer to "General technical information", section 3.2.3.

Lead spacing 27.5 mm

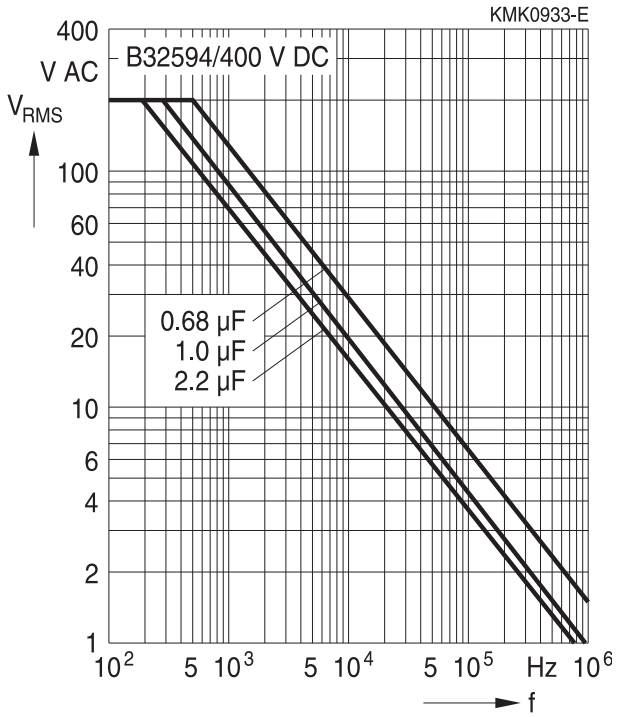
100 V DC/63 V AC



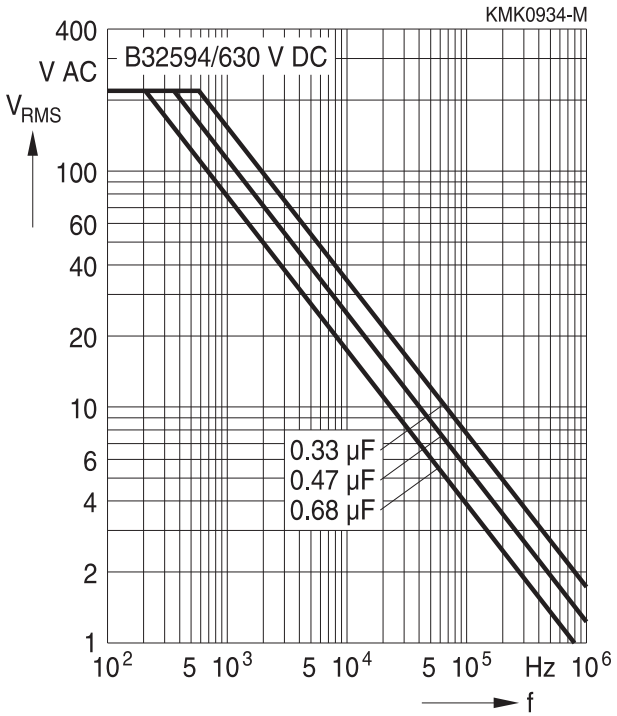
250 V DC/160 V AC

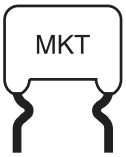


400 V DC/200 V AC



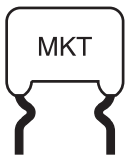
630 V DC/220 V AC





Testing and Standards

Test	Reference	Conditions of test	Performance requirements
Electrical parameters	IEC 60384-2:2005	Voltage proof, 1.4 V_R, 1 minute Insulation resistance, R_{ins} Capacitance, C Dissipation factor, tan δ	Within specified limits
Robustness of terminations	IEC 60068-2-21:2006	Tensile strength (test Ua1) Wire diameter | Tensile force $0.3 < d_1 < 0.5$ mm | 5 N $0.5 < d_1 < 0.8$ mm | 10 N	No visible damage Capacitance and tan δ within specified limits
Resistance to soldering heat	IEC 60068-2-20:2008, test Tb, method 1A	Solder bath temperature at 260 ±5 °C, immersion for 4 seconds (lead spacing ≤ 10 mm), 10 seconds (lead spacing > 10 mm)	$\Delta C/C_0 \leq 2\%$ $\lvert\Delta \tan\delta\rvert \leq 0.003$ for C ≤ 1 µF $\lvert\Delta \tan\delta\rvert \leq 0.002$ for C > 1 µF
Rapid change of temperature	IEC 60384-2:2005	T_A = lower category temperature T_B = upper category temperature Five cycles, duration t = 30 min.	$\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta \tan\delta\rvert \leq 0.003$ for C ≤ 1 µF $\lvert\Delta \tan\delta\rvert \leq 0.002$ for C > 1 µF $R_{ins} \geq 50\%$ of initial limit
Vibration	IEC 60384-2:2005	Test F_C: vibration sinusoidal Displacement: 0.75 mm Accleration: 98 m/s² Frequency: 10 Hz ... 500 Hz Test duration: 3 orthogonal axes, 2 hours each axe	No visible damage
Bump	IEC 60384-2:2005	Test Eb: Total 4000 bumps with 390 m/s² mounted on PCB Duration: 6 ms	$\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta \tan\delta\rvert \leq 0.003$ for C ≤ 1 µF $\lvert\Delta \tan\delta\rvert \leq 0.002$ for C > 1 µF $R_{ins} \geq 50\%$ of initial limit
Climatic sequence	IEC 60384-2:2005	Dry heat Tb / 16 h Damp heat cyclic, 1st cycle +55 °C / 24 h / 95% ... 100% RH Cold Ta / 2 h Damp heat cyclic, 5 cycles +55 °C / 24h / 95% ... 100% RH	$\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta \tan\delta\rvert \leq 0.005$ for C ≤ 1 µF $\lvert\Delta \tan\delta\rvert \leq 0.003$ for C > 1 µF $R_{ins} \geq 50\%$ of initial limit
Damp heat, steady state	IEC 60384-2:2005	Test Ca 40 °C / 93% RH / 56 days	$\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta \tan\delta\rvert \leq 0.005$ for C ≤ 1 µF $R_{ins} \geq 50\%$ of initial limit



B32593, B32594

General purpose (stacked/wound)

Test	Reference	Conditions of test	Performance requirements
Endurance A	IEC 60384-2:2005	85 °C / 1.25 V_R / 2000 hours	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta \tan\delta\rvert \leq 0.003$ for $C \leq 1\,\mu F$ $\lvert\Delta \tan\delta\rvert \leq 0.002$ for $C > 1\,\mu F$ $R_{ins} \geq 50\%$ of initial limit
Endurance B	IEC 60384-2:2005	100 °C / 1.25 V_C / 2000 hours	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta \tan\delta\rvert \leq 0.003$ for $C \leq 1\,\mu F$ $\lvert\Delta \tan\delta\rvert \leq 0.002$ for $C > 1\,\mu F$ $R_{ins} \geq 50\%$ of initial limit

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, we are 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 a 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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5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply**.

7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard.** The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements (“CSR”) TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System.** For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.
8. The trade names EPCOS, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.tdk-electronics.tdk.com/trademarks.

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